

# INITIAL ENVIRONMENTAL EXAMINATION REPORT (IEE)

# PHALANGGAN RUNGRUEANG SOLAR POWER PLANT

**Project Name : Phalanggan Rungrueang Solar Power Plant**

**Project Site : Udon Thani Province, Thailand**

**Project Owner : Phalanggan Rungrueang Co., Ltd.**

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**PREPARED BY**

**May 2024**



**TLT CONSULTANTS CO., LTD.**

# IEE OF PHALANGNGAN RUNGRUEANG SOLAR POWER PLANT PHALANGNGAN RUNGRUEANG CO., LTD.

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## EXECUTIVE SUMMARY

### 1. INTRODUCTION

Phalangnan Rungrueang Co., Ltd. (The Project Developer) is a subsidiary of Gulf Energy Development Public Company Limited (GED) has planned to develop the Solar Development Solar Power Plant Project. This project aims to generate electric power from solar energy using photovoltaic technology or solar cells installed on the ground installed capacity of 77.281 MWp. All generated electricity is expected to sell to EGAT under 25 year-agreement.

The Project is covering an area of 729,095.20 sq.m (72.91 ha), located on 45 land title deeds in Na Kha Subdistrict, Mueang Udon Thani District, Udon Thani Province, about 585 km northeast of Bangkok which purchased land during July-September 2022. The transmission line is 115 kV will laid within the right-of-way (ROW) of public roads, from front of the Project to Udon Thani 1 substation and Ban Phue substation, a distance of approximately 8.7 kilometers. The Provincial Electricity Authority (PEA) is responsible for the construction of this transmission line as well as obtaining the appropriate permissions from relevant agencies such as the Department of Highways and the Department of Rural Roads.

### 2. LEGISLATIVE REQUIREMENT

According to the Regulations of the Energy Regulatory Commission on the Criteria for Preparing a Code of Practice Report and a Report of Compliance with the Code of Practice for the Operation of Electricity Generation B.E. 2565 (2022), the development of the Project is required to conduct the Code of Practice (CoP) Report for non-fuel Power Plants. According to the ADB Safeguard Policy Statement (2019), Equator Principle 4 and IFC, the development of the Project falls under category B and C from an environmental and social point of view respectively.

The Project Developer has appointed TLT Consultants Co., Ltd. for preparing the CoP report which was submitted to and was approved by the Energy Regulatory Commission (ERC) on 12 December 2023, this Initial Environmental Examination Report (IEE Report) and the Social Compliant Audit (SCA) report in line with applicable ADB's Safeguard Policy Statement (SPS), International Finance Corporation Performance Standard (IFC-PS), Equator Principles (EP), Asian Infrastructure Investment Bank (AIIB) and other related parties to support financial arrangement with Lender and key stakeholder for further step of project implementation.

### 3. DESCRIPTION OF THE PROJECT

The Project is covering an area of 729,095.20 sq.m (72.91 ha). Approximately 62.07 % of the total area is the power generation and 30.65% is empty space, road, walkways, or parking area, and others (ponds, existing drains) while the rest is the supporting facilities such as power generation control building, waste storage, admin office, green area, switchyard or substation.

Main equipment installed in the Project area includes PV modules, inverters and transformers. Details are as following;

Photovoltaic Module

- Number (PV modules) : 127,738
- Peak power generation capacity (Wp) : 605
- Dimensions (W x H x D) (mm) : 2,465×1,134×30
- Installation angle (degree): 11

Mounting Structure

- Material : Aluminum fixed with poles

Inverter

- Number (inverters) 184
- Output (kVA) 300
- Dimensions (W x H x D) (mm) 1,048×732×395
- Weight (with mounting plate) (kg) 122

Transformer

- Number of 60 MVA transformer 1
- Number of 3.437 MVA transformer 19

Transmission Line

- Distance of approximately 8.7 km.
- Power lines Aluminum conductor (AAC) with a size of 400 sq.mm.
- Transmission circuit Single circuit, double conductor
- Utility poles 22 m. height  
Reinforced concrete poles with a base size not exceeding 0.9×2.2×3.0 m.

**4. ASSESSMENT OF ENVIRONMENTAL AND SOCIAL IMPACT& RISKS**

**4.1 Air Quality**

Construction Phase

The construction activities during this phase that might cause dust dispersion and affected to the ambient air quality include; land clearance and site preparation for building and supporting facilities related to power generation activities. The box model has been adopted to predict the TSP concentration. The predicted TSP-24 hrs is 0.013 mg/m<sup>3</sup>. When combined with the current measurements for the 24-hour average Total Suspended Particulate (TSP), which has a maximum value of 0.073 mg/m<sup>3</sup>. The resulting 24-hour average Total Suspended Particulate (TSP) is within the air quality standards specified by the national standard (not exceeding 0.33 mg/m<sup>3</sup>).

Moreover, the Project has determined prevention and correction measures to minimize the impact on ambient air quality such as spraying water at the area with topsoil

stripping, material stacking, and entrance of the construction site, and keeping construction materials tidily. Therefore, the impact will be low.

#### Operation Phase

The project activities during this phase involves electricity generation from solar cells. There will be no sources of continuous air pollution from the project operations. No air pollution impact during operation phase is anticipated.

## **4.2 Noise**

#### Construction Phase

The construction activities during this phase that might cause noise impact to the construction worker and surrounding communities include; solar panel installation and the construction activities in the power station building area that are divided into three main activities: 1) site preparation, 2) foundation and pile construction, and 3) building and public utility system construction. The noise level from the construction equipment and machines has been collected from the Update of Noise Database for Prediction of Noise on Construction and Open Sites, Department for Environment Food and Rural Affairs, UK Government (2005) to predict the noise level at the nearest sensitive receptors surrounding the project area.

The predicted Leq 24 hrs from the construction activities at the 2 receptors, houses located in the southwest direction and houses located in the east direction. The highest overall noise level at the houses located in the southwest direction is 61.3 dB(A). Additionally, the noise impact from construction activities in the area of the power station building at a distance of 996 meters from the source to the community reaches a maximum level of 41.7 dB(A). When combined with the measured noise levels, the highest overall noise level is 61.1 dB(A).

The highest overall noise level at the houses located in the east direction is 61.1 dB(A). Additionally, the noise impact from construction activities in the area of the power station building at a distance of 870 meters from the source to the community reaches a maximum level of 42.9 dB(A). When combined with the measured noise levels, the highest overall noise level is 61.1 dB(A).

The total noise level, Leq 1 hr during daytime at the 2 receptors will increase in background level over 3 dB(A) that exceeded IFC noise level guidelines. Therefore, installation of a noise barrier at the construction sites near those receptors is required to reduce the noise level. After installation the noise barrier, the total Leq 24 hrs and increasing of Leq 1 hr during daytime will reduce and become less than 3 dB(A) in accordance with IFC guidelines. The impact will be moderate.

#### Operation Phase

The project activities during this phase involves electricity generation from solar cells. There will be no loudly equipment or machines. Therefore, there will be no noise level impact.

### **4.3 Reflection and Heat**

#### Construction and Operation Phases

The project is designed to use PV panels that are coated with an anti-reflective coating to reduce the amount of light that is reflected away from the panel's surface, which also helps increase the efficiency of the solar cells. Additionally, the project includes a layout design that clusters panels in a way that minimizes reflective surfaces, which can also reduce glare. Therefore, the project design contributes to reducing reflections from the PV panels, minimizing the impact on nearby residents.

### **4.4 Biodiversity**

#### Construction Phase

The primary activities during the construction phase include site preparation and various construction operations inside the project area. The impact of land preparation for construction will be low because it will only occur for a limited period of time inside the project area and the pole construction area.

The project's construction will cause noise and vibration, which may disturb the wildlife. Since the project area is agricultural land, the wildlife that inhabits it has evolved to live in disturbed agricultural environments as a consequence of long-term human activity. As a result, the construction will mainly cause noise-sensitive species to relocate away from the source of the disturbance. Nonetheless, the disruption time will be short, so the impact will be low.

#### Operation Phase

The project activities during this phase involve electricity generation from solar cells. There will be no impact on Biodiversity.

### **4.5 Aquatic Ecology**

#### Construction and Operation Phases

There is no surface water course in the construction area, the nearest is public waterway at the south of the project site about 50 meters from the Project boundary. All generated wastewater during this phase will be collected and treated prior to disposal offsite by an agency authorized by government agencies. The wastewater will not be discharged to the outside. Therefore, there is no impact on the aquatic ecology.

## 4.6 Socio-economics

### Construction Phase

- **Potential Positive Impacts**

- *Employment of Local People:* The Project has a policy to be given first priority to be hired local people which qualified to work non-skill and skill labors. However, this employment is temporary during the construction phase. There will be limited and positive impact in terms of development of local people and improvement of the quality of life for people in the community.

- *Local Economic Promotion:* the construction workers will be bought a consumer product from the local shop/stores nearby the construction site and workers' camp. It will increase the cash flow and improve the local economy. However, it will be temporary only 12 months during construction phase, the positive impact will be low.

- **Potential Negative Impacts**

- *Disturbance and annoyance to the community from construction activities:* The construction activities, especially the transportation activities may increase the traffic volume and accidents on National Highway No. 2255 and the public roads designated for accessing and exiting the project at certain times of each day, and caused noise impact to communities along the road. However, the Project has determined the prevention and correction measures to minimized impact during this phase. Therefore, the impact level will be low.

### Operation Phase

- **Potential Positive Impacts**

- *Local Development and Improvement of the Quality of Life for Local People:* The local administrative organizations will collect taxes from the Project, such as local maintenance tax, building and land tax, and a share of value-added tax. This revenue can be used for local development. In addition, the Project has several community relations campaigns to establish positive relationships and pay back to the community. The Project will also support local activities throughout the operation phase. Therefore, the positive impact will be moderate.

- *Employment of Local People:* The Project given the first priority to hire the local people who qualified to the work requirements. The employment during this phase comprised security guards (5 people in total), an inspector, and maintenance personnel (2 people in total). The Project recognizes that local communities desire their people to collaborate on the Project. To meet this demand, the Project will prioritize hiring workers from local communities whose qualifications match the Project's standards, particularly during the two times of solar panel cleaning per year. As a result, the total impact of local employment is positive, with a modest impact level.

- *Activities Promoting Community Relations:* The Project has public relations campaigns about its operations regularly to establish an accurate understanding and minimize concerns among people living near the Project. The purpose is to establish a

implemented throughout the operation phase. Therefore, the positive impacts will be moderate.

- **Potential Negative Impacts**

- *Concerns over the Project Operation:* The communities around the Project area may have concerns about the Project operations. Therefore, the Project has several plans to establish an accurate understanding and assure confidence in the Project development. There are channels to receive complaints and resolve the impacts from the Project development and hear suggestions from relevant parties. Therefore, the impact will be low.

#### **4.7 Gender Assessment**

##### Construction and Operation Phases

The first priority for labor of construction will be given to local people for both skilled and non-skilled workers. However, a substantial number of workers will come from outside. As such, GBVH risks and issues may arise most specifically from labor influx. To prevent and mitigate GBVH risk, the Project mandates the prevention measures, so the impact will be low.

#### **4.8 Influx Management**

##### Construction Phase

- **Impacts within the Construction Workers' Camp**

- *Sanitation:* There are 618 construction workers (Maximum) during construction phase. The contractor will provides the workers' camp with proper welfare and utilities include; accommodation, bathrooms and toilets, electricity, tap water, drinking water, wastewater management, and solid waste management comply with the Notification of the Labor Welfare Committee on Standards of Residence as Labor Welfare for Employees in the Type of Construction Business B.E. 2559 (2016) and relevant laws or international standards, including recommendations and suggestions from ADB, as well as the Project developer's own experiences. Therefore, the health impacts on the construction workers will be low.

- *Medical Welfare Provision:* The Contractors strictly comply with the Notification of the Labor Welfare Committee regarding standards for residential welfare for construction labor, B.E. 2559 (2016), and provide first aid equipment and medical supplies within the construction area, including a medical shuttle, according to the Ministry of Labor Regulations on the provision of welfare in business establishments B.E. 2548 (2005). Therefore, the health impacts on the construction workers will be low.

- **Impact to the Surrounding Communities**

- *Wastewater Management:* If the contractor discharges treated waste or sewage outside into natural water sources or private areas, the contractor must obtain permission from relevant government agencies or landowner to ensuring that the



discharged sewage will not have adverse environmental impacts in the future. In addition, the contractor shall provide a retention pond at workers' camp and conduct water quality monitoring once a month to ascertain the water quality before discharging.

- *Noise:* Noise from workers' camp may disturb the communities at nighttime because of high number of workers. This could cause conflict with local people. The Project and the contractors shall strictly implement preventive and mitigating measures to control and monitor the workers so that they do not create problems to surrounding communities at nighttime.

- *Transportation:* The project's transportation activities during the construction phase do not significantly impact the service level of Highway no. 2255. The road's level of service remains the same (Level A), allowing vehicles to move freely at free-flow speed.

- *Impacts on Public Health Services and Public Infrastructure:* With a large number of construction workers, if there is a communicable disease or epidemic occurs in the workers' camp, there is a chance that the disease may spread to the surrounding communities. Communicable diseases such as sexually transmitted diseases, hepatitis, pneumonia, diarrhea, and diseases that are carried by insects, such as dengue fever could be areas of concern. Common cold and flu caused by probably new strains are very well possible, as well as respiratory tract diseases. If illness occurs, it will increase the service burden on the local primary health care unit, namely, Ban Na Kha Subdistrict Health Promotion Hospital. It is necessary that the Project and the contractors strictly comply with the relevant laws and regulations.

- *Conflict with the local people:* The Project gives the first priority to qualified local people to be hired and worked with the project, and in case of necessary to hire other or foreign workers, and also established prevention and mitigation measures such as periodically visit nearby communities throughout the construction phase to inquire and listen to opinions about environmental impacts from the project construction activities, set up the coordination center to receive recommendations and complaints about disturbances from the project construction, immediately investigate and take remedial action, in case of complaints by people about impacts from the project construction activities.

- *Economic Impact from Influx of Workers:* Population influx as well as the presence of sizeable outsider workforce can disturb social dynamics, for example with the increased demand or pressure on services and resources such as housing, education, health services. Differences in social norms as well as income levels can create social jealousy. Artificial inflation of prices locally can also create potential tension.

Due to a significant influx of workers from external sources, there is a heightened risk of several impacts emerging as aforementioned, particularly associated with labor migration. To minimize risks, the Project has implemented preventive measures, so the impact is low.

### Operation Phase

There are only 5 permanent employees at the normal operation work in the Project area during this phase, 2 persons as an inspector and a maintenance staff, and additionally, approximately 20 individuals, who are expected to be local residents, will be

hired occasionally for cleaning solar panels. This will not significantly increase to cause influx situation. Therefore, the health impacts on both project employees and nearby communities will be low and negligible.

## **4.9 Occupational Health Impact Assessment**

### Construction Phase

The construction activities may cause occupational diseases and occupational health risk such as fall of objects, hit on head, electric shock, traffic accident, etc. Therefore, the project determined the prevention and correction measures and adequate training program in occupational health and safety to minimize the occupational health impact. Moreover, the contractor will provide first aid equipment and medical supplies within the construction area, including a medical shuttle, according to the Ministry of Labor Regulations on the provision of welfare in business establishments B.E. 2548 (2005). Therefore, the occupational health impacts on the construction workers will be low.

Dust (Particulate Matter) and noise from the construction activities could be caused adverse health impact to the construction workers. However, the project spraying water at the area with topsoil stripping, material stacking, and entrance of the construction site, and keeping construction materials tidily to minimizes the dust dispersion and provide personal protective equipment (PPE), consisting of safety helmets, safety shoes, goggles, and task-specific personal safety equipment appropriate to working conditions and risks that may arise from work. Therefore, the occupational health impacts on the construction workers will be low.

### Operation Phase

The project determined the prevention and correction measures and adequate training program in occupational health and safety associated with the Project's operations include field inspections, safety maintenance, and cleaning of the solar panels. Regularly inspection and safety shall be carried out in accordance with the criteria prescribed by relevant law and guideline to minimize the occupational health impact. Therefore, the occupational health impacts on the project staff will be low.

## **4.10 Health Impact Assessment**

### Construction phase

The Qualitative Risk Assessment approach has adopted to evaluate the health impact assessment with a Health Risk Matrix. Considering the interaction between project activities, environmental and health baseline condition, the identified health risk impact are air pollution, noise, solid waste, transportation, occupational health and safety, and sharing public health services. Therefore, the prevention and correction measures on these issues shall be determined to minimize the impact.

### Operation Phase

The identified health risk impact during this phase is solid waste, transportation, occupational health and safety. Therefore, the prevention and correction measures on these issues shall be determined to minimize the impact.

## **4.11 Land Use**

### Construction and Operation Phases

The project site is located in Zone 3.9 as stipulated in the Ministerial Regulations to Enforce the Udon Thani Provincial Comprehensive Plan B.E. 2560 (2017), which can be used for agricultural and related to agriculture (green color) for agricultural purposes, residential purposes, educational institutions, religious institutions, government institutions, public utilities and public facilities. The development of the solar power plant not prohibit under this regulation. Therefore, there is no impact on land use.

## **4.12 Land Transportation**

### Construction and Operation Phases

The results showed that the project's transportation activities during the both construction and operation phases do not significantly impact the service level of National Highway No. 2255. The road's level of service remains the same (Level A), allowing vehicles to move freely at free-flow speed, where the driver can select the speed of travel without being influenced by other means of transport in the traffic flow. Therefore, the impact will be low.

## **4.13 Solid Waste Management**

### Construction Phase

Waste from the consumption of construction workers is expected quantity of 525.3 kg/day. The Project will prepare an adequate number of trash bins at several spots so that authorized agencies can collect it for disposal outside of the Project area. Waste from construction activities is approximately 26 tons/year. Some of the waste will be separated for sale or reuse while the rest of the waste will be stored before coordinating with authorized agencies for appropriate disposal. Therefore, the impact on solid waste management during construction phase will be low.

### Operation Phase

The staff consumption waste is estimated at 22.95 kg/day (Maximum). The Project will provide sufficient garbage bins with tightly cover at various points within office building. This is done prior to authorize agencies from the government coming in to collect and transport the waste.

Waste from scheduled maintenance, damaged or deterioration solar panels, and rainwater contaminated will be collected and storage in the designated area prior contact

an agency authorized by the Department of Industrial Works for disposal outside the Project area. Therefore, the impact level is low.

#### **4.14 Wastewater Management**

##### Construction Phase

Wastewater from workers consumption is generated approximately 43.26 m<sup>3</sup>/day; and effluent from construction machinery and equipment washing is generated approximately 10.00 m<sup>3</sup>/day. The project will treat wastewater from workers consumption using a septic tank and contact local agencies for proper disposal. Also, effluent from construction machinery and equipment washing will be collected at the clarifier to separate water and grease before sending it to be disposed of outside the Project by agencies authorized by government agencies. Therefore, the impact on wastewater management during the construction phase will be low.

##### Operation Phase

Wastewater from staff consumption is generated approximately 1.89 m<sup>3</sup>/day and effluent from solar modules washing is generated 3.19 m<sup>3</sup>/day during dry season. The wastewater from staff consumption will be treated by septic tank with anaerobic filters and removed by an authorized agency for appropriate treatment. In addition, effluent from solar module washing will be left to be evaporate or seep into the ground naturally without affecting the quality of surface water. As a result, the impact on wastewater management in the operation phase will be low.

#### **4.15 Water Drainage**

##### Construction Phase

Prior to project development, the area was an agricultural area. There will be minor site adjustment to consolidate installation of ground-mounted solar modules and minor land use for building construction. The water drainage condition during construction phase will remain the same as the existing condition. Therefore, the impact on drainage during the construction phase will be low.

##### Operation Phase

The Project will prepare a retention pond with a capacity of 350 m<sup>3</sup> to collect run-off water which can be holding at least three hours, and control the discharging rate not exceeded the existing condition. Therefore, the operation phase will not have any impact of water drainage on the surrounding areas.

#### **4.16 Major Hazard**

##### Construction and Operation Phases

Risk and Hazard Assessment has adopted the regulations of Department of Industrial Works: Criteria of Hazard Indication, Risk assessment and Risk Management Plan, B.E. 2543 (2000). The results from risk and hazard assessment found that the short

circuit and fire in the equipment caused by personnel/equipment being in wet conditions contacts with electrical equipment (Human Error) is a high risk level and prevention and correction measures are required. The Project determined to arrange appropriate solar panels washing plan and encourage the staff to strictly follow the prescribed procedures, PPE (e.g., helmets, safety gloves, safety shoes, etc.), must always be used in the operation and must always be kept in ready to use condition, and establish clear operational procedure for panels washing to ensure that the electricity is turned off before panel washing. Therefore, the impact will be low.

#### **4.17 Climate Change Risk Assessment (CCRA)**

##### Construction and Operation Phases

The implementation of the Project is categorized as “Category B” (Projects with potential limited adverse environmental and social risks and/or impacts that are few in number, generally site-specific, largely reversible and readily addressed through prevention and correction measures), a CCRA required under EP4 Principle. The results of CCRA can be summarized as following;

- **GHG Emissions from Project Implementation:** the highest GHG emitted is estimated at 2,279.08 tonne CO<sub>2</sub>-eq/year during construction phase, while the avoided GHG is estimated at -75,679.80 tonne CO<sub>2</sub>-eq/year throughout the operation phase. Therefore, the project caused the positive impact to climate change and the “Transition Risks” is no need to consider.

- **Results of Climate Change Risk Assessment**

- *Storm and Heavy Rain:* The structure of PV Solar structure is design in accordance with DPT. 1311-50 standard, and could be tolerate for wind speed at 30 m/s or 108 km/hr. (the wind speed of storm is range from 89-102 km/hr.). Therefore, the impact will be low.

- *Flood:* The Project area locate in non-flooding risk area (Less than 3 time in 10 year period) and the solar panel level designed to be set at least 0.50 m higher than the ground elevation as recommended in the Flood Risk Assessment for the Project. Therefore, the impact will be low.

#### **4.18 Human Right Risk Assessment**

##### Construction and Operation Phases

Result of Human Rights Risk and Impact Assessment found that the impact on the occupational health and safety, discrimination, working hours, and community safety & standard of living is medium to high. Prevention and correction measures are required. Therefore, the Project determined the prevention and correction measures such as arranged occupational safety management in a systematical and efficient manner in conformity with the requirements of occupational safety, health and environment law relating to construction, and GBVH, so the impact is low.

## 4.19 Transmission Line

### Construction Phase

The transmission line laid within the right-of-way (RoW) of public roadways, the agricultural land encroaching in the RoW will be affected by the construction area of 5 sq.m. When the value of crops lost owing to this shift in land use is calculated, it is low when compared to the total potential yield per rai. Furthermore, the PEA has a policy that allows farmers to harvest crops in areas where power transmission poles will be built as early as possible in accordance with the building timetable. As a result, the influence on land use for farmers constructing areas is regarded as low.

### Operation Phase

**Electromagnetic field:** design and construction of transmission line will be in accordance with EGAT Operation Code for Transmission Line System. There is requirement of electric field and magnetic field of international commission on non-ionizing radiation protection (ICNIRP) on electromagnetic radiation. All quantities do not exceed the standard. It can be assured that the construction of transmission line by EGAT will not pose impact of electric field and magnetic field to people living near the line.

**Biodiversity:** The migratory bird found in the project study area are little birds that can shift direction faster than larger birds and most of them migrate alone or in small groups. Based on this data, it is possible to conclude that the project's location, the size of the birds, and the size of their migratory groups, all of which are common causes of collisions with transmission lines, present a low risk of such collisions. As a result, the impact on migrating birds inhabiting the project area is low.

**Transportation:** regular maintenance can disturb traffic flow as partial or full lane closures for maintenance activities. However, the regular PEA practices will be followed, including as providing adequate signage to inform drivers of construction work ahead or lane closures and keeping local communities informed about construction schedules. Hence, the impact on traffic will be low.

## 5. ENVIRONMENTAL & SOCIAL MANAGEMENT PLAN AND SYSTEM

### 5.1 Environmental and Social Management Plan

Based on the environmental and social impact assessment, the project development has some impacts during construction and operation phases. Phalangngan Rungrueang Co., Ltd. will be responsible for implementation of corresponding mitigation measures and monitoring programs in order to ensure that the project development during both phases will have impacts within an acceptable level. The implementation will be under the responsibility of the EPC (Engineering Procurement and Construction) Contractor and the Project owner, Phalangngan Rungrueang Co., Ltd.

Measures	Construction Phase	Operation Phase
Preventive and Mitigation	<ul style="list-style-type: none"> <li>- Air quality</li> <li>- Noise</li> <li>- Water quality and drainage</li> <li>- Reflection and heat</li> <li>- Biodiversity</li> <li>- Socio-economics and public participation</li> <li>- Gender-based violence and harassment (GBVH)</li> <li>- Public health and safety</li> <li>- Occupational health and safety</li> <li>- Transportation</li> <li>- Solid waste management</li> <li>- Major hazard and emergency</li> <li>- Land maintenance</li> </ul>	<ul style="list-style-type: none"> <li>- Water quality</li> <li>- Socio-economics and public participation</li> <li>- Occupational health and safety</li> <li>- Solid waste management</li> <li>- Green area and aesthetics</li> <li>- Land access</li> </ul>
Monitoring	<ul style="list-style-type: none"> <li>- Air quality</li> <li>- Noise</li> <li>- Water use and effluent quality</li> <li>- Socio-economics and public participation</li> <li>- Occupational health and safety</li> <li>- Transportation</li> <li>- Solid waste management</li> </ul>	<ul style="list-style-type: none"> <li>- Water use and effluent quality</li> <li>- Socio-economics and public participation</li> <li>- Occupational health and safety</li> <li>- Solid waste management</li> </ul>

## 5.2 Emergency Preparedness and Response Plan

Emergency Preparedness and Response Plan (ERP) is to be prepared by EPC Contractor for construction phase and submit to the project proponent for concurrence, while ERP for operation phase is to be prepared by the Project. ERP shall cover emergency incidents that may occur in the construction sites during the construction of the Project components and in the project area during operation phase. The emergency incidents could have adverse impacts on the environment, and on health and safety of construction workers, project staff, nearby factories, and nearby communities.

## 6. STAKEHOLDER ENGAGEMENT

Pre-engagement meeting was conducted to gather the information from the public and stakeholders regarding the preparation of an environmental report. This was initiated at the early stage of Project development with the aim of presenting preliminary Project details to gather feedback, concerns, and suggestions from stakeholders regarding the Project. The meeting was held on April 8, 2023 from 09.00 a.m. to 12.00 p.m. at the meeting room of Na Kha SAO, Mueang Udon Thani District, Udon Thani Province and during May 30-31, 2023 via conferencing platform with the participants of 79.

Public hearing was conducted to collect feedback on the draft result of environmental impact assessment and propose preventing, mitigating, and monitoring measures. The aim is to instill confidence in the public and stakeholders regarding the

report and its measures. The Project organized a public hearing and engagement session with the community and stakeholders on June 15, 2023 from 09.00 a.m. to 12.00 p.m. at the multipurpose building of Na Kha SAO, Mueang Udon Thani, Udon Thani Province with participant 284.

The opinion, concerns, and suggestion were raised during the public consultations regards to project details, impact from the project on environmental and social aspects, occupational health and safety, socio-economics and public consultation.



## **CHAPTER 1**

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# **PROJECT BACKGROUND, LEGAL COMPLIANCE, IMPACT SIGNIFICANCE, AND CATEGORIZATION**

## **CHAPTER 1**

### **PROJECT BACKGROUND, LEGAL COMPLIANCE, IMPACT SIGNIFICANCE, AND CATEGORIZATION**

#### **1.1 PROJECT BACKGROUND**

##### **1.1.1 Project Development Status**

Phalangngan Rungrueang Co., Ltd. has plan to develop the Phalangngan Rungrueang Solar Power Plant Project. This Project aims to generate electric power from solar energy using photovoltaic technology or solar cells installed on the ground with an installed capacity of 77.281 MWp to supply electric power to the government under the government policy to support renewable energy or clean energy. The Project is located on land with a valid title deed in Na Kha Subdistrict, Mueang Udon Thani District, Udon Thani Province. The total area is 729,095.20 square meters. The Project is required to prepare the Code of Practice (CoP) Report for non-fuel power plants according to the Regulations of the Energy Regulatory Commission on the criteria for preparing a Code of Practice report and a report of compliance with the Code of Practice for the operation of electricity generation B.E. 2565 (2022). The CoP report which was submitted to and was approved by the Energy Regulatory Commission (ERC) on 12 December 2023.

At present stage financial arrangement for implementation of the Project is being discussed with Financial Institutions (Lenders). Initial Environmental Examination (IEE) Report is then required during this process. This IEE report is the document that addresses the Environmental and Social Risks and Impact associate with any project activities during the project lifecycle which could pose any direct, indirect or reputational risks to project developer and subsequently to the financial institutions and other key stakeholders as part of project implementation. Phalangngan Rungrueang Co., Ltd. has engaged TLT Consultants Co., Ltd. to prepare this IEE Report for the Phalangngan Rungrueang Solar Power Plant Project in line with applicable ADB's Safeguard Policy Statement (SPS), International Finance Corporation Performance Standard (IFC-PS), Equator Principles (EP) and other related parties. This IEE Report will be used to support financial arrangement with Lender and key stakeholder for further step of project implementation.

##### **1.1.2 Project Developers**

Phalangngan Rungrueang Co., Ltd, the developers of the Phalangngan Rungrueang Solar Power Plant is a subsidiary of Gulf Energy Development Public Company Limited (GED) that invests in conventional and renewable power generation and distribution businesses, as well as natural gas supply and distribution, infrastructure development projects, and digital business. Phalangngan Rungrueang Co., Ltd. operates renewable power generation business and its headquarter is at 87 M. Thai Tower 10<sup>th</sup> Floor, All Seasons Place, Wireless Road, Lumpini, Pathumwan, Bangkok 10330.

### 1.1.3 Project Location, Area of Influence and Key Sensitive Receptors

#### (1) Project Location

The Phalangngan Rungrueang Solar Power Plant Project is located on the 729,095.20-square meter land in Na Kha Subdistrict, Mueang Udon Thani District, Udon Thani Province (as shown in **Figure 1.1-1**), about 585 km northeast of Bangkok.

#### (2) Area of Influence (AoI) and Key Sensitive Receptors

Based on definition of AoI by IFC-PS1, the following AoIs of the Project were identified:

- Communities located within 3-kilometer radius from the Project site may be affected by the Project's construction activities, such as noise from building construction; and materials, equipment, and worker transportation to the construction site about 64 trips/day. Hence, the study area for environmental impacts has been determined as shown in **Figure 1.1-1**.

- The Project will connect to and transmit generated electricity into the Provincial Electricity Authority (PEA) nation grid. The PEA will construct a 8.7 kilometers long 115 kV high-voltage transmission line, linking the project to Udon Thani 1 substation and Ban Phue substation (as shown in **Figure 1.1-2**). It is noted that the transmission line will be constructed, owned and operated by the PEA. The transmission line for the project will be laid within the Right of Way (RoW) of public roads. AoI of the Project's transmission line for the study, in particular associated with the construction and operation EHS impacts is set at 200 meters corridor (100 m from each side of the line route) covering 4 villages in Na Kha Subdistrict (Village no. 1 Ban Na Kha, Village no. 3 Ban Thon Noi, Village no. 7 Ban Thon Yai and Village no. 11 Ban Dong Rai)

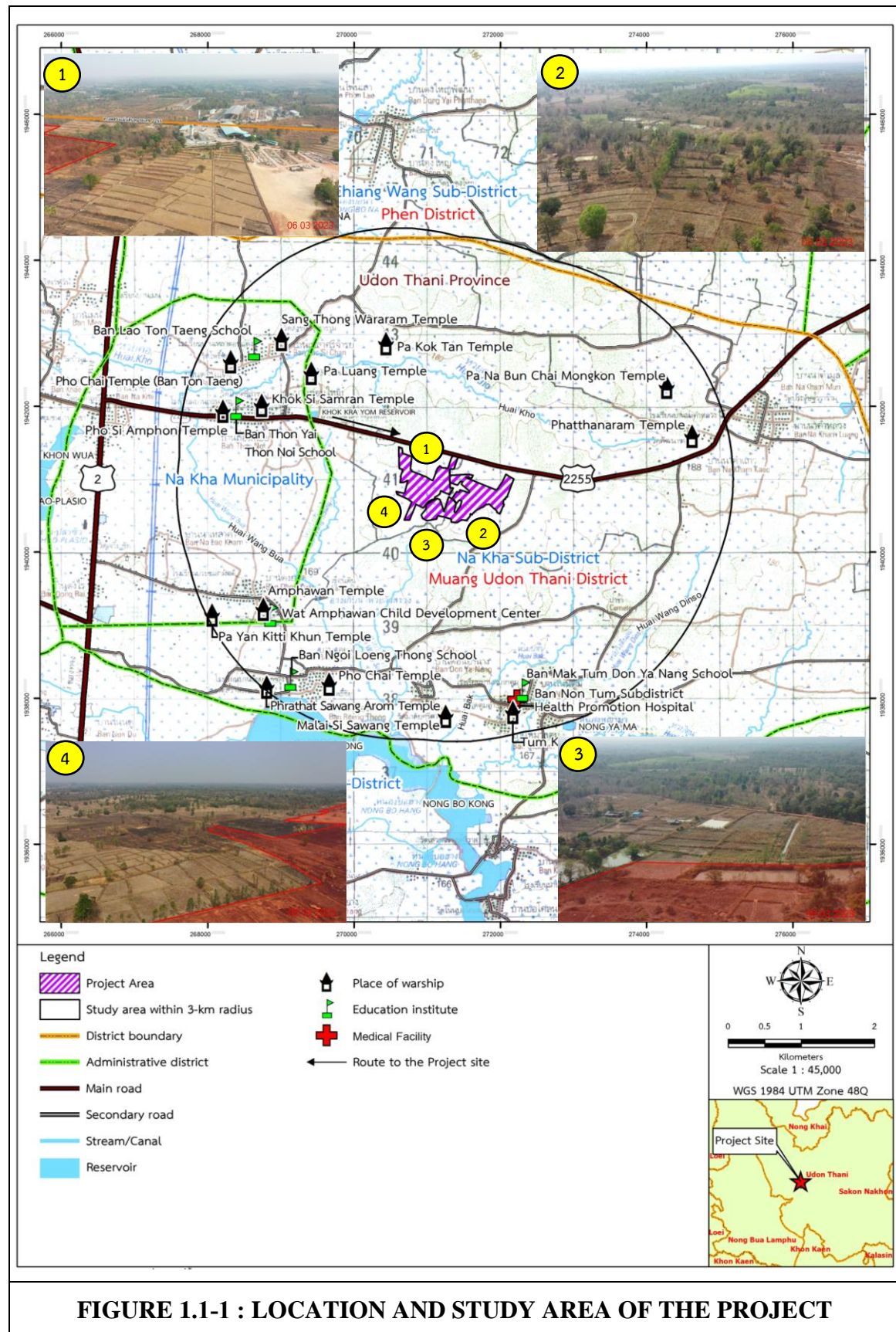
#### (3) Key Sensitive Receptors

The key sensitive receptors include, but are not limited to,

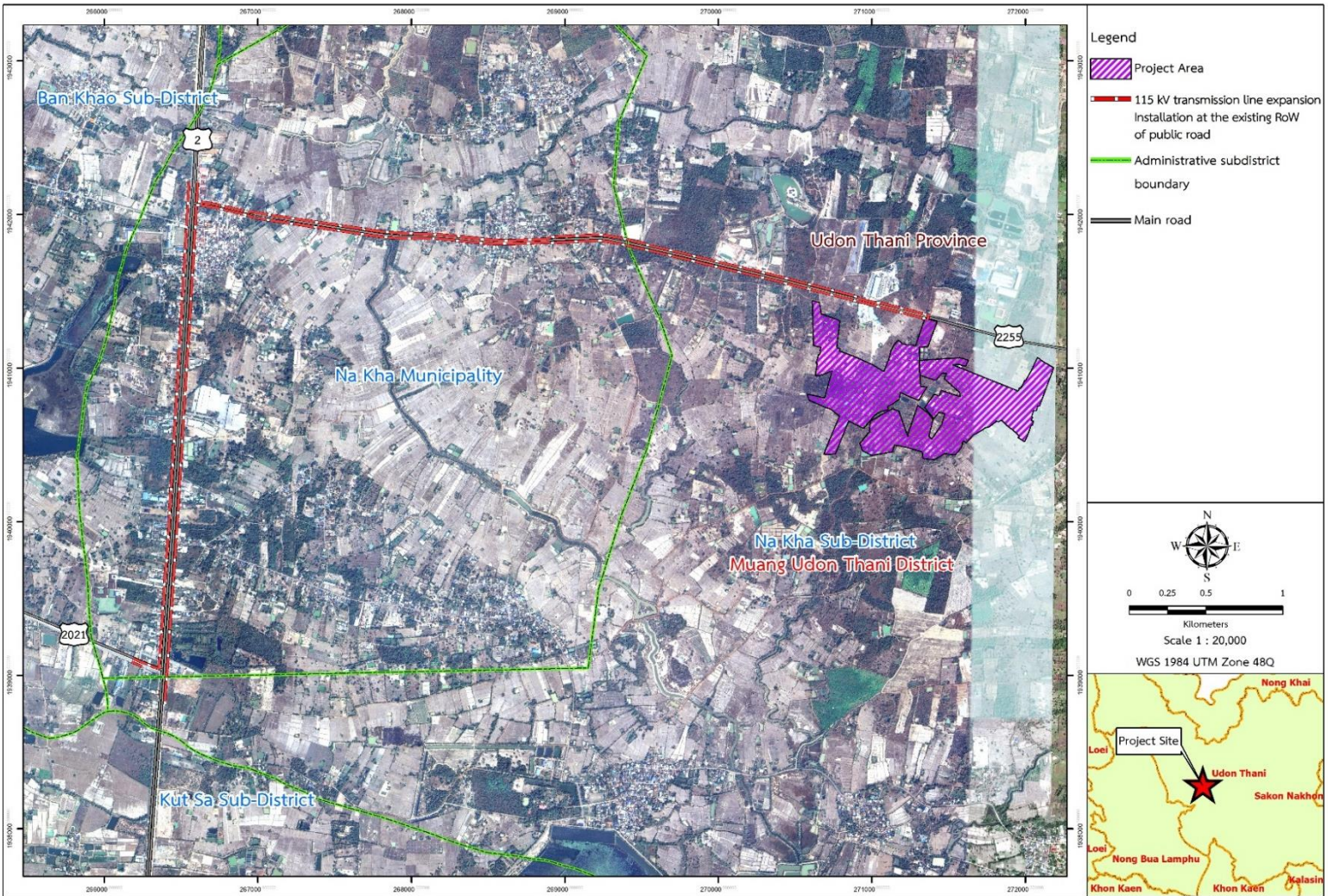
- Communities in the AoI, which are listed in **Table 1.1-1**.
- Public facilities in the affected communities such as health care facilities.

**TABLE 1.1-1  
KEY SENSITIVE RECEPTORS WITHIN AREA OF INFLUENCE**

Province	District	Subdistrict	Key Sensitive Receptors
Udon Thani	Mueang Udon Thani	Na Kha	Village no. 1 Ban Ngoi
			Village no. 3 Ban Thon Noi
			Village no. 4 Ban Non Tum
			Village no. 5 Ban Don Ya Nang
			Village no. 6 Ban Na Kham Luang
			Village no. 7 Ban Thon Yai
			Village no. 8 Ban Don Taeng
			Village no. 9 Ban Dong Yuat
			Village no. 10 Ban Lao Si Chan
			Village no. 13 Ban Na Kham Kaeo
			Village no. 14 Ban Loeng Thong
			Village no. 16 Ban Mak Tum
			Sang Thong Wararam Temple
			Pa Luang Temple
			Khok Si Samran Temple
			Pho Chai Temple (Ban Don Taeng)
			Pho Si Amphon Temple
			Amphawan Temple
			Pa Yan Kittikhun Temple (Pa Dong Yuat Temple)
			Pho Chai Temple
			That Sawang Arom Temple
			Malai Si Sawang Temple
			Tum Kham Temple
		Patthanaram Temple	
		Pa Nabun Chai Mongkhon Temple	
		Pa Kok Tan Temple	
		Ban Lao Don Taeng School	
Ban Thon Yai Thon Noi School			
Ban Mak Tum Don Ya Nang School			
		Chiang Wang	Village no. 3 Ban Dong Yai
			Village no. 16 Ban Dong Charoen



**FIGURE 1.1-1 : LOCATION AND STUDY AREA OF THE PROJECT**



**FIGURE 1.1-2 : TRANSMISSION LINE ROUTE OF THE PROJECT**

#### 1.1.4 Data Sources

During the course of project preparation, several studies were conducted and be used as references for this study as listed below:

- Code of Practice report of Phalangngan Rungrueang Solar Power Plant Project prepared by Fourtier Consultants Co., Ltd. approved on 12 November 2023.
- Environmental Safety Assessment report of Phalangngan Rungrueang Solar Power Plant Project prepared by Fourtier Consultants Co., Ltd., submitted to the Department of Industrial Works in August 2023.
- Social Compliance Audit Report (SCAR) for Phalangngan Rungrueang Solar Power Plant prepared by TLT Consultants Co., Ltd. (February 2023)

References that are collected from other related sources include;

- Asian Development Bank (ADB)
  - ADB Environmental Assessment Guidelines (December 2003)
  - Safeguard Policy Statement (June 2009)
- International Finance Corporation (IFC)
  - Environmental, Health, and Safety General Guidelines (April 2007).
  - Stakeholder Engagement: A Good Practice Handbook for Companies, Doing Business in Emerging Markets (2007)
  - Guide to Human Rights Impact Assessment and Management (HRIAM) (September 2011)
  - Performance Standards on Environmental and Social Sustainability (2012)
- Equator Principles (EP)
  - EP4 (July 2020)
  - The Equator Principles Implementation Note, Equator Principles Association (September 2020)
  - Guidance Note on Implementation of Human Rights Assessments under the Equator Principles (September 2020)
  - Guidance Note to Support Effective Consistent Application of the Equator Principles (July 2022)
  - Guidance Note on Climate Change Risk Assessment (May 2023)

## 1.2 OBJECTIVE OF THE STUDY

The objectives of the study and preparation of the IEE Report for Phalangngan Rungrueang Solar Power Plant Project are as follows:

(1) To investigate the Project details, such as location, construction plan, construction activities, and environmental management process, to be used in assessing the environmental and social impacts that may occur from the Project development to be comprehensive and appropriate as much as possible.

(2) To investigate the existing environmental condition of the Project area and the surrounding area within a radius of 3 kilometers from the Project fence line; as well as of the transmission line within a 100-meter radius from the centerline to be used as basic information for environmental and social impact assessment, using primary data from field surveys and secondary data from relevant agencies.

(3) To assess the environmental and social impact from Project development both in the construction phase and operation phase

(4) To determine mitigation measures and monitoring measures for environmental impacts that may arise from project operations

(5) To prepare the IEE report for approval from Financial Institutions (Lenders)

## 1.3 COMPLIANCE WITH NATIONAL LAW, REGULATION AND PERMITS

### 1.3.1 Applicable Laws and Regulations

Thai laws and regulations which are applicable to the Project preparation, construction and operation stages are summarized below.

Applicable Law and Regulation	Legal Requirement for Project Compliance	Responsible Authorities
<b>Code of Practice (CoP) Report and Environmental Safety Assessment (ESA) Report Preparation</b>		
Regulations of Energy Regulatory Commission re: the Criteria for Preparing a Code of Practice Report and Monitoring Report for Electricity Generation Business B.E. 2565 (2022)	The Regulations prescribes that the applicant for a license or the licensee of thermal with a capacity lower than 10 MW and non-combustion power plants must submit the following reports: 1) Preliminary Code of Practice (CoP) report, 2) Final CoP report, and 3) CoP compliance monitoring report. There are specific guidelines for preparing those reports for each type of power plants. The CoP reports must be submitted to the Energy Regulatory Commission (ERC) to review before issuing licenses or approving changes to existing licenses, and to review and make comments on the CoP compliance monitoring report which will be provided to licensees at least once a year to monitor their energy company operations.	Office of Energy Regulatory Commission



Applicable Law and Regulation	Legal Requirement for Project Compliance	Responsible Authorities
<b>Code of Practice (CoP) Report and Environmental Safety Assessment (ESA) Report Preparation (Cont'd)</b>		
<ul style="list-style-type: none"> <li>– Notification of the Ministry of Industry on Preparation of a Report on Environmental Safety Assessment B.E.2552 (2009)</li> <li>– Notification of the Ministry of Industry on Preparation of a Report on Environmental Safety Assessment (No.2) B.E.2559 (2016)</li> </ul>	<p>The Notification prescribes that anyone wishing to apply for a factory business license or a license to expand a factory based on the types or categories of factories listed in this announcement must submit a report on environmental safety assessment (ESA) in one copy, along with the application for a factory business license or a license to expand a factory, as applicable. Production of electricity from solar energy with capacity over 1,000 kW is required to prepare ESA.</p>	Ministry of Industry
<b>Construction and Operation Stages</b>		
Provincial Electricity Authority Act (Version 4) B.E.2542 (1999)	<p>The Act prescribes the main provision as follows.</p> <ol style="list-style-type: none"> <li>1. Establishment of the provincial electricity authority (PEA), capital, and reserves</li> <li>2. Supervision, control, and management</li> <li>3. Construction and maintenance of the electric energy transmission system</li> <li>4. PEA's Relations with the government</li> <li>5. Petition and aids for the officials of PEA</li> <li>6. Accounting, auditing, and examining</li> </ol>	Provincial Electricity Authority
Labour Protection Act B.E. 2541 (1998)	<p>The Act provides a wide range of protections for workers. Its key provisions include working hours, wages, overtime compensation, leave, welfare, occupational safety, health and environment, child labor, termination and severance, creation of labor court, employee's rights in case of merger, female employee protections, Lodgment and consideration of complaints, employee welfare fund, and penalties.</p>	Ministry of Labour
Ministerial Regulation on the Prescribing of Standard for Conducting Health Check-Up of Employees Working with Risk Factors B.E. 2563 (2020)	<p>The Ministerial Regulation states that the employer shall provide health check-up for the employees who work with risk factors, by completing the first health check-up for employees within thirty days from the first day the employee is employed; and subsequent health check-ups shall be conducted at least once a year.</p>	Ministry of Labour
Ministerial Regulation Concerning Labour Welfare Provision in an Establishment B.E. 2548 (2005)	<p>The Ministerial Regulation prescribes that an employer shall provide necessary welfare to employees such as clean drinking water not less than one station for not exceeding forty employees, bathrooms and toilets with the layout and number as prescribed in the Building Control Law and other related laws, maintenance of cleanliness and hygiene, and provision of necessary kits for first aid and medical service in an adequate quantity for employees in the workplace.</p>	Ministry of Labour

Applicable Law and Regulation	Legal Requirement for Project Compliance	Responsible Authorities
<b>Construction and Operation Stages (Cont'd)</b>		
<ul style="list-style-type: none"> <li>– Ministerial Regulation on the Prescribing of Standard for Administration and Management of Occupational Safety, Health and Environment Regarding Fire Prevention and Suppression B.E. 2555 (2012)</li> <li>– Ministerial Regulation on the Prescribing of Standard for Administration and Management of Occupational Safety, Health and Environment Regarding Fire Prevention and Suppression (No.2) B.E. 2561 (2018)</li> </ul>	<p>The Ministerial Regulation stipulates that there shall be fire prevention and suppression system in workplace and the fire prevention and suppression system must be kept ready for efficient and safe use. The Ministerial Regulation sets forth the safety requirements related to buildings and fire exits; prevention of fire from sources of heat dissipation, flammable materials, and explosives; disposal of combustible waste; lightning protection; and operations related to fire safety and reporting of the results of firefighting and evacuation drills.</p>	Ministry of Labour
<p>Ministerial Regulation on the Prescribing of Standard for Administration and Management of Occupational Safety, Health and Environment in Relation to Heat, Light and Noise B.E. 2559 (2016)</p>	<p>The Ministerial Regulation requires that the employer shall control and maintain the levels of heat, light and noise within the workplace where employees are working not to exceed the defined standard. In case the levels exceed the prescribed standard, personal protective equipment shall be provided as appropriate throughout working hours. Measurement and analysis of working conditions shall be conducted, and health checkups shall be arranged for employees who work in the working conditions that may be harmful by heat, light or noise.</p>	Ministry of Labour
<p>Notification of the Ministry of Industry on Management of Waste and Unused Materials B.E. 2566 (2023)</p>	<p>The Notification stipulates waste codes and types of waste or unusable materials from factory operations. The waste exempt from being in compliance with this Notification shall be: (1) waste that consists of feces or urine that occurs within the factory premises (2) non-hazardous wastes from offices, housing and canteen located in a factory area, and consumption within a factory area; (3) wastewater conveyed via pipe for off-site treatment; (4) unused materials, such as gas pressure containers that can be reused or refilled; and In addition, the Notification sets forth prescriptions and guidelines for waste generators, prescriptions and guidelines for hazardous waste collection and transportation, and prescriptions and guidelines for waste processors.</p>	Ministry of Industry

Applicable Law and Regulation	Legal Requirement for Project Compliance	Responsible Authorities
<b>Construction and Operation Stages (Cont'd)</b>		
Notification of the Department of Labour Protection and Welfare Prescribing Personal Protective Equipment Standards B.E.2554 (2011)	The Notification requires that an employer shall provide the employees with and require them to wear personal protective equipment in accordance with the standards specified by the Director-General. The standards shall be appropriate for the type or category of work performed by employees.	Department of Labour Protection and Welfare, Ministry of Labour
Notification of the Department of Labour Protection and Welfare on Rules, Procedures and Conditions of Training for Executives, Supervisors and Employees Regarding Occupational Safety, Health and Environment of the Workplace B.E. 2555 (2012)	The Notification of the Department of Labour Protection and Welfare requires that an employer shall provide occupational safety, health and environment training to be attended by executives, supervisors and every employee in order to safely administer, manage and execute the occupational safety, health and environment. In the case where an employer hires employees to work, changes the employee's work, workplace or machinery or equipment, which may harm the life, physique, mentality and health of the employees, the employer shall provide training for every employee prior to commencement of work.  In the event that an employer is unable to provide training for an employee, the employer shall arrange for such employee to attend training at the Occupational Safety, Health and Environment Promotion Institute or an agency specified or recognized by the Department of Labour Protection and Welfare.	Department of Labour Protection and Welfare, Ministry of Labour

### 1.3.2 Project Developer Policy Statement on Environment and Social Management, Biodiversity, and Human Rights Aspects

As Gulf Energy Development PCL. (GED) environmental and social management (E&S) policy applies to all members of Gulf Group of Companies, Phalangnan Rungrueang Co., Ltd., a subsidiary of GED, is required to apply the E&S policy which have been posted on GED's website. They are detailed below.

#### 1.3.2.1 Environmental and Social Management Policy

Gulf Energy Development Public Company Limited recognizes the importance of conducting business with environmental and social responsibility while working to reduce negative impacts along the value chain, from project planning and development to operations and maintenance to decommissioning, and including related business and support activities such as supplier selection and procurement, distribution and logistics, mergers and acquisitions, and managerial and administrative activities. The Company shall strive to do so with a focus on the following areas.

**i. General Provisions**

a. The Company shall implement and maintain an environmental and social management system (ESMS) covering key issues as outlined in the Company's Sustainability Framework as well as context-specific issues where required, and will work to continuously improve its environmental and social management performance throughout the organization.

b. The ESMS shall cover all businesses under the Company, including any sites under the Company's management, and shall apply to all key business activities including: due diligence and feasibility studies, mergers and acquisitions, project implementation, operations, logistics and transmission/distribution, and decommissioning, as well as goods and services provided to the Company.

c. The Company shall comply with relevant national laws at a minimum, and shall strive to comply with other applicable national and international environmental and social safeguard requirements or other relevant regulations related to environmental and social management.

d. The Company shall collaborate with, and communicate its commitments and expectations to, key counterparties, including contractors, suppliers and business partners, as well as other stakeholders throughout the Company's value chain, to encourage increased awareness of environmental issues, develop greater understanding of the Company's environmental and social management policy, and improve environmental and social management performance within the Company and among its stakeholders.

e. The Company shall ensure appropriate and sufficient training related to environmental and social management for its employees on a regular basis, and collaborate with key counterparties and stakeholders to ensure contractors, suppliers or other individuals under the Company's responsibility receive appropriate and sufficient training on relevant issues.

f. The Company shall incorporate environmental and social issues, including occupational health and safety issues, into its risk management process, and shall strive to develop appropriate risk prevention and mitigation measures including establishing emergency and business continuity plans.

g. The Company shall establish a procedure to investigate any major incidents related to environmental, social or safety issues in order to determine the cause, identify impacts, develop remediation plans, develop prevention and mitigation plans, and communicate lessons learned throughout the organization for future improvement. The Company's Executive Committee shall have the authority to designate the investigation team, consider the findings of the investigation, and, in the event of wrongdoing, determine the appropriate punishment and/or remediation as required.

h. The Company shall monitor and review its environmental and social management performance on a regular basis, and report on the performance to the Company's management and Board of Directors at least quarterly, as well as disclose information about the Company's environmental and social management performance to key stakeholders and/or publicly, where appropriate.

## **ii. Environmental Management**

a. The Company shall comply with applicable local, national and/or international environmental laws at a minimum, and shall strive to operate in accordance with internationally-accepted standards and regulations for environmental management.

b. The Company shall establish clear processes and procedures for environmental management to be implemented within the organization and within its projects, and shall regularly review and revise such processes and procedures at least annually and whenever a major change or event occurs.

c. The Company may set environmental performance targets for specific issues or areas of operation, such as waste and/or emissions reduction targets, and shall regularly monitor its environmental performance with the aim of continuous improvement in environmental management.

d. The Company shall consider key issues such as biodiversity, waste management, greenhouse gas emissions, air emissions, water management, resource management, and impacts to local communities and/or ecosystems as part of its environmental management.

e. The Company shall establish an environmental monitoring committee or shall designate an environmental team to monitor environmental performance and identify any potential environmental issues for the Company or its projects that need to be managed.

f. The results of the environmental performance monitoring shall be reported to the Company's management and the Board of Directors on a regular basis, and reported to relevant management or Board Committees and external entities as required. The Company's environmental performance may also be disclosed through public channels where appropriate.

## **iii. Social Management**

a. The Company shall consider key issues such as human rights, diversity and non-discrimination, labor rights, occupational health and safety, and community relations as part of its social management.

b. The Company shall comply with applicable local, national and/or international laws related to occupational health and safety, labor rights, and other social issues at a minimum, and shall strive to operate in accordance with internationally-accepted standards and regulations for occupational health and safety management, human rights, and labor rights.

c. The Company shall establish clear processes and procedures for occupational health and safety management to be implemented within the organization and within its projects, and shall regularly review and revise such processes and procedures at least annually and whenever a major change or event occurs.

d. The Company may set social performance targets for specific issues or areas of operation, including a zero accident target in relation to occupational health and safety, and shall regularly monitor its performance with the aim of continuous improvement in social and occupational health and safety management.

e. The Company shall establish an occupational health and safety committee or shall designate a safety team to monitor occupational health and safety performance and identify any potential safety issues that need to be managed for the Company, its projects, its employees, or other individuals under the Company's responsibility. Prioritization of issues, along with management and action plans, shall be developed in consultation with the Company's employees, contractors, workers, and/or their representatives to ensure key issues are addressed.

f. The Company shall provide appropriate and sufficient training and capacity-building related to social and occupational health and safety issues for its employees, contractors, and other individuals under the Company's responsibility.

g. The results of the social and occupational health and safety performance monitoring shall be reported to the Company's management and the Board of Directors on a regular basis, and reported to relevant management or Board committees and external entities as required. The Company's social performance may also be disclosed through public channels where appropriate.

### 1.3.2.2 Biodiversity Policy

GED will:

- i. Ensure governance of biodiversity at the executive and Board levels.
- ii. Provide a framework for the management of biodiversity based on the mitigation hierarchy (avoid, minimize, remediate, offset), taking into account both direct and indirect drivers that result in biodiversity or ecosystem change, covering: a. Objectives and strategy, b. Study and research, c. Risk assessment, d. Action plans, e. Monitoring and assessment.
- iii. Comply with laws and regulations governing biodiversity conservation areas<sup>1</sup>, avoiding operational activities in areas with high biodiversity importance where possible and appropriate, and apply the precautionary principle in its decision-making process as appropriate.
- iv. Integrate biodiversity management in the Company's environmental and social management system, including ensuring that issues related to biodiversity are monitored and managed throughout the lifespan of projects, from conception to retirement.
- v. Undertake and/ or support actions, such as reforestation, to preserve biodiversity with no net loss and no net deforestation, where necessary, appropriate and feasible.
- vi. Engage with external parties and relevant stakeholders, including the Ministry of Natural Resources and Environment, to develop appropriate biodiversity action plans for the Company's operations where required
- vii. Support education and advocacy related to environmental responsibility:
  - a. Among all departments and at all levels within the Company
  - b. Among external stakeholders including business partners, suppliers, contractors, and the communities in which the Company operates

### 1.3.2.3 Human Rights Policy

Gulf Energy Development Public Company Limited is aware of the importance of respecting and upholding the human rights of its stakeholders and the general society, and shall strive to do so with a focus on the following areas.

i. General provisions

a. The Company shall support a human rights due diligence process to engage with its stakeholders to identify, assess, manage, and, where applicable, prevent or mitigate human rights risks and related issues in key areas including within the Company, in its projects, and within the local communities where the Company operates.

b. The Company shall ensure fair and equal treatment of stakeholders, respecting the diverse nature of people, and placing emphasis on avoiding discrimination based on sex, gender, age, race, ethnicity, religion, nationality, and any other non-merit-based attributes.

c. The Company shall communicate its commitments and expectations regarding human rights to its stakeholders through the appropriate and relevant channels.

d. The Company shall provide appropriate reporting and whistleblowing channels as well as a clear grievance mechanism to manage any such reports, including managing fair and equitable remediation where necessary and appropriate.

ii. Within the Company and its projects

a. The Company respects labor rights and complies with labor laws, including complying with regulations regarding appropriate working hours and conditions, relevant freedoms and collective rights as appropriate, as well as supporting appropriate welfare benefits and compensation for employees beyond the legal minimum wage.

b. The Company shall support gender equality and women's rights, including supporting equal pay for equal work based on a non-discriminatory, merit-based performance evaluation process.

c. The Company shall provide and maintain a safe and healthy workplace for employees with consideration for all aspects of employee well-being (including physical, mental, emotional, social well-being), and comply with applicable safety and health laws and regulations.

d. The Company shall maintain a ZERO TOLERANCE POLICY regarding child labor, slave labor, forced labor, or any form of human trafficking.

iii. Stakeholders and the general society

a. The Company shall support human rights throughout its value chain through monitoring and advocacy, including educating and/or advocating for human rights both within the Company and among external stakeholders including business partners, suppliers, contractors, and the communities in which the Company operates.

b. The Company shall support corporate social responsibility programs and initiatives that promote human rights, with a focus on education, health, work and environmental protection, for children, local communities and the general society. These commitments shall be undertaken within the framework of sustainability and good

corporate social responsibility to ensure that the Company continues to create a positive impact in all spheres where it operates.

c. These commitments shall be undertaken within the framework of sustainability and good corporate social responsibility to ensure that the Company continues to create a positive impact in all spheres where it operates.

## **1.4 SCREENING AND SCOPING OF ENVIRONMENTAL AND SOCIAL IMPACT**

**(1) Approach for Screening and Scoping** includes the following steps.

- Identifying the distinct project activities that could potentially produce an interaction with the physical, biological, or social environment during each phase of the project;
- Identifying the probable receptor types existing in the project area. Receptors for the physical, biological, and social environments;
- The creation of a matrix that lists the project activities against the likely affected receptor types;
- The supporting explanation for ‘no interactions’ that were scoped out from further assessment is provided in this Chapter; and
- An assessment of potential impacts interactions is provided in Chapter 4.

**(2) Result of Screening and Scoping**

The project life cycle is separated into two major phases: construction and operation. There are major actions that may affect specific E&S components during various phases. Each E&S component's expected impact was assessed. **Table 1.4-1** shows the outcome of the project's screening and scoping E&S impact. There were E&S components identified as being unaffected by Project operations. The following are the supporting explanations for E&S component having no impact from the Project activities.



**TABLE 1.4-1  
 SCREENING AND SCOPING RESULT OF ENVIRONMENTAL AND  
 SOCIAL COMPONENTS FOR THE PHALANGNGAN RUNGRUEANG  
 SOLAR POWER PLANT PROJECT**

Project Activities	E&S Components Affected by Project Activities
<p><b>Construction phase</b></p> <ul style="list-style-type: none"> <li>– Land acquisition</li> <li>– Site preparation</li> <li>– Transport and stockpiling of construction materials and equipment</li> <li>– Construction of building</li> <li>– Installation of supporting structures, invertors, solar modules, substation, and transformer</li> </ul>	<ul style="list-style-type: none"> <li>– Soil</li> <li>– Climate change risk</li> <li>– Air quality</li> <li>– Noise</li> <li>– Surface water quality</li> <li>– Terrestrial ecology</li> <li>– Aquatic biological resources</li> <li>– Socio-economic</li> <li>– Public health</li> <li>– Human rights risk</li> <li>– Occupational health and safety</li> <li>– Land use</li> <li>– Land transportation</li> <li>– Solid waste management</li> <li>– Wastewater management</li> </ul>
<p><b>Operation phase</b></p> <ul style="list-style-type: none"> <li>– Electricity production</li> </ul>	<ul style="list-style-type: none"> <li>– Climate change risk</li> <li>– Surface water quality</li> <li>– Flood risk</li> <li>– Electromagnetic field</li> <li>– Terrestrial ecology (Wildlife)</li> <li>– Aquatic biological resources</li> <li>– Socio-economic</li> <li>– Public health</li> <li>– Human rights risk</li> <li>– Occupational health and safety</li> <li>– Land transportation</li> <li>– Solid waste management</li> <li>– Wastewater management</li> <li>– Water drainage</li> <li>– Major hazard</li> </ul>

## 2.1) Construction Phase

- **Geology/Seismology:** the construction of the Project will be conducted above ground, which will not impact the geology. In addition, the Project site is not situated near the active fault; hence, the project will not be affected by the earthquake.
- **Hydrology:** there will be minor site adjustment to consolidate installation of ground-mounted solar modules and minor land use for building construction. The water drainage condition during construction phase will remain the same as the existing condition.
- **Topography:** the Project was designed to have minor modification to the land slope and condition, such as grading and leveling.
- **Indigenous People:** there is no indigenous people in the subdistricts where the Project is situated in.
- **Physical and Cultural Heritage:** there is no physical and cultural heritage nearby the Project area.
- **Water Use / Electricity and Energy Use:** during the construction phase will rely on the supply of water and electricity from Provincial Water Authorities and Provincial Electricity Authorities respectively with sufficient capacity. The impact on the water and electricity use of the surrounding communities can be negligible.

## 2.2) Operation Phase

- **Geology/Seismology:** the project's operations will take place above ground, with no impact on the geology. Furthermore, the project site is not located near an active fault, thus it will be unaffected by the earthquake.
- **Air quality/Noise:** there will be no sources which will cause the potential air quality and noise impacts.
- **Topography:** the Project was designed to have minor modification to the land slope and condition, such as grading and leveling.
- **Indigenous People:** there is no indigenous people in the subdistricts where the Project is situated in.
- **Physical and Cultural Heritage:** there is no physical and cultural heritage nearby the Project area.
- **Land Use:** Even the operation of solar power plant was converted from agricultural area, the surrounding areas still remain primarily agricultural. In such a scenario, the overall land use will be limited to the converted area itself.
- **Water Use / Electricity and Energy Use:** during the operation phase, water and electricity will be supplied by Provincial Water Authorities and Provincial Electricity Authorities respectively with sufficient supply capacity. The impact on the water and electricity use of the surrounding communities can be negligible.

## 1.5 PROJECT CATEGORIZATION

According to the ADB's SPS, Equator Principle 4 and IFC, the definition for project categories is defined as following.

- Category A** – Projects with potential significant adverse environmental and social risks and/or impacts that are diverse, irreversible or unprecedented. These impacts may affect an area larger than the sites or facilities subject to physical works. An environmental impact assessment is required;
- Category B** – Projects with potential limited adverse environmental and social risks and/or impacts that are few in number, generally site-specific, largely reversible and readily addressed through mitigation measures. An initial environmental examination is required; and
- Category C** – Projects with minimal or no adverse environmental and social risks and/or impacts. No environmental assessment is required although environmental implications need to be reviewed.

Based on the preliminary assessment of impact significance of each environmental aspects for the Project in **Table 1.4-1**, the determination of project category is as follows:

**Environment:** The Project has the potential to have an impact on some environmental and social issues, particularly during the construction phase. Its effects will typically be caused by constructing activity, worker consumption, and worker influx, all of which will last about a year and can be readily addressed by mitigation measures. Following that, the operations phase will focus on producing electricity from solar power. The primary impact such as solid waste and wastewater will come from staff consumption. Their management is governed by laws and regulations, and they can be minimized by appropriate measures. As a result, the project is categorized as **Category B**.

**Involuntary Resettlement:** the Project is situated on land owned by Phalanggan Rungrueang Co., Ltd., which was acquired through a willing-seller-willing-buyer scheme. The price was negotiated until the landowners agreed to sell. The land transaction and payment occurred in the presence of Land Office authorities. In addition, consultants interviewed the landowners about the land sale process. Project officials approached landowners [*This information has been removed as it falls within the exceptions to disclose specified in paragraph 17(2) of ADB's Access to Information Policy.*] to discuss the purchase of the land for the installation of a solar power plant. The land was sold [*This information has been removed as it falls within the exceptions to disclose specified in paragraph 17(2) of ADB's Access to Information Policy.*] after successful price negotiations. Prior to the sale, the land was primarily used for cultivation of rice and cassava. Following the sale, almost all landowners used a share of the money to pay off long-standing debts, spend for live, and save for an emergency reserve. They continue to farm on other areas of land that they own. As a result, there will be no physical and economic displacement. Thus, the Project can be classified as **Category C** regarding involuntary resettlement.

**Indigenous People:** There was no information from subdistrict administrative organization about indigenous people, for example indigenous or ethnic groups are not mentioned in their social information. In addition, according to the ethnic group database of the Princess Maha Chakri Sirindhorn Anthropology Centre (Public Organization), there are no ethnic groups in the area of Na Kha Subdistrict (**Source:** <https://ethnicity.sac.or.th/database-ethnic>). It can be concluded that there are no people in the project area who:

- Self-identify as members of a distinct indigenous cultural group and recognition of this identity by others;
- Have collective attachment to geographically distinct habitats or ancestral territories in the project area and to the natural resources in these habitats and territories;
- Have customary cultural, economic, social, or political institutions that are separate from those of the dominant society and culture; or
- Use a distinct language, often different from the official language of the country or region.

As such, the Project can be categorized as **Category C** regarding indigenous people.

## **CHAPTER 2**

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### **PROJECT DESCRIPTION**

## CHAPTER 2 PROJECT DESCRIPTION

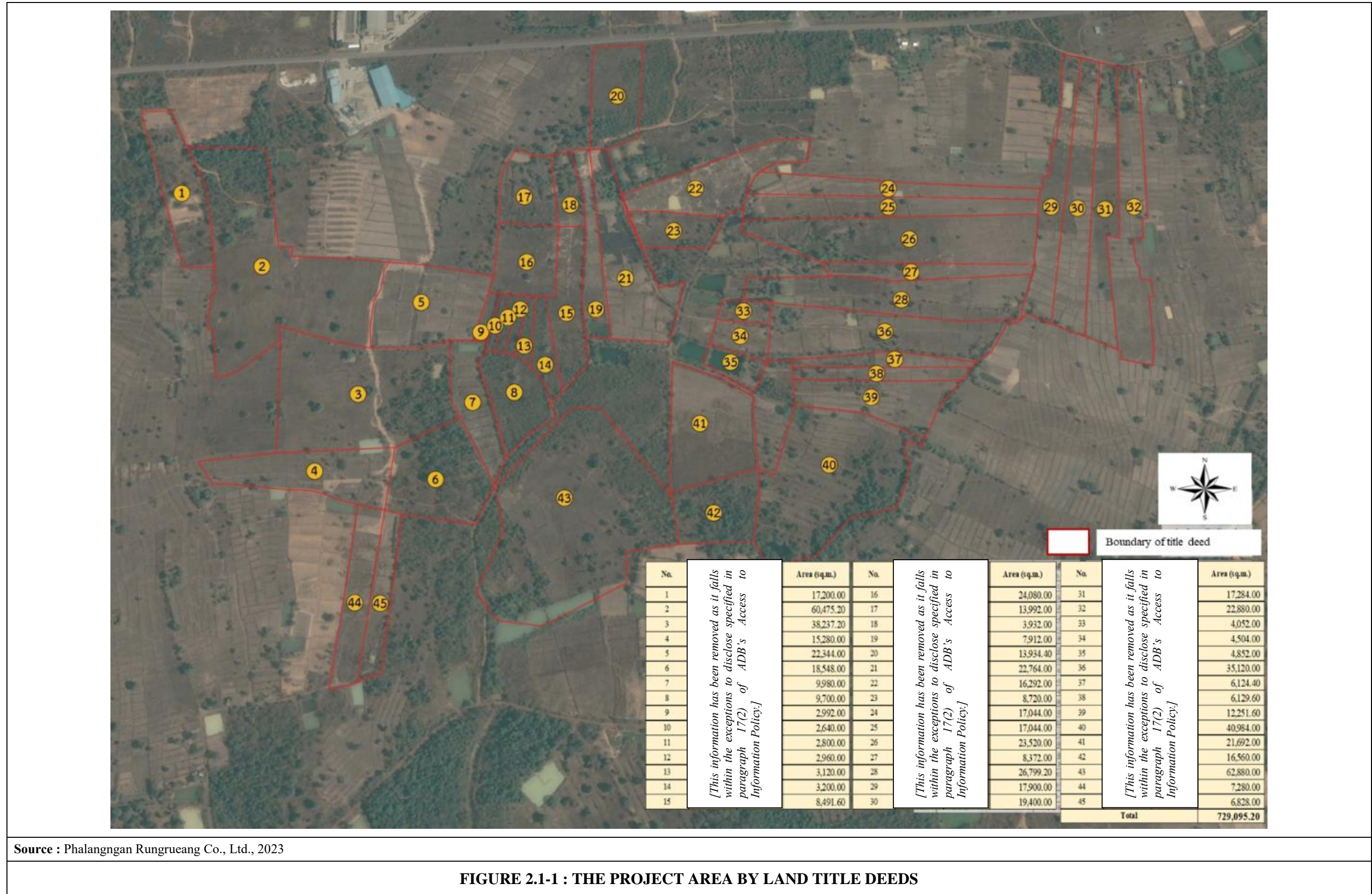
### 2.1 PROJECT LAYOUT AND UTILIZATION

The Phalangngan Rungrueang Solar Power Plant Project has a total area of 729,095.2 sq.m., which is located on land with 45 title deeds (**Appendix 2A**) in Na Kha Subdistrict, Mueang Udon Thani District, Udon Thani Province as shown in **Figure 2.1-1**. The Project has already purchased land *[This information has been removed as it falls within the exceptions to disclose specified in paragraph 17(2) of ADB's Access to Information Policy.]* Most of the area is for power generation, accounting for 452,533.10 sq.m. or 62.07 percent, power generation control building 216.0 sq.m. or 0.03 percent, spare parts, material, equipment, waste storage area, and maintenance area 120.00 sq.m. or 0.02 percent, green area 1,625.00 sq.m. or 0.22 percent, buffer area 49,501.60 sq.m. or 6.79 percent, switchyard or substation 1,599.00 sq.m. or 0.22 percent, empty space or road, walkways, or parking space 221,568.2 sq.m. or 30.39 percent and other areas (ponds and existing drains) 1,932.3 sq.m. or 0.26 percent. More details are shown in **Table 2.1-1**. The diagram of land use is shown in **Figure 2.1-2**.

**TABLE 2.1-1  
LAND USE IN THE AREA OF THE PHALANGNGAN RUNGRUEANG POWER  
PLANT PROJECT**

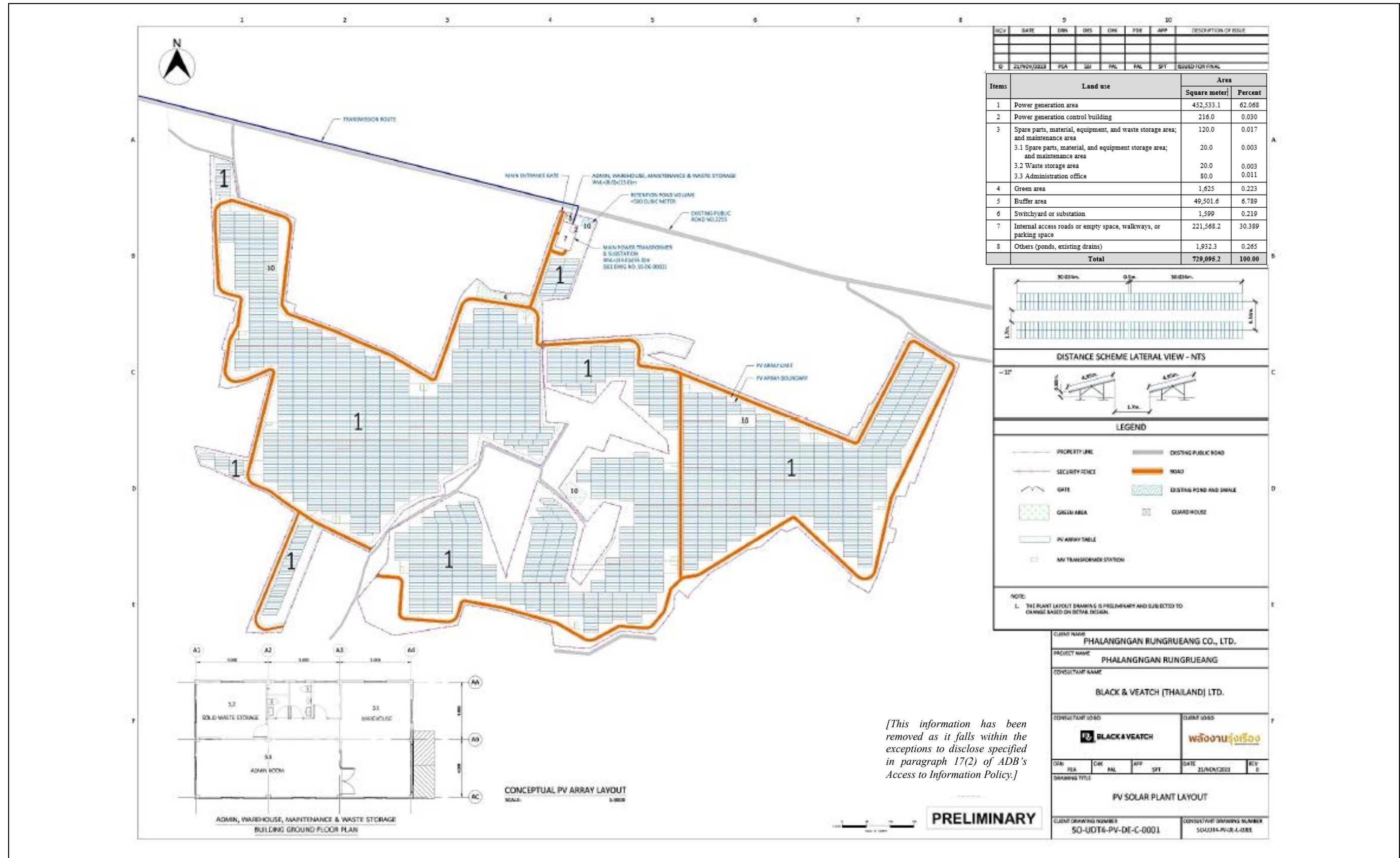
Items	Land use of the Project	Area	
		sq.m.	Percent
1	Power generation area	452,533.10	62.07
2	Power generation control building	216.00	0.03
3	Spare parts, material, equipment, waste storage area, and maintenance area	120.00	0.02
4	Green area	1,625.00	0.22
5	Buffer area	49,501.60	6.79
6	Switchyard or substation	1,599.00	0.22
7	Empty space or roads, walkways, or parking space	221,568.20	30.39
8	Others (ponds, existing drains)	1,932.30	0.26
	<b>Total</b>	<b>729,095.20</b>	<b>100.00</b>

Source : Phalangngan Rungrueang Co., Ltd., 2023



Source : Phalanggan Rungreang Co., Ltd., 2023

**FIGURE 2.1-1 : THE PROJECT AREA BY LAND TITLE DEEDS**



Source : Phalangngan Rungrueang Co., Ltd., 2023

FIGURE 2.1-2 : LAND USE IN THE AREA OF THE PHALANGNGAN RUNGRUEANG SOLAR POWER PLANT PROJECT



## 2.2 PROJECT COMPONENTS

The Phalangnan Rungrueang Solar Power Plant Project is a non-combustion power plant that generates electric power from solar energy using photovoltaic technology or solar cells installed on the ground system. Main equipment installed in the Project area includes PV modules, inverters and transformers. The details of main technology and equipment can be summarized below and the land acquisition for those components are presented in **Table 2.2-1**.

### 2.2.1 Power Generation Area

#### 2.2.1.1 Photovoltaic (PV) Modules

The Project will use monocrystalline silicon PV modules that have been tested and certified with the IEC61215, IEC61730, ISO9001:2015, ISO14001:2015, ISO 45001:2018, or equivalent standards to ensure that its safety complies with the Thai Industrial Standards Institute (TIS) or equivalent to international standards. In total, there will be 127,738 PV modules. Each PV module has a peak power generation capacity (Peak Power Watts: Pmax) of 605 watts (Wp), with a total installed capacity of 77.281 megawatts (MWp). A PV module is 2,465 mm in width, 1,134 mm in height, 30 mm in thickness, and 34.6 kg in weight. Monocrystalline PV modules do not cause light reflection. In addition, the installation angle is 11 degrees horizontally. So, it does not affect the visibility of people living near the Project area (**Appendix 2B**).

#### 2.2.1.2 Mounting Structures

The PV module mounting structure is made of aluminum fixed with poles. The beams are made of rustproof galvanized steel. This structure can withstand the force of the wind speed not less than 30 meters per second (**Appendix 2C**).

#### 2.2.1.3 Inverters

Inverters convert the electric power generated from PV modules by turning direct current to alternating current. The Project will use inverters that comply with the regulations or requirements of the Provincial Electricity Authority and have passed the standards of IEC62109, IEC61727, IEC62116, or equivalent standards. There will be 184 inverters, with a capacity of 300.00 kVA each or equivalent. Total installed capacity of 55.200 megawatts (MWac). The inverters are 1,048 mm in width, 732 mm in height, 395 mm in thickness, and 122 kg in weight (**Appendix 2D**).

#### 2.2.1.4 Transformers

Transformers convert electric power into high-voltage electricity to increase the voltage enough to supply electricity. The Project will install one transformer of 60 megavoltamperes (MVA) and 19 transformers of 3.437 megavolt-amperes (MVA) (**Appendix 2E**).

**TABLE 2.2-1  
LAND ACQUISITION FOR PROJECT COMPONENTS**

Project Component	Location*	Area Requirement (sq.m.)	Percent of Total Project Area (%)	Mode of Land Acquisition	Status of Land Acquisition
1. Power generation area	Situated around the Project site	452,533.10	62.07	Willing-buyer-willing-seller scheme	Purchased by Phalangngan Rungrueng Co., Ltd. <i>[This information has been removed as it falls within the exceptions to disclose specified in paragraph 17(2) of ADB's Access to Information Policy.]</i>
2. Power generation control building	Situated in the northern part of the Project site	216.00	0.03		
3. Storage area, and maintenance area	Situated at the north of the Project site	120.00	0.02		
4. Green area	Situated at the north of the Project site	1,625.00	0.22		
5. Buffer area (setback area from the project fence)	Next to the fence around the Project site	49,501.60	6.79		
6. Switchyard or substation	Situated in the northern part of the Project site	1,599.00	0.22		
7. Empty space or roads, walkways, or parking space	Internal roads surround the Project site and pass through the center of the Project site.	221,568.20	30.39		
8. Others (ponds, existing drains)	Ponds is situated at the center, the west, the east, and the north of the Project site	1,932.30	0.26		
9. Transmission line	Starts from front of the Project to cut and turn point of the existing 115-kV transmission lines to Udon Thani 1 substation and Ban Phue substation	1,055.00**	Not included in the Project area	Within RoW of public roads	PEA will apply for approval from the relevant authorities for the lands within RoW.
<b>Total</b>		<b>729,095.20</b>	<b>100.00</b>		

**Remarks:** \* See the project components in **Figure 2.1-1**.

\*\* The area requirement for transmission line is estimated from the area require for each area of utility pole's construction 5 sq. m. and approximately 211 utility poles in total. This area is within RoW of public roads , so it is not included in the Project area.

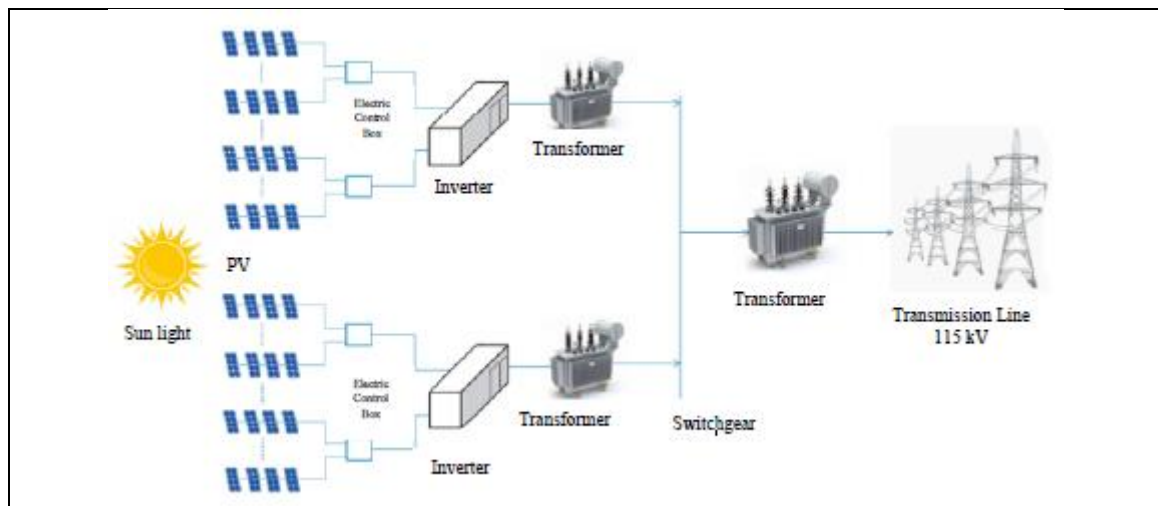
### 2.2.1.5 Switch Gears

7 units of indoor 22 kV switch gear consisting of disconnecting switches, fuse, or circuit breakers are employed. Switch gear controls and protect equipment in case of abnormality or equipment malfunction occurs in the electricity generation process. They are designed to meet IEC 62271-200 and Provincial Electricity Authority Regulations on Power Network System Interconnection Code B.E. 2559 (2016).

### 2.2.1.6 Electrical Substation

The electricity generation process starts when sunlight, which is an electromagnetic wave, comes in contact with PV modules, which are semiconductor. The contact will cause positive and negative charged particles to move in opposite directions.

The movement of such positive and negative charged particles generates direct current power. Such DC power will be supplied to a device called "inverter" to convert direct current into alternating current, then sent to the transformer to convert to high voltage of 115 kV in order to supply power to EGAT (**Figure 2.2-1**). The single line diagrams of PV modules are shown in **Figure 2.1-2 (Appendix 2F)**.

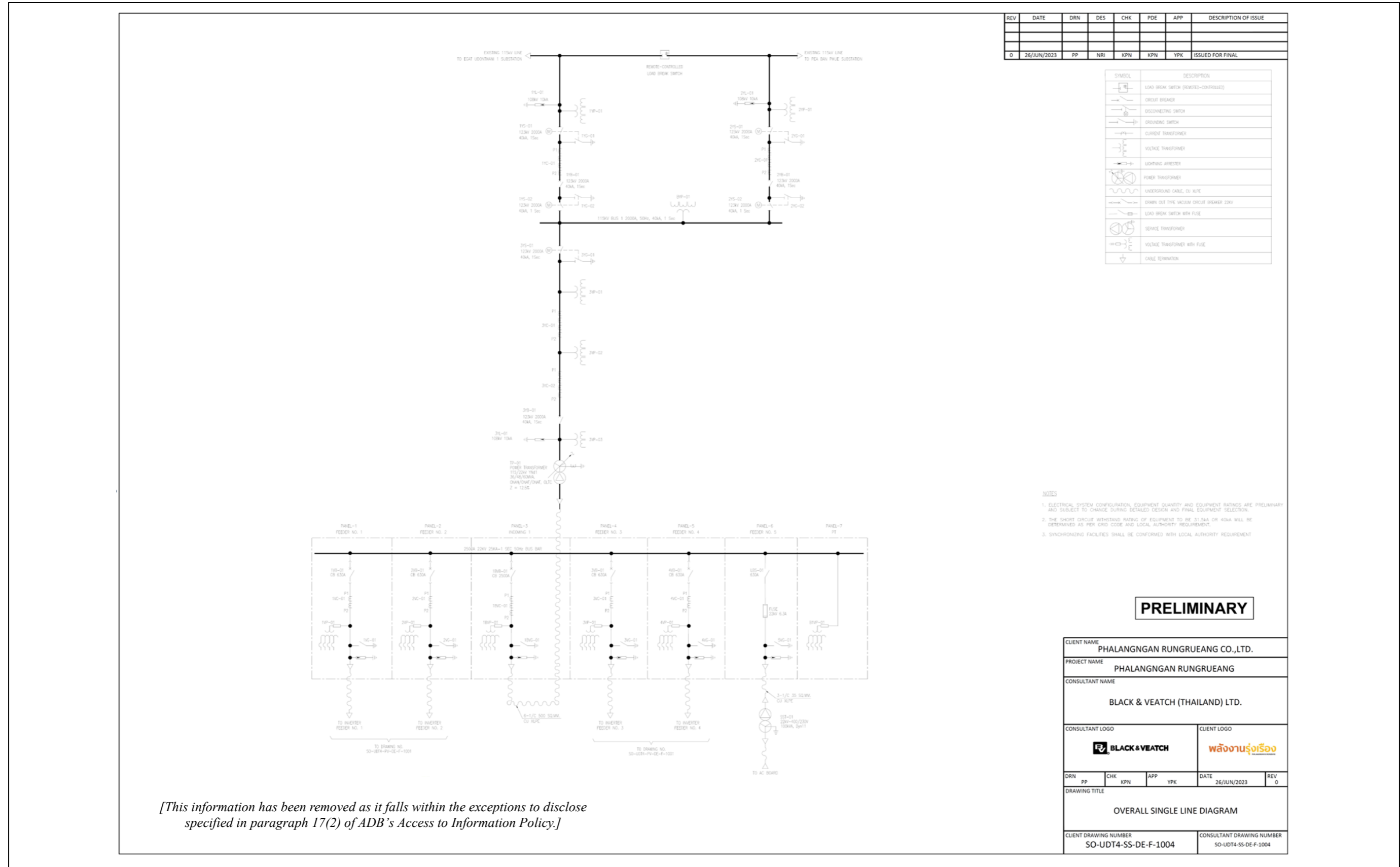


Source : Phalangngan Rungrueang Co., Ltd., 2023

**FIGURE 2.2-1: ELECTRIC POWER GENERATION FROM SOLAR ENERGY**

### 2.2.1.7 Cabling

The connection of the solar energy production system with the power distribution system of the Provincial Electricity Authority (PEA) is designed with inverters, which are devices used to convert direct current electricity from the production system into alternating current electricity for supply to the distribution network. In this regard, the connection with the PEA distribution network will adhere to the electrical installation standards for Thailand, established by the Engineering Institute of Thailand under the Royal Patronage (Standard TIS 022001-22). The installation will be supervised by licensed Control System Engineers specializing in electrical power, as stipulated by the Professional Engineers Act B.E. 2542 (1999).



Source : Phalangan Rungreang Co., Ltd., 2023

**FIGURE 2.2-2 : SINGLE LINE DIAGRAM FOR PV MODULES OF THE PROJECT**

### 2.2.1.8 Communications

The project will coordinate with telephone and internet service providers to obtain fixed line services and high speed internet or Broad Band Internet, including mobile phones for communication within the organization with external agencies and the general public. In addition, the project has provided an emergency communication system in the project's fire prevention and suppression plan.

### 2.2.1.9 Site Security and Fencing

The project area will be enclosed by transparent fencing, and clear signs stating the area limits will be placed. In addition, fences will be placed to separate the public road located in the project area (as shown in **Figure 2.1-1**), so the access to the public road will not be restricted or limited. Furthermore, security officers will be stationed at a security guard house located at the main entrance gate.

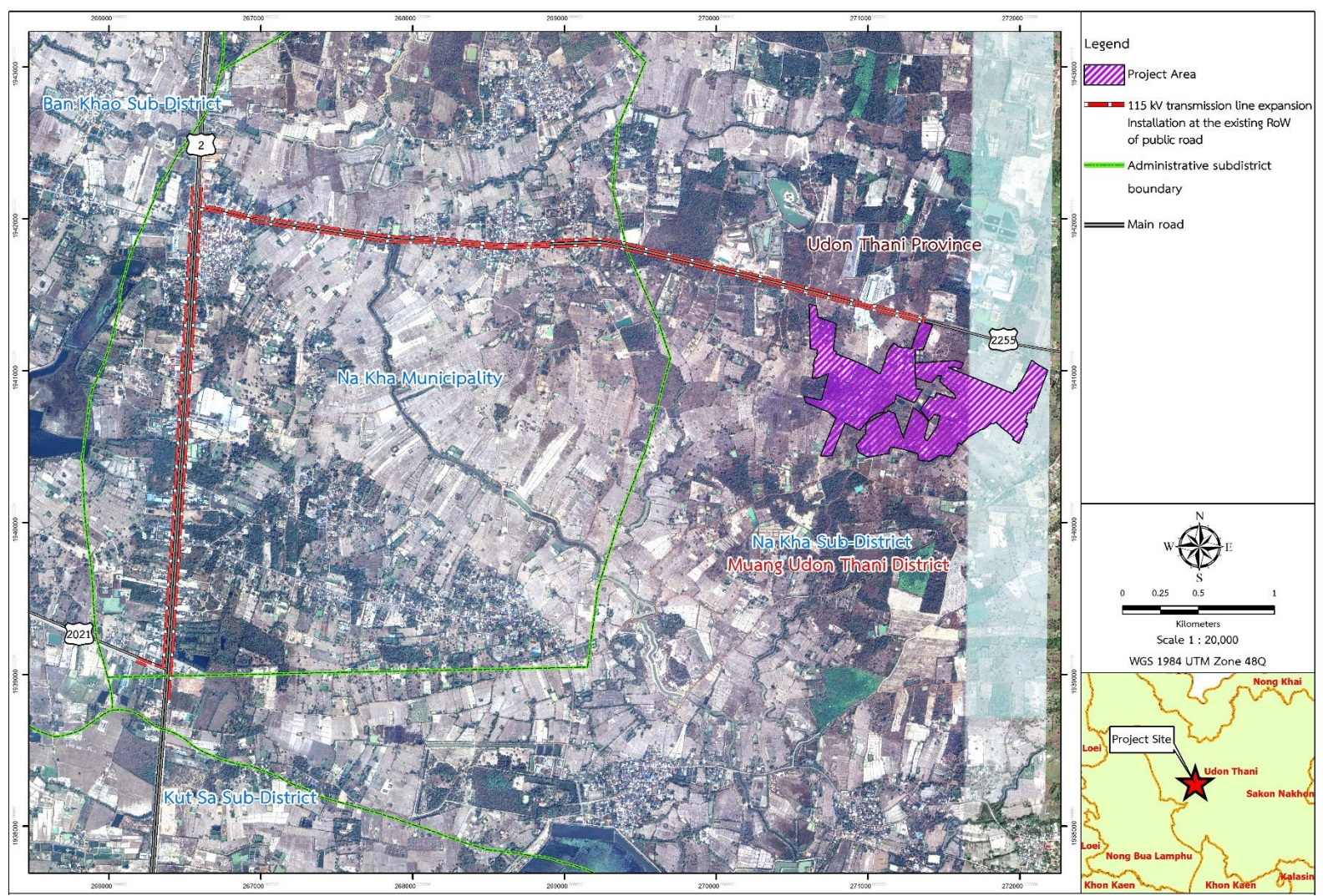
### 2.2.1.10 Access Road

There is public road surrounding the project site and directly connects to the Project site (as presented in **Figure 2.1-1**), which the Project will use it as the access road to the project area. In addition, there will be internal roads around the Project area.

## 2.2.2 Transmission Line

The Project involves the construction of a 115 kV transmission line (TL), which is one of the Project components. The total length of the transmission line is 8.7 kilometers, starting from a substation within the Project area along the right-of-way (RoW) of the public roads until it the the cut and turn point of the existing 115-kV transmission lines to Udon Thani 1 substation and Ban Phue substation (**Figure 2.2-3**). The TL will be constructed, owned and operated by PEA. It is noted that the TL will not be financed under the financing arrangements with the Lenders and will therefore be considered as Associated Facility.

In order to minimized the impact of the TL installation activities on the community, the PEA design the routing of the TL within the Right of Way (RoW) of other governmental infrastructures such as roads, canals, etc. The TL route is presented in **Figure 2.2-3**. The **Table 2.2-1** presents a summary of the TL features.



**FIGURE 2.2-3 : TRANSMISSION LINE ROUTE OF THE PROJECT**

**TABLE 2.2-2  
OVERALL PROJECT’S DESCRIPTION AND ASSOCIATED FACILITY**

<b>Detail</b>	<b>Transmission Line</b>
Owner	Provincial Electricity Authority (PEA)
Location	Right of Way (RoW) along the public roads is required for the construction of a 115-kV transmission line. The transmission line spans a total length of 8.7 kilometers, starting from the project’s substation to the the cut and turn point of the existing 115-kV transmission lines to Udon Thani 1 substation and Ban Phue substation
Components	<ol style="list-style-type: none"> <li>1. Transmission Line: 400 square millimeters All Aluminum Conductor (AAC).</li> <li>2. Transmission Circuit: Single circuit, Double conductor.</li> <li>3. Electricity Poles: Reinforced concrete poles with a height of 22 meters, and about 0.9 x 2.2 x 3.0 meters (width x length x depth) of foundation dimensions.</li> </ol>
Study area and affected villages	<p>100-m. from the transmission line route, covering 4 villages in Na Kha Subdistrict, Mueang Udon Thani District, Udon Thani Province.</p> <p><b>Na Kha Subdistrict Municipality</b></p> <ul style="list-style-type: none"> <li>- Village no. 1 Ban Na Kha</li> <li>- Village no. 3 Ban Thon Noi</li> <li>- Village no. 7 Ban Thon Yai</li> <li>- Village no. 11 Ban Dong Rai</li> </ul>

### 2.2.2.1 Approach of Transmission Line Construction

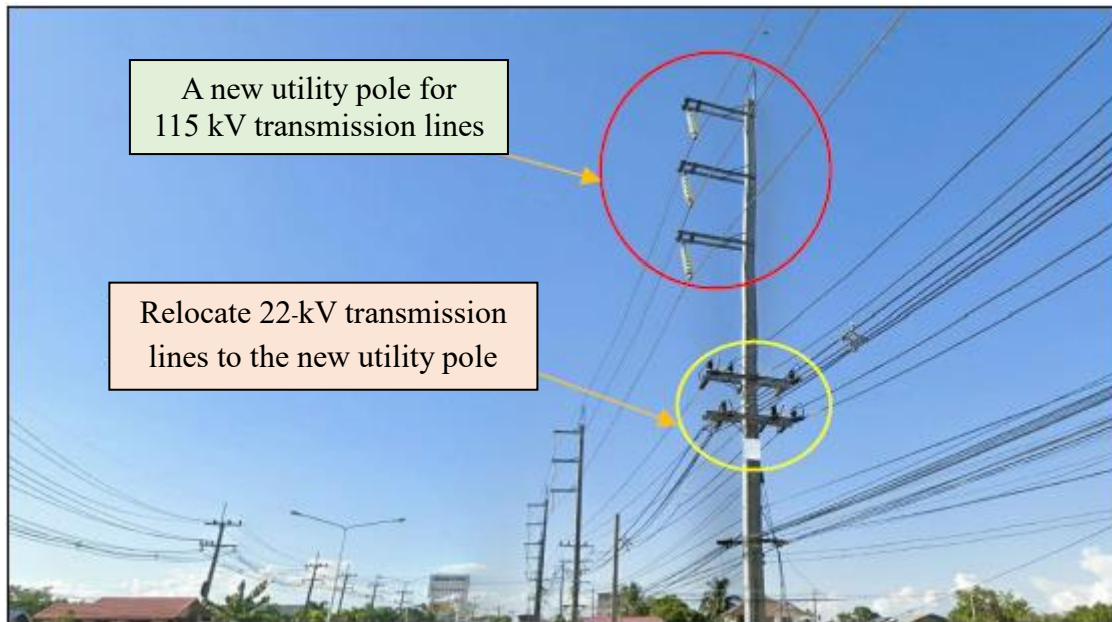
The power transmission lines will be constructed within the right-of-way of the public roads with 2 following approaches:

(1) Construction within the area where PEA’s power lines exist will be done using two approaches:

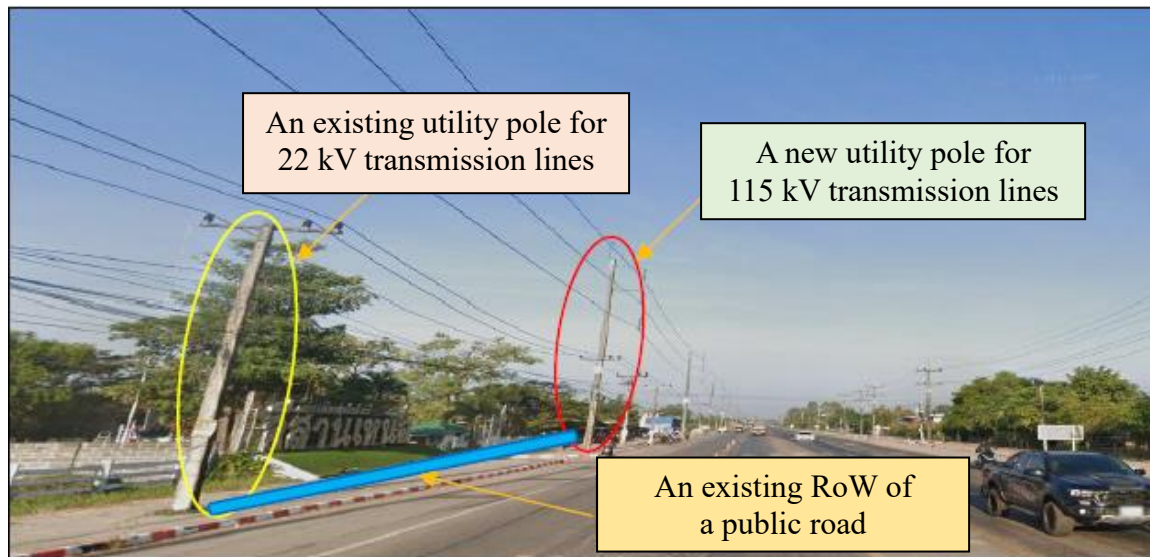
- Construction of new utility poles for the 115 kV power transmission lines, which will replace the existing utility poles for the PEA's 22 kV power transmission lines. The original 22 kV electricity transmission lines will be relocated to the new utility poles (as shown in **Figure 2.2-4**).

- Construction of new utility poles for the 115 kV power transmission lines along the same alignment as the existing utility poles for the PEA’s 22 kV power transmission lines, without displacing the old PEA power transmission lines (as indicated in **Figure 2.2-5**).

(2) In areas where there are no existing power transmission lines within the right-of-way, new utility poles and power transmission lines will be constructed along the right-of-way, as shown in the example of the utility pole alignment in **Figure 2.2-6**.

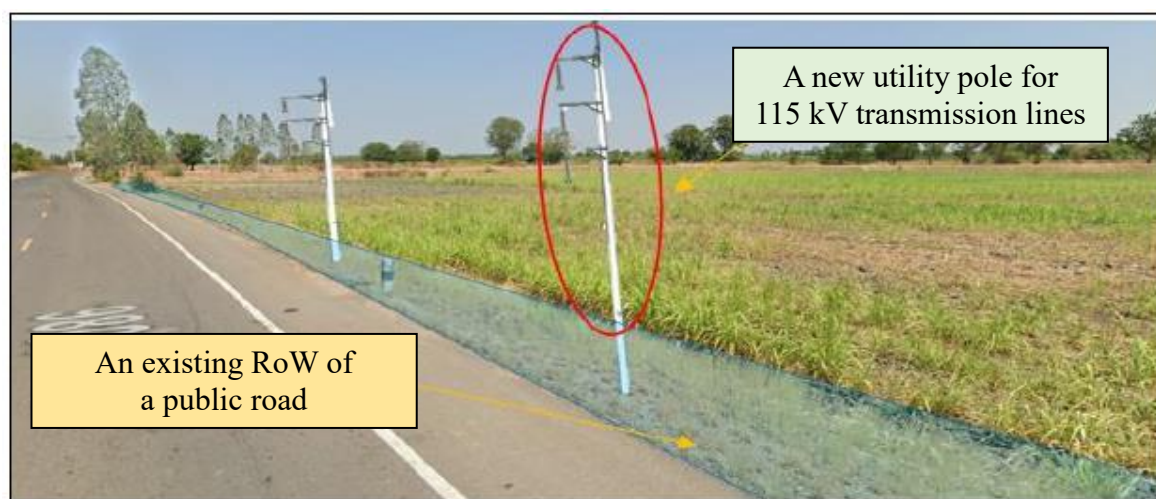


**FIGURE 2.2-4 : AN EXAMPLE OF THE CONSTRUCTION OF UTILITY POLES FOR 115 KV TRANSMISSION LINES TO REPLACE THE EXISTING PEA UTILITY POLES**



**FIGURE 2.2-5 : AN EXAMPLE OF THE CONSTRUCTION OF UTILITY POLES FOR 115 KV TRANSMISSION LINES IN THE SAME ALIGNMENT AS THE EXISTING PEA UTILITY POLES**





**FIGURE 2.2-6 : AN EXAMPLE OF THE CONSTRUCTION OF UTILITY POLES FOR 115 KV TRANSMISSION LINES IN AREAS WHERE THERE ARE NO EXISTING UTILITY POLES**

#### **2.2.2.2 Procedure of Transmission Line Construction**

The construction of the Project's transmission line falls under the purview of the PEA and will occur within the restricted right-of-way of public roads, which is under the jurisdiction of the Department of Highways or the Department of Rural Roads or local administrative organizations. The PEA is responsible for obtaining the appropriate permissions from those agencies. The following are the procedures to be followed when designing and constructing power transmission lines in accordance with regulations of the Provincial Electricity Authority for the Establishment of Electrical Systems in B.E. 2559 (2016):

1. Supplement the physical site survey with data and maps obtained from the Geographic Information System (GIS) of the electrical system.
2. Conduct an examination and assessment of the tangible site conditions in order to utilize the information in the design and creation of plans. The plans ought to align with the existing conditions of the site.
3. For design purposes, coordinate with pertinent government and private sector agencies to obtain information regarding right-of-way areas.
4. Assess site conditions with respect to diverse impediments, including communication lines, fiber optic cables, and water drainage pipelines, in order to precisely delineate the electrical system configuration.
5. Obtain permission or consent from the respective landowners or agencies prior to constructing the electrical system or cutting down trees, branches, or roots in government agency areas traversed by construction projects. Such restricted areas consist of national highways, railway tracks, irrigation zones, forest preserves and more.

*[This information has been removed as it falls within the exceptions to disclose specified in paragraph 17(2) of ADB's Access to Information Policy.]* During construction, issues arising will be monitored, The project will coordinate with PEA to ensure resolution.

### **2.2.2.3 Stakeholder Engagement for the Transmission Line**

Engagement regards to the transmission line will be conducted by PEA as developer and owner of the TL. Hence, the engagement will be conducted by PEA as follow.

1) Typically, PEA notifies those living along the planned transmission line in proper time before construction begins.

2) PEA will seek permission from authorities responsible for managing Right-of-Way (RoW) areas for use of land for construction and for cutting trees or roots within the RoW.

### **2.2.2.4 Compensation for Damages Caused by PEA's Operations**

PEA indicated that in the event that the construction of the TL requires clearance or removal of encroaching structures, plants, trees within the RoW or generates disputes with neighboring residents, PEA will try to alter the design to avoid such clearance. In the event that the removal of the encroachment is unavoidable, PEA will request that the RoW agencies, such as the Department of Highways to negotiate with the land users to remove their structures. *[This information has been removed as it falls within the exceptions to disclose specified in paragraph 17(2) of ADB's Access to Information Policy.]*

For damages caused to properties and assets within local land ownership (outside of RoW), compensations can be claimed from PEA in accordance with the Provincial Electricity Authority Act (Version 4) B.E. 2542 (1999), stating: if there is any damage to the owner or possessor of an immovable property or a holder of other right as a result of the act officials from construction and maintenance of the electric energy transmission system, such person may claim compensation from PEA.

The compensation will be paid in accordance with the Provincial Electricity Authority's Regulations Concerning the Practice of Compensating for Damages or Providing Humanitarian Assistance to External Parties, B.E. 2564 (2021), state that in cases where damage is caused by a tortious act of PEA or arises from the performance of duties by its employees or workers, the following procedures should be undertaken:

1) In the event that an external party's property is damaged, consideration should be given to deducting depreciation according to the condition of the property or using the market price at the time of the incident as part of the assessment before proposing to the authorized person to approve the payment of damages.

2) In cases where an external party is deceased and the heirs make a claim for damages from PEA, the authorized person should provisionally approve an initial payment of damages to the heirs of the deceased not exceeding 50,000 baht. Subsequently, a fact-finding committee shall consider determining the damages, taking into account the status and actual damages incurred by the individual concerned.

3) In cases where an external party sustains injuries or disabilities, or loses their capacity, a fact-finding committee shall consider determining the damages by comparing guidelines for considering compensation payments as specified in the annex of these

regulations. However, this does not include medical expenses and other damages such as loss of earnings or loss of support.

#### **2.2.2.5 PEA's Complaint Receiving Channel**

Complaints about impacts from PEA's operations can be made through the following channels:

- 1) Hotline 1129
- 2) Complaints via electricity billing officers or local electricity offices
- 3) The website of the Provincial Electricity Authority

When the PEA receives a complaint, they will respond within 30 days, and the complainant can track the progress of the complaint resolution on the PEA's website.

### **2.3 PROJECT ALTERNATIVES**

#### **2.3.1 Site Selection**

The project developer has acquired the lands for Phalangan Rungrueang Solar Power Plant Project through willing-buyer-willing-seller scheme [*This information has been removed as it falls within the exceptions to disclose specified in paragraph 17(2) of ADB's Access to Information Policy.*]. The criteria for site selection was in compliance to the regulations of the Energy Regulatory Commission Regarding the supply of electricity from renewable energy in the form of Feed-in Tarff (FiT) for the year 2022-2030 for the group without fuel costs, B.E. 2565 (2022) and according to the regulations of the Energy Regulatory Commission Regarding the criteria for the preparation of the Code of Practice Report and the Compliance Report with the Code of Practice for the Operation of Electricity Generation, B.E. 2565 (2022), stipulates that the project area must not violate any laws about the location that is currently in effect, such as:

- (1) The project must not violate the law on town planning.
- (2) The project must not violate the law on the promotion and conservation of national environmental quality.
- (3) The project must not violate the law on ancient monuments and antiques.
- (4) The project must not be contrary to the resolution of the Cabinet.
- (5) In case the project is located in an industrial estate or other areas that look like industrial estates must not contradict the law on the Industrial Estate Authority of Thailand.

Furthermore, the project location must not cause any impact on the reflection of light in the vicinity of the airport or be in a vulnerable area or have safety standard requirements. Before purchasing the land, the project owner ensured that it met the aforementioned standards. The inspection provided the following results:

### 2.3.1.1 Compliance with the Relevant Laws

#### (1) Udon Thani Comprehensive Town Plan

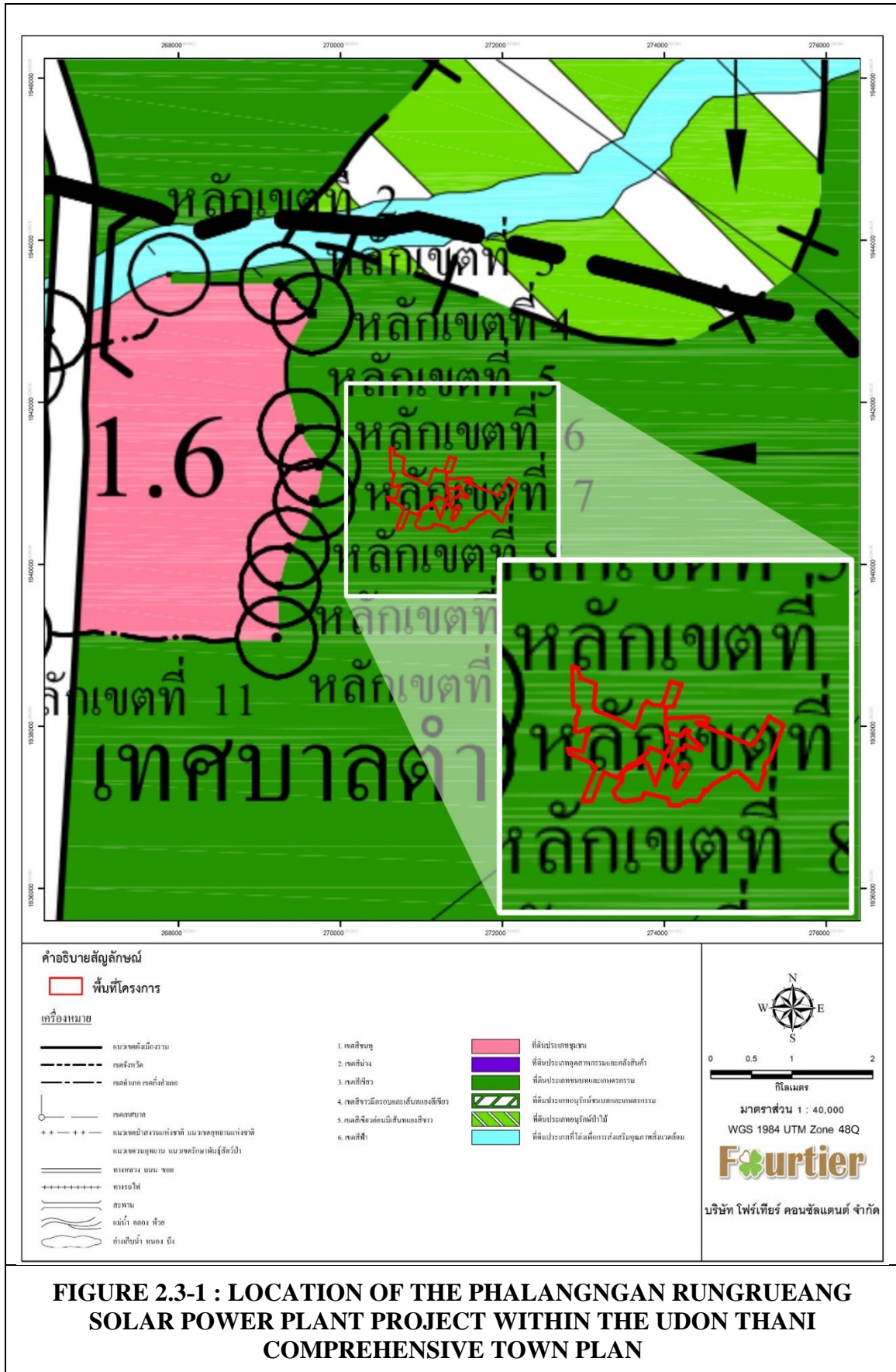
Phalangngan Rungrueang Co., Ltd. has verified the land type and land use according to the Ministry of Interior's regulations mandates the implementation of the Udon Thani Comprehensive Town Plan B.E.2560 (2017). Bureau of National and Regional Planning has notified the results of the land use inspection. (Copy of the land use inspection letter is attached as **Appendix 2G**). The letter states that the company can establish the Phalangngan Rungrueang Solar Power Plant Project in zone number 3.9 (**Figure 2.3-1**) according to the regulations on Udon Thani Comprehensive Town Plan B.E.2560 (2017). The area is designated for land use as agricultural and related to agriculture (green color) for agricultural purposes, residential purposes, educational institutions, religious institutions, government institutions, public utilities and public facilities. The list that determines the type, kind, and category of prohibited plants attached to Udon Thani Comprehensive Town Plan B.E.2560 (2017) does not state to prohibit plant number 88 (1) solar power generating plants.

#### (2) Other Relevant Laws

The Project has been certified that the Project site does not violate Enhancement and Conservation of National Environmental Quality Act, and is not located within or near a 1-kilometer radius of wildlife conservation areas, wildlife sanctuary areas, national parks, ancient sites the compliance of project location to the law on city planning and the law on the enhancement and conservation of national environmental quality in accordance to the Regulation of the Energy Regulatory Commission with the criteria for preparing a Code of Practice report and monitoring report for Electricity Generation Business B.E. 2565 (2022).

### 2.3.1.2 Reflective Effect on the Airport

The location of a solar power plant project must not cause any reflective effects on the airport vicinity areas. Based on the examination, the Phalangngan Rungrueang Solar Power Plant Project is approximately 17.4 kilometers away from Udon Thani International Airport and is not within the airspace safety zone as announced by the Ministry of Transport regarding the designated area near Udon Thani Airport in Ban Phue and Muang districts, Udon Thani province, which is an airspace safety zone established in 1992. Therefore, the Project does not cause reflective effects on the airport. In addition, there was no safety standard requirement in the Project area and surrounding areas.



## 2.3.2 Solar PV Technology

### (1) Monocrystalline Solar Panels

Monocrystalline solar panels are a type of photovoltaic technology that is made from a single crystal structure, usually silicon. The advantages of this technology include:

- High energy conversion efficiency compared to other types of solar panels. It can generate more electricity from the same intensity of sunlight.
- Have a lifespan of 25 years or more.

However, the cost of monocrystalline panels is more expensive in comparison with other PV technologies.


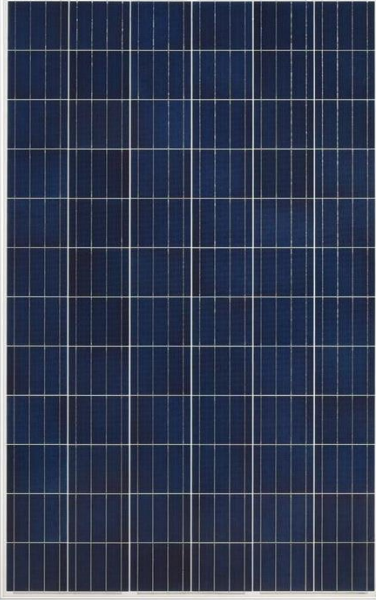
### (2) Polycrystalline Solar Panels

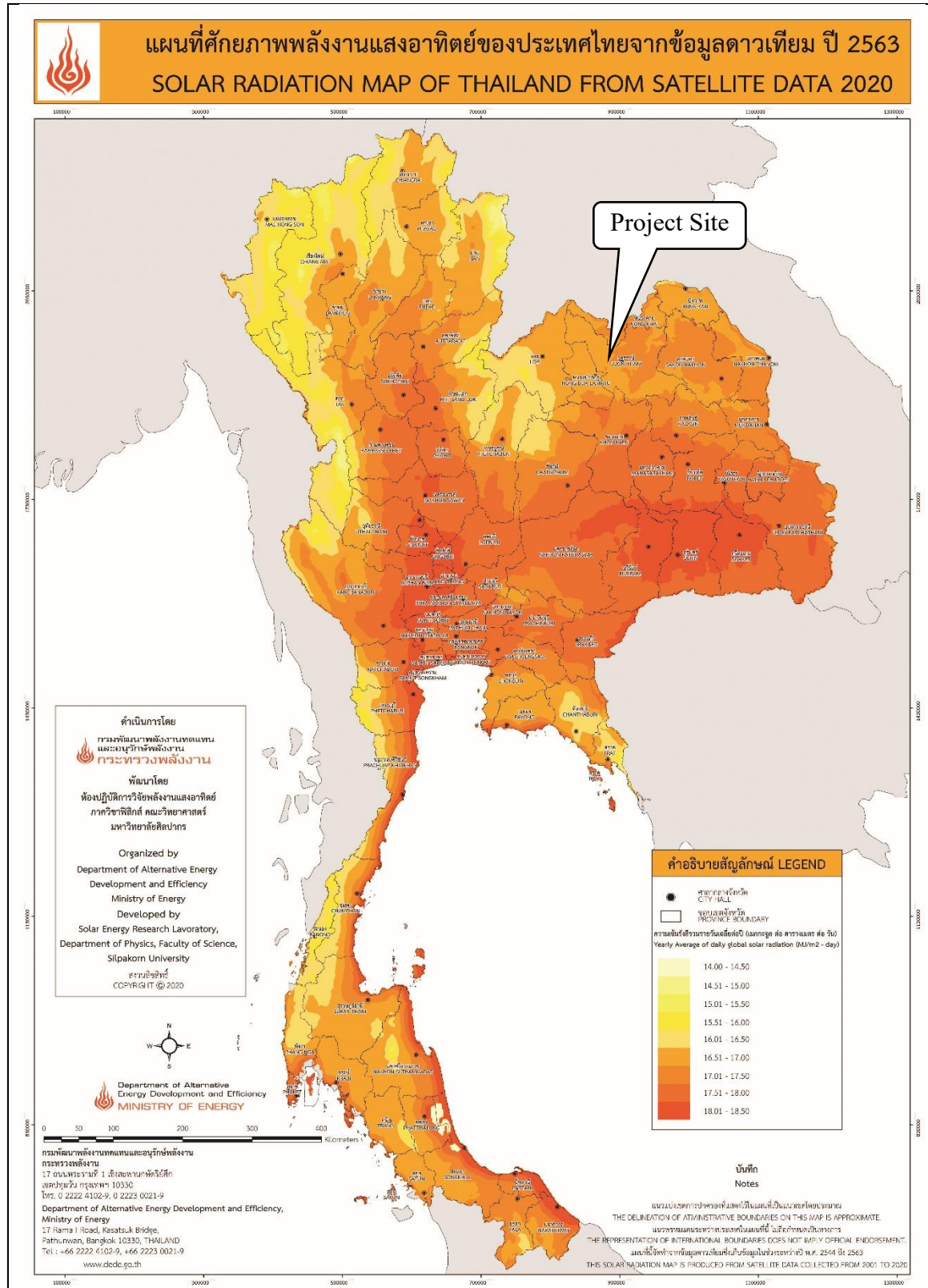
Polycrystalline solar panels are a type of photovoltaic technology made from multiple crystal structures of silicon. Its advantages include; more cost-effective and more tolerate to high temperature in comparison with monocrystalline panels. However, Polycrystalline solar panels typically have lower energy conversion efficiency compared to monocrystalline panels, therefore they generate less electricity from the same intensity of sunlight.

Comparison between Monocrystalline Silicon and Polycrystalline Silicon as shown in **Figure 2.3-2**. According to the advantages and disadvantages of solar PV technology (monocrystalline and polycrystalline), the project chose monocrystalline silicon because it produces more electricity than polycrystalline.

## 2.3.3 Solar Resource and Supply

Solar energy is an important factor in the solar power generation system. The project has studied the potential of solar power generation in the project site from the solar energy potential map of Thailand based on satellite data as shown in **Figure 2.3-3**. From the report of renewable energy in Thailand 2020 of the Department of Alternative Energy Development and Efficiency, it was found that the annual average light intensity in Na Kha sub-district, Mueang Udon Thani district, Udon Thani province is about 17.54 MJ/square meter-day. Therefore, these areas have the potential to generate electricity from solar energy.

	
<p><b><u>Monocrystalline Silicon</u></b></p> <ul style="list-style-type: none"><li>- Best electricity generation</li><li>- Takes up little space</li><li>- Life span more than 25 years</li><li>- Shadows affect electricity generation</li></ul>	<p><b><u>Polycrystalline Silicon</u></b></p> <ul style="list-style-type: none"><li>- Produces less electricity than Monocrystalline</li><li>- Takes up a lot of space</li><li>- Life span more than 25 years</li><li>- Shadows affect electricity generation</li></ul>
<p><b>FIGURE 2.3-2 : COMPARISON BETWEEN MONOCRYSTALLINE SILICON AND POLYCRYSTALLINE SILICON</b></p>	



Source : Thailand Alternative Energy Situation, 2020

**FIGURE 2.3-3 : THE SOLAR RADIATION MAP OF THAILAND FROM SATELLITE DATA**



## **2.4 PROJECT IMPLEMENTATION PHASING AND ACTIVITIES**

### **2.4.1 Construction Phase**

#### **2.4.1.1 Project Area**

The construction phase will take about 12 months, with a maximum of 618 workers on site at a given time. The contractor will procure all workers and provide a worker camp with the proper welfare and environment as mentioned above. Construction activities will include the following:

##### **(1) Site Preparation**

The preparation of the Project area and equipment installation takes place within the Project's designated boundaries. Perimeter fences are constructed to prevent intrusion and facilitate security management. Additionally, the site preparation is done by land clearance, cut and fill method only within the designated boundaries. The construction equipment used for site preparation is as follow:

- Tracked excavator
- Dozor
- Compactor
- Dump truck

##### **(2) Mounting Structure Construction**

Mounting structure will be constructed to support the solar panels concurrently with the construction of the building and civil works. The work will start with the foundations for installing the support columns and bases for the solar panel arrays. Subsequently, the solar panels and other equipment will be installed on these structures in sequential order. The construction equipment utilized for this activity is as follow:

- Excavator pile driver
- Generator (4.5 kW)

##### **(3) PV Module Installation**

Once the mounting structured are completed, PV modules will be installed and secured in place facing South with a 11-degree tilting angle. Each row is 1.7 meter apart. The solar panels will be installed at a height of approximately 0.8 meters above ground level, facing south and tilted at an angle of 11 degrees in a north-south direction.

##### **(4) Construction of Other Components**

After site preparation, the Project shall commence the construction of buildings and civil works, including the construction of a control building for managing the electricity production system, the construction of the electrical switchyard or substation area, and related support areas. During the construction activities for the building

foundation work will involve, excavation and piling activities; hence, the equipment used for the construction is as follow:

- Hydraulic hammer rig
- Concrete mixer truck
- Tracked excavator
- Cranes
- Dump truck

#### **(5) Commissioning**

After complete installation and inspection of PV system, electricity from production system will be transferred to the grid. At this period, the contractor will hand over the system to the Project owner.

#### **2.4.1.2 Camp Site**

During the construction phase, the labor camp will be established to house labors imported by contractors from outside of the local areas. The project labor camp will be located outside of the project's boundaries. Currently, the labor camp location has not been determined because the project developer has yet to select the Engineering, Procurement, and Construction (EPC) contractor who will provide input and advice on rental area for the labor camp. However, the Project provides general guidelines for selecting a site for the labor camp as follows:

**(1) Physical Suitability and Constraints:** The land must be suitable for development, taking into account any limitations such as flooding risk, and sensitive area from the work site or other sources.

**(2) Environmental Impact:** The development should have the least possible impact on major natural features and environmental assets. Considerations include biodiversity, local ecosystems, and potential contamination.

**(3) Community and Cultural Values:** Protecting key community or cultural values is critical for maintaining positive relationships with local residents.

**(4) Access to Infrastructure and Services:** Worker accommodation must be supported by physical infrastructure (such as roads, water supply, and power) and community services (such as healthcare and shopping). This guarantees that workers have a decent standard of living and that the development does not overburden local services.

Furthermore, the project developer has established welfare criteria for worker camp construction, which were developed by referencing and/or adapting relevant laws or international standards, including recommendations and suggestions from ADB, as well as the project developer's own experiences, as shown below:

### **(1) Surrounding Environment**

- Clearly display signs indicating residential areas
- Equip sturdy and secure fences around the residential areas
- Ensure sufficient lighting along roads or general areas for safety in residential areas
- Provide adequate parking spaces for the number of residents
- Implement security systems and closed-circuit television
- Appoint a supervisor to oversee the accommodation area
- Establish a routine for keeping the area clean and hygienic, involving daily cleaning by the staff and regular check-ups by company personnel
- Conduct training in regulations, health, and infectious disease prevention

### **(2) Accommodation**

- Room size should be at least 3 square meters per person, with a minimum width of 2.5 meters and a minimum height of 2.4 meters.
- Rooms must have doors, windows, or ventilation openings that connect to the outside to allow natural airflow. This collective open space should be no less than 10% of the room area, excluding door areas, window areas, and ventilation areas that connect to other rooms or internal building pathways.
- If accommodations are built in a continuous or combined manner and have a total length of 45 meters, there must be a gap between rows of at least 2.5 meters.
- The foundation and structure of the accommodation rooms must be safe and sturdy.
- Rooms or buildings should be able to prevent insects and reptiles, such as installing wire mesh or constructing buildings at least 50 centimeters above the ground.

### **(3) Bathrooms and Toilets**

- Bathrooms and toilets must adhere to sanitary standards, providing clean water for washing, cleaning, and equipped with cleaning facilities.
- Bathrooms and toilets can be separate or combined in the same room, but must be segregated by gender
- Size for Bathrooms and toilets:
  - In the case of separate rooms, the size must be no less than 1 square meter, with an internal width of at least 1 meter.
  - In the case of combined rooms, the size must be no less than 1.5 square meters, with an internal width of at least 1 meter.

- Bathrooms and toilets must have ventilation openings equal to at least 10% of the room area or have sufficient natural airflow or exhaust fans.
- The distance from the bathroom floor or toilet floor to the lowest part of the wall must be at least 2 meters.
- The bathroom and toilet area must have a slope not less than 1 in 100, with drainage points at the lowest part of the sloped floor.
- The number of toilets (for defecation), bathrooms, and handwashing basins must comply with the proportions specified in Ministerial Regulation No. 63 (B.E. 2551 (2008)) under the Building Control Act B.E. 2522 (1979).
  - For male workers ranging from 41 to 80 people, there must be 3 toilets, 3 bathrooms, and 1 handwashing basin, with an additional increase of 1 for every 50 additional residents.
  - For female workers ranging from 41 to 80 people, there must be 3 toilets, 3 bathrooms, and 1 handwashing basin, with an additional increase of 1 for every 50 additional residents.
- Adequate and appropriate space for changing clothes

#### **(4) Electrical System and Equipment**

- Electrical equipment must be in a safe and undamaged condition, equipped with safety devices to prevent electrical leakage, including grounding for transformers, electrical panels, etc.
- Ensure the presence of circuit breakers to control electrical usage
- In cases where electrical wiring is on ground or underground, use secure and safe conduits for the electrical cables.

#### **(5) Water Use**

- Provide clean and sufficient water for worker consumption

#### **(6) Drinking Water**

- Drinking water for workers must be clean.
  - If bottled water are provided, the manufacturing company must meet the quality standards for drinking water as required by the law or international standards.
  - If water filtration systems are installed, the quality of the drinking water must meet the standards set by the Ministry of Public Health, and regular inspections must be conducted every three months.
- There must be at least one drinking water station provided for every 40 workers, and additional stations should be provided in proportion to the number of workers, with one station for every additional 40 workers.
- Containers for storing drinking water must be tightly sealed and regular cleaning must be carried out consistently.

### **(7) Wastewater Treatment System**

- Septic tanks must be located at least 10 meters away from rivers or public water sources.
- Gas venting lines must have a diameter of no less than 2.5 centimeters, at the height level that not cause disturbance by odor.
- The wastewater treatment system must sufficient for the volume of wastewater generated in the residential area.
- In the case of discharge into natural water sources, must obtain permission from relevant government agencies or landowner to ensure that the discharged sewage will not have adverse environmental impact in the future. In the case of discharge into private areas, consent must be obtained in writing from the landowner.
- The wastewater treatment system should be capable of treating wastewater to meet the quality standards according to the announcement of the Ministry of Natural Resources and Environment regarding the standards for controlling the discharge of wastewater from certain types and sizes of buildings, B.E. 2548 (2005) before discharge to surrounding environment.

### **(8) Solid Waste Management**

- Waste bins must be categorized, such as organic waste, general waste, recyclable waste, and hazardous waste.
- Waste bins must have tightly sealed lids and be sufficient in size for the amount of waste.
- Disposal of waste must comply with public health regulations, by being disposed of by government agencies or with permission from the government only.

### **(9) Rainwater Drainage**

- Rainwater drainage channels must surround the worker accommodation area to prevent overflow into surrounding areas.
- Rainwater drainage channels must be able to accommodate the volume of rainwater falling in the area.
- The direction of the rainwater drainage channels must flow towards a rainwater storage pit before being discharged into public water sources and should not flow into adjacent areas.

### **(10) Health Management**

- Provide essential household remedy in sufficient quantities and maintain a list as per the Ministry of Public Health regulations regarding employee welfare in the workplace, B.E. 2548.

- In cases where there are more than 200 residents, there must be at least one bed in the first aid room. In cases where there are more than 1,000 residents, there must be at least two beds in the first aid room.
- Ensure clear contact information for the medical facility is available in easily visible areas.
- Provide transportation with readiness at all times for transporting workers to the medical facility

### **(11) Fire Prevention**

- Establish criteria or areas for cooking, such as prohibiting open-fire or gas cooking. Designate cooking areas and/or dining rooms, especially for centralized food warming (Canteen).
- Provide fire extinguishers in accordance with government regulations and standards for managing occupational health, safety, and environmental conditions related to fire prevention and control, as per the Occupational Safety, Health, and Environment Management in the Workplace to Prevent and Control Hazardous Incidents Act, B.E. 2555 (2012).
- Implement an alarm system capable of signaling emergencies to cover the entire area
- Develop a fire prevention and suppression plan, including inspection, training, awareness campaigns, firefighting, evacuation, and relief measures
- Conduct regular drills for fire evacuation and firefighting plans within 6 months of occupancy and annually thereafter following the initial drill

### **2.4.2 Operation Phase**

The installed equipment will generate electricity for 25 years according to their useful lifetime. The operation will require 5 persons to administer the electric power generation from solar energy and security guards, and 2 persons as inspector and maintenance staff. Their regularly duties are as the following.

(1) Monitoring the plant operation real-time from the control room. The control system has been designed so that remote monitoring of the plant productivity, weather information, factors related to electricity production such as light intensity, temperature, etc. can be monitored remotely.

(2) Onsite schedule inspection and report the status of the equipment and the plant to ensure the plant working efficiently

(3) Security control by patrolling the site to ensure safety of the plant, staff, and visitors in addition to monitoring using CCTV system

In addition, the solar panels selected for the Project are expected to have a lifespan of approximately 25-30 years. The efficiency of electricity production will be regularly monitored, both from the control room and through field inspections. In case of any deterioration or damage, the solar panels will be replaced.

Furthermore, since the solar panel structures have safety glass covers on top to protect the panels, any dust or debris on the surface can reduce their efficiency by blocking

sunlight. Therefore, the Project plans to employ 20 workers from outsource to clean the solar panels an average of twice a year or as needed. Cleaning will be done manually by using water spraying methods. The Project shall source water for cleaning from the regional water supply, Provincial Waterworks Authority (PWA), Udon Thani Branch. However, Solar module cleaners do not work permanently at the Project site since the Project will clean the panels two times a year, taking about 60 days each time. Therefore, in the operation phase, there will be a maximum of 27 workers on some days.

**Table 2.4-1** presented the project timeline of the key activities of the project.

**TABLE 2.4-1  
PROJEC TIMELINE**

Activities	Duration (Month)	Month																					
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	
1. Design work	2	█																					
2. Preparation of CoP and ESA report	7		█																				
3. Obtaining permission from relevant authorities	3							█															
4. Construction	12										█												
4.1 Detailed engineering design	2									█													
4.2 Equipment transportation	5									█													
4.3 Building and civil works	5										█												
4.4 Installation of solar panel support structure	4											█											
4.5 Installation of inverters, and solar panels	7												█										
4.6 Installation of power station equipment and transformers	4																█						
4.7 Installation of public utilities	2																			█			
5. System testing and commissioning	2																					█	
6. Connecting to power grid																							★

Source : Phalangngan Rungrueang Co., Ltd., 2023



## 2.5 UTILITY SYSTEMS

### 2.5.1 Water Use

#### (1) Construction Phase

In the construction phase, the Project will obtain water by purchasing from Provincial Water Authority, Udon Thani Branch (**Appendix 2H**) and transport by truck to serve the needs of the Project. The estimated maximum amount of water consumption is 93.26 m<sup>3</sup>/day which uses water for the following construction activities as show in **Table 2.5-1**.

- Consumption of construction workers requires about 43.26 m<sup>3</sup>/day. This is calculated based on the maximum number of workers (618 persons), where one person consumes 70 liters a day (Kriengsak Udomsinrot, 1996).

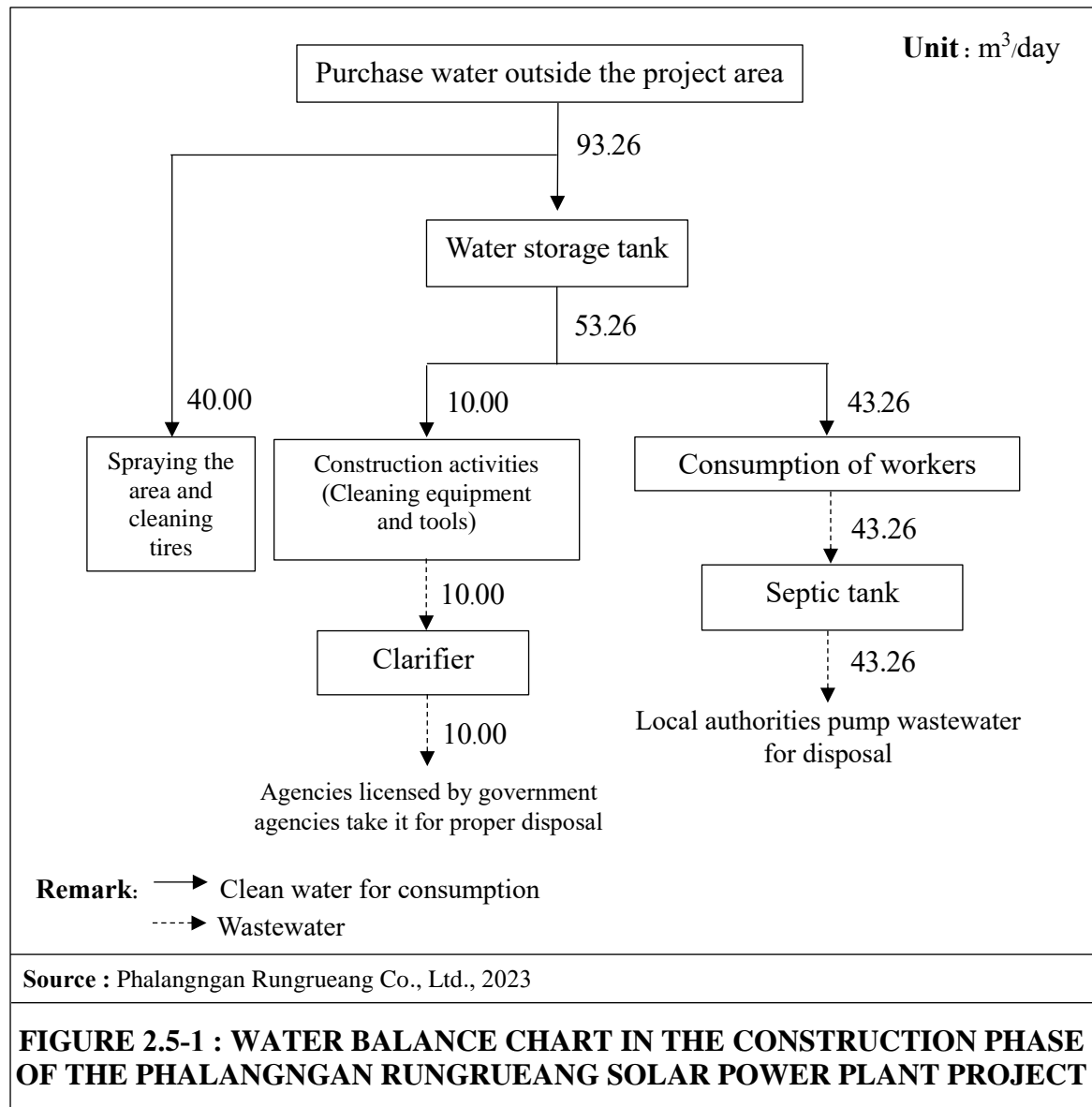
- The water used for construction activities is expected to have a water demand of approximately 50.00 m<sup>3</sup>/day. The majority of this water will be used for spraying the ground area to prevent dust and for washing vehicle tires before leaving the site, amounting to approximately 40.00 m<sup>3</sup>/day. Additionally, about 10.00 m<sup>3</sup>/day will be used for cleaning equipment and tools.

The water balance chart is shown in **Figure 2.5-1**.

**TABLE 2.5-1**  
**THE AMOUNT OF WATER USED IN THE PROJECT IN**  
**THE CONSTRUCTION PHASE**

Details of water use	Amount (m <sup>3</sup> /day)	Source
1. Consumption of workers	43.26	Suppliers within Mueang Udon Thani District (using water trucks to transport water to the project area)
2. Water use for construction activities		
- Spraying the area and cleaning tires	40.00	
- Cleaning equipment and tools	10.00	
<b>Total</b>	<b>93.26</b>	

**Source :** Phalangngan Rungrueang Co., Ltd., 2023



## (2) Operation Phase

In the operation phase, the Project will obtain water by purchasing from Provincial Water Authority, Udon Thani Branch to serve the needs of the Project operation. The estimated maximum amount of water consumption is 13.24 m<sup>3</sup>/day as shown in **Table 2.5-2**, which uses water for the following construction activities.

1) The water for consumption has the maximum volume of 1.89 m<sup>3</sup>/day. The details are explained below.

- Employees administering the electric power generation from solar energy and security guards (5 persons) will consume a maximum of 0.35 m<sup>3</sup>/day. (This is based on the assumption that one person consumes 70 liters a day (Kriengsak Udomsinrot, 1996)).

– An inspector and a maintenance staff (2 persons per month) will consume a maximum of 0.14 m<sup>3</sup>/day. (This is based on the assumption that one person consumes 70 liters a day (Kriengsak Udomsinrot, 1996)).

– Solar module cleaners (20 persons) will consume a maximum of 1.40 m<sup>3</sup>/day. (This is based on the assumption that one person consumes 70 liters a day (Kriengsak Udomsinrot, 1996)).

2) Water for cleaning solar modules: The Project will have 127,738 solar modules, with a cleaning plan of two times a year (no cleaning in the rainy season). Each cleaning time takes 60 days, using the rate of 1.5 liters/panel/time. Therefore, the required amount of water is 3.19 m<sup>3</sup>/day or 383.22 m<sup>3</sup>/yr.

3) Water for watering plants in the green area covering 1.02 rai (1,625 m<sup>2</sup>). This activity will require water of about 8.16 m<sup>3</sup>/day (based on the rate of 8 m<sup>3</sup>/rai/day).

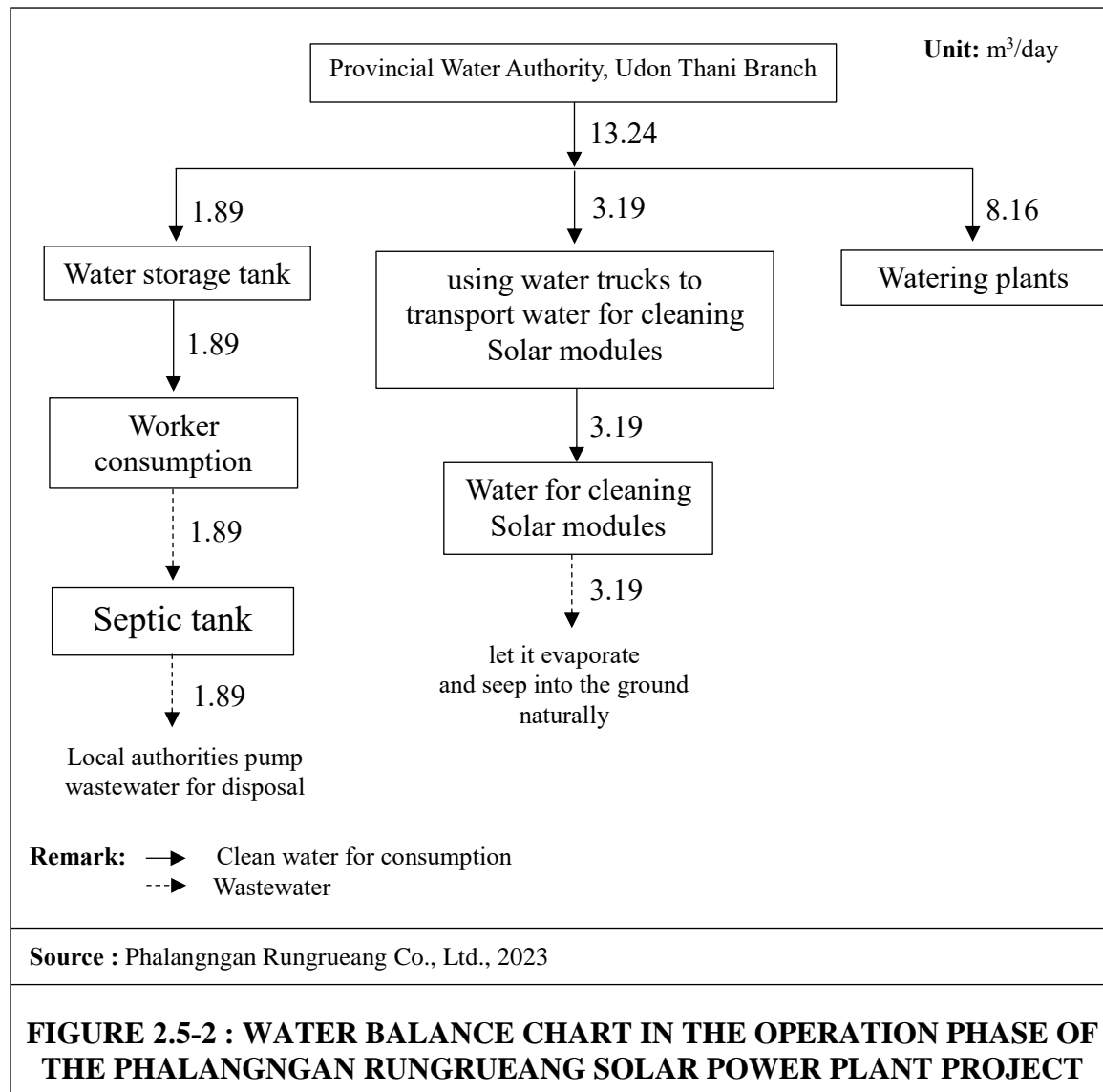
The water balance chart during operation phase is shown in **Figure 2.5-2**.

**TABLE 2.5-2**  
**THE AMOUNT OF WATER USED IN THE PROJECT IN**  
**THE OPERATION PHASE**

Details of water use	Amount (m <sup>3</sup> /day)	Source
1. Consumption of workers <sup>1/</sup>	1.89	Suppliers within Mueang Udon Thani District (using water trucks to transport water to the project area)
2. Water for cleaning Solar modules	3.19	
3. Watering plants	8.16	
<b>Total</b>	<b>13.24</b>	

**Remarks :** <sup>1/</sup> Maximum of water consumption on days for workersregular staff (5 people/day), staff for inspection and maintenance (2 people/day), and workers from the contracting company who come in to clean the solar panels (20 people/day), all working on the same day.

**Source :** Phalangngan Rungrueang Co., Ltd., 2023



## 2.5.2 Electricity Use

### (1) Construction Phase

In the construction activities of the Project, some equipment or machines will use electricity from the Provincial Electricity Authority. The power demand during the construction phase is not high. The Provincial Electricity Authority, has the capacity to adequately supply the power.

### (2) Operation Phase

Internal use of electricity i.e. office building and lighting systems will be sourced from the district's electrical supply, Provincial Electricity Authority.

### 2.5.3 Water Drainage System and Flood Prevention System

#### (1) Construction Phase

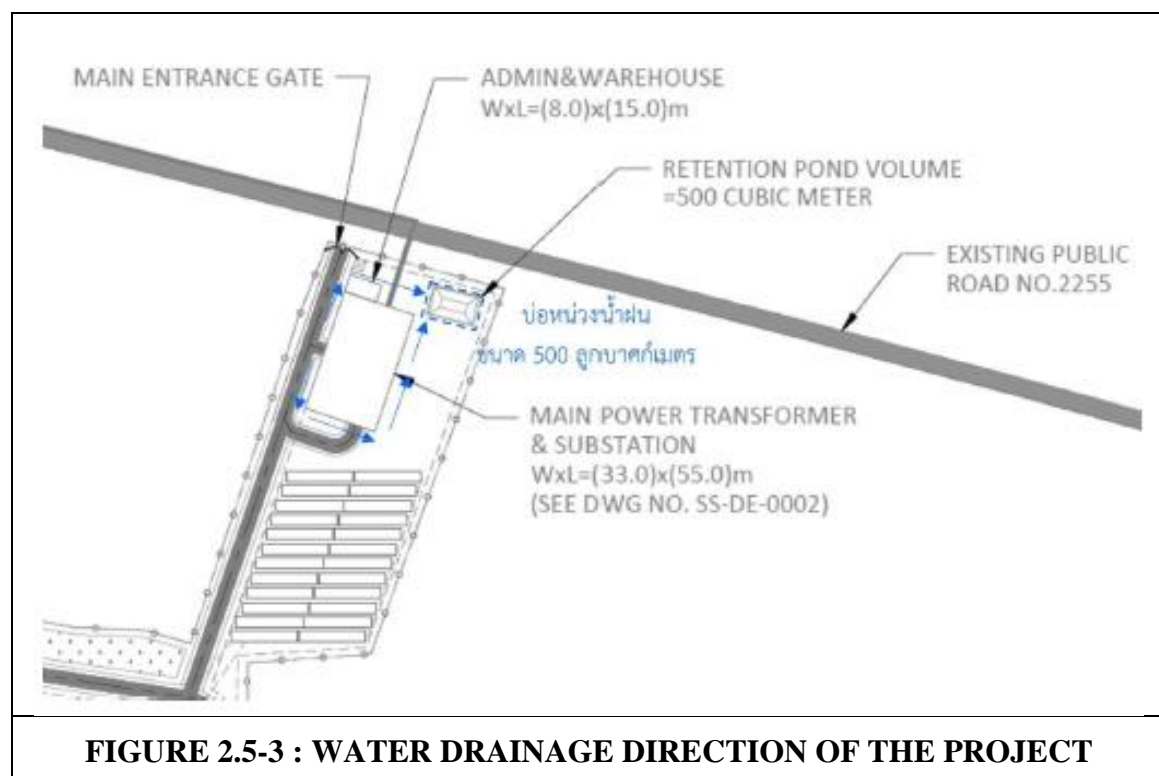
The existing condition of the project area was agricultural land. As the project is developed, the construction area will be prepared by slightly adjusting the ground level to be suitable for installing solar panels on the ground and constructing various buildings within the project area. The drainage in the area where solar panels are installed will remain the same as before the project's development.

#### (2) Operation Phase

##### 1) Non-contaminated rainwater

The Project will modify land only at the power generation control building, storage areas of spare parts, tools, materials, waste, and maintenance, the switchyard or substation and supporting area related to power generation, which covers only 1,935.0 m<sup>2</sup>. This may change the water drainage capacity in such areas from before the Project development. That is the amount of non-contaminated rainwater will increase after development within three hours by 312.92 m<sup>3</sup>.

Therefore, the Project has designed a retention pond with a capacity of 500 m<sup>3</sup> to collect rainfall in the Project area for 3 hours (as shown in **Figure 2.5-3**) and will control the rainfall drainage rate from the Project area not to exceed the current drainage rate. The calculation of the size of the Project's retention pond is shown in **Appendix 2I**.



## 2) Contaminated rainfall

Contaminated rainfall in the Project area is caused by the rainfall around the 60-MVA transformers. One transformer requires an installation area of 33.60 m<sup>2</sup>. It is important to collect rainfall in that area to prevent contaminating outside areas. The amount of oil-contaminated rainfall that may occur at the transformers can be calculated using the rational method as below

$$Q = 0.278 CIA$$

Where Q = Rainfall flow rate (m<sup>3</sup>/sec)

C = Coefficient of rainfall flow rate (C = 0.9)

I = Average rainfall intensity in the 25-year period during a 3-hour duration = 49 mm/hr.

(Source : Frequency Analysis of Maximum Rainfall for Each Period at A.Nam Phong C.Khon Kaen (1971-1989), titled “The relationship between rain intensity-period-rain frequency and the percentage of distribution of the maximum rainfall in the 24-hour period in the northeast region”, Royal Irrigation Department, Ministry of Agriculture and Cooperatives, 2001)

A = Area of the transformers = 33.60 m<sup>2</sup>

Therefore

$$\begin{aligned} Q &= 0.278 \times 0.9 \times 49 \times 0.00003360 \\ &= 0.00041 \text{ m}^3/\text{sec} \\ &= 1.48 \text{ m}^3/\text{hr} \end{aligned}$$

Therefore, the rainfall at a 60-mVA transformer will contain oil-contaminated rainfall of 0.00041 m<sup>3</sup>/s or 1.48 m<sup>3</sup>/hr. The Project will contain contaminated rainfall in the dike near the transformers, with a capacity of 16.8 m<sup>3</sup>, before sending to the oil sump to separate oil from the water. After that, the Project will contact an authorized agency for proper disposal.

### 2.5.4 Transportation and Logistics

#### (1) Construction Phase

In the construction phase of the Project, construction materials, machines, equipment, and workers will be transported to the Project area. The incoming people and materials may temporarily increase the traffic on Highway No.2 (Udon Thani-Nongkhai), Highway No.2255 (Na Kha-Sum Sao), as well as the public roads designated for accessing and exiting the project (see in **Figure 2.2-3**). The construction period for the project is estimated to be around 12 months. It is anticipated that there will be an increase in traffic volume due to construction activities as followings.

(1) 6-wheel trucks transporting construction workers (32 trips a day) during 07.00 am-08.00 am and 04.00 pm-06.00 pm.

(2) 10-wheel trucks for transporting for transporting solar panels and the supporting structures for solar panels (Mounting Structures) (10 trips a day). However, the project has stipulated that transportation will only occur during daylight hours for a total of 8 hours per day, avoiding peak hours from 07.00 am-08.00 am and 04.00 pm-06.00 pm.

(3) Water transport vehicles (10-wheeler trucks) totaling 10 trucks (20 trips per day) are used. (Derived from the water consumption of construction personnel, which amounts to 43.26 m<sup>3</sup>/day, and construction water usage of 50 m<sup>3</sup>, totaling 93.26 m<sup>3</sup>/ day)

(4) 10-wheel trucks transporting sewage (10 trips a day)

In summary, during the construction phase, there will be a maximum of 16 vehicles (32 trips per day) during peak hours (07.00 am-08.00 am and 04.00 pm-06.00 pm), and during normal hours, there will be a maximum of 20 vehicles (40 trips per day) in terms of traffic volume.

## **(2) Operation Phase**

The operational phase will involve travel along the same routes used for accessing and exiting the project area as during the construction phase. It is anticipated that transportation and traffic activities due to operation activities as followings.

(1) Regular staff vehicles (small 4-wheeled cars), totaling 2 vehicles (4 trips per day), will run round trips for staff transportation during peak hours (07.00 am-08.00 am and 04.00 pm-06.00 pm)

(2) The inspector and maintenance staff will small 4-wheeled car, totaling 1 vehicle (2 trips per week), will run round trips for staff involved in maintenance and inspection during peak hours (07.00 am-08.00 am and 04.00 pm-06.00 pm).

(3) Solar panel cleaning staff shuttle vehicles (4-wheeled cars), totaling 5 vehicles (10 trips per day), will run round trips for staff transportation every 3 months during the dry season (07.00 am-08.00 am and 04.00 pm-06.00 pm).

(4) Waste transport vehicles will include 1 sludge suction vehicle (2 trips per month) and vehicles transporting waste from the solar power generation system. The project will collect and store waste in designated areas within the office building and material storage for subsequent disposal by authorized agencies, along with deteriorated solar panels. The latter vehicles will number 1 (2 trips every 3 months).

(5) Water trucks used for cleaning solar panels during the dry season will operate for 120 days. A total of 1 water truck (10-wheeler) will make 2 trips per day.

In summary, during the operational phase, there will be a maximum of 8 vehicles (16 trips per day) during peak hours (07.00 am-08.00 am and 04.00 pm-06.00 pm), and during normal hours, there will be a maximum of 3 vehicles (6 trips per day).

## 2.6 ENVIRONMENTAL MANAGEMENT

### 2.6.1 Air Quality

#### (1) Construction Phase

Activities during the construction phase that contribute to air pollution include preparing the area for solar panel installation, constructing buildings, and various public utility systems, as well as transportation for construction equipment and personnel transportation. These activities can generate dust and particulate matter dispersion. Thus, the project will conduct water spraying on the construction area to prevent the dispersion of dust and particulate matter and minimize the impact on nearby residential areas.

#### (2) Operation Phase

During the operation phase of solar power plant, it does not cause any air and noise pollution.

### 2.6.2 Noise

#### (1) Construction Phase

Activities in the construction phase that might cause noise are land clearing for the power generation control building, spare parts, material, waste storage area and maintenance area, the switchyard area or substation, and power generation supporting area and related areas, the construction of structures and buildings, which will take place for a short time. Installation of PV modules on the ground will cause low noise during the installation because the Project will use screw piles, which generate low noise compared to typical piles. Construction activities or the use of machinery and equipment that generate loud noises are prohibited between 08:00 am and 07:00 pm. Furthermore, the project has prepared personal protective equipment (PPE) such as earplugs and earmuffs to protect workers from potential hazards and excessive noise exposure.

#### (2) Operation Phase

The power generation process of the Project is to generate electric power from PV modules or solar cells, which does not generate noise impact on the communities and sensitive receptors.

### 2.6.3 Water Quality

#### (1) Construction Phase

Wastewater from construction activities occurs at a maximum of approximately 53.26 m<sup>3</sup>/day as presented in **Table 2.6-1**. The details are as follows:

– Wastewater from the consumption of workers occurs at a maximum of 43.26 m<sup>3</sup>/day. This is calculated from the maximum number of workers at 618 people. The project will treat wastewater using a septic tank provided by the contractor. Regarding treated wastewater and sewage, the contractor will contact local agencies for proper disposal



according to the guidelines specified in the Public Health Act B.E. 2535 (1991) and the Ministerial Regulations on Sewage Management Hygiene B.E.2561 (2018).

– Effluent from cleaning equipment and tools, approximately 10.00 m<sup>3</sup>/day will be collected at the clarifier to separate water and grease before sending it to be disposed of outside the Project by agencies authorized by government agencies.

**TABLE 2.6-1  
WASTEWATER MANAGEMENT DURING THE CONSTRUCTION PHASE**

Source	Amount (m <sup>3</sup> /day)	Wastewater Management
1. Wastewater from the consumption of workers	43.26	Coordinate for authorized waste collection vehicles from local authorities to enter and conduct waste collection and disposal activities.
2. Effluent from cleaning equipment and tools	10.00	Collect wastewater into a settling tank for sedimentation before further utilization.
<b>Total</b>	<b>53.26</b>	

Source : Phalangngan Rungrueang Co., Ltd., 2023

## (2) Operation Phase

The effluent generated during the operation period comes from water consumption activities as shown in **Table 2.6-2**, including:

(1) Wastewater from consumption will be generated at a maximum of approximately 1.89 m<sup>3</sup>/day. The details are explained below.

– Employees in charge of the Project's solar power generation system and the Project's security staff (5 people) generate 0.35 m<sup>3</sup> of wastewater per day.

– An inspector and a maintenance staff (2 persons per month) generate 0.14 m<sup>3</sup> of wastewater per day.

– PV module cleaners (20 people) generate 1.40 m<sup>3</sup> of wastewater per day.

Therefore, in the operation phase, there will be a maximum staff of the Project of 27 people per day, including the Project staff and PV module cleaners. They will generate wastewater from water consumption of 1.89 m<sup>3</sup>/day. Such wastewater will be collected in the septic tank. Treated wastewater and sewage will be pumped out and disposed of by local agencies, according to the guidelines specified in the Public Health Act B.E. 2535 (1991) and the Ministerial Regulations on Sewage Management Hygiene B.E. 2561 (2018).

(2) Wastewater from cleaning PV module is about 3.19 m<sup>3</sup>/day (panel cleaning two times a year). This proportion of wastewater is chemical-free, but contaminated with dust particles. It will be left to evaporate or seep into the ground naturally without affecting the quality of surface water.

**TABLE 2.6-2  
WASTEWATER MANAGEMENT DURING THE OPERATION PHASE**

Source	Amount (m <sup>3</sup> /day)	Wastewater Management
1. Wastewater from the consumption of workers	1.89	Coordinate for authorized waste collection vehicles from local authorities to enter and conduct waste collection and disposal activities.
2. Wastewater from cleaning Solar module	3.19	Left to evaporate or seep into the ground naturally
<b>Total</b>	<b>5.08</b>	

Source : Phalangnan Rungrueang Co., Ltd., 2023

#### 2.6.4 Solid Waste

##### (1) Construction Phase

Solid waste generated during construction mainly consists of the following:

- Solid waste from consumption of construction workers, such as food scraps, plastic bags, and paper waste, is estimated to amount 525.30 kilograms per day from the maximum of 618 workers per day (the rate of waste generation is 0.85 kg per person per day (Kriengsak Udomsinrot, 1994)). The Project had instructed contractor to provide sufficient garbage bag and garbage bins with tightly cover at various points within project construction area. This is done prior to authorized agencies from the government coming in to collect and transport the waste.

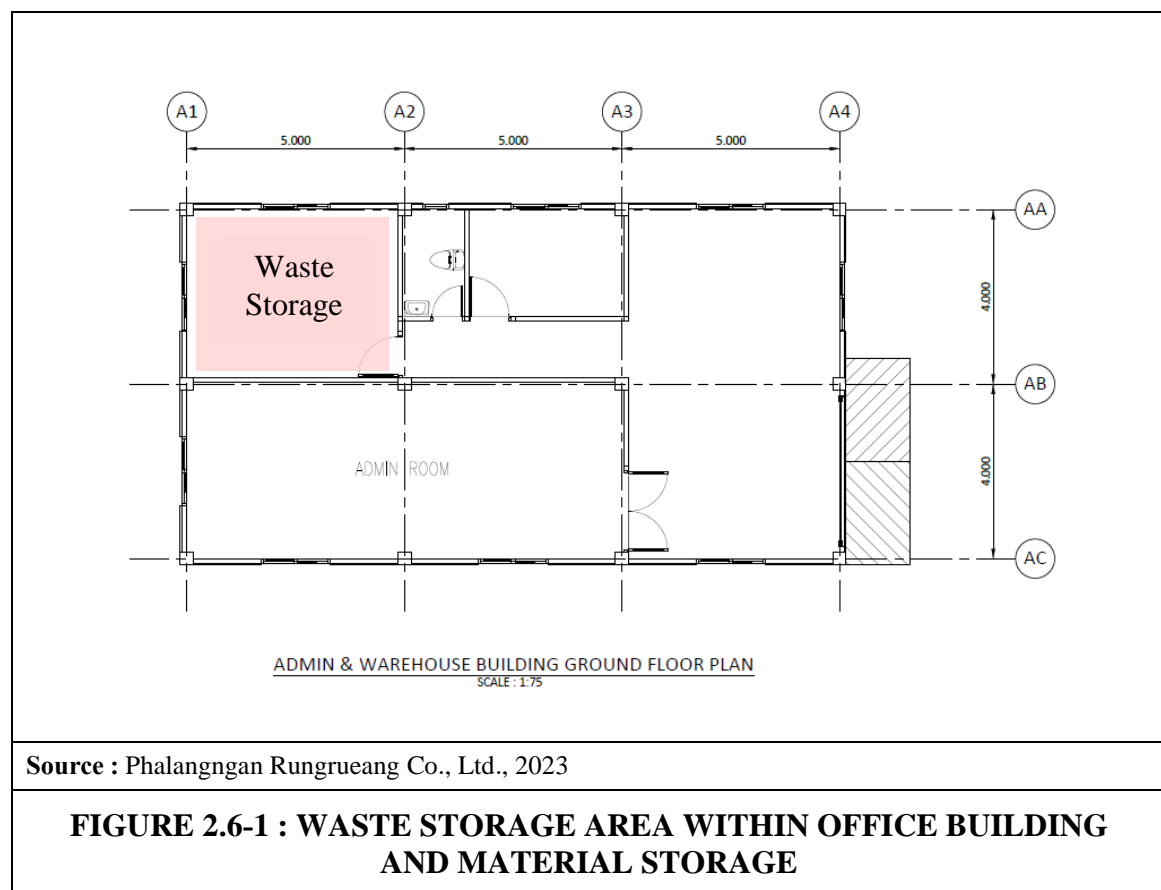
- Solid waste generated from solar panel installation activities, mainly consisting of packaging materials, is expected to amount to approximately 26 tons per year. Some of these materials can be sold or reused. The project will sort and separate them for resale or reuse. The materials that cannot be sold will be collected and coordinated for disposal by authorized agencies using appropriate methods.

##### (2) Operation Phase

- Solid waste from consumption of the Project staff, is estimated to amount 22.95 kilograms per day from the maximum of 27 people per day (the rate of waste generation is 0.85 kg per person per day (Kriengsak Udomsinrot, 1994)). The Project will provide sufficient garbage bins with tightly cover at various points within office building. This is done prior to authorized agencies from the government coming in to collect and transport the waste.

- Waste generated from the solar power generation system consists mainly of wiring scraps, and electronic components from maintenance activities, amounting to approximately 3.20 tons per year or 267 kilograms per month. The project has prepared an area of about 20 m<sup>2</sup> for collecting and storing the waste within the office building and material storage (**Figure 2.6-1**). The waste will then be transported to authorized facilities for industrial waste disposal. The project will ensure compliance with the Ministry of Industry's announcement regarding the management of waste and unused materials, B.E. 2566 (2023).

- PV modules used in this Project have a lifespan of 25 years. In case of damage or deterioration, the Project will send the damaged parts for disposal outside the Project area by disposers holding a license from the Department of Industrial Works.



## 2.7 OCCUPATIONAL HEALTH AND SAFETY

The Project provides Occupational Health, Safety, and Environment policy for as follows;

- (1) The safety management system shall be put in place in compliance with the law and occupational health requirements as well as related international standards.

- (2) Recognition and maintenance shall be ensured for occupational health principle to control and prevent hazards from business operation, which may impact the welfare and asset of the Company and its personnel.

(3) Resources shall be allocated to ensure continuous development of the occupational health management system.

(4) The following occupational health guidelines are established.

- Occupational health is the first priority of all personnel of the Company.
- The Company shall support the improvement of the workplace environment to ensure safety and minimize accident risk exposure as well as support and encourage safety activities to build awareness and attitude for occupational health so as to maintain the occupational health standard, aiming for zero accident.
- Supervisors of all levels shall lead, oversee, and support personnel of the Company to ensure uninterrupted occupational health.
- Personnel of the Company shall consider about the safety of themselves, colleagues, and the Company's assets throughout the operating period.
- Personnel of the Company shall cooperate in occupational health projects and propose ideas for further safety and operations improvement.

(5) The Company shall comply with relevant safety laws and regulations throughout the life cycle of its projects.

(6) The Company shall take into consideration as part of its decision-making and risk assessment processes potential environmental and social impacts, including issues related to the health and safety of employees, local communities and other relevant stakeholders.

### **(1) Construction Phase**

The Project will comply with requirements, regulations, and obligations throughout the construction phase. Occupational health, safety and environment programs will be implemented in the preparation of occupational health and safety requirements as a standard for the contractor. The contractor must agree to perform the work in accordance with the Company's policy and relevant regulations, laws, and rules. There are guidelines for the contractor as follows:

(1) The Project determines working conditions in the agreement with the construction contractor and the team working within the Project and enforces occupational safety, health, and working environment measures both in the design, construction, and operation to comply with laws, standards, and regulations on occupational health and safety.

(2) The contractor must prepare workplace safety plan for the construction and propose it before starting construction activities.

(3) The contractor of the Project must establish an occupational safety and health working environment committee in accordance with the guidelines set forth in the relevant Ministerial Regulations. The occupational safety, health and working environment manager will report directly to the top management of the Project and hold a meeting of the said Committee at least once a month to evaluate the results and suggest solutions to the problems.

(4) The contractor shall provide basic personal protective equipment (PPE), including safety helmets, safety boots, and safety goggles, to all construction

workers and specific PPE for working conditions and risks that may arise due to the nature of work, at the minimum quantity required by law. The quality of PPE shall comply with the standard set forth in the Notification of the Department of Labor Protection and Welfare on Standards for Personal Safety Protection Equipment B.E. 2554 (2011).

(5) The contractor shall put on warning signs in the construction areas, dangerous areas, and areas that require entrants to wear PPE.

(6) The contractor shall establish a permit system to grant permission to perform certain types of work as required by law.

(7) The contractor shall prepare a coordination plan with the local firefighting unit in preparation for emergency response.

(8) The contractor shall prepare first-aid kits, basic medicines, and emergency vehicles according to the Ministerial Regulations on the provision of welfare in the workplace B.E. 2548 (2005)

(9) The contractor shall provide adequate utilities for construction workers according to the sanitation principles, such as clean drinking water and restrooms.

(10) In case the contractor provides a worker camp, the contractor must comply with the Notification of the Labor Welfare Committee on Standards of Residence as Labor Welfare for Employees in the Type of Construction Business B.E. 2559 (2016).

## **(2) Operation Phase**

The Project establishes occupational safety and health in the operation phase. The occupational safety, health, and working environment policy was determined to comply the guidelines set forth in the Occupational Safety, Health, and Environment Act B.E. 2554 (2011) and the Labor Protection Act B.E. 2541 (1998). The safety action plans are established as follows:

(1) The plan on industrial hygiene consists of a survey on industrial hygiene, preparation of an annual audit plan for industrial hygiene, analyzing the audit results and follow-up on corrections, and summarizing the performance of occupational health.

(2) The health examination, evaluation, and monitoring plan includes physical examinations based on the risks specified in the ministerial regulation on the prescribing of the standard for physical examinations of employees performing risky tasks B.E. 2563 (2020) for all employees in order to prepare an industrial hygiene plan.

(3) A preventive plan for the working environment includes safety measures for noise and hazard risks to prevent harm to operators. This also complies with relevant legal requirements, such as the Notification of the Ministry of Industry on Safety Protection Measures in Factory Operations Regarding Working Environment B.E. 2546 (2003).

(4) Fire prevention and suppression plan: The Project must prepare an action plan in accordance with the guidelines specified in the Ministerial Regulations prescribing standards for the management and implementation of occupational safety, health, and working environment related to fire prevention and suppression B.E. 2555 (2012) and the Notification of the Ministry of Industry on Fire Prevention and Suppression in Factories B.E. 2552 (2009). Some measures are, for example, the installation of fire prevention and suppression equipment that is sufficient and in compliance with international standards, as well as the annual fire drill.

Additionally, the project will coordinate with relevant agencies in the area to provide support in case of severe emergencies that cannot be controlled. This support may include additional equipment and personnel to assist in suppressing the incident. The project will ensure that all fire extinguishing equipment, including portable fire extinguishers, is regularly inspected and maintained to ensure its immediate usability during an emergency. The installation of this equipment will be done in various areas within the project area, such as office buildings, building control systems, electricity production areas, and electrical transformers. The design of the equipment will meet the standards set by the Engineering Institute of Thailand under His Majesty the King's Patronage (EIT) and the National Fire Protection Association (NFPA).

## 2.8 COMMUNITY RELATIONS

Project implementation may cause both direct and indirect impacts on the environment and well-being of surrounding communities. With the aims for sustainable development and fostering understanding with the communities, the project has established an action plan to enhance knowledge and understanding about the project. This will strengthen confidence in the development of the project, as well as enable community benefit or activities support for local communities starting from the construction phase to the operation phase. The project has prepared guidelines for the implementation in each aspect as follows.

(1) Environmental conservation programs e.g., school in power plants project, environmental site visit project or supporting environmental activities of the community, etc.

(2) Programs relevant to society, child and youth e.g., supporting the activities of educational institutions in the area and supporting sports activities, etc.

(3) Health programs e.g., the Village Health Volunteer Potential Development project (VHVs), etc.

(4) Cultural and tradition programs e.g., supporting the Kathin ceremony, supporting Songkran traditions, etc.

Example of Future CSR Plan is shown in **Table 2.8-1**.

**TABLE 2.8-1  
EXAMPLE OF FUTURE CSR PLAN**

Activities	Implementation	Target Group	Objectives	Budget	Responsible Parties
<b>1. Environment</b>					
- Open-house events for project visits and project learning	Organize educational field trips to visit and provide knowledge about the Solar project.	1. Communities within a 3-kilometer from the project boundary 2. Educational Institutions 3. Relevant Agencies	1. To provide the community with knowledge and understanding of the project's operations, including the project's environmental management. 2. To disseminate project information.	To be determined	CSR Department
- Education zone within the power plant	Conduct activities to provide knowledge and visit the production processes of the project, as well as energy-saving methods.	Educational Institutions within a 3-kilometers from the project boundary	1. To provide the community with knowledge and understanding of the project's operations, including the project's environmental management. 2. Promote campaigns on energy conservation.	To be determined	CSR Department and the Project
- Supporting community environmental activities	Conduct activities to provide knowledge and visit the production processes of the project, as well as energy-saving methods.	Educational Institutions within a 3-kilometers from the project boundary	1. To provide the community with knowledge and understanding of the project's operations, including the project's environmental management. 2. Promote campaigns on energy conservation.	To be determined	CSR Department and the Project
<b>2. Social, Child, Youth</b>					
- Supporting educational institution activities	Support teaching and learning materials and activities for educational institutions.	Educational Institutions within a 3-kilometers from the project boundary	To support teaching materials	To be determined	CSR Department

**TABLE 2.8-1  
EXAMPLE OF FUTURE CSR PLAN (CONT'D)**

<b>Activities</b>	<b>Implementation</b>	<b>Target Group</b>	<b>Objectives</b>	<b>Budget</b>	<b>Responsible Parties</b>
- Supporting sports activities	Support sports equipment and school sports budget.	Communities within a 3-kilometer from the project boundary	To promote physical exercise.	To be determined	CSR Department
- Supporting National Children's Day activities	Support budget and gifts for National Children's Day activities.	Communities within a 3-kilometer from the project boundary	To build good relationships with the community.	To be determined	CSR Department
<b>3. Health</b>					
- Village Health Volunteer (VHV) Development Project	Support training sessions and provide support for basic health examination equipment.	Health Promoting Hospital and VHV within a 3-kilometers from the project boundary	1. Promoting health awareness among the community members. 2. Encouraging comprehensive health check-ups for the community.	To be determined	CSR Department
<b>4. Cultural and Tradition</b>					
- Supporting budget for local community cultural and traditional events	Provide budget support for local community cultural and traditional events as appropriate and opportunities.	Communities within a 3-kilometer from the project boundary	To collaborate in preserving and perpetuating local traditions.	To be determined	CSR Department
- Supporting budget for merit-making events	Support budget and participate in merit-making events at the temple in the area of operation and within a 3-kilometer study radius.	Communities within a 3-kilometer from the project boundary	To collaborate in preserving and perpetuating local traditions.	To be determined	CSR Department
- Supporting budget for Songkran Festival events	Participate in community activities and support drinking water for public service points.	Communities within a 3-kilometer from the project boundary	1. To collaborate in preserving and perpetuating local traditions. 2. To be part of creating road safety during festivals.	To be determined	CSR Department



## 2.9 ENVIRONMENTAL AUDIT COMMITTEE

The project will establish an Environmental Audit Committee to enhance confidence and disseminate clear and continuous project information. In addition, the project recognizes the importance of the environment and well-being of the communities, therefore the community is encouraged to be a part in the environmental impact monitoring both during the construction phase and the operation phase. The establishment of the committee will be completed at least 1 month before construction to be a center for communication, monitoring, inspection, control and concerns reduction. This will enable clear understanding and ensure that the communities and the project co-exist in harmony. The objectives of the establishment of the Environmental Impact Assessment Committee, including the structure and authority of the committee are as follows:

### (1) Objective

a) To publicize, enhance understanding and good relations related to operations related to the environment of the project to the surrounding communities through the Environmental Audit Committee.

b) To be a communication channel between the communities and the project for complaints and opinions receiving on the project implementation.

c) To have a central organization representing surrounding communities and related government agencies with an authority to inspect and consider the complaints of surrounding communities regarding the project environmental impacts.

### (2) Structure of the committee

The Environmental Audit Committee consists of representatives from various sectors, including public sector representative committees, state representative committees, honorary committee and company representative committees. The members of the public sector representative committee must be at least half of the committee. The total number of committees from all sectors is 29 with the details as follows.

a) Public sector representative committees are nominated from each sub-district or municipality in a radius of 3 kilometers in accordance with the proportion of each sub-district as follows.

- 11 public sector representatives from Na Kha sub-district
- 3 public sector representatives from Na Kha Subdistrict Municipality
- 3 public sector representatives from Chiang Wang sub-district

b) State representative committees are as follows.

- 1 representative from the district where the project is located
- 1 representative from each local government organization of the project site area and area within a radius of 3 kilometers from the project boundary, which is total 3 persons as follow.

– 1 representative of Na Kha Subdistrict Administrative Organization (SAO)

- 1 representative of Na Kha Subdistrict Municipality

– 1 representative of Chiang Wang SAO

- A director of the Subdistrict Health Promoting Hospital (SHPH) of the project area
- 1 representative from educational institutions in the project area
- 4 additional state representatives, 1 representative per organization as follows.

- Representative of Udon Thani Provincial Industrial Office
- Representative of the Udon Thani Provincial Natural Resources and Environment Office

- Representative of the Udon Thani Provincial Energy Office
- Representative of the Office of the Energy Regulatory Commission

Region 4 (Khon Kaen)

- c) 1 honorary committee
- d) 1 company representative committee

**(3) The committee nomination process** is described as follows:

**a) Public sector representative committee**

The nomination of representatives from the public sector shall be in accordance with the requirements or methods or practices of each sub-district or municipality, which might be election or nomination.

**b) Committee qualifications**

- **Public sector representative committees** must be qualified as follows.
  - Minimum age is 25 years old on the date of nomination or election and must not be disqualified as follows.

- Having inappropriate behavior, being malfeasant, being sentenced to bankruptcy or being sentenced to imprisonment by a final judgment except for a petty offense or an offense committed through negligence.

- Being a person of unsound mind or having mental insanity or was ordered by the court to be an incompetent or equivalent to incompetent person.

- Being listed in the household registration in that sub-district area at least one year prior to the nomination date.

- **State representative committees**

The committees are nominated from the government agencies and local administrative organizations within the project area and the area within a radius of 3 kilometers from the project boundary.

- **Honorary committee**

There will be 1 honorary committee collaboratively nominated by the public sector representatives committee and company (Phalangngan Rungrueang Co., Ltd.,) representative committee.

### **Qualifications of honorary committee**

- Minimum age is 30 years old on the date of nomination.
- Processing knowledge and capability to monitor environmental impacts or any aspect related to the operation or having appropriate behavior or being approved or respected by the public.
- Must not be disqualified as follows.
  - Being malfeasant, being sentenced to bankruptcy or being sentenced to imprisonment by a final judgment except for a petty offense or an offense committed through negligence.
  - Being a person of unsound mind or having mental insanity or was ordered by the court to be an incompetent or equivalent to incompetent person.

#### **• Company representative committee**

The company representative committee is nominated by Phalangngan Rungrueang Co., Ltd.

#### **(4) Term of committee**

a) The term of office of the committees is 4 years from the date of appointment with a limitation to 2 consecutive terms.

b) At the end of the term, if the nomination of new committee appointment has not been proposed, the committee who retired by rotation shall remain in office for continuous duties until the nominated or newly appointed committee members undertake their duties. The temporary duties must not exceed ninety days from retirement by rotation date.

c) In the case of termination before the end of the term, the nomination and appointment of a committee of the same category shall be carried out within forty-five days from the termination date. The nominated or appointed committee shall hold the position in place for the remaining term of the replaced committee.

d) In the case of termination before the end of the term where the remaining term is less than ninety days, nomination or appointment of the new committee may not be executed. The board of committee will consist of the remaining committee members.

e) Addition to the retirement by rotation, the committee be terminated when:

- Death
- Retirement
- Having inappropriate behavior while holding the committee position e. g. , not attending the meeting for 3 consecutive times without reasonable cause. or malfeasant or having lower competency to perform committee duties and being dismissed by majority of the board of committee.
- Being sentenced to bankruptcy or being sentenced to imprisonment by a final judgment except for a petty offense or an offense committed through negligence.
- Being a person of unsound mind or having mental insanity or was ordered by the court to be an incompetent or equivalent to incompetent person.

f) For meeting frequency, the committee meeting must be attended by not less than half of the total number of the board of committee for constitution of a quorum. The meeting will be held every six months. In case of urgency, the meeting can be held before the general schedule if half of the board of committees resolve to summon the meeting.

g) The decision of the meeting shall be made by a majority of votes. One committee can cast one vote. If the votes are equal, the chairman of the meeting shall cast an additional vote as a casting vote.

**(5) Power and duties** are as follows.

a) Establish guidelines and procedures for monitoring the environmental impact of the project.

b) Gather complaints, consider and make a decision on the complaints and suggestions of the public sector regarding the environmental impacts from the construction and operation of the project.

c) Give an opinion or proposal for the project improvement or modification to be in line with the requirements set out in the project's Code of Conduct (CoP) report.

d) Make recommendations to government agencies for the project improvement or modification to be in line with the requirements set out in the project's Code of Conduct (CoP) report.

e) Appoint assistants as appropriate.

f) Establish a good understanding between the community and the project. and coordinate with relevant agencies.

g) Assess environmental quality according to the environmental preventive and corrective measures and the environmental monitoring measures of the project.

h) Conduct site visit to inspect the construction and various operations of the project.

i) Publicize accurate project information to the public.

j) Set guidelines for complaints receiving, appealing, making decision on the complaints from public sector, or other guidelines necessary for the operation.

k) Post the public complaints and announce the decision of the working group at the offices of government agencies in the area in at least 3 public locations.

l) Jointly consider the case that requires damage compensation if it can be proved that damages are caused by the project operation.

## **CHAPTER 3**

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# **EXISTING ENVIRONEMNTAL CONDITIONS**

## CHAPTER 3

### EXISTING ENVIRONMENTAL CONDITIONS

The study on current environmental conditions encompass physical conditions, biological conditions, quality of life, and human use value within a 3-kilometer radius from the project site. The study area also includes sensitive areas in Na Kha Subdistrict and Chiang Wang Subdistrict, Mueang Udon Thani District, Udon Thani Province. The gathered data on existing environmental conditions is elaborated below.

#### 3.1 PHYSICAL CONDITIONS

##### 3.1.1 Geology and Soil

###### (1) Geology

The geological data collected from Udon Thani geological maps of the Geological Bureau, Department of Mineral Resources (2009), shows that the study area has two types of geological conditions, as depicted in **Figure 3.1-1**, along with the following details:

**(a) Maha Sarakham Formation (Kms)** is unconformably overlaid Khok Kruat Formation and underlined Phu Thok Formation. This formation is distributed in central both the Sakon Nakhon and the Khorat basins. This formation consist siltstone, shale, and sandstone, brick red, purplish red, thin to thick bedded with rock salt, potash, gypsum and anhydrite. They are mainly three evaporite cycles divided into six units from bottom to top namely lower salt, lower clastic, middle salt, middle clastic, upper salt and upper clastic units.

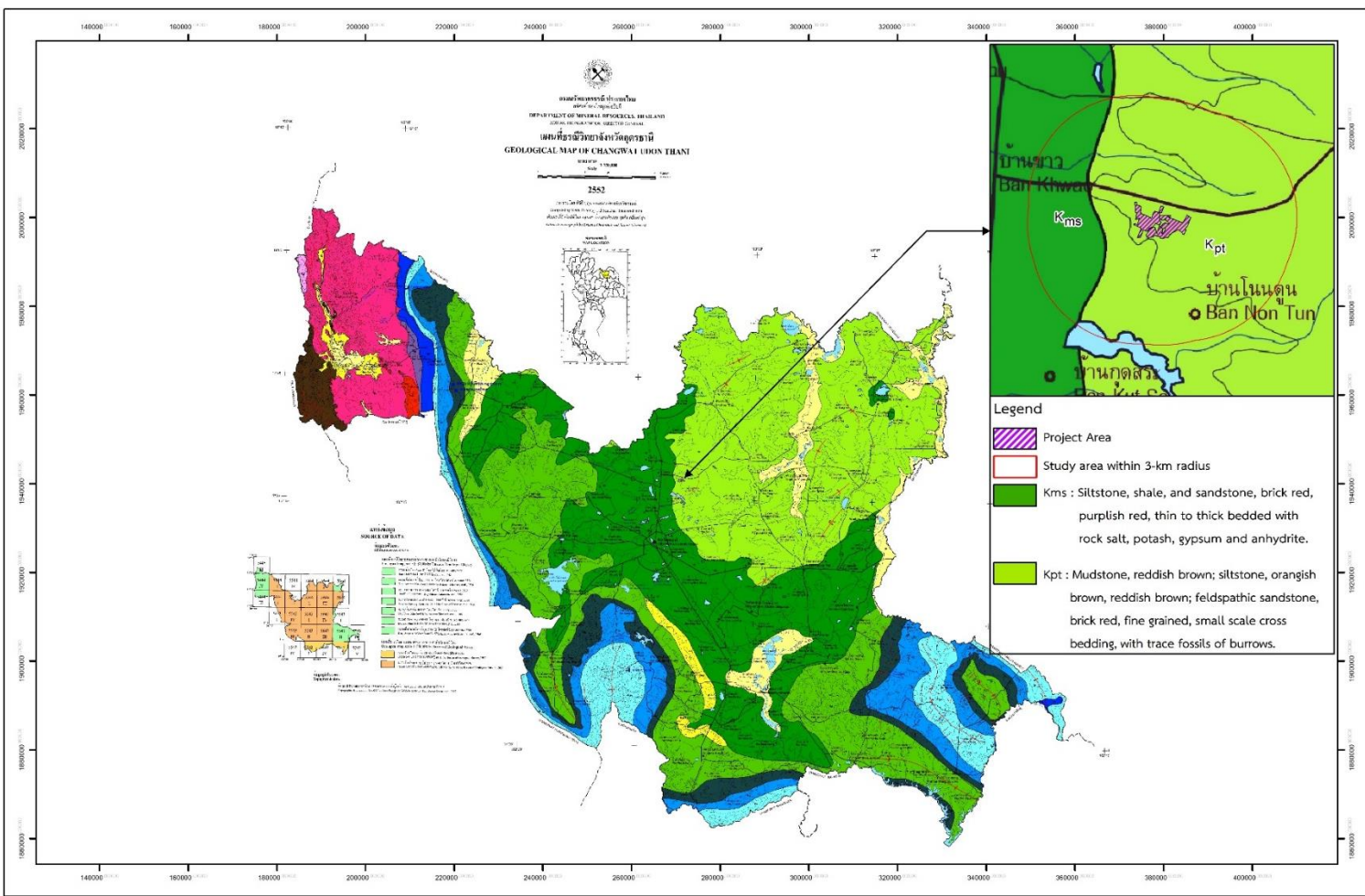
**(b) Phu Thok Formation (Kpt)** Phu Tok Formation as consisting of two sandstone types, one with very large scale cross-bedding and the other with small wavy bed structure. Since the formation is red, fine-grained, well sorted, and friable, he concluded that it was an eolian deposit. This formation is consists mudstone, reddish brown siltstone, orangish brown, reddish brown feldspathic sandstone, brick red, fine grained, small scale cross bedding, with trace fossil of burrows.

The study area is situated within Phu Thok Formation.

###### (2) Seismicity

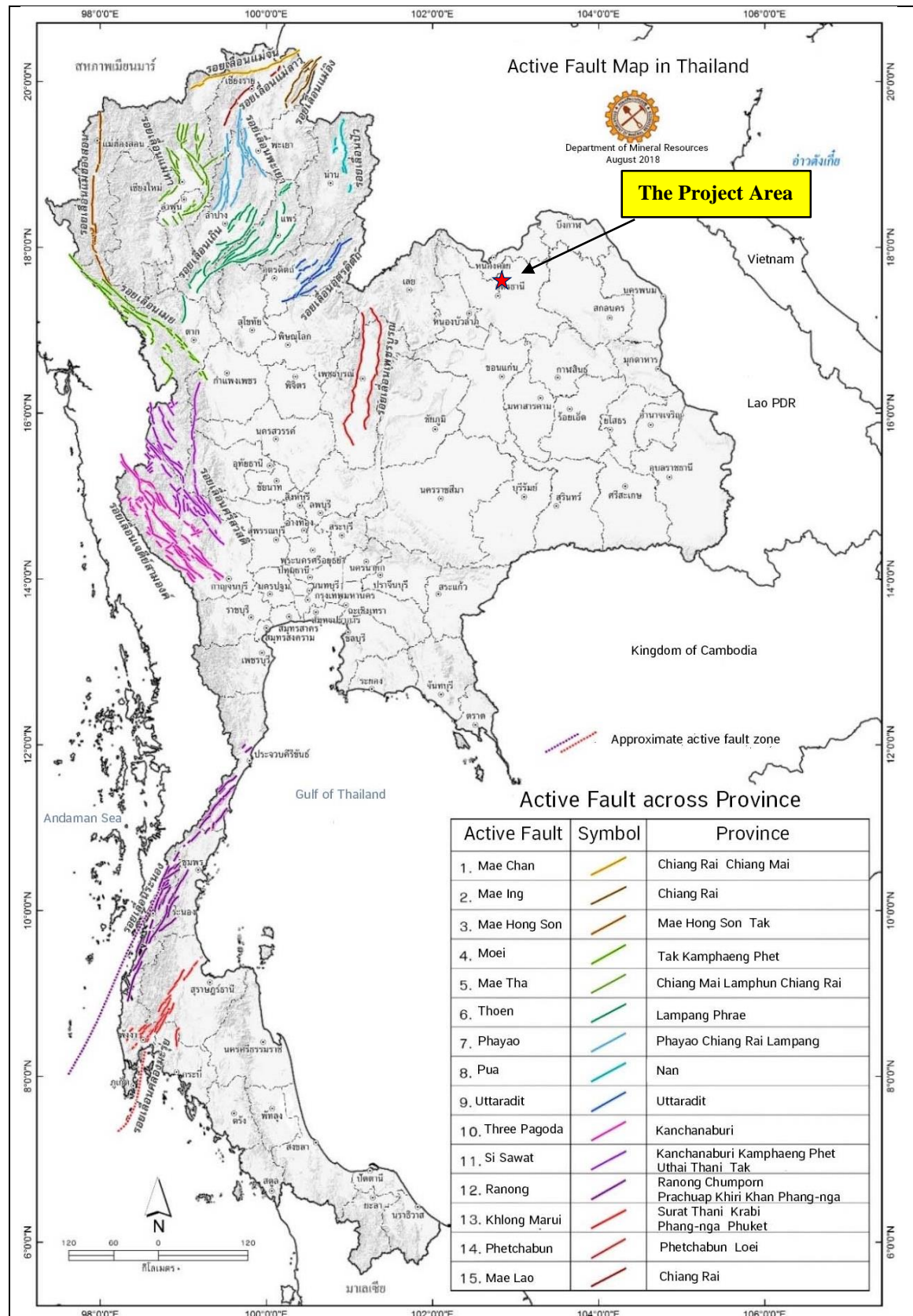
The seismicity data collected from related agencies and reports, including earthquake statistics from earthquake statistics of the Earthquake Observation division, Thai Meteorological Department 2018-2023 and risk area information from a map showing active fault lines in Thailand of the Department of Mineral Resources 2020 and earthquake maps from the Atlas book of Active Faults in Thailand 2018.

The project is situated in Udon Thani Province. This finding aligns with the risk area information derived from the map illustrating active faults in Thailand, as provided by the Department of Mineral Resources in 2020. This information is presented in **Figure 3.1-2**, indicating that Udon Thani Province does not have active fault lines.



Source : Geological Bureau, Department of Mineral Resources, 2009

**FIGURE 3.1-1 : UDON THANI GEOLOGICAL CONDITIONS**



Source : Active fault maps in Thailand Department of Mineral Resources, March 2020

**FIGURE 3.1-2 : ACTIVE FAULTS AND EPICENTERS OF EARTHQUAKES IN THAILAND**

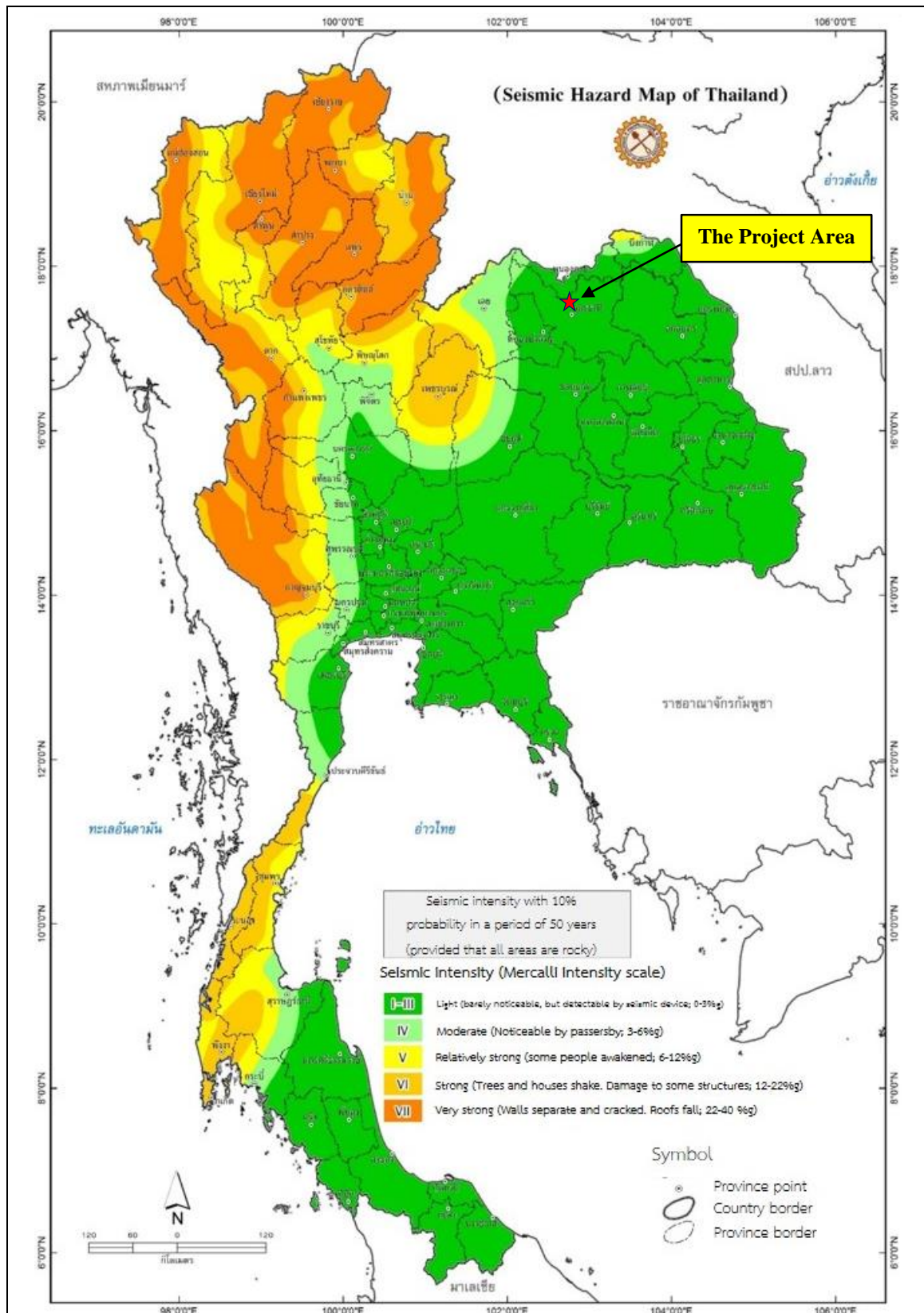


The Thai earthquake map of October 2016 revision (2018 Thailand Active Fault Atlas Book) (**Figure 3.1-3**) shows the intensity of earthquakes. The intensity measurement of an earthquake refers to the phenomena that occur during and after the earthquake, such as people's feelings, shaking or damage of objects and buildings, changes in the physical nature of the ground, etc., using the 12-rank Modified Mercalli Scale (MM Scale) from least to most severe earthquakes as shown in **Table 3.1-1**. It shows that in the project area and the study area if an earthquake occurs, there will be an earthquake of magnitude 5 Mercarily, which is a relatively strong level. Almost everyone can feel it. Many people are shocked. Objects are unstable and overturned. Pillars and trees are swaying. The Udon Thani Province is defined as a low seismic hazard region.

**TABLE 3.1-1**  
**LEVELS OF EARTHQUAKE INTENSITY BASED ON THE MODIFIED**  
**MERCALI SCALE (MM)**

Level	Ground Conditions
I	Not felt except by very few under especially favorable conditions.
II	Felt only by a few people at rest, especially on upper floors of buildings. Delicately suspended objects may swing.
III	Felt quite noticeably by people indoors, especially on upper floors of buildings: Many people do not recognize it as an earthquake. Standing vehicles may rock slightly. Vibrations are similar to the passing of a truck, with duration estimated.
IV	Felt indoors by many, outdoors by few during the day: At night, some are awakened. Dishes, windows, and doors are disturbed; walls make cracking sounds. Sensations are like a heavy truck striking a building. Standing vehicles are rocked noticeably.
V	Felt by nearly everyone; many awakened: Some dishes and windows are broken. Unstable objects are overturned. Pendulum clocks may stop.
VI	Felt by all. Some heavy furniture is moved; some chimneys are broken. Damage is slight
VII	Damage is negligible in buildings of good design and construction; but slight to moderate in well-built ordinary structures; damage is considerable in poorly built or badly designed structures; some chimneys are broken. Noticed by motorists.

**Source :** The Earthquake Observation division, Thai Meteorological Department, 2023  
([www.seismology.tmd.go.th](http://www.seismology.tmd.go.th))



Source : Department of Mineral Resources, 2016

**FIGURE 3.1-3 : SEISMIC HAZARD MAP OF THAILAND**

### (3) Soil Resources

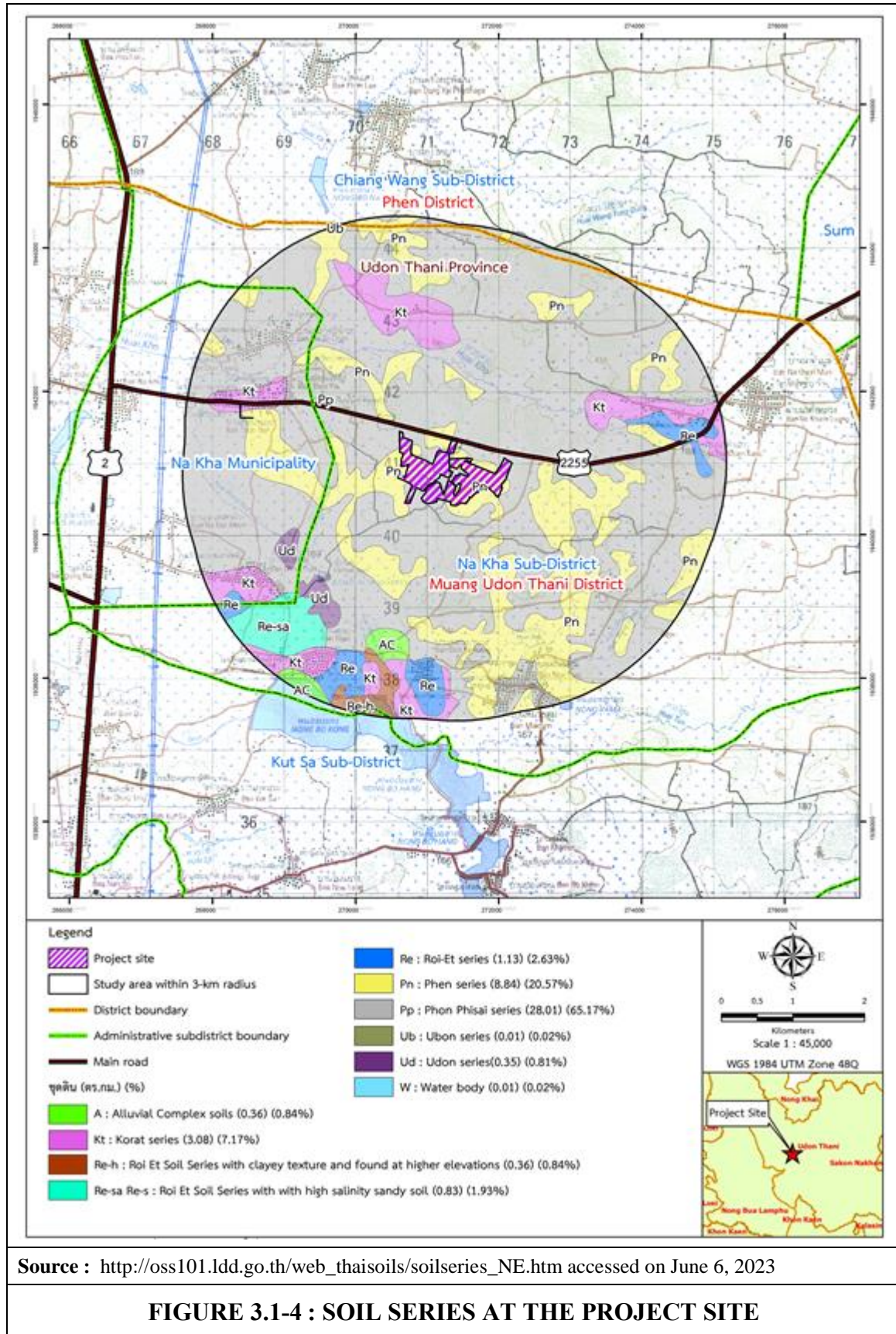
The review of soil resources from Soil Resources Survey and Research Division of the Land Development Department ([http://oss101.ldd.go.th/web\\_thaisoils/soilseries\\_NE.htm](http://oss101.ldd.go.th/web_thaisoils/soilseries_NE.htm)) on June 6, 2023 illustrated soil series at the study area as shown in **Figure 3.1-4**. The predominant soil series in the study area is Phon Phisai (Pp) soil series (65.17%), followed by Phen (Pn) soil series (20.57%) and Korat (Kt) soil series (7.17%). In the project area, the predominant soil series is Phen (Pn) soil series, with the central part of the project area consisting of Phon Phisai (Pp) soil series. Each soil series in the project area has the following details:

#### (a) Phen series (Pn)

Phen series is formed from finely grained sediment that is deposited on top of bedrock. It is found in the lower parts of the earth's surface where the terrain is relatively flat, with a slope ranging from 0-2%. The soil has poor drainage and water flow is slow on the surface. It has moderate permeability in the topsoil and lower permeability in the subsoil. The soil is typically loamy to sandy in texture, with a brown or gray-brown color. It may have spots of brown, yellow-brown, and/or red-yellow coloration. The subsoil, within 50 centimeters, is often a clayey-sandy mixture, with a high sand content in the upper subsoil and a clayey texture in the lower subsoil. The amount of gravel decreases with depth. The upper subsoil is light brown in color, while the lower subsoil is gray and may have spots of red-yellow and red throughout. The soil's plasticity index ranges from 5-50% by volume within 150 centimeters from the surface. The soil reaction is slightly acidic (pH 5.5-6.5) in the topsoil and strongly acidic (pH 4.5-5.0) in the subsoil. The limitations for utilizing sandy soil are its low fertility. To cultivate crops, organic and chemical fertilizers should be applied to enhance soil fertility. Adequate water sources should also be provided for irrigation purposes.

#### (b) Phon Phisai series (Pp)

Phon Phisai series is formed from finely grained sediment that is deposited on top of bedrock. It has a relatively flat to gently undulating surface with a slope ranging from 1-5%. The soil has moderate drainage, and water flow on the surface is moderate too fast. It has moderate permeability in the topsoil and slower permeability in the subsoil. The soil is predominantly loamy, reaching gravelly layers. The topsoil is loamy sand or loam, with a dark gray-brown color. The upper subsoil is loamy with some sand and gradually becomes loamy with more sand and gravel content in the lower subsoil. It has a brown or dark brown color. The subsoil within 50-100 centimeters is predominantly loamy with a high gravel content or highly gravelly loam, and it transitions to clayey with a high gravel content or highly gravelly clayey soil. It has a light gray or light gray-brown color, with spots of reddish-brown or yellowish-brown iron nodules. The soil reaction is strongly acidic to slightly acidic (pH 5.0-6.5) in the topsoil and strongly acidic to moderately acidic (pH 4.5-5.5) in the subsoil. The limitations for utilizing Phon Phisai series are its predominantly gravelly layers. The topsoil is relatively sandy, which limits its use for field crops. In such cases, it is recommended to select crops with shorter roots, such as corn, millet, mung beans, and others. However, in the case of fruit trees or perennial plants, it is advisable to mix the soil with organic fertilizer and backfill the planting hole with the mixture before planting the trees.



In summary, the soil in the project area is predominantly characterized by moderate drainage, moderate water flow on the soil surface, and moderate permeability. The soil is deep, with the topsoil being sandy with loamy or sandy loam content. This poses a risk of water scarcity for crops during the growing season and is also susceptible to erosion. The consulting company has conducted an assessment of soil erosion in the project area based on the guidelines of the "Soil Erosion Assessment in Thailand" by the Department of Land Development (B.E. 2543) (2000). The assessment revealed an estimated soil erosion rate of approximately 7.12 tons per acre per year. When compared to the severity of soil erosion levels in Thailand, it was found that the rate of soil loss in the project area falls into the moderate category. The details of the soil erosion assessment can be found in **Appendix 3A**.

### 3.1.2 Climate and Meteorology

Climatic and meteorological data were collected from Udon Thani Meteorological Station for the 30-year period (1993-2022) (station code 48354), located at Nong Khon Kwang Subdistrict, Mueang Udon Thani District, Udon Thani Province. It is the closest meteorological station to the project area. It is located at latitude 17° 23' 0.0" North and longitude 102° 48' 0.0" East. The climate and meteorological conditions of Udon Thani are as follows:

#### (1) Climate conditions

The project is located in Udon Thani province, influenced by 2 types of monsoons, namely the northeast monsoon, which blows from the northeast during the cool season causing Udon Thani to encounter cool and dry conditions, and the southwest monsoon, which blows from the sea and ocean and prevails during the rainy season, causing rain and moist air in Udon Thani, there are 3 seasons as follows.

- **Winter** starts from mid-October to mid-February which is the northeast monsoon season. A high-pressure area from China with coolness and dryness will spread to cover Thailand during this period. The coolest weather is in December and January.
- **Summer** starts when the northeast monsoon ends, around mid-February to mid-May. A south and a southwest wind prevails during this period causing hot and sweltering weather in general. The weather is extremely hot in March and April.
- **Rainy** starts from mid-May to mid-October. It is during the southwest monsoon that prevails over Thailand. The monsoon trough across the southern region of Thailand will move up and straddles the northern and northeastern regions respectively. It causes much more rain from mid-May onwards. August is the wettest period of the year.

#### (2) Meteorological conditions

Based on the collection of meteorological data from Udon Thani Meteorological Station for the 30-years (1993-2022) (station code 425301/48427), which is the closest meteorological station to the project study area as shown in **Table 3.1-2**. It can be summarized as follows.

- **Atmospheric pressure** - The mean atmospheric pressure in the whole year is 1,009.22 hectopascals. The highest mean atmospheric pressure is in December, with 1,014.6 hectopascals. The lowest mean atmospheric pressure is in July, with 1,004.7 hectopascals.

**TABLE 3.1-2  
METEOROLOGICAL STATISTICS FROM UDON THANI  
METEOROLOGICAL STATION FOR 30-YEAR PERIODS (1993-2022)**

Station : UDON THANI Elevation of station above MSL : 177 Meters  
 Index Station : 48357 Height of barometer above MSL : 178.10 Meters  
 Latitude : 17° 23' 0.0" N Height of Thermometer above ground : 1.50 Meters  
 Longitude : 102° 48' 0.0" E Height of wind vane above ground : 12.00 Meters  
 Height of rain gauge : 0.80 Meters

Elements	N-Years	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	Annual
<b>Pressure (hPa)</b>														
Mean	30	1013.9	1012.1	1009.7	1008.1	1006.5	1005.1	1004.7	1005.2	1007.4	1010.7	1012.6	1014.6	1009.22
Mean Daily Range	30	5.7	6.0	6.0	5.7	4.9	4.1	3.8	4.0	4.6	4.8	5.0	5.3	4.99
Ext .Max.	30	1028.24	1025.14	1.29.53	1019.86	1014.98	1012.03	1012.34	1012.97	1017.33	1020.94	1022.39	1026.65	1029.53
Ext .Min.	30	1001.9	1001.45	998.28	997.72	995.73	996.24	996.33	995.40	995.74	997.80	1001.88	1002.02	995.40
<b>Temperature (Celsius)</b>														
Mean Max.	30	30.4	32.6	35.1	36.4	34.9	33.7	32.8	32.4	32.2	32.1	31.6	29.6	32.8
Ext .Max.	30	37.6	39.2	42.0	43.0	42.4	38.6	39.8	38.1	36.0	36.5	37.0	35.6	43.0
Mean Min.	30	16.6	18.6	22.0	24.4	25.0	25.2	25.0	24.7	24.3	23.0	20.2	16.7	22.1
Ext .Min.	30	7.0	7.8	11.4	15.7	20.4	21.6	21.8	21.1	21.0	14.2	10.3	4.2	4.2
Mean	30	23.0	25.2	28.1	29.8	29.1	28.8	28.3	27.9	27.7	27.2	25.5	22.9	27.0
<b>Dew Point Temp.(C°)</b>														
Mean	30	15.5	16.9	19.2	21.6	23.6	24.2	24.1	24.1	24.1	22.0	19.0	15.9	20.8
<b>Relative Humidity (%)</b>														
Mean	30	66	63	62	64	74	78	79	81	82	75	70	67	71.7
Mean Max.	30	87	85	82	83	89	91	91	92	94	91	89	88	88.5
Mean Min.	30	41	40	40	43	54	60	62	65	64	55	47	44	51.3
Ext .Min.	30	16	13	10	15	21	33	26	36	36	25	25	14	10.0
<b>Visibility (Km.)</b>														
Mean	30	8.6	7.8	7.6	9.5	11.1	11.9	12.0	11.7	10.6	9.2	9.9	9.0	9.9
07.00LST	30	5.7	5.6	6.0	8.3	10.1	11.0	11.0	10.6	8.9	7.3	7.4	6.1	8.2
<b>Cloud Amount (1-10)</b>														
Mean	30	2.3	2.3	3.1	4.1	6.1	6.9	7.5	7.7	6.5	4.3	3.1	2.4	4.7
<b>Wind (Knots)</b>														
Prev .Wind	30	E	E	E	E	S	S	SW	W	E	E	NE	E	-
Mean	30	1.7	1.8	2.0	2.0	2.0	2.0	2.1	2.0	1.7	1.7	1.7	1.9	1.9
Max.	30	24.0	32.0	43.0	45.0	46.0	41.0	36.0	41.0	34.0	26.0	30.0	20.0	46.0
<b>Pan Evaporation (mm.)</b>														
Total	30	112.7	122.0	155.1	167.5	156.5	138.1	129.0	122.9	113.1	124.2	116.0	114.6	1571.7
<b>Rainfall (mm)</b>														
Total	30	5.3	25.7	48.2	77.7	195.9	216.9	223.6	288.3	251.3	95.5	18.6	5.3	1452.3
Num .of Days	30	2.2	3.2	6.0	8.2	17.2	19.4	20.8	22.0	18.1	8.6	3.0	1.0	129.7
Daily Max.	30	20.6	54.9	70.9	103.7	113.7	103.6	274.5	192.6	144.7	92.6	64.2	47.3	274.5
<b>Sunshine Duration (hr.)</b>														
Mean	30	-	-	-	-	-	-	-	-	-	-	-	-	16.0
<b>Phenomena (Days)</b>														
Fog	30	0.6	0.3	0.0	0.0	0.0	0.1	0.0	0.0	0.2	0.1	0.3	0.3	1.9
Haze	30	20.6	22.0	24.6	16.2	3.8	0.4	0.2	0.1	4.0	13.0	13.0	17.5	135.4
Hail	30	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1
Thunder Storm	30	0.1	1.2	3.4	6.7	12.5	12.8	9.1	9.4	8.0	2.6	0.4	0.1	66.3
Squall	30	0.0	0.1	0.3	0.3	0.6	0.6	0.2	0.2	0.1	0.1	0.0	0.0	2.5

Source : Thai Meteorological Department, 2023

- **Temperature** - The mean temperature in the whole year is 27.0 °C. The highest mean temperature is in April at 29.8 °C. The lowest mean temperature is in December at 22.9 °C.

- **Relative humidity** - The mean relative humidity in the entire year is 71.7 percent. The highest monthly mean relative humidity is in September, with 82.0 percent. The lowest monthly mean of relative humidity is in March, with 62.0 percent.

- **Wind speed and wind direction** - The mean wind speed is 1.9 knots. The lowest monthly mean wind speed is in January and September-November. The highest monthly mean wind speed is in July. The wind direction blows from the east (E) from January to April, September to October, and December; the south (S) from May to June; the southwest (SW) in July; and the west (W) in August.

- **Rainfall** - The annual rainfall is 1,452.30 mm. The highest rainfall is in August, with 288.3 mm. The lowest rainfall is in January and December, with 5.3 mm. The total number of rainy days for the year is 129.7 days.

### 3.1.3 Air Quality

Air quality monitoring was conducted in the project vicinity that may be affected by the project. It was conducted 2 times during dry season and rainy season, at two stations, are as follows:

A1 : Pa Nabun Chai Mongkhon Temple is about 2.48 kilometers NE from the project area,

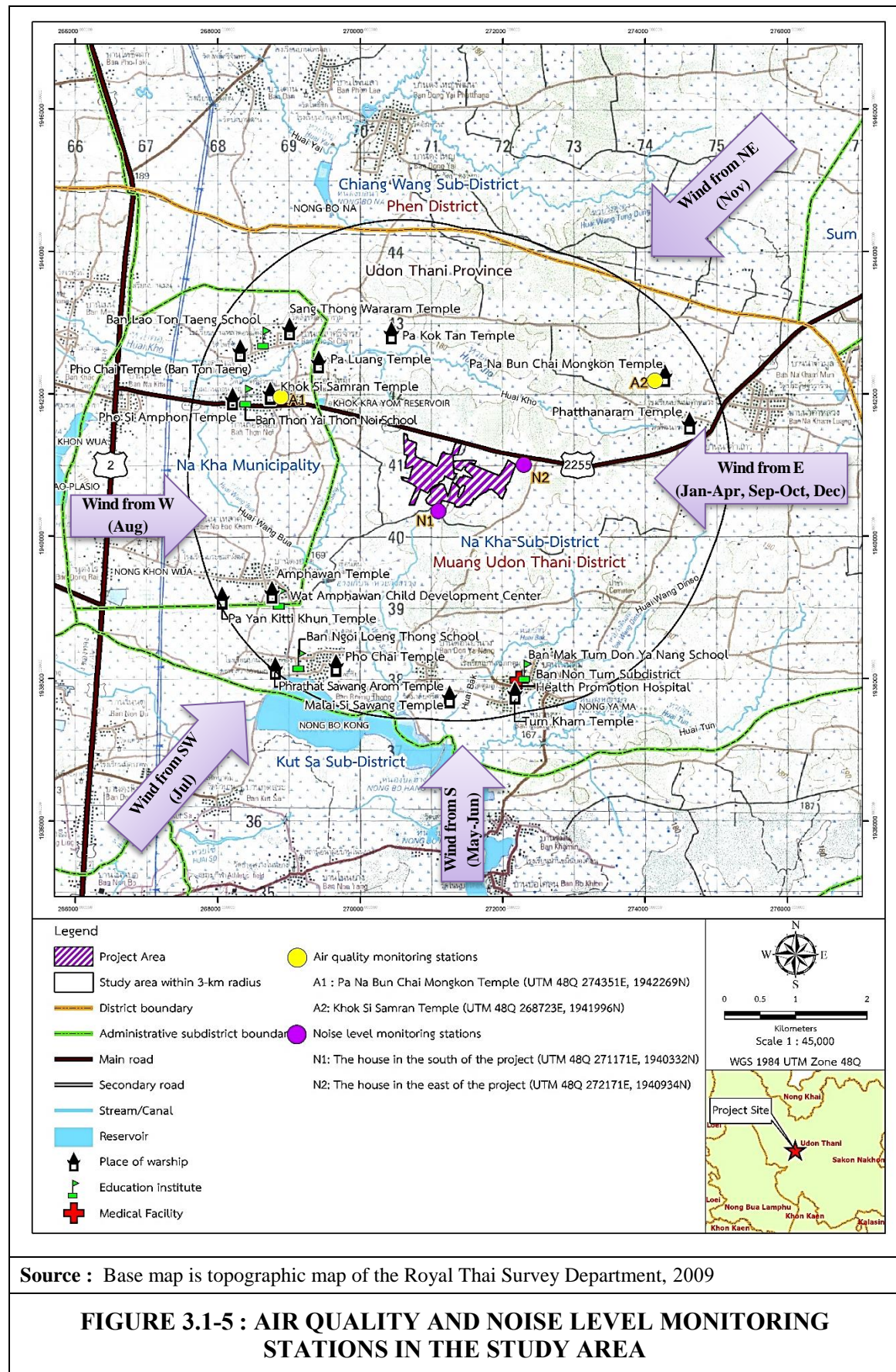
A2 : Khok Si Samran Temple is about 1.91 kilometers WNW from the project area.

Which, focusing on the location from the data of wind and topographical conditions of the study area as shown in **Figure 3.1-5**.

The measured parameters included Total Suspended Particles (TSP), and Particulate Matter with a diameter of less than 10 micrometers (PM-10). During rainy season, ambient air quality measurements were conducted in the study area between 6-11 June 2023. For the dry season, ambient air quality measures were conducted between 2-7 November 2023. The measure parameters included Total Suspended Particles (TSP), Particulate Matter with a diameter of less than 10 micrometers (PM-10), and Particulate Matter with a diameter of less than 2.5 micrometers (PM-2.5) as shown in **Figure 3.1-6**.

The sampling and analysis methods follow the Royal Gazette or other systems approved by the Pollution Control Department, as shown in **Table 3.1-3**.

The results of ambient air quality monitoring in rainy season and dry season at Pa Nabun Chai Mongkhon Temple (A1) and Khok Si Samran Temple (A2) show that the concentration of 24-hour average TSP and 24-hour average PM-10 comply with ambient air quality standard, as shown in **Table 3.1-4**, **Figure 3.1-7**, and **Appendix 3B**. It is summarized as follows.




Source : Base map is topographic map of the Royal Thai Survey Department, 2009

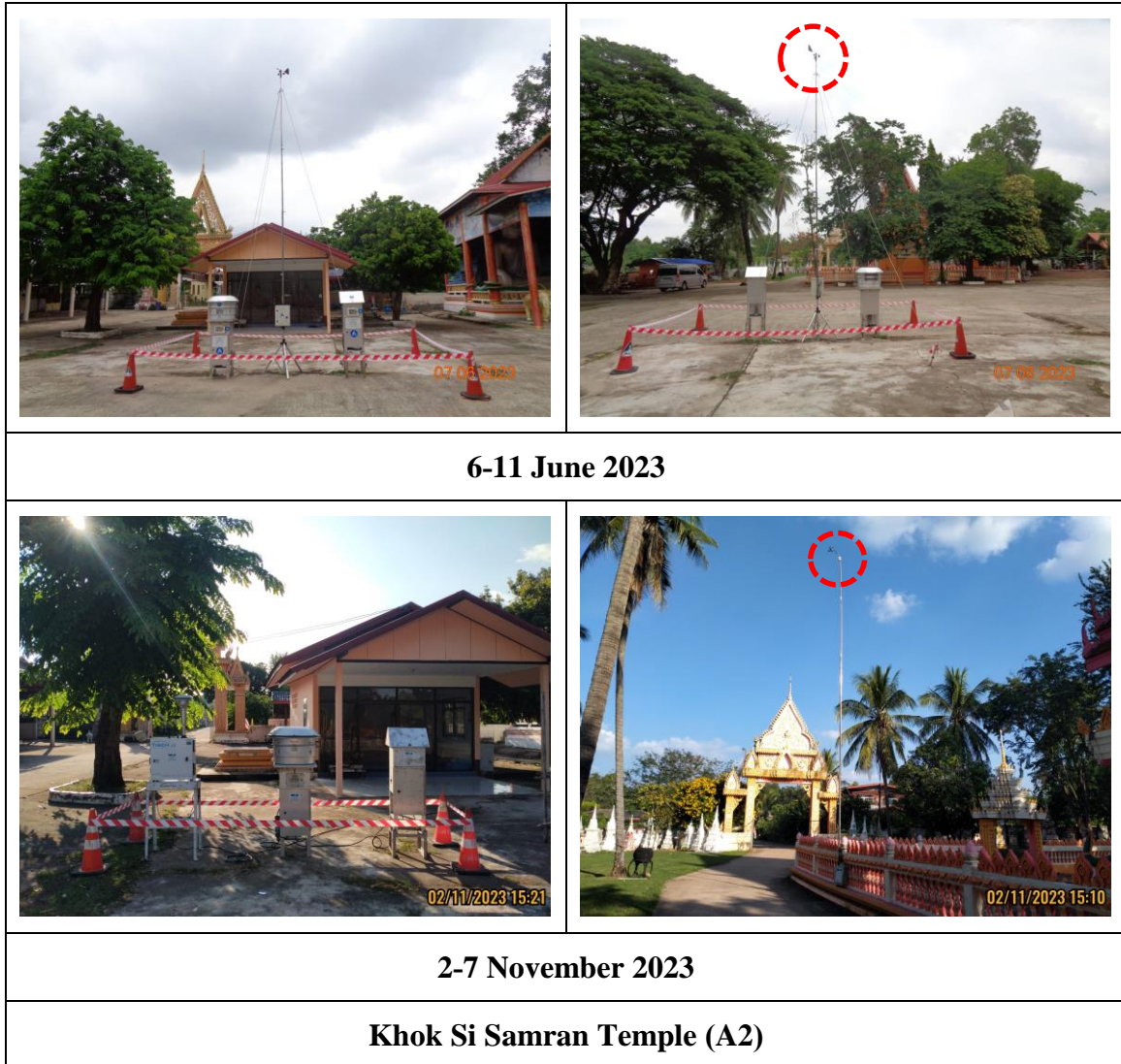
**FIGURE 3.1-5 : AIR QUALITY AND NOISE LEVEL MONITORING STATIONS IN THE STUDY AREA**






 Wind speed and wind direction measurement

**FIGURE 3.1-6 : AMBIENT AIR QUALITY MONITORING ACTIVITIES AT THE PROJECT AREA BETWEEN 6-11 JUNE 2023 AND 2-7 NOVEMBER 2023**



 Wind speed and wind direction measurement

**FIGURE 3.1-6 : AMBIENT AIR QUALITY MONITORING ACTIVITIES AT THE PROJECT AREA BETWEEN 6-11 JUNE 2023 AND 2-7 NOVEMBER 2023 (CONT'D)**

**TABLE 3.1-3  
AIR QUALITY INDEX, SAMPLING AND AIR QUALITY ANALYSIS  
METHODS**

Variables	Sampling methods	Analysis methods	Reference
1. Total Suspended Particulates; TSP	High Volume Air Sampler	Gravimetric Method	1/, 2/
2. Particulate matter with a diameter of less than 10 microns (PM-10)	PM10- Size Selective, High-Volume Air Sampler	Gravimetric Method	1/, 2/
3. Particulate matter with a diameter of less than 2.5 microns (PM-2.5)	PM-2.5 Size Selective, Low-Volume Air Sampler	Gravimetric Method	3/
4. Wind Speed and Wind Direction	Wind Vane and Cup Anemometer	EPA Method (WRPLOT Utility Program)	-

**Note:** 1/ Notification of the National Environment Board, No. 10 (B.E. 2538) on ambient air quality standards  
2/ Notification of the National Environment Board, No. 10 (B.E. 2538) on ambient air quality standards  
3/ Notification of the National Environment Board (B.E. 2565) on PM-2.5 ambient air quality standards

### (1) Total suspended particulate (TSP) , 24-hour average

*During rainy season*, the average 24-hour TSP concentration at Pa Nabun Chai Mongkhon Temple (A1) and Khok Si Samran Temple (A2) are in the range of 0.011-0.044 and 0.016-0.036 mg/m<sup>3</sup>, respectively. *During dry season*, the average 24-hour TSP concentration at Pa Nabun Chai Mongkhon Temple (A1) and Khok Si Samran Temple (A2) are in the range of 0.043-0.073 and 0.042-0.072 mg/m<sup>3</sup>, respectively. There are within the National ambient air quality standard value prescribed in the Notification of the National Environmental Board no. 24 (2004) that determines 24-hour average TSP not exceeding 0.33 mg/m<sup>3</sup>.

### (2) PM-10, 24-hour average

*During rainy season*, the average 24-hour PM-10 concentration at Pa Nabun Chai Mongkhon Temple (A1) and Khok Si Samran Temple (A2) are in the range of 0.009-0.018 and 0.015-0.024 mg/m<sup>3</sup>, respectively. *During dry season*, at Pa Nabun Chai Mongkhon Temple (A1) and Khok Si Samran Temple (A2) are in the range of 0.023-0.039 and 0.026-0.043 mg/m<sup>3</sup>, respectively. There are within the National ambient air quality standard value prescribed in the Notification of the National Environmental Board no. 24 (2004) that determines 24-hour average PM-10 not exceeding 0.12 mg/m<sup>3</sup>. Comparing to the WHO standards /General EHS Guidelines, IFC (2007) , it is found that the 24-hour average PM10 level is within the standard, which specifies a limit not exceeding 0.050 mg/m<sup>3</sup>.

### (3) PM-2.5, 24-hour average

*During dry season*, at Pa Nabun Chai Mongkhon Temple (A1) and Khok Si Samran Temple (A2) are in the range of 0.0108-0.0293 and 0.0101-0.0282 mg/m<sup>3</sup>, respectively. There are within the National ambient air quality standard value prescribed in the Notification of the National Environmental Board (2022) that determines 24-hour average PM-2.5 not exceeding 0.0375 mg/m<sup>3</sup>. Comparing to the WHO standards/ General EHS Guidelines, IFC (2007), it is found that the 24-hour average PM2.5 level exceeds the standard, which specifies a limit not exceeding 0.025 mg/m<sup>3</sup>.

**TABLE 3.1-4  
RESULTS OF AMBIENT AIR QUALITY IN THE STUDY AREA**

Monitoring station	Monitoring date	Monitoring result (mg/m <sup>3</sup> )		
		24-hour average TSP	24-hour average PM10	24-hour average PM2.5
Pa Nabun Chai Mongkhon Temple (A1)	6-7 June 23	0.022	0.017	-
	7-8 June 23	0.011	0.011	-
	8-9 June 23	0.027	0.009	-
	9-10 June 23	0.044	0.018	-
	10-11 June 23	0.031	0.014	-
	<b>Max – Min</b>	<b>0.011-0.044</b>	<b>0.009-0.018</b>	-
	2-3 Nov 23	0.071	0.039	0.0247
	3-4 Nov 23	0.073	0.038	0.0293
	4-5 Nov 23	0.071	0.037	0.0141
	5-6 Nov 23	0.046	0.024	0.0158
	6-7 Nov 23	0.043	0.023	0.0108
	<b>Max – Min</b>	<b>0.043-0.073</b>	<b>0.023-0.039</b>	<b>0.0108-0.0293</b>
Khok Si Samran Temple (A2)	6-7 June 23	0.029	0.015	-
	7-8 June 23	0.016	0.016	-
	8-9 June 23	0.035	0.019	-
	9-10 June 23	0.032	0.024	-
	10-11 June 23	0.036	0.020	-
	<b>Max – Min</b>	<b>0.016-0.036</b>	<b>0.015-0.024</b>	
	2-3 Nov 23	0.069	0.041	0.0188
	3-4 Nov 23	0.070	0.038	0.0282
	4-5 Nov 23	0.069	0.043	0.0269
	5-6 Nov 23	0.072	0.042	0.0203
	6-7 Nov 23	0.042	0.026	0.0101
	<b>Max – Min</b>	<b>0.042-0.072</b>	<b>0.026-0.043</b>	<b>0.0101-0.0282</b>
<b>National Standard Values</b>		<b>0.33<sup>1/</sup></b>	<b>0.12<sup>1/</sup></b>	<b>0.0375<sup>2/</sup></b>
<b>WHO/IFC Guidelines Values<sup>3/,4/</sup></b>		-	<b>0.050</b>	<b>0.025</b>

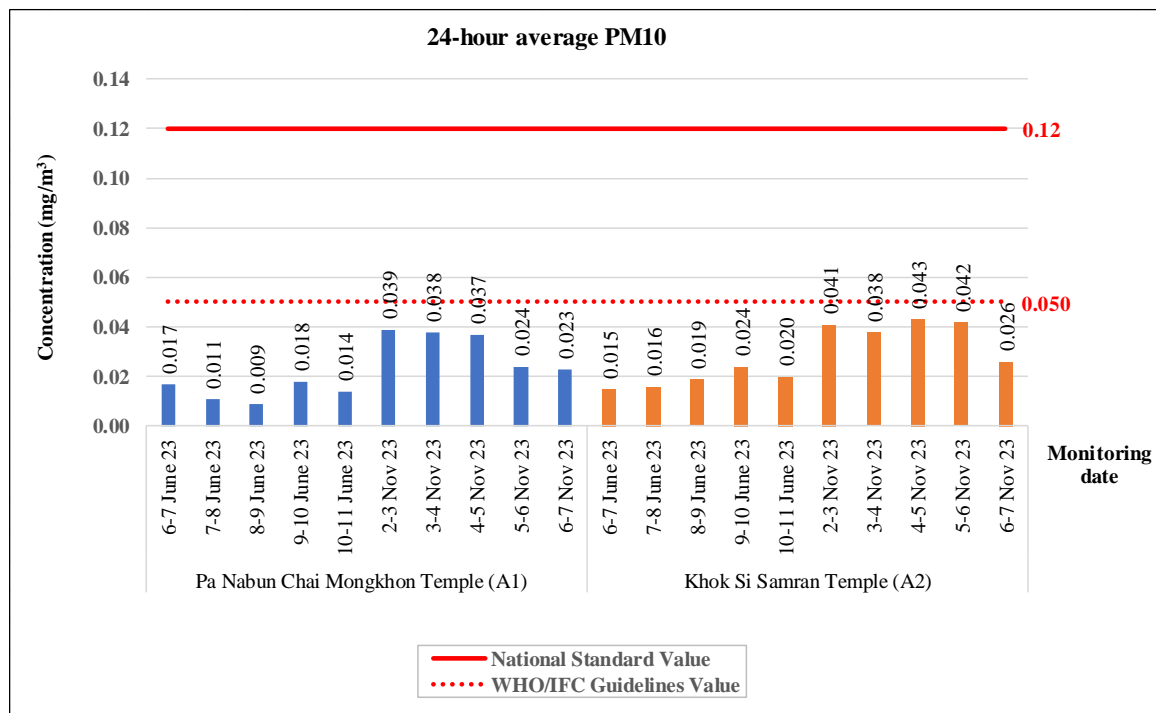
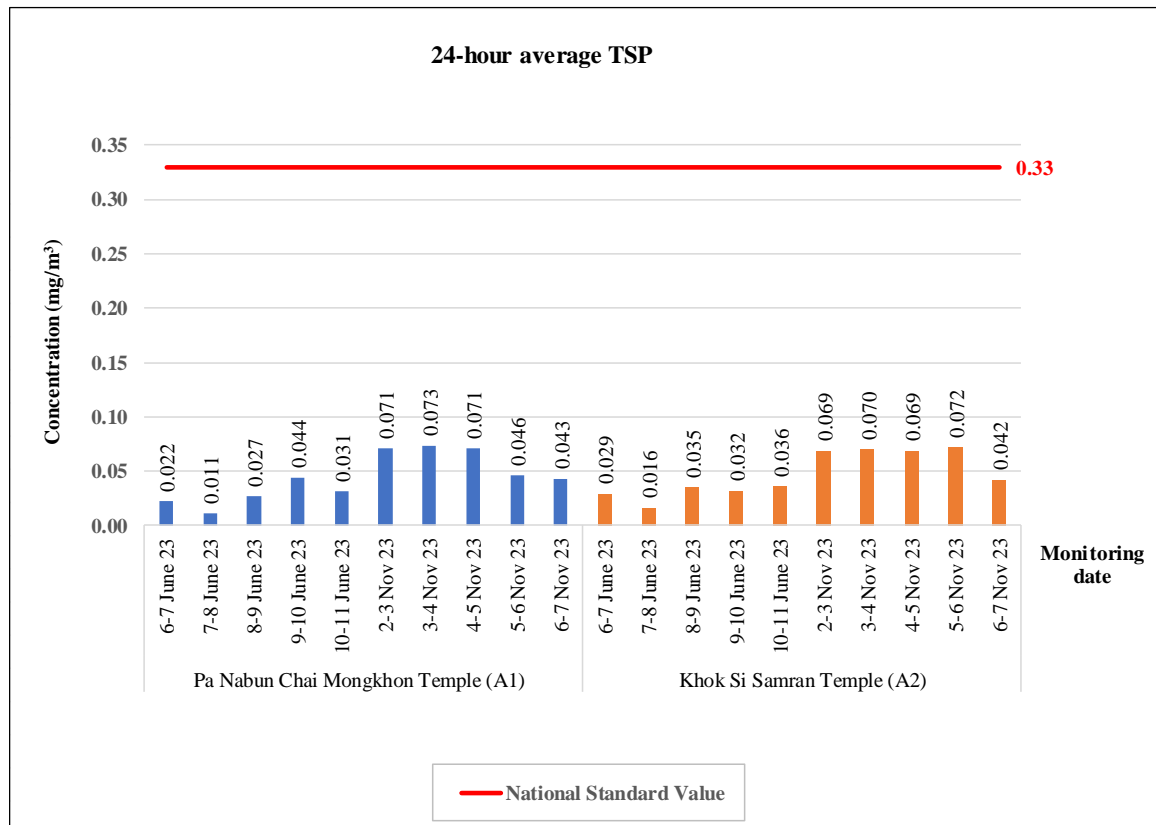
**Remark:** <sup>1/</sup> The Notification of the National Environmental Board on National Ambient air quality standards no. 24 (2004)

<sup>2/</sup> The Notification of the National Environmental Board on the standard of PM-2.5 in ambient air (2022)

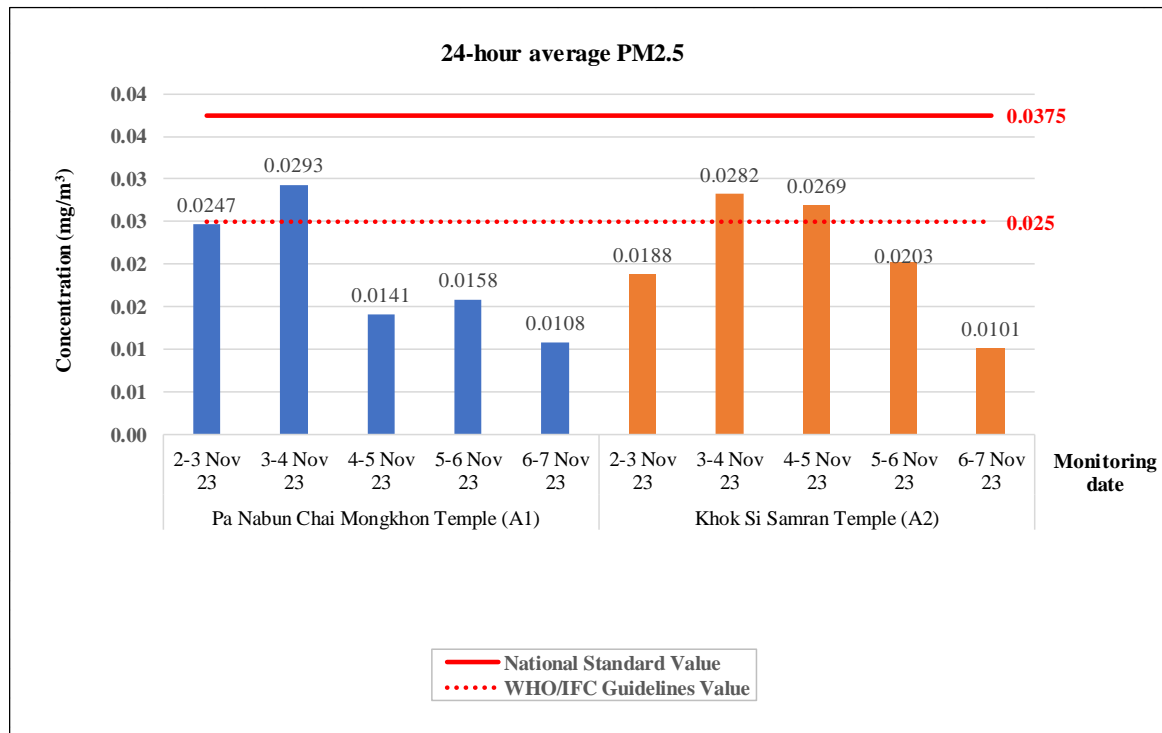
<sup>3/</sup> WHO Ambient Air Quality Guidelines, Air Quality Guidelines Global Update, 2005

<sup>4/</sup> Environmental, Health, and Safety (EHS) Guidelines, General EHS Guidelines: Environmental, Air Emissions and Ambient Air Quality, IFC, 2007

**Source:** Analysis by ALS Laboratory Group (Thailand) Co., Ltd. during 6-11 June 2023 and Environment Research & Technology Co., Ltd. during 2-7 November 2023



**FIGURE 3.1-7: GRAPH SHOWING THE MONITORING RESULTS OF AMBIENT AIR QUALITY**



**FIGURE 3.1-7: GRAPH SHOWING THE MONITORING RESULTS OF AMBIENT AIR QUALITY (CONT'D)**

**(4) Wind Speed and Wind Direction**

Wind speed and wind direction measurements were conducted in the study area same period with ambient air quality sampling, at 2 stations: Pa Nabun Chai Mongkhon Temple (A1) and Khok Si Samran Temple (A2)

(A1) : Pa Nabun Chai Mongkhon Temple : the monitoring results conducted in the rainy season (during 6 - 11 June 2023) showed the average wind speed were 0.3-1.7 m/s with the main direction from the south- southeast (SSE). For the dry season (during 2 - 7 November 2023), the average wind speed were <0.4-0.9 m/s with the main direction from the east-northeast (ENE) as shown in **Table 3.1-5**.

(A2) : Khok Si Samran Temple : the monitoring results conducted in the rainy season (during 6- 11 June 2023) showed the average wind speed were 0.3-1.7 m/s with the main direction from the south-southwest (SSW) and southeast (SE). For the dry season (during 2-7 November 2023), the average wind speed were <0.4-0.9 m/s with the main direction from the north-northeast (NNE) as shown in **Table 3.1-5**.

**TABLE 3.1-5**  
**RESULTS OF WIND SPEED AND DIRECTIONS IN THE STUDY AREA**

Monitoring station	Monitoring date	Monitoring results	
		Prevailing wind direction	Average wind speed (m/s)
Pa Nabun Chai Mongkhon Temple (A1)	6-11 June 23	South-southwest (SSW) and Southeast (SE)	0.3-1.7
	2-7 Nov 23	North-northeast (NNE)	<0.4-0.9
Khok Si Samran Temple (A2)	6-11 June 23	South-southeast (SSE)	0.3-1.7
	2-7 Nov 23	East-northeast (ENE)	<0.4-0.9

**Source :** Analysis by ALS Laboratory Group (Thailand) Co., Ltd. during 6-11 June 2023 and Environment Research & Technology Co., Ltd. during 2-7 November 2023.

### 3.1.4 Noise

The project conducts sound level measurements in the community closest to the project site that may be affected by the project operation. The measurement was conducted two times in 2 stations as shown in **Figure 3.1-5**, are as follows:

- N1 : The house in the south of the project is about 20 meters from the project area,
- N2 : The house in the east of the project is about 43 meters from the project area.

The measurements were performed for 5 consecutive days, including working days and holidays between 6-11 June 2023, and 7 consecutive days, including working days and holidays between 2-9 November 2023 as shown in **Figure 3.1-8**. The parameters are 24-hour equivalent sound level ( $L_{eq}$  24 hr), sound level at the 90<sup>th</sup> percentile ( $L_{90}$ ), day-night average sound level ( $L_{dn}$ ) and the maximum sound level ( $L_{max}$ )

The measurement uses an integrating sound level meter according to the standard IEC 651 or IEC 804 of the International Electrotechnical Commission, IEC. The sound level calculation method is according to the International Organization for Standardization, ISO, as shown in **Table 3.1-6**.

The results of sound level measurements between 6-11 June 2023 and 2-9 November 2023, at the house in the south of the project (N1) and the house in the east of the project (N2) show that the sound level is within standard value, as shown in **Table 3.1-7** and **Figure 3.1-9** and **Appendix 3C**. Details are as follows.



**FIGURE 3.1-8 : SOUND LEVEL MEASUREMENT IN THE PROJECT AREA BETWEEN 6-11 JUNE 2023 AND 2-9 NOVEMBER 2023**

**TABLE 3.1-6  
INDEX OF SOUND ANALYSIS, SAMPLING METHOD AND ANALYSIS METHOD**

Index	Sampling	Analysis method	Reference
$L_{eq}$ 24 hr	Integrating Sound Level Meter	International Organization for Standardization	1/
$L_{90}$			
$L_{dn}$			
$L_{max}$			

**Note :** <sup>1/</sup> Notification of the National Environment Board, No. 15, 1997 on General Noise Level Standards



### (1) 24-hour equivalent sound level ( $L_{eq}$ 24 hr)

During 6 - 11 June 2023, the equivalent 24-hour noise level at the house in the south of the project (N1) and the house in the east of the project (N2) are between 46.2-50.6 and 55.3-61.0 dB(A), respectively, during 2 - 9 November 2023, the house in the south of the project (N1) and the house in the east of the project (N2) are between 46.7-48.0 and 49.9-57.7 dB(A), respectively, which is within the general noise level standard criteria according to the Notification of the National Environment Board, No. 15 (B.E. 2540) that sets the value not more than 70 dB(A).

### (2) Maximum sound levels ( $L_{max}$ )

During 6 - 11 June 2023, the maximum noise level at the house in the south of the project (N1) and the house in the east of the project (N2) are between 70.9-91.5 and 73.6-97.4 dB(A), respectively, during 2 - 9 November 2023, the maximum noise level at the house in the south of the project (N1) and the house in the east of the project (N2) are between 68.1-78.2 and 74.2-81.5 dB(A), respectively, There are within the general noise level standards according to the Notification of the National Environment Board No. 15 (B.E. 2540) that set the value not less than 115 dB(A).

### (3) Day-night average sound levels ( $L_{dn}$ )

During 6 - 11 June 2023, the average daytime and nighttime noise level at the house in the south of the project (N1) and the house in the east of the project (N2) are between 50.2-53.4 and 61.4-69.8 dB(A), respectively. During 2 - 9 November 2023, they are between 53.1-54.1 and 56.1-66.0 dB(A), respectively.

### (4) Sound level at the 90<sup>th</sup> percentile ( $L_{90}$ ) (Background Noise Level)

During 6 - 11 June 2023, the background noise level at the house in the south of the project (N1) and the house in the east of the project (N2) are between 38.2-41.2 and 45.2-51.3 dB(A), respectively. During 2 - 9 November 2023, they are between 41.2-44.1 and 46.2-49.7 dB(A), respectively.

When comparing to the standards posted on the Notification of the National Environmental Board no. 15 (1997) prescribing the ambient noise levels standards, the findings showed all monitored noise levels were within the standards ( $L_{eq}$  24 hr) no greater than 70 dB(A) and  $L_{max}$  no greater than 115 dB(A)). Comparing to the WHO standards, it is found that the 1-hr equivalent sound level ( $L_{eq}$  1 hr) exceeds the WHO standard, which specifies a limit not exceeding 55 dB(A) during daytime (07:00 - 22:00) and 45 dB(A) during nighttime (22:00-07:00).

**TABLE 3.1-7**  
**RESULTS OF AMBIENT NOISE LEVELS IN THE AREAS ADJACENT TO**  
**THE PROJECT**

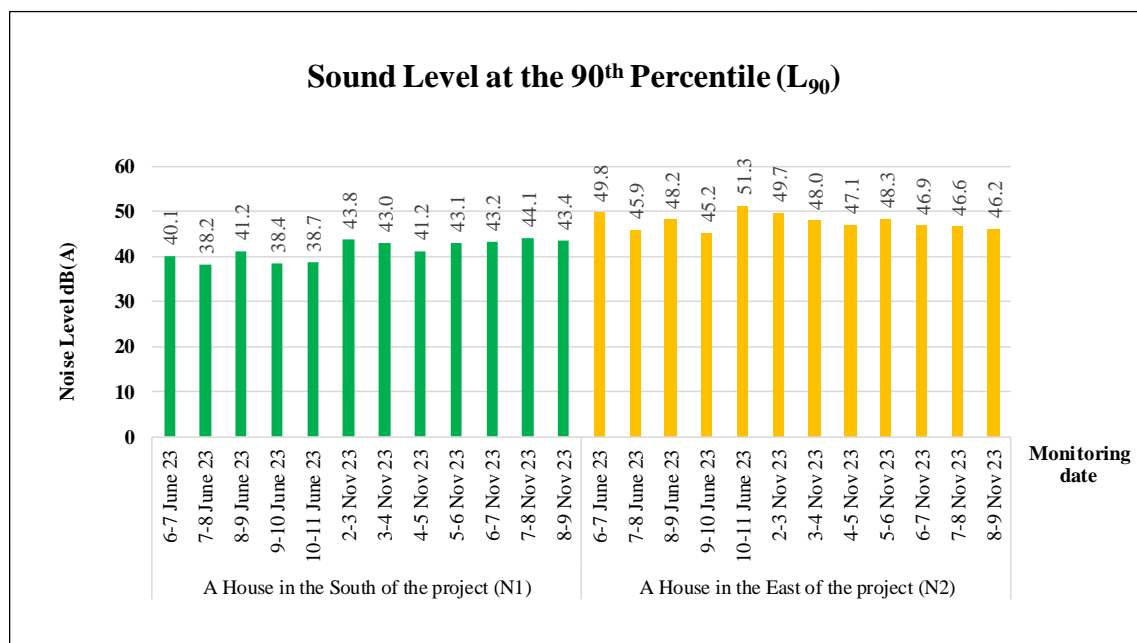
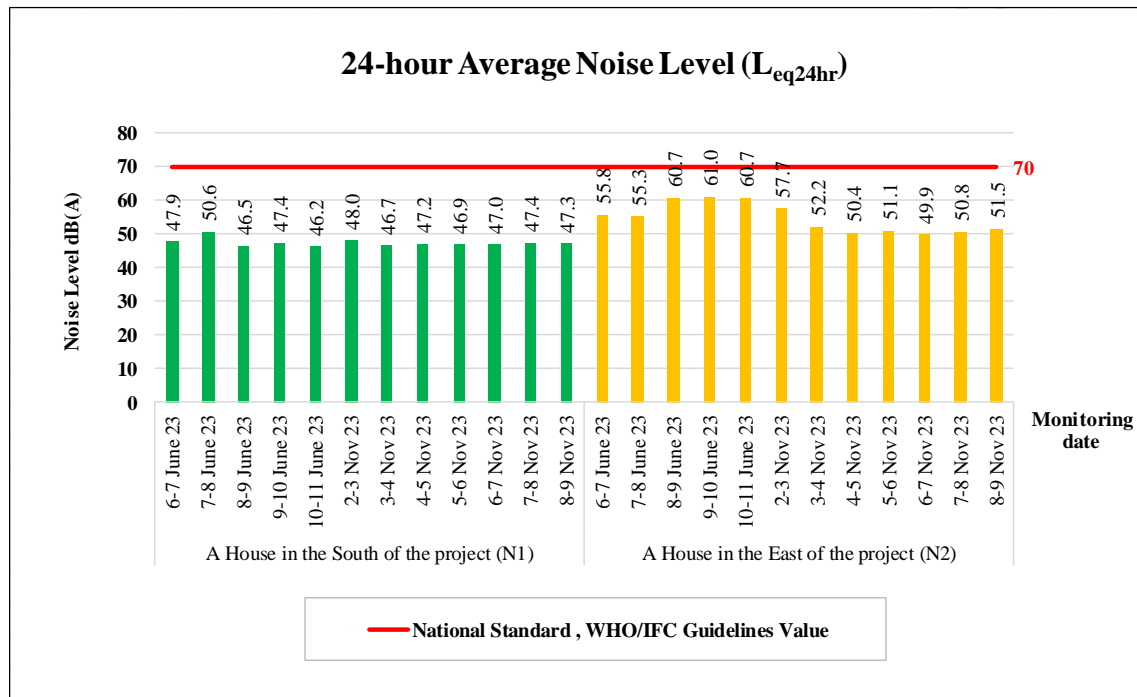
Monitoring station	Monitoring date	Monitoring results dB(A)					
		L <sub>eq</sub> 1 hr		L <sub>eq</sub> 24 hr	L <sub>90</sub>	L <sub>dn</sub>	L <sub>max</sub>
		Daytime 07:00 - 22:00	Nighttime 22:00 - 07:00				
A House in the South of the project (N1)	6-7 June 23	42.3-54.9	39.0-52.8	47.9	40.1	53.4	70.9
	7-8 June 23	41.2-61.9	39.3-47.9	50.6	38.2	52.8	91.5
	8-9 June 23	41.4-54.8	38.6-46.9	46.5	41.2	51.2	71.7
	9-10 June 23	42.2-55.7	38.8-48.6	47.4	38.4	51.4	84.6
	10-11 June 23	43.5-53.0	37.6-47.6	46.2	38.7	50.2	73.4
	<b>Min -Max</b>	<b>41.2-61.9</b>	<b>37.6-52.8</b>	<b>46.2-50.6</b>	<b>38.2-41.2</b>	<b>50.2-53.4</b>	<b>70.9-91.5</b>
	2-3 Nov 23	42.1-53.9	44.0-50.6	48.0	43.8	53.6	78.2
	3-4 Nov 23	42.3-50.2	42.5-51.3	46.7	43.0	53.1	68.1
	4-5 Nov 23	42.2-50.8	43.3-51.3	47.2	41.2	53.2	74.9
	5-6 Nov 23	40.0-49.7	44.2-50.4	46.9	43.1	53.6	77.1
	6-7 Nov 23	41.7-50.4	44.7-49.0	47.0	43.2	53.4	74.8
	7-8 Nov 23	41.5-50.0	46.1-50.1	47.4	44.1	54.1	73.9
	8-9 Nov 23	41.5-50.4	45.6-50.8	47.3	43.4	54.0	75.6
	<b>Min -Max</b>	<b>40.0-53.9</b>	<b>42.5-51.3</b>	<b>46.7-48.0</b>	<b>41.2-44.1</b>	<b>53.1-54.1</b>	<b>68.1-78.2</b>
A House in the East of the project (N2)	6-7 June 23	41.9-63.5	51.6-58.6	55.8	49.8	62.2	78.2
	7-8 June 23	42.6-63.7	49.3-56.6	55.3	45.9	61.4	97.4
	8-9 June 23	41.3-66.8	47.2-65.9	60.7	48.2	68.5	75.1
	9-10 June 23	43.5-68.5	48.5-65.3	61.0	45.2	67.9	73.6
	10-11 June 23	44.5-64.2	48.6-66.5	60.7	51.3	69.8	74.0
	<b>Min -Max</b>	<b>41.3-68.5</b>	<b>47.2-66.5</b>	<b>55.3-61.0</b>	<b>45.2-51.3</b>	<b>61.4-69.8</b>	<b>73.6-97.4</b>
	2-3 Nov 23	43.7-61.5	54.5-62.7	57.7	49.7	66.0	81.2
	3-4 Nov 23	42.5-57.3	47.3-52.4	52.2	48.0	57.3	79.9
	4-5 Nov 23	41.5-56.0	46.9-52.0	50.4	47.1	56.1	74.7
	5-6 Nov 23	42.1-58.2	46.9-52.4	51.1	48.3	56.4	81.5
	6-7 Nov 23	42.5-55.7	46.7-52.2	49.9	46.9	56.1	75.5
	7-8 Nov 23	41.8-55.8	45.2-56.5	50.8	46.6	57.2	74.2
	8-9 Nov 23	42.4-55.1	46.6-55.9	51.5	46.2	58.9	79.4
	<b>Min -Max</b>	<b>41.5-61.5</b>	<b>45.2-62.7</b>	<b>49.9-57.7</b>	<b>46.2-49.7</b>	<b>56.1-66.0</b>	<b>74.2-81.5</b>
<b>National Standard Values <sup>1/</sup></b>	-	-	<b>70</b>	-	-	<b>115</b>	
<b>WHO/IFC Guidelines Values <sup>2/,3/</sup></b>	<b>55</b>	<b>45</b>	<b>70</b>	-	-	-	

**Standards :** <sup>1/</sup> The Notification of the National Environmental Board on National Ambient noise levels standards no. 15 (1997)

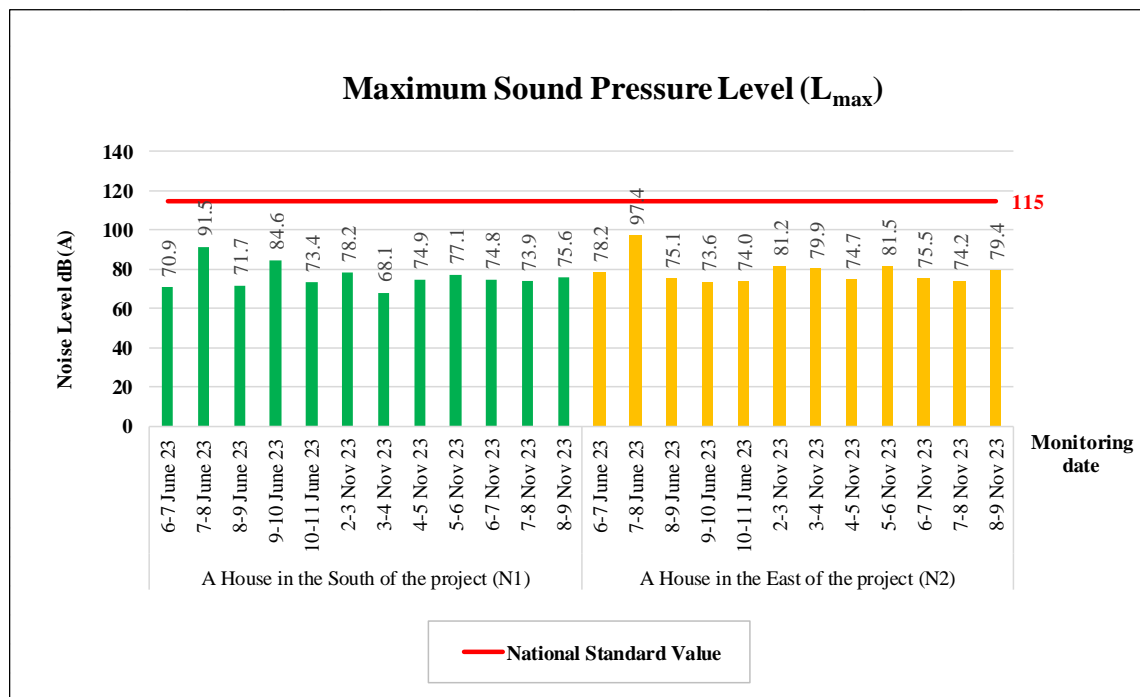
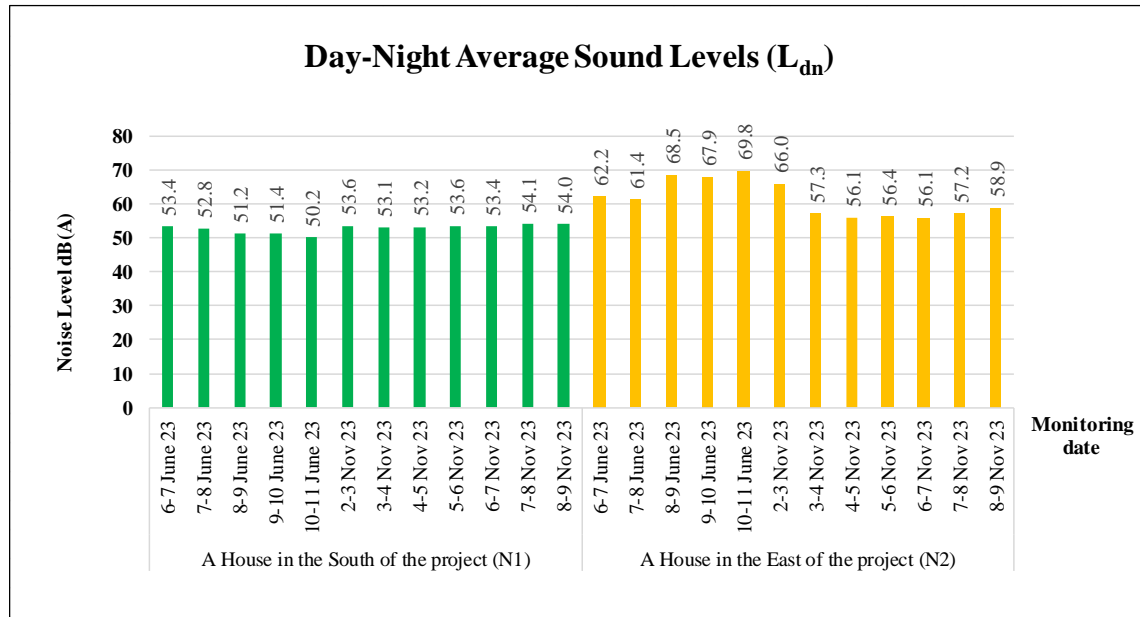
<sup>2/</sup> For acceptable indoor noise levels for residential, institutional, and educational settings refer to Guidelines for Community Noise, World Health Organization (WHO), 1999

<sup>3/</sup> Environmental, Health, and Safety (EHS) Guidelines, General EHS Guidelines: Environmental, Noise Management, IFC, 2007

**Source :** Analysis by ALS Laboratory Group (Thailand) Co., Ltd. during 6-11 June 2023 and Environment Research & Technology Co., Ltd. during 2-9 November 2023



**FIGURE 3.1-9 : GRAPH SHOWING THE RESULTS OF SOUND LEVEL MEASUREMENT**



**FIGURE 3.1-9 : GRAPH SHOWING THE RESULTS OF SOUND LEVEL MEASUREMENT (CONT'D)**

### 3.1.5 Hydrology and Water Quality

#### (1) Hydrology

Secondary data is collected from related reports and documents. i.e., information about canals, rivers and related water resources in the project area conducted by related agencies such as 1: 50,000 topographical map of the Royal Thai Survey Department and the Royal Irrigation Department, etc.

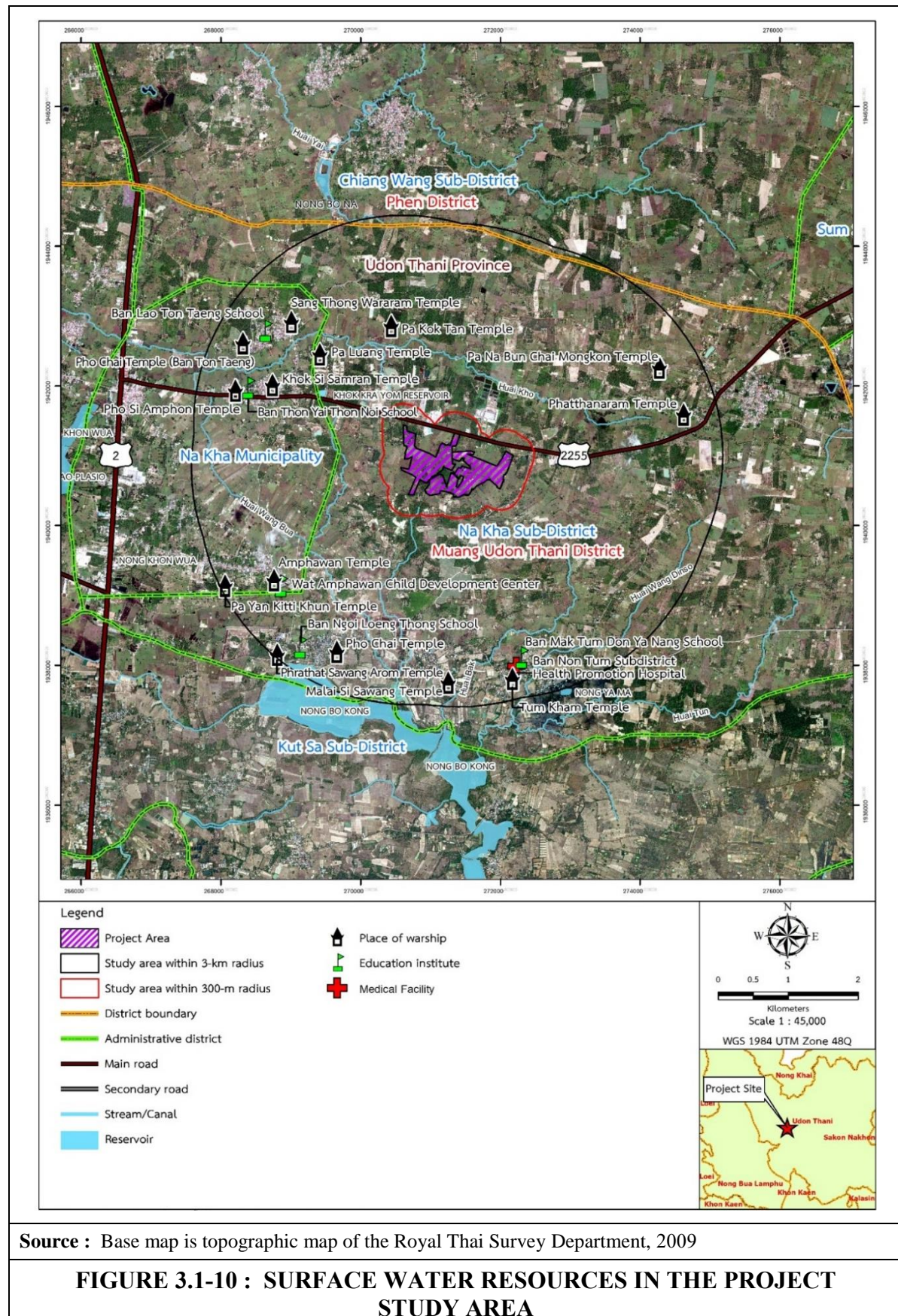
There are natural water sources in study area within 3-kilometer radius from the project boundary, i.e., Huai Kho, Huai Wang Suang, Huai Wang Bua, Huai Wang Dinso, and Huai Bak as shown in **Figure 3.1-10**. Moreover, there are three reservoirs, i.e., Khok Kra Yom reservoir, Nong Ya Ma reservoir, and Nong BoKong reservoir which serve as a water storage facility for the agricultural area. (**Figure 3.1-10**).

#### (2) Surface water quality

The water quality measurement was carried out in a public waterway located in the south of the project site which are considered to be the nearest surface water resources to the project site (about 50 meters from the Project boundary). These data were treated as database prior to project implementation. The surface water quality was measured at three monitoring stations including a public waterway located in the south of the project site (SW1), a public waterway at distance of 1 kilometer located in the south of the project site a (SW2), and a public waterway at distance of 2 kilometers located in the south of the project site (SW3) (the location of measurement stations is as presneted in **Figure 3.1-11**) once in rainy season on 12 June 2023. The measured parameters include flow rate, temperature, pH, suspended solids (SS), total dissolved solids (TDS), dissolved oxygen (DO), chemical oxygen demand (COD), biochemical oxygen demand (BOD<sub>5</sub>), total coliform bacteria (TCB), and fecal coliform (FCB). The results were compared to the Notification no.8 (1994) of the National Environmental Board on National standards for surface water quality Type 4 : water sources recieving effluent from certain human activities and be consumable after processed through normal disinfection and special processes to improve water quality and for industrial use. The measurement results are presented in **Table 3.1-8** and their detail is attached in **Appendix 3D**. Summary results of individual monitoring stations are as follows.

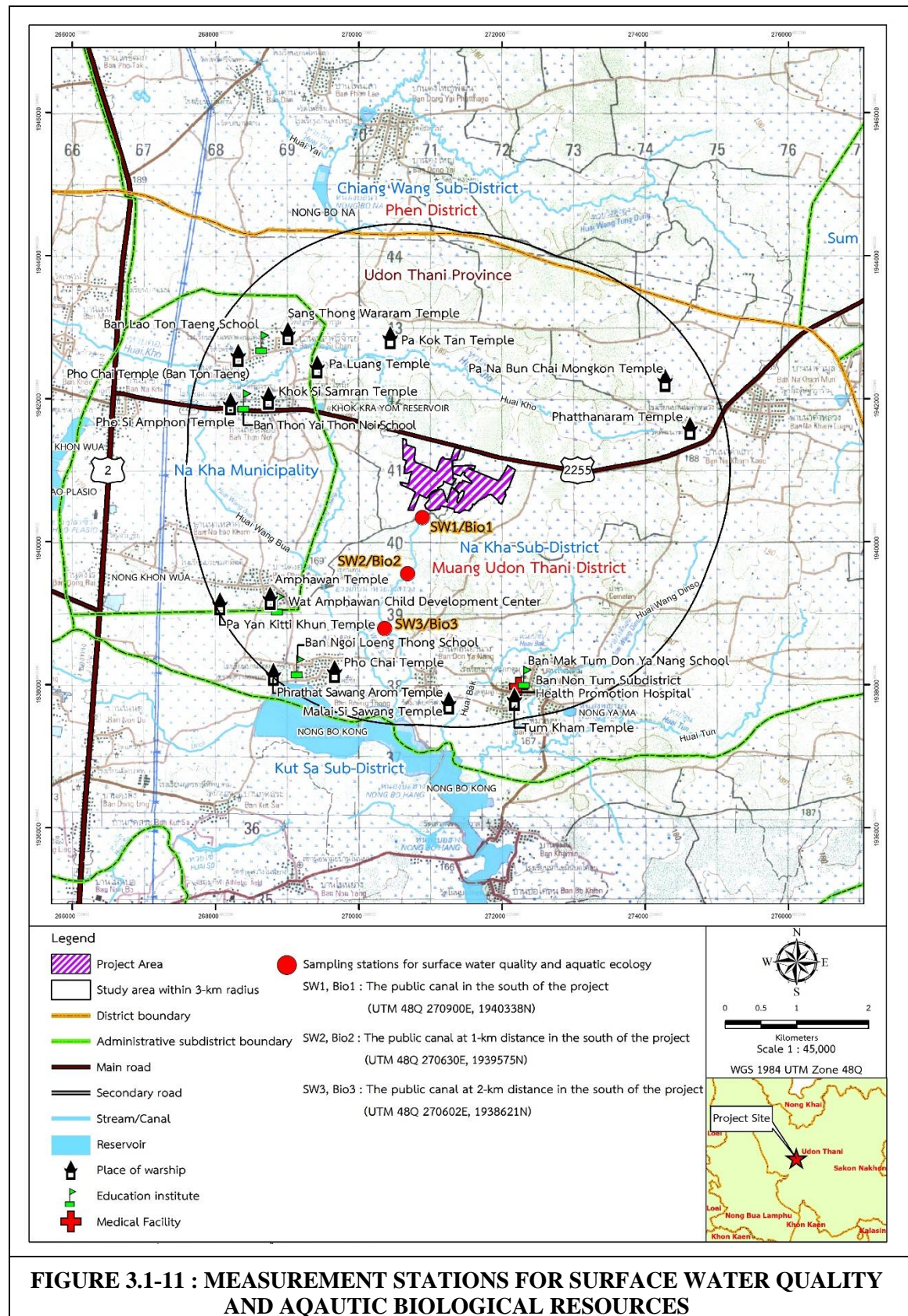
##### (a) A public Waterway Located in the East of the Project Site (SW1)

- Physical water quality: water in Huai Muang stream at SW1 is still water with a temperature of 28.6 °C. The concentration of suspended solids in the water is 21 mg/l.
- Chemical water quality: the water has pH of 6.9, total dissolved solids (TDS) of 16 mg/l, dissolved oxygen (DO) of 5.3 mg/l, COD of 34 mg/l, BOD of 4.0 mg/l.
- Biological water quality: the water has total coliform bacteria (TCB) of 240 MPN/100 ml and fecal coliform bacteria (FCB) of 13 MPN/100 ml.



Source : Base map is topographic map of the Royal Thai Survey Department, 2009

**FIGURE 3.1-10 : SURFACE WATER RESOURCES IN THE PROJECT STUDY AREA**



**FIGURE 3.1-11 : MEASUREMENT STATIONS FOR SURFACE WATER QUALITY AND AQUATIC BIOLOGICAL RESOURCES**

**TABLE 3.1-8  
RESULTS OF SURFACE WATER QUALITY MEASUREMENT IN THE AREAS ADJACENT TO THE PROJECT SITE**

No.	Parameters	Unit	Analysis Results			Standards <sup>1/</sup>
			Public Waterway at the South of the Project Site (SW1)	Public Waterway at a Distance of 1 km. at the South of the Project Site (SW2)	Public Waterway at a Distance of 2 km. at the South of the Project Site (SW3)	
1.	Flow rate**	m <sup>3</sup> /hr	-	-	-	-
2.	Temperature	°C	28.6	29.1	31.1	2/
3.	pH	-	6.9	6.8	7.4	5.0-9.0
4.	Suspended solids (SS)	mg/L	21.0	60.0	43.0	-
5.	Total dissolved solids (TDS)	mg/L	16.0	488.0	884.0	-
6.	Dissolved oxygen (DO)	mg/L	5.3	3.4	3.2	≥2.0
7.	COD	mg/L	34.0	97.0	67.0	-
8.	BOD	mg/L	4.0	16.0	6.9	≤4.0
9.	Total coliform bacteria (TCB)	MPN/100 ml	240.0	790.0	240.0	-
10.	Fecal coliform bacteria (FCB)	MPN/100 ml	13.0	130.0	13.0	-

**Remarks :** <sup>1/</sup> The Notification no. 8 (1994) of the National Environmental Board in accordance with the Enhancement and Conservation of the National Environmental Quality Act B.E. 2535 (1992) on National standards for surface water quality Type 4: water sources receiving effluent from certain human activities and be consumable after processed through normal disinfection and special processes to improve water quality and for industrial use

<sup>2/</sup> No greater than 3 degree Celcius over an ambient temperature

\* Exceed Type 4 water quality

\*\* Water characteristic is still water and has water only in a rainy season. It is unable to measure water flow rate.

**Source :** Fourtier Consultants Co., Ltd., 2023



**(b) A Public Waterway at a Distance of 1 Kilometer Located in the South of the Project Site (SW2)**

- Physical water quality: water in Huai Muang stream at SW1 is still water with a temperature of 29.1 °C. The concentration of suspended solids in the water is 60 mg/l.
- Chemical water quality: the water has pH of 6.8, total dissolved solids (TDS) of 488 mg/l, dissolved oxygen (DO) of 3.4 mg/l, COD of 97 mg/l, BOD of 16 mg/l.
- Biological water quality: the water has total coliform bacteria (TCB) of 790 MPN/100 ml and fecal coliform bacteria (FCB) of 130 MPN/100 ml.

**(c) A Public Waterway at a Distance of 2 Kilometers Located in the South of the Project Site (SW3)**

- Physical water quality: water in Huai Muang stream at SW1 is still water with a temperature of 31.1 °C. The concentration of suspended solids in the water is 43 mg/l.
- Chemical water quality: the water has pH of 7.4, total dissolved solids (TDS) of 884 mg/l, dissolved oxygen (DO) of 3.2 mg/l, COD of 67 mg/l, BOD of 6.9 mg/l.
- Biological water quality: the water has total coliform bacteria (TCB) of 240 MPN/100 ml and fecal coliform bacteria (FCB) of 13 MPN/100 ml.

The results of surface water quality monitoring in a public waterway at SW1, SW2, and SW3 show that most monitoring parameters are within the standard value of surface water quality sources according to the Notification of the National Environment Board No. 8 (B.E. 2537), type 4–water sources receiving effluent from certain human activities and be consumable after processed through normal disinfection and special processes to improve water quality and for industrial use, except the BOD at all stations that exceeds the standard type 4. This is because these water sources are still water with small amount of water contained. Also, there was heavy rain many days prior to the sampling date and caused contamination of water from outside sources.

### 3.1.6 Topography

Secondary data on topography was collected from various sources, including work-related study reports and a topographic map from the Royal Thai Survey Department with a scale of 1:50,000. Additionally, a study of satellite imagery was conducted to assess the current land use of the area, its topographical features, and the distinctive characteristics of both the project site and its surrounding area.

The general topography of Udon Thani province consists of high plains. Towards the west, there are mountains and contiguous forests, extending in a long stretch along the province's border and descending towards the south. On the eastern side, the terrain gradually slopes down from the high plateau, leading to lower plains in the northeastern part of the province. Multiple waterways converge and flow through this region, eventually joining the Mekong River. This geographical setting makes the area suitable for general cultivation.

The project area is situated in Na Kha Subdistrict, Mueang Udon Thani District, Udon Thani Province with the elevation of 176.11-188.73 meters MSL. The prevailing topography in the vicinity of the project area encompasses vast plains, gently rolling landscapes, uplands, and paddy fields.

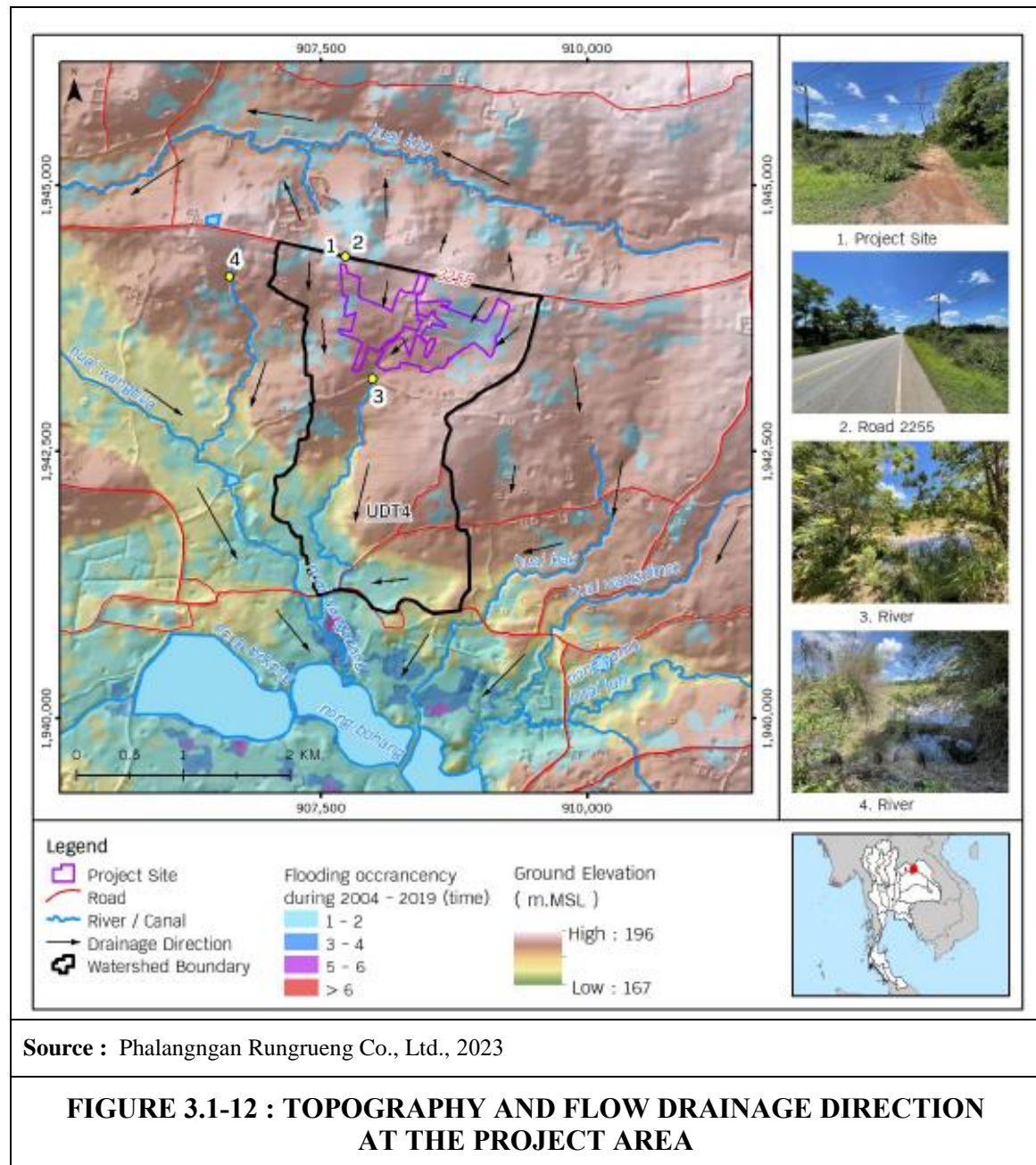
### 3.1.7 Flood Risk

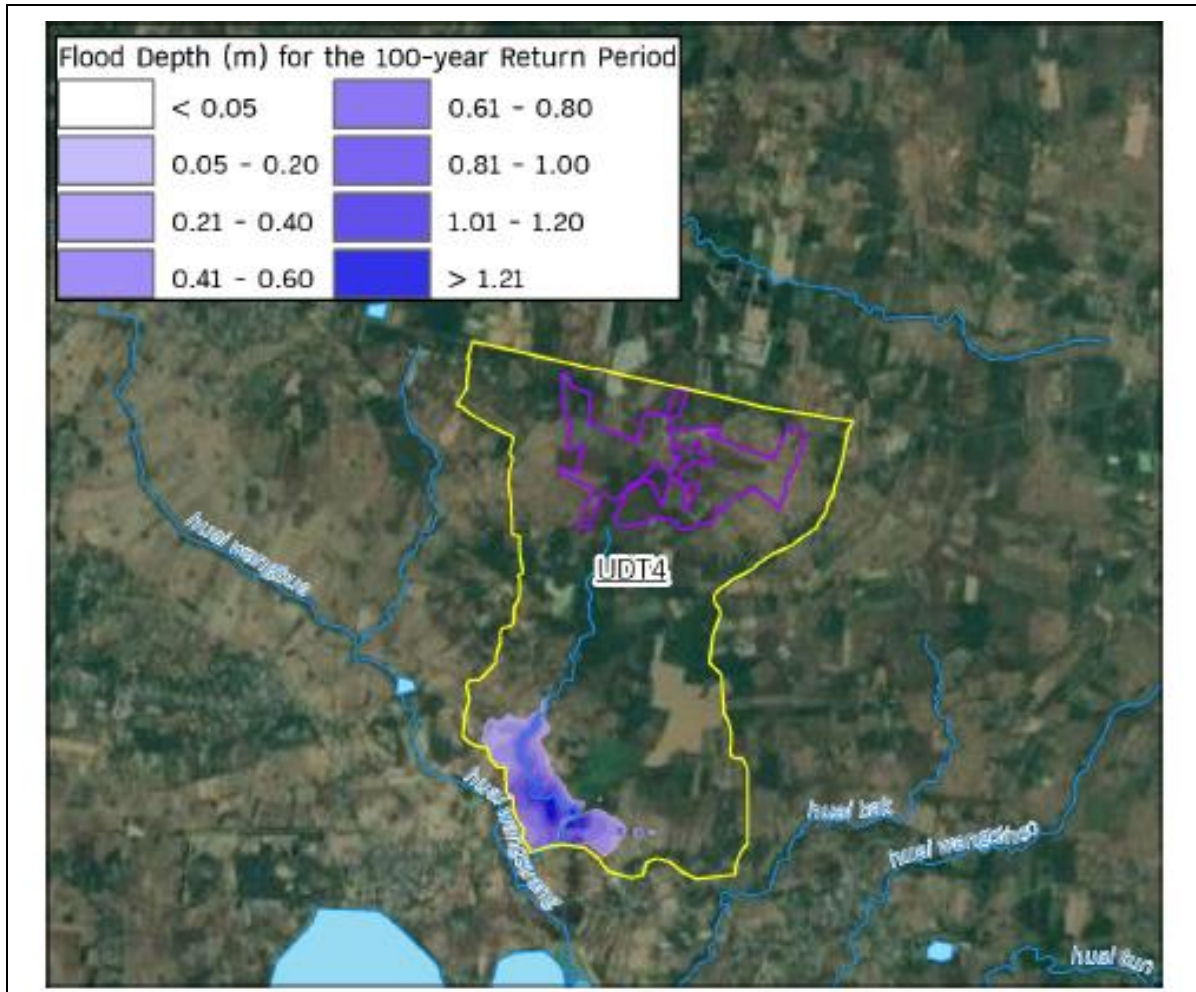
According to the preliminary flood risk analysis report of Phalangngan Rungrueang Co., Ltd. (August, 2023), the project area is near Road 2255, with a road level of approximately +194.00 m.MSL and elevations ranging from +176.11 to +188.73 m.MSL. The slope of the area draining water via the project is downward from north to south (**Figure 3.1-12**), with ground elevations ranging from approximately +167.50 m.MSL to +190.50 m.MSL.

Flooding in the study area is primarily caused by overland flow from the upstream area, which slopes downward to the project site. As a result, all rainfall runoff will pass through the project area and into the Huai Wangsuang. According to GISTDA (Geo-Informatics and Space Technology Development Agency) data, the project area has been flooded 1-2 times in the last 15 years. Furthermore, a flood risk assessment for a project area using various hydrological and hydraulic calculations. Elevation-volume curves, derived from topographic data, assessed flood elevation. The findings indicate that the project area has a low flood risk, as its average elevation (+182.40 m MSL) is significantly higher than the maximum water level (+169.29 m MSL) projected for the 100-year return period. (**Figure 3.1-13**)

### 3.1.8 Solar Radiation

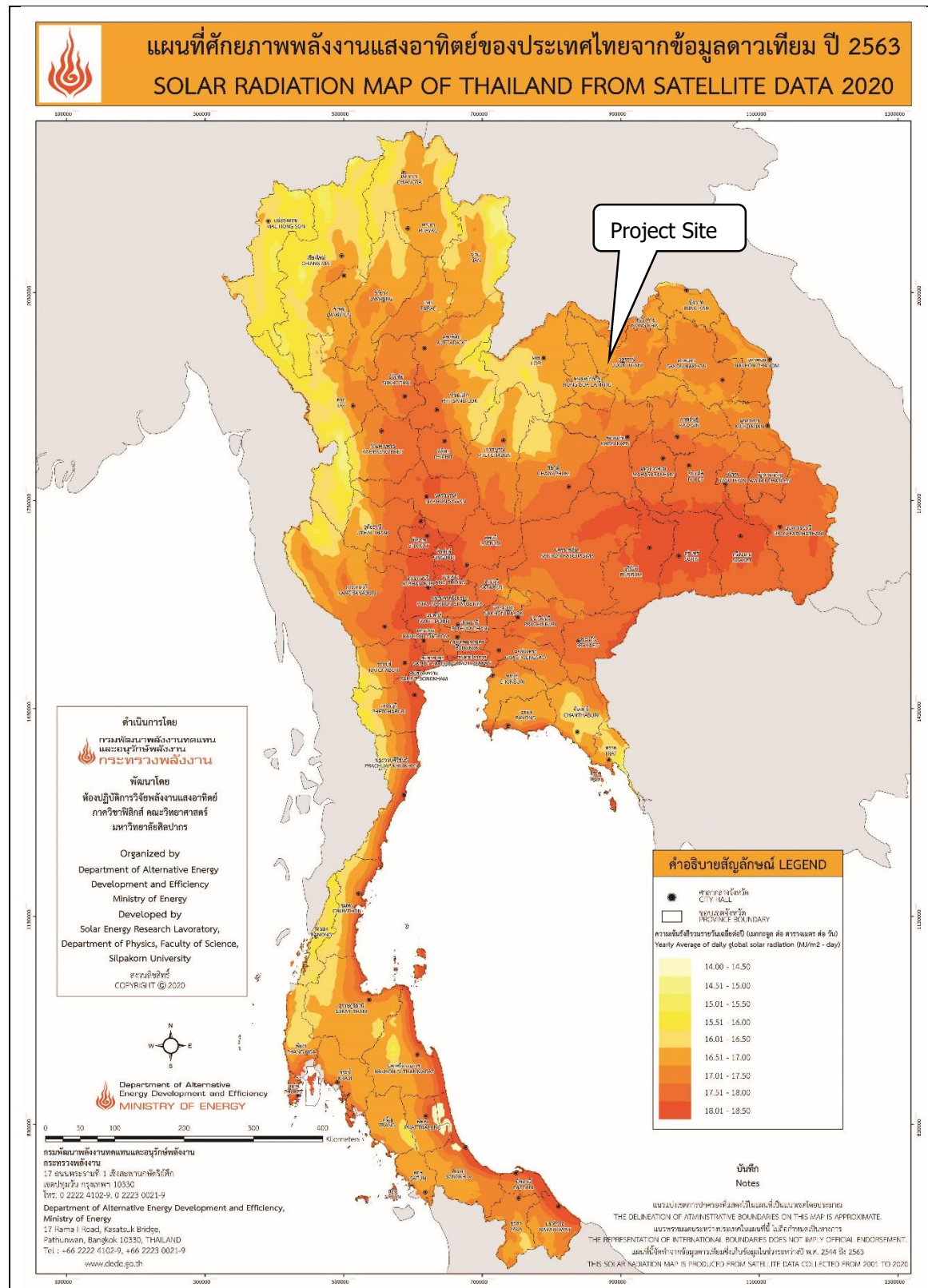
Based on a solar radiation map of Thailand from satellite data (2020), the distribution of solar radiation per year shows that the areas with the highest solar radiation are in the central and northeastern regions (**Figure 3.1-14**). When averaging the daily solar radiation intensity per year for Na Kha sub-district, Mueang Udon Thani district, Udon Thani province it is found is about 17.54 MJ/square meter-day. Therefore, these areas have the potential to generate electricity from solar energy.





Source : Phalangngan Rungrueng Co., Ltd., 2023

**FIGURE 3.1-13 : EVALUATED FLOOD RISK MAP FOR THE 100-YEAR RETURN PERIOD**



Source : Thailand Alternative Energy Situation, 2020

**FIGURE 3.1-14 : THE SOLAR RADIATION MAP OF THAILAND FROM SATELLITE DATA**

## 3.2 BIOLOGICAL CONDITIONS

### 3.2.1 Terrestrial Ecology

#### 3.2.1.1 Forest Resources

##### (1) Secondary Data Collection

The secondary data on forest resources from the summary information of Udon Thani Province, Office of Udon Thani Provincial (<https://anyflip.com/nbtvd/raab/>) and Royal Forest Department shows that Udon Thani Province, with an area of approximately 11,730 square kilometers, has total forest resources of approximately 4,653.96 square kilometers. The forest resources of Udon Thani Province are 21 national reserved forests, as shown in **Table 3.2-1**.

Within the study area of the project, Tambon Chiang Wang Forest, Tambon Phen Forest and Tambon Sum Sao Forest was found approximately 1 kilometer from the project area to the north of the project (as shown in **Figure 3.2-1**). However, the forest reserve area located within the aforementioned study area is located in Zone E, which the Cabinet has resolved that land within the degraded national forest reserve and degraded permanent forest areas with squatters occupying them (except for conservation forest areas under the law or Cabinet resolution) be transferred to the Royal Forest Department to be allocated to the Agricultural Land Reform Office (ALRO), its current land use is agricultural land and deserted areas as shown in **Figure 3.4-1**.

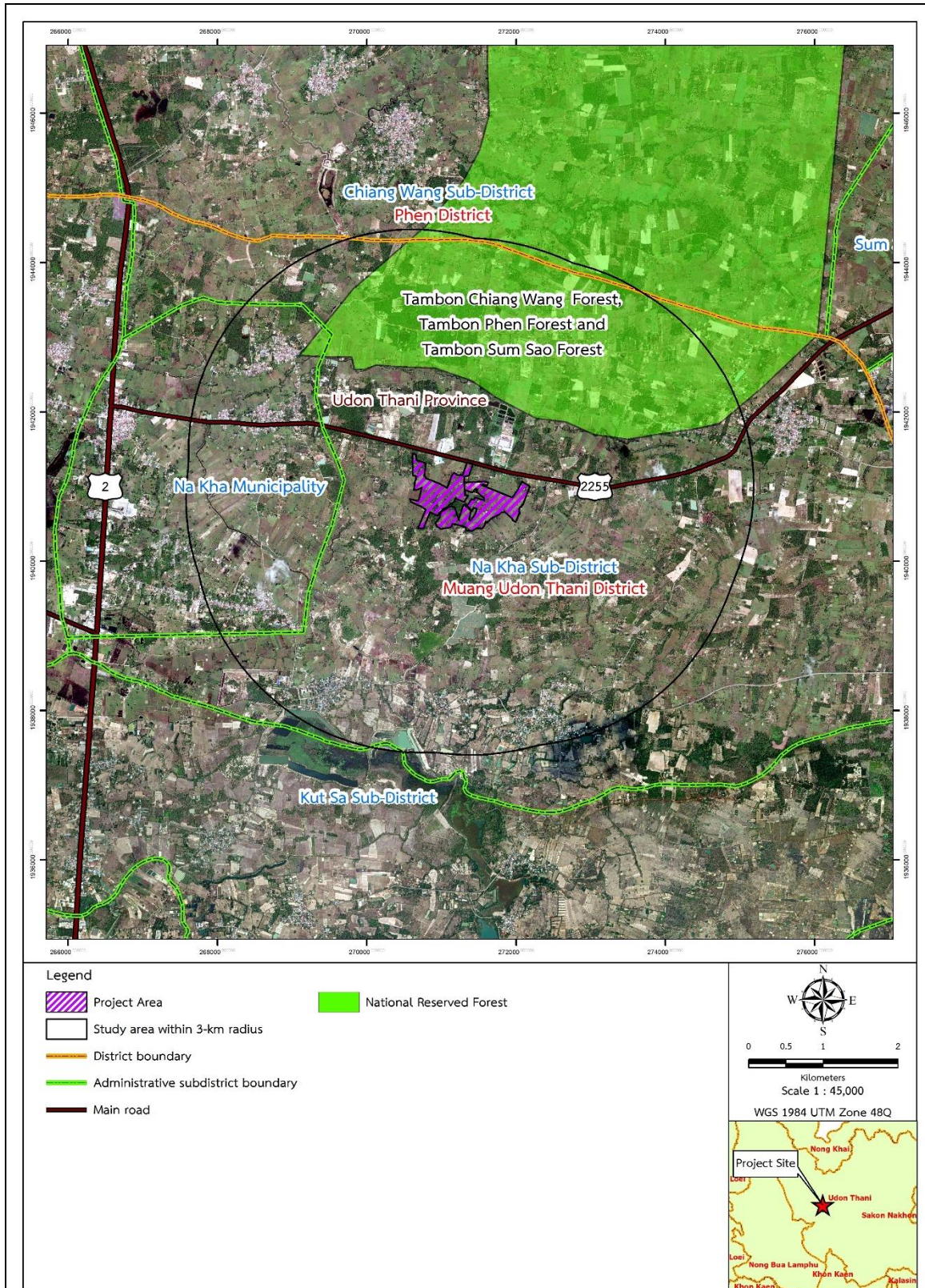
**TABLE 3.2-1  
NATIONAL RESERVED FOREST OF UDON THANI PROVINCE**

No.	Name of forest	District	Subdistrict	Area (square kilometers)
1	Kut Chap Forest	Ban Phue / Mueang Udon Thani	Khuea Nam / Ban Mek / Kut Chap / Mak Ya	310.09
2	Khuea Nam Forest	Ban Phue	Klang Yai / Hai Sok / Mueang Phan / Khuea Nam / Champa Mong / Kham Bong	266.00
3	Khok Thap Than Forest and Khok Wang Duean Ha Forest	Phen	Sum Sao / Ban Lao	127.00
4	Khok Nam Khem Forest and Khok Don Pho	Phen	Sang Khom / Phen	174.00
5	Dong Nong Khun Forest and Dong Nong Hai Forest	Mueang Udon Thani / Nong Wua So	Nikhom Songkhro / Ban Tat / Mak Ya	33.04

**TABLE 3.2-1  
NATIONAL RESERVED FOREST OF UDON THANI PROVINCE (CONT'D)**

No.	Name of forest	District	Subdistrict	Area (square kilometers)
6	Tambon Chiang Wang Forest, Tambon Phen Forest and Tambon Sum Sao Forest	Phen	Chiang Wang / Phen / Sum Sao	92.93
7	Thom Forest and Kha Forest	Non Sa-at / Kumphawapi	Thom Na Ngam / Si O	109.00
8	Na Yung Forest and Nam Som Forest	Nam Som	Na Khae / Na Yung / Nong Waeng / Nam Som / Na Ngua	1,102.00
9	Hua Na Kham Forest, Ba Yao Forest, Nong Kung Thap Ma Forest and Nong Ya Kai Forest	Si That / Kumphawapi	Ba Yao / Hua Na Kham / Na Yung	713.81
10	Ban Chan Forest No.1	Ban Dung	Na Mai	15.50
11	Ban Chan Forest No.2	Ban Dung	Thon Na Lap / Ban Chan / Na Mai / Ban Dung / Wang Thong	158.50
12	Ban Chit Forest, Chai Wan Forest, Nong Lak, and Khon Sai Forest	Chai Wan / Nong Han	Khon Sai / Ban Chit / Nong Lak / Phon Sung / Chai Wan	334.30
13	Ban Dung Forest, and Dong Yen No.1 and No.2	Ban Dung	Wang Thong / Ban Muang / Phon Sung / Om Ko	63.20
14	Pa Kho Forest, Pho Si Samran Forest and Saeng Sawang Forest	Nong Saeng / Kumphawapi / Non Sa-at	Saeng Sawang / Pa Kho / Huai Koeng / Pho Si Samran / Non Sa-at	152.37
15	Pa Tai Forest and Khok Mai Ngam Forest	Nong Han / Thung Fon	Ban Daeng / Sabaeng / Soi Phrao / Thung Yai	142.34
16	Phan Don Forest and Pa Kho Forest	Kumphawapi	Soephloe / Pa Kho / Phan Don / Pho Si Samran	307.77
17	Pho Si Samran Forest	Kumphawapi	Pho Si Samran / Non Sa-at / Bung Kaeo	139.82
18	Wiang Kham Forest and Si That Forest	Kumphawapi / Si That	Wiang Kham / Hua Na Kham / Si That / Ban Prong / Champi	184.48
19	Nong Bu Forest and Nong Han Forest	Mueang Udon Thani / Nong Han	Nong Han / Phon Ngam	25.81
20	Nong Ya Sai Forest, Tha Lad Forest, Wang Chai Forest and Lam Pao	Wang Sam Mo	Nong Ya Sai	19.00
21	Mak Ya Forest	Nong Wua So	Mak Ya / Up Mung	215.00

Source : Roya Forest Department, 2023



Source : Forest Land Management Office, Royal Forest Department, 2023

**FIGURE 3.2-1 : FOREST AREA IN UDON THANI PROVINCE**



## (2) Field Survey

The forest resources in the study area or Ecologically Appropriate Area of Assessment (EAAA) (project footprint and its proximity within a 3-kilometer radius from the project footprint boundary) were surveyed during 6-8 November 2023. The survey focus on the abundance of forest. However, the survey was not conducted at the transmission line as a part of transmission line about 3.4 km. out of 8.7 km. will be situated in a 3-km radius from the project footprint boundary or within EAAA, and the remaining will be laid in the right-of-way along the public roads where the most of land use are communities and buildings.

### (2.1) Study Procedure

1) Collect the land use information in the year 2022. Categorize the land use types by visual translation from the drone and update the information to indicate the study areas of ecology and forest resources.

2) Survey the area for topography, plant communities and current characteristics of the land use of the project area. Information from the geographic information system, such as Google Earth, will be employed to plan the field survey and data collection.

3) Survey the varieties of plant in the study area. Emphasis is made on the types of trees with the chest-level height of 1.30 m. and diameter of more than 4.5 cm.

4) Survey the varieties of plant in the project footprint. Emphasis is made on the types, quantity, diameter, height and position of trees with the chest-level height of 1.30 m. and diameter of more than 4.5 cm.

5) Data analysis

5.1) Analyze the types of trees, for example, common name, scientific name, family name, and habit.

5.2) Analyze the carbon sequestration of the perennial plant in the project area

5.2.1) Calculate the volume of above ground biomass of the perennial plant with Ogawa et al. (1965)'s Allometric Equation, as follows:

$$W_S = 0.0396 (D^2H)^{0.933}$$

$$W_B = 0.00349(D^2H)^{1.027}$$

$$W_L = (28.0/W_S + W_B + 0.025)^{-1}$$

$$W_T = W_S + W_B + W_L$$

when  $W_S$  is the biomass of the trunk (kilogram)

$W_B$  is the biomass of the branch (kilogram)

$W_L$  is the biomass of the leave (kilogram)

$W_T$  is all the above ground biomass (kilogram)

D is the chest-level diameter (centimeter)

H is the height (meter)

5.2.2) Calculate the below ground biomass of the perennial plant. The ratio of the dry weight of the root to the trunk is 27.0 (IPCC, 2006).

5.2.3) Calculate the average of carbon in the plant tissue. The ratio of carbon in the biomass of the perennial plant is 47.0 (IPCC, 2006).

5.2.4) Calculate the carbon sequestration of the perennial plant. Employing all the biomass, carbon in the biomass of the perennial plant and carbon dioxide and carbon, as follows:

$$\text{the carbon sequestration (kgCO}_2\text{eq)} = \text{biomass (kg)} \times 0.47 \times (44/12)$$

5.2.5) Analyze the environmental valuation or analysis of the carbon sequestration. The carbon sequestration is multiplied by the price of current carbon credit trading, according to Thailand Greenhouse Gas Management Organization (2023).

6) Status assessment will assess the trees' status, both the tree legal protection and tree preservation orders, with details as follows:

6.1) Tree legal protection is the tree that is protected by the forest act, B.E. 2562 (2019). It is categorized into 2 types as follows:

– Restricted wood type A. The wood business of this type must be authorized by the authorized person or concession according to the law. The wood is listed in the Restricted Wood declared under the Royal Decree, B.E. 2530 (1987) and the Restricted Wood declared under the Royal Decree, B.E. 2565 (2022).

– Restricted wood type B. This is specially restricted by the government or rare wood. The wood business is prohibited except for the special permit from the Minister of Agriculture and Cooperatives of Thailand. The wood is listed in the Restricted Wood declared under the Royal Decree, B.E. 2530 (1987).

6.2) The following Conservation status will be considered.

– Department of National Park, Wildlife and Plant Conservation (DPN) (2017) will be considered according to the status of threatened plants in Thailand. The status can be categorized into 8 types:

- (1) Rare: R (rare to find plants);
- (2) Critically endangered animal: CR (plants are critically endangered in the nature);
- (3) Endangered animal: EN (plants are riskily endangered in the nature);
- (4) Vulnerable animal: VU (plants are vulnerably endangered in the nature);
- (5) Near threatened animal: NT (plants are nearly threatened in the nature);
- (6) Least concern animal: LC (plants are generally found and not in the risk endanger);
- (7) Data deficient: DD (data is deficient to be in any status); and
- (8) Not listed

– The IUCN Red List of Threatened Species (2022-2) is categorized into 7 types:

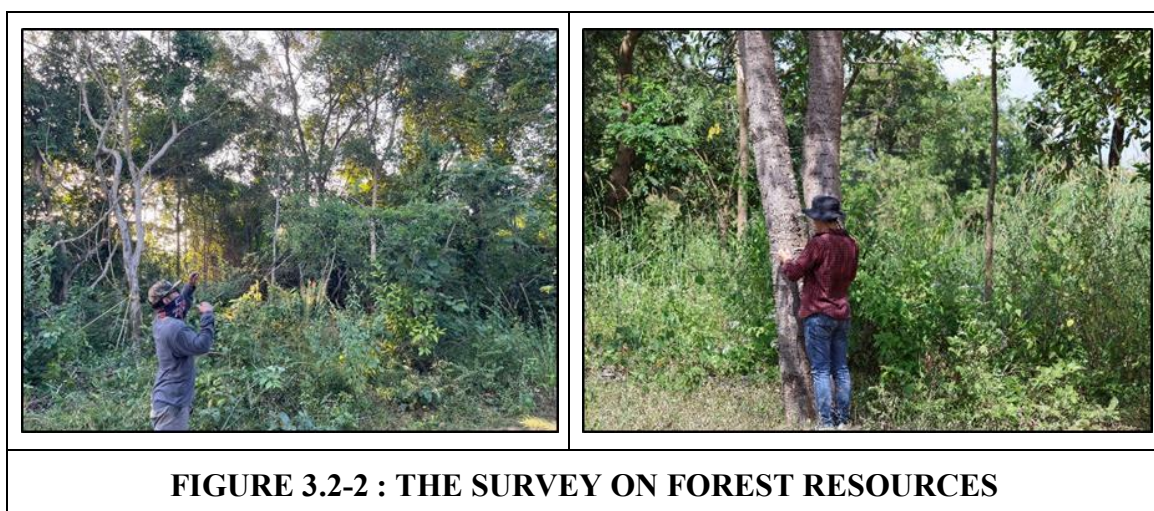
- (1) critically endangered animal: CR (plants are critically endangered in the nature);
- (2) endangered animal: EN (plants are riskily endangered in the nature);
- (3) vulnerable animal: VU (plants are vulnerably endangered in the nature);
- (4) near threatened animal: NT (plants are nearly threatened in the nature);
- (5) least concern animal: LC (plants are generally found and not in the risk endanger);
- (6) data deficient: DD (data is deficient to be in any status); and
- (7) not listed.







## (2.2) Survey Results

The study results of the forest resources in the study area (**Figure 3.2-2**) are as follows:

### 1) Land use in the study area

From the topographical, plant community, and the current land use survey in the study area (the project footprint and its proximity within a 3-kilometer radius from project footprint boundary), it is found that there is no forest area, afforestation or forestry plantations. The topographical is the plain with communities and agricultural area, such as rice paddy field, cassava, sugar cane, eucalyptus, field crops, horticultural crops, and livestock (cow and buffalo). The trees found in the study area are generally those grown by local communities, as listed in **Table 3.2-2** (with example photos in **Figure 3.2-3**).



	
Ka Sam Pik ( <i>Vitex peduncularis</i> )	Indian Walnut ( <i>Albizia lebeck</i> )
	
Burma padauk ( <i>Pterocarpus macrocarpus</i> )	Siamese senna ( <i>Cassia fistula</i> )
	
Gurjan ( <i>Dipterocarpus tuberculatus</i> )	Teng ( <i>Shorea obtuse</i> )
<b>FIGURE 3.2-3 : EXAMPLES OF PLANTS FOUND IN THE STUDY AREA</b>	

## 2) The Forest Ecosystem in the EAAA

- **Plant Diversity**

Based on the tree survey, there are 39 types of trees in the EAAA. They are as listed in **Table 3.2-2**.

- **The Plant Status**

From the survey of forest resources in the EAAA, there are 39 types of trees. With reference to the protected status by the forest act, B.E. 2562 (2019), there are 21 restricted wood type A (53.85%) and 18 types of plant that are not listed in the restricted wood (46.15%) (see **Table 3.2-2**). The restricted wood type B was not found.

According to the IUCN Red List of Threatened Species (2022-2), the three endangered plants (EN) were found, namely Burma padauk (*Pterocarpus macrocarpus*), Makha mong (*Azelia xylocarpa*), and Teak (*Tectona grandis*); one Vulnerable species (*Hopea odorata*); and four near threatened plants (NT), i.e, *Eucalyptus camaldulensis*, Teng (*Shorea obtusa*), Gurjan (*Dipterocarpus tuberculatus*), and Hairy Keruing (*Dipterocarpus obtusifolius*) as address in **Table 3.2-2**.

## 3) The Forest Ecosystem along the Transmission Line Route

The transmission lines for the project will be laid from the project to the cut and turn points of the existing 115-kV transmission lines to Udon Thani 1 substation and Ban Phue substation, following the public road right of way for a total distance of 8.7 kilometers. A land use inspection was undertaken along the transmission line route, but no tree species were surveyed. However, a 3.4-kilometer section of the transmission line would pass through EAAA, where a tree survey has previously been conducted. For the remaining approximately 5.3 kilometers, most of the land is utilized for buildings and communities, areas with bush and trees, as well as unused land, with a small portion being agricultural areas (rice, eucalyptus, and rubber plantations). The land use types in these locations are also present in the segments that pass through EAAA, therefore the types of trees along the transmission line route outside of EAAA are expected to be the same as those observed in the surveyed areas indicated above.

**TABLE 3.2-2**  
**LIST OF TREES FOUND IN THE STUDY AREA**

No.	Common Name	Family Name	Scientific Name	Habit	Status		No. of Tree			Total
					DNP (2017)	IUCN (2022-2)	Restricted Wood Type A	Restricted Wood Type B	Not Listed	
1	Wild almond	IRVINGIACEAE	<i>Irvingia malayana</i>	T	-	LC	1,182	-	-	1,182
2	Wild guava	LECYTHIDACEAE	<i>Careya arborea</i>	T	-	-	1,767	-	-	1,767
3	Ka sam pik	LAMIACEAE	<i>Vitex peduncularis</i>	T	-	LC	3	-	-	3
4	Siamese rough bush	MORACEAE	<i>Streblus asper</i>	T	-	LC	-	-	1	1
5	Siamese senna	FABACEAE	<i>Cassia siamea</i>	T	-	LC	-	-	4,124	4,124
6	Cowa	CLUSIACEAE	<i>Garcinia cowa</i>	ST	-	LC	590	-	-	590
7	Ngio pa	MALVACEAE	<i>Bombax anceps</i>	T	-	-	-	-	4	4
8	Ebony	EBENACEAE	<i>Diospyros rhodocalyx</i>	T	-	LC	2,356	-	-	2,356
9	Ceylon oak	SAPINDACEAE	<i>Schleichera oleosa</i>	T	-	LC	1,188	-	-	1,188
10	Teng	DIPTEROCARPACEAE	<i>Shorea obtusa</i>	T	-	NT	2,952	-	-	2,952
11	Burma padauk	FABACEAE	<i>Pterocarpus macrocarpus</i>	T	-	EN	3,554	-	-	3,554
12	Indian walnut	FABACEAE	<i>Albizia lebbek</i>	T	-	LC	2,360	-	-	2,360
13	Sacred fig tree	MORACEAE	<i>Ficus rumphii</i>	T	-	-	-	-	591	591
14	Hog plum	ANACARDIACEAE	<i>Spondias bipinnata</i>	T	-	-	-	-	1,179	1,179
15	Makha mong	FABACEAE	<i>Azalia xylocarpa</i>	T	-	EN	590	-	-	590
16	Siamese rosewood	FABACEAE	<i>Sindora siamensis</i>	T	-	LC	2,361	-	-	2,361
17	Kurchi	APOCYNACEAE	<i>Holarrhena pubescens</i>	T	-	LC	1,187	-	-	1,187
18	Hairy Keruing	DIPTEROCARPACEAE	<i>Dipterocarpus obtusifolius</i>	T	-	NT	2,954	-	-	2,954
19	Gurjan	DIPTEROCARPACEAE	<i>Dipterocarpus tuberculatus</i>	T	-	NT	3,543	-	-	3,543
20	Indian mulberry	RUBIACEAE	<i>Morinda coreia</i>	ST	-	-	-	-	5	5
21	Red zebra wood	ANACARDIACEAE	<i>Melanorrhoea usitata</i>	T	-	-	1,781	-	-	1,781
22	Siamese neem tree	MELIACEAE	<i>Azadirachta indica</i>	T	-	LC	4,720	-	-	4,720

**TABLE 3.2-2**  
**LIST OF TREES FOUND IN THE STUDY AREA (CONT'D)**

No.	Common Name	Family Name	Scientific Name	Habit	Status		No. of Tree			Total
					DNP (2017)	IUCN (2022-2)	Restricted Wood Type A	Restricted Wood Type B	Not Listed	
23	Copper pod	FABACEAE	<i>Peltophorum dasyrachis</i>	T	-	LC	4,130	-	-	4,130
24	Red paper bark tree	MYRTACEAE	<i>Syzygium antisepticum</i>	T	-	-	-	-	594	594
25	Ivory	APOCYNACEAE	<i>Wrightia arborea</i>	T	-	LC	2,944	-	-	2,944
26	Iron wood	DIPTEROCARPACEAE	<i>Hopea odorata</i>	T	-	VU	-	-	1,778	1,778
27	Brown Salwood	FABACEAE	<i>Acacia mangium</i>	T	-	LC	-	-	3,533	3,533
28	Jamba	FABACEAE	<i>Xylocarpus xylocarpa</i>	T	-	LC	1,766	-	-	1,766
29	Queen's flower	LYTHRACEAE	<i>Lagerstroemia speciosa</i>	T	-	LC	-	-	1,178	1,178
30	Eucalyptus species	MYRTACEAE	<i>Eucalyptus camaldulensis</i>	T	-	NT	-	-	2,944	2,944
31	Kra thum khok	RUBIACEAE	<i>Mitragyna hirsuta</i>	T	-	-	-	-	1,178	1,178
32	Velvet-leaved Aporosa	EUPHORBIACEAE	<i>Aporosa villosa</i>	T	-	LC	-	-	1,178	1,178
33	Devil tree	APOCYNACEAE	<i>Alstonia scholaris</i>	T	-	LC	2,355	-	-	2,355
34	Sasswood	FABACEAE	<i>Erythrophleum succirubrum</i>	T	-	-	-	-	1,178	1,178
35	Flambuoyant tree	FABACEAE	<i>Delonix regia</i>	T	-	LC	-	-	1,766	1,766
36	Bastard Teak	FABACEAE	<i>Butea monosperma</i>	T	-	LC	-	-	2,355	2,355
37	Golden shower	FABACEAE	<i>Cassia fistula</i>	T	-	LC	2,944	-	-	2,944
38	Teak	LAMIACEAE	<i>Tectona grandis</i>	T	-	EN	-	-	2,944	2,944
39	Thai crape myrtle	LYTHRACEAE	<i>Lagerstroemia floribunda</i>	T	-	-	-	-	2,355	2,355
<b>Total Number of Trees (unit)</b>							<b>47,227</b>	<b>-</b>	<b>28,885</b>	<b>76,112</b>
<b>Total Number of Plant Species (species)</b>							<b>21</b>	<b>-</b>	<b>18</b>	<b>39</b>

**Remarks:**

- Habit: T = Tree, S/T = Shrub/Tree, ST = Shrubby Tree, ExT = Exotic Tree
- Status: the restricted wood according to the forest law are categorized into 2 types:
  - 1) Restricted wood type A: the wood business of this type must be authorized by the authorized person or concession according to the law.
  - 2) Restricted wood type B: this is specially restricted by the government or rare wood.
- DNP (2017) = plants listed in Threatened Plants in Thailand
- IUCN (2022) = plants listed in IUCN Red List of Threatened Species. Version 2022-2

CR = critically endangered animal    EN = endangered animal    VU = vulnerable animal  
NT = near threatened animal    LC = least concern animal    - = no status

#### 4) Carbon Sequestration of Perennial Plants

There are 145 trees found in the project footprint. After the above and below ground biomass analysis with Allometric equations, it is found that the biomass of the trees is 42,277.68 kg; the biomass of the trunk is 27,162.04 kg, and the biomass of the branch is 6,117.24 kg, the biomass of the leaves is 10.23 kg, and the biomass of the roots is 8,988.17 kg (**Table 3.2-3**).

Carbon Sequestration from all the biomass, carbon in the biomass of the Perennial plants and carbon dioxide and carbon indicated that the Carbon Sequestration of the trees in the project area is 72.86 ton carbon dioxide.

**TABLE 3.2-3  
BIOMASS OF THE TREES IN THE PROJECT AREA**

Plant community	Biomass (kg)				
	Trunk (W <sub>s</sub> )	Branch (W <sub>B</sub> )	Leaves (W <sub>L</sub> )	Roots (W <sub>R</sub> )	Total
Trees in the project footprint	27,162.04	6,117.24	10.23	8,988.17	42,277.68

#### 5) The Tree Valuation

The environmental valuation is the calculation for carbon sequestration. The analysis is done by the carbon sequestration multiplied by the carbon credit trading of forest project (286.15 Baht/ton carbon dioxide). The Carbon Sequestration of the trees in the project is 72.86 ton carbon dioxide. The environmental valuation of the trees in the project is 20,848.47 Baht. (**Table 3.2-4**).

**TABLE 3.2-4  
THE ENVIRONMENTAL VALUATION FROM ASSESSMENT OF  
CARBON SEQUESTRATION**

Plant community	Carbon Sequestration (ton carbon dioxide)	Valuation (Baht)
Trees in the project area	72.86	20,848.47

**Remarks :** Refer to the trading price of carbon credit of the forest area, November 2023  
Thailand Greenhouse Gas Management Organization, ([www.carbonmarket.tgo.or.th](http://www.carbonmarket.tgo.or.th))



### 3.2.2 Wildlife Resources

#### (1) Secondary Data Collection

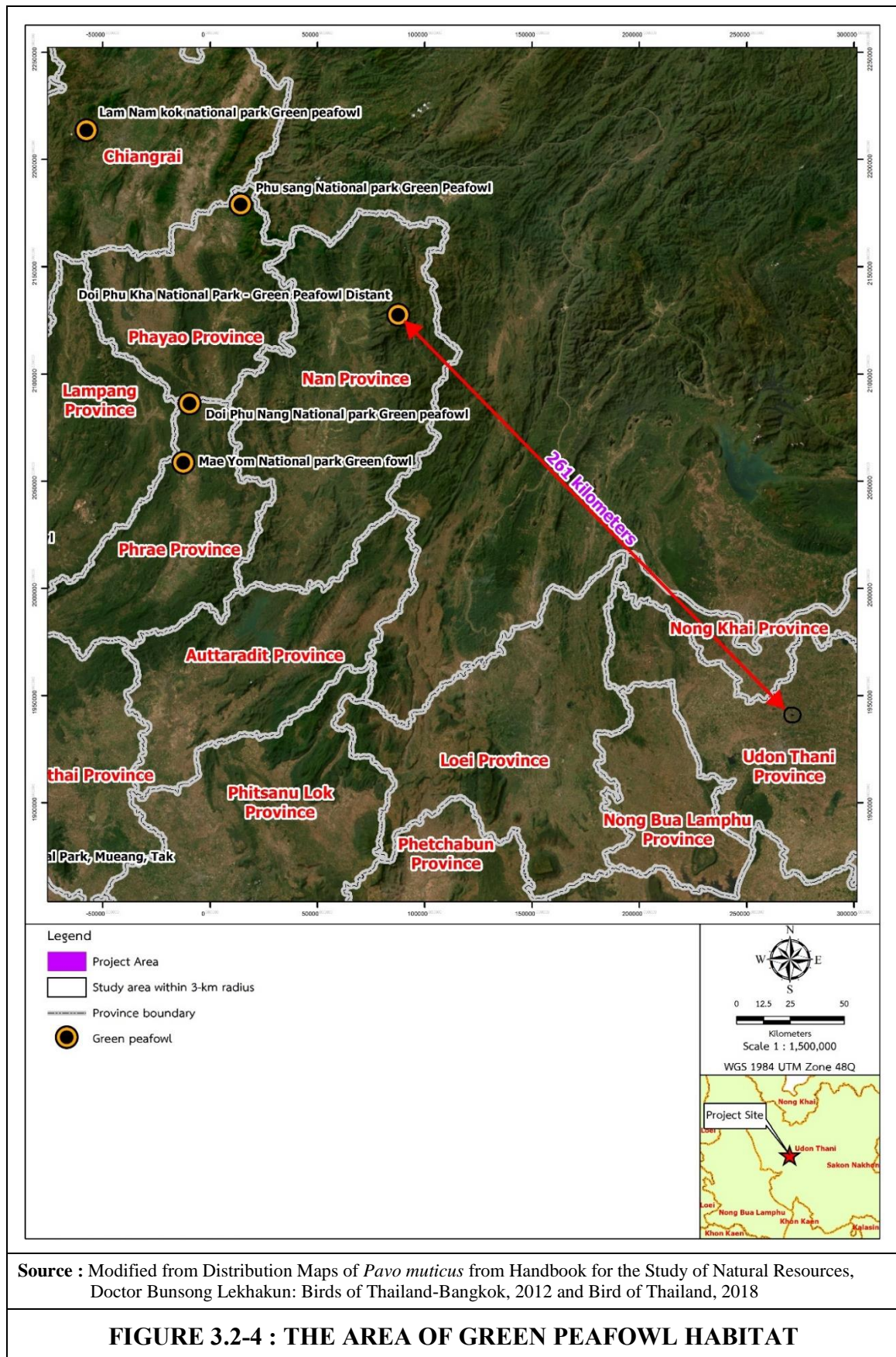
The Reserved Forest, Kut Chap Forest, is approximately 10 kilometers west of the project area for wildlife resources. which have been surveyed and found are as follows: *Macaca mulatta*, *Callosciurus erythraeus*, *Tupaia minor*, *Euroscaptor klossi*, *Galeopterus variegatus*, *Hylobates lar*, *Sus scrofa*, *Gallus gallus*, *Paradoxurus pholidota*, *Duttaphrynus melanostictus*, *Kaloula pulchra*, *Amyda cartilaginea*, *Varanus bengalensis*, *Bronchocela cristatella*, *Leiolepis reevesii*, *Eutropis multifasciata*, *Ranguna manii*, *Ardea alba*, etc.

In addition, according to the proximity report generated from IBAT there were an Green Peafowl (*Pavo muticus*) endangered species within 50 kilometers of the Project site,. Furthermore, based on the examination of habitat and sighting information in Thailand for Green Peafowl, the following data was found.

#### **Green Peafowl (*Pavo muticus*)**

The habitat of Green Peafowl in Thailand is mixed deciduous forest and secondary growth mainly along rivers, sometimes extending to cultivated areas. The population of Green Peafowl in Thailand appears to be stable or even increasing in some areas. In Jun District, Phayao Province, located in Northern Thailand, a combination of farmland and forest within and around the Wiang Lor wildlife sanctuary supports a significant and growing population of Green Peafowl. The population in this area is estimated to be several hundred birds, possibly reaching 1,000 or more. Local cultural beliefs and a community-based conservation project led by Phayao University may have contributed to their recovery in this region. At Huai Kha Khaeng Wildlife Sanctuary in western Thailand, encounter rates between 1992 and 2013-2015 showed an increase in numbers in most peripheral areas of the sanctuary, while numbers in the core area remained stable. Increased patrols to control hunting are believed to have facilitated this recovery (<https://datazone.birdlife.org/species/factsheet/green-peafowl-pavo-muticus/text> retrieved on 26 November 2023).

However, the distribution of Green Peafowl is limited to protected areas in the northern and western regions of Thailand. Specifically, they can be found in Mae Jarm National Park and Doi Phu Kha National Park in Nan Province (as presented in **Figure 3.2-4**) (Handbook for the Study of Natural Resources, Doctor Bunsong Lekhakun: Birds of Thailand-Bangkok (2012), and Bird of Thailand (2018)), which are over 200 kilometers away from the project area. Therefore, it can be inferred that the project area, study area, and transmission corridor of the project, which includes agricultural and community areas, are not suitable habitats for Green Peafowl.



## (2) Field Survey

The wildlife resources in the study area or Ecologically Appropriate Area of Assessment (EAAA) (project footprint and its proximity within a 3-kilometer radius from the project footprint boundary) were surveyed during 6-8 November 2023. However, the survey was not conducted at the transmission line as a part of transmission line about 3.4 km. out of 8.7 km. will be situated in a 3-km radius from the project footprint boundary, and the remaining will be laid in the right-of-way along the public roads where the most of land use are communities and buildings.

### (2.1) Study Procedure

1) Collect the diversities of wildlife in the study area (the project footprint and its proximity within a 3-km radius from the project footprint boundary). The 2 study techniques are described as follows:

1.1) The direct search is the field survey that requires walking survey to cover the ecosystem characteristics in the project footprint. The 3 survey stations (as shown **Figure 3.2-5**), indicated by the ecosystem of the wildlife, consist of (1) 8 stations within the project footprint, (2) the 4 areas at the border of the project footprint, and (3) the 4 areas within a 3-km radius from the project footprint boundary for wildlife searching or traces of wildlife, such as footprints, dung, carcass, hair, marks, hole and burrow, den, trap and noise of wildlife. The searching method of wildlife are as follows:

- Reptiles and mammals. The survey in all conditions of ecosystem is made by looking under the log, stone, and pile of leaves, tree hollow or look up the trees.
- Birds. Binoculars is the tools used to look for the birds in all conditions of ecosystem, especially the area where bird foods, such as ripe fruits, are grown, and water resources. The species of birds are indicated by listening to their sounds.
- Amphibians. The adult and tadpole will be found in the water resources. Tadpole will be easier to be found during the daytime.
- Bats. The survey in all conditions of ecosystem is made by harp trap and net, especially the area where bird foods, such as ripe fruits, are grown, and water resources.

The survey records the diversities of wildlife from the traces in the ecosystem. The photographic rate is also recorded in order to assess the level of relative abundance.

1.2) The indirect inquiry is to collect the information by asking the local residence near the project footprint. The indirect inquiry is done many times in various areas for the accurate and update results.

2) During the wildlife survey, an ecological assessment of the area was carried out, which included an examination of the territory to determine its potential as a wildlife habitat. The purpose of this evaluation was to better understand the relationship between the various types and patterns of wildlife exploitation in the area. The investigation looked at habitats, food sources, including plants used by wildlife, and both temporary and permanent water sources.

3) The wildlife classification and accuracy check need the reference documents as follows:

- Amphibians refers to the document of Piyawan et al. (2019), Tanya (2003), Weerayuth (2009), Biodiversity-Based Economy Development Office (2016), and Taylor (1962).

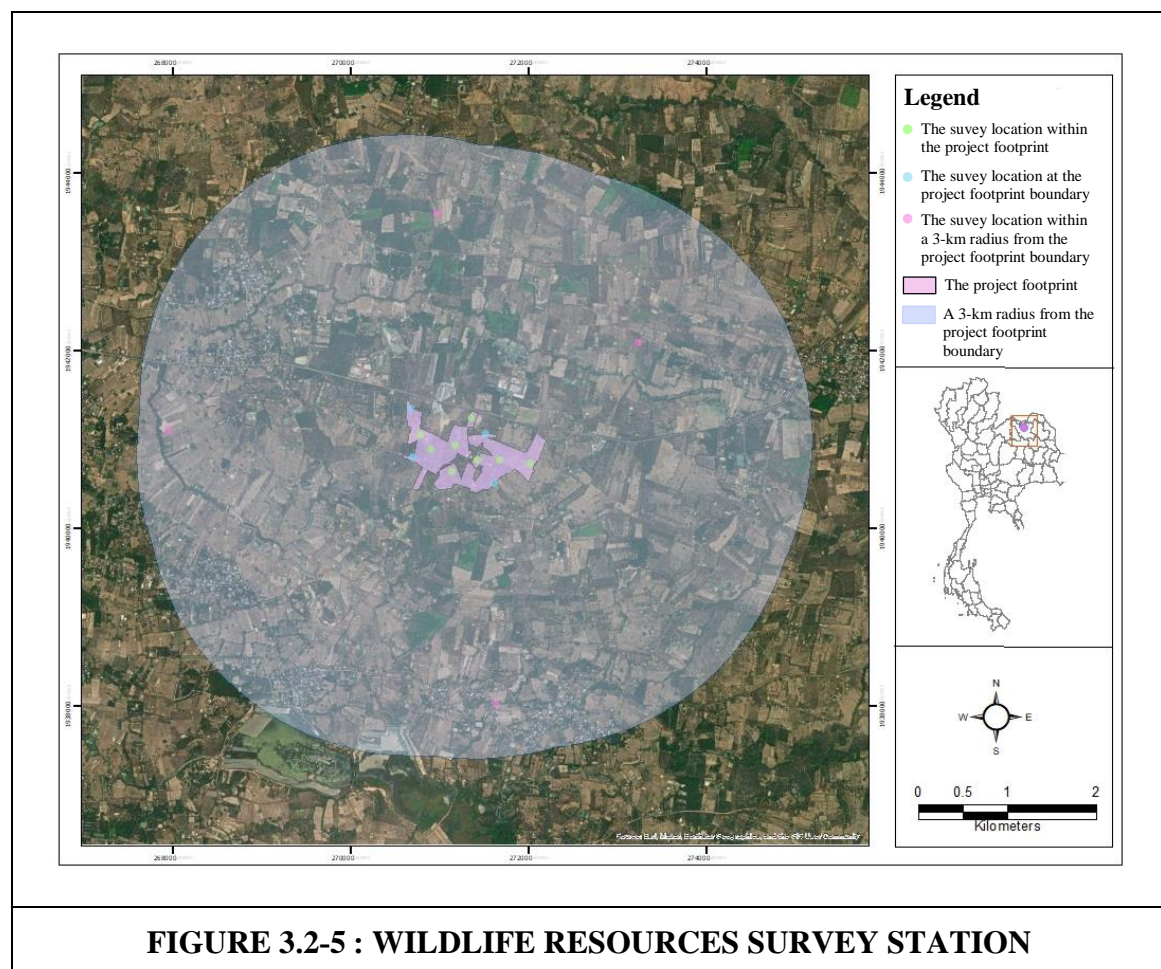
- Reptiles refers to the document of Biodiversity- Based Economy Development Office (2016), Weerayuth (2009), Chan-ard et al. (2015), Cox (1991), Cox et al. (1999), Das (2010, 2012), and Taylor (1963, 1965).

- Birds refers to the document of Treesucon and Limparungpatthanakij (2018), Jarujin et al. (2018), Chaiyan et al. (2008), Prasit (2008), Lekagul and Round (1991), and Robson (2002).

- Bats refers to the document of Prateep (2007), Pipat (2011).

- Mammals refers to the document of Francis (2001, 2008), and Lekagul and McNeely (1977).

4) Diversities of wildlife will be listed in groups of taxonomy. Amphibians and reptiles employs the study of Vitt and Caldwell (2009). The birds employs the study of Treesucon and Limparungpatthanakij (2018). The mammals and bats employs the study of Wilson and Reeder (2005). The list includes the wildlife information in the area, the relative abundance, and status of each type of wildlife.



5) The diversities of wildlife from the direct research and the inquiry will be listed the groups of taxonomy, and relative abundance. The assessment of relative abundance uses the frequency of encountering each wildlife to calculate, employing the study of Pettingill (1970).

$$\text{Percentage of relative abundance} = \frac{\text{Times of Encounter} \times 100}{\text{Times of survey}}$$

The 3 levels of relative abundance are as follows:

- abundant or common: the species of wildlife are quite common, with the relative abundance of 67-100%;
- common: the species of wildlife are common, with the relative abundance of 34-66%; and
- less common: the species of wildlife are not frequently found or the information comes from the inquiry, with the relative abundance of 1-33%.

6) Wildlife status is the assessment of status for legal protection and for reservation, with details as follows:

6.1) Legal protection status. Wildlife is protected by the Wild Animal Reservation and Protection Act, B.E.2562 (2019).

- Reserved wildlife animals are rare wild animal species which have to be reserved. The reserved wild animals are listed in the Wild Animal Reservation and Protection Act, B.E. 2562 (2019) (Thai government gazette, 2562 (2019)).
- Protected wildlife are wild animals that are important to the ecosystem. The decreasing protected animals can affect the ecosystem. They are listed in the Wild Animal Reservation and Protection Act, B.E. 2562 (2019) (Thai government gazette, B.E.2546 (2003)).

Other wildlife are non-protected animals. They are commercially raised, have a large population in the natural conditions or they can cause damage to the economic.

6.2) Reservation status by Natural Resources and Environmental Policy and Planning (2020) is considered by the threatened status and IUCN (2022-2) which is the international standard and worldly accepted. The threatened animals are categorized into 7 levels as follows:

- (1) Critically endangered animal: CR (animals are critically endangered in the nature);
- (2) Endangered animal: EN (animals are riskily endangered in the nature);
- (3) Vulnerable animal: VU (animals are vulnerably endangered in the nature);
- (4) Near threatened animal: NT (animals are nearly threatened in the nature);
- (5) Least concern animal: LC (animals are generally found and not in the risk endanger);
- (6) Data deficient: DD (data is deficient to be in any status); and
- (7) Not listed.

## (2.2) Study Results

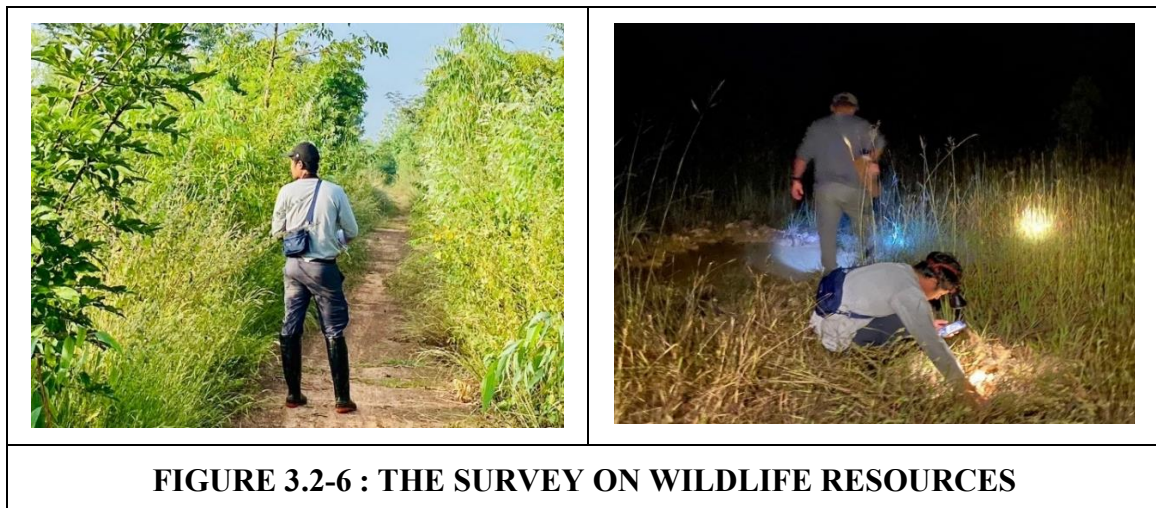
The study results of the wildlife resources in EAAA (**Figure 3.2-6**) are as follows:

### (2.2.1) Wildlife Species Found within the EAAA

#### 1) Numbers of Wildlife Species

According to the information of wildlife from the direct encounter and from the inquiry, there are 102 species of wildlife: 32 species in the project area and 102 species in the radius of 3 km from the project area (**Table 3.2-5**), with details as follows:

- Mammals: 11 species or 10.8% of a total found species
- Birds: 57 species or 55.9% of a total found species
- Reptiles: 21 species or 20.6% of a total found species
- Amphibians: 13 species or 12.7% of a total found species



**FIGURE 3.2-6 : THE SURVEY ON WILDLIFE RESOURCES**

**TABLE 3.2-5  
SPECIES OF WILDLIFE FOUND FROM THE SURVEY**

Wildlife group	Number of species		Number of wildlife	
	species	Percentage	In the project area	In a radius of 3 km of the project area
Mammals	11	10.8	3	11
Birds	57	55.9	18	57
Reptiles	21	20.6	5	21
Amphibians	13	12.7	6	13
<b>Total</b>	<b>102</b>	<b>100.0</b>	<b>32</b>	<b>102</b>

## 2) Diversities of Wildlife

The survey details of 4 groups and 102 species of wildlife with their diversities and ecological distribution are as follows:

**2.1) Mammal:** there are 11 species of mammals found in the survey area, as listed in the **Table 3.2-6**. Two species of order Chiroptera or the Insect-eating bats and the remaining 9 species fall under the Rodentia and Scandentia orders. These species possess sharp front teeth that are well-suited for both feeding and self-defense. Most of these mammals are relatively small in size.

**2.2) Birds:** a total of 57 bird species were found in the project area and within the 3-kilometer radius of the project boundary. There are 39 resident species and 18 migratory species (as listed in **Table 3.2-7**). The majority of these species are found in agricultural areas, fallow areas, community spaces, and near water supplies. Eight of the 18 migratory bird species migrate from the Northern Hemisphere, including Russia and China, with birds passing via Thailand on their way to other countries such as Malaysia, Indonesia, and Australia. The remainder are both resident and locally migratory species.

**2.3) Reptiles:** a total of 21 reptile species were found in the survey, as listed in **Table 3.2-8**. Two species belong to the Testudines order: Malayan snail-eating turtle (*Malayemys macrocephala*), and Asian softshell turtle (*Amyda cartilaginea*). The remaining 19 species fall under the Squamata order, which are covered in scales.

**2.4) Amphibian:** a total of 13 amphibian species were discovered during the survey, both in the study project area and within a 3-kilometer radius of the project boundary, as listed in **Table 3.2-9**. These amphibians belong to the Anura group, which includes frogs/toads (*Anura*) without tails. They rely on their skin for gas exchange and therefore require constantly moist skin. They inhabit water or areas with high humidity and are active during the night when temperatures decrease and humidity increases. Among the 13 species, some live on land, in flowing water, still water, or in paddy fields. Seven species primarily reside in or near bodies of water. The remaining six species live on land, in trees, or in humid areas and lay their eggs in water.

The example photos of the found species from the survey are presented in **Figure 3.2-7**.

**TABLE 3.2-6**  
**LIST OF MAMMAL FOUND IN THE SURVEY AREA**

Order/Family/Species	Abundance	Status			Area of occurrence	
		1	2	3	1	2
<b>Order Chiroptera</b>						
<b>Family Vespertilionidae</b>						
1. Lesser Asiatic yellow bat ( <i>Scotophilus kuhlii</i> )	Moderate	P	LC	LC	✓	✓
2. Lesser large-tooth bat ( <i>Myotis horsfieldii</i> )	Low	P	LC	LC	×	✓
<b>Order Rodentia</b>						
<b>Family Muridae</b>						
3. Asian house rat ( <i>Rattus tanezumi</i> )	Moderate	-	LC	LC	✓	✓
4. Lesser bandicoot rat ( <i>Bandicota savilei</i> ) *	Low	-	LC	LC	×	✓
5. Greater bandicoot rat ( <i>Bandicota indica</i> ) *	Low	-	LC	LC	×	✓
6. Polynesian rat ( <i>Rattus exulans</i> ) *	Moderate	-	LC	LC	✓	✓
7. Fawn-colored mouse ( <i>Mus cervicolor</i> )	Low	-	LC	LC	×	✓
8. Ricefield rat. ( <i>Rattus argentiventer</i> )	Low	-	LC	LC	✓	✓
<b>Family Sciuridae</b>						
9. Finleyson's squirrel ( <i>Callosciurus finlaysonii</i> )	High	-	LC	LC	×	✓
10. Indochinese ground squirrel ( <i>Menetes berdmorei</i> ) *	Low	-	LC	LC	×	✓
<b>Order Scandentia</b>						
<b>Family Tupaiidae</b>						
11. Northern treeshrew ( <i>Tupaia belangeri</i> ) *	Low	-	LC	LC	×	✓

**Remarks:** Areas of occurrence : 1 = project area      2 = a radius of 3 km of the project boundary  
 Status: 1 = the Wild Animal Reservation and Protection Act, B.E.(2019) 2562  
 - = not protected by law    P = protected wildlife    R = reserved wildlife  
 2 = Natural Resources and Environmental Policy and Planning (2020)  
 CR = critically endangered animal    EN = endangered animal  
 VU = vulnerable animal                NT = near threatened animal  
 LC = least concern animal            = - no status  
 3 = IUCN (2022-2)  
 CR = critically endangered animal    EN = endangered animal  
 VU = vulnerable animal                NT = near threatened animal  
 LC = least concern animal            = - no status  
 \* = from inquiry



**TABLE 3.2-7**  
**LIST OF BIRD FOUND IN THE SURVEY AREA**

Order/Family/Species	Abundance	Migration status		Status			Area of occurrence	
		Resident	Migration	1	2	3	1	2
<b>Order Passeriformes</b>								
<b>Family Aegithinidae</b>								
1. Common Iora ( <i>Aegithina tiphia</i> )	Moderate	✓	×	P	LC	LC	×	✓
<b>Family Artamidae</b>								
2. Ashy Woodswallow ( <i>Artamus fuscus</i> )	Moderate	✓	✓	P	LC	LC	×	✓
<b>Family Alaudidae</b>								
3. Indochinese Bushlark ( <i>Mirafra erythrocephala</i> )	Low	✓	×	P	LC	LC	×	✓
<b>Family Cisticolidae</b>								
4. Common Tailorbird ( <i>Orthotomus sutorius</i> )	Moderate	✓	×	P	LC	LC	×	✓
5. Yellow-bellied Prinia ( <i>Prinia flaviventris</i> )	Low	✓	×	P	LC	LC	✓	✓
6. Plain Prinia ( <i>Prinia inornata</i> )	Low	✓	×	P	LC	LC	✓	✓
<b>Family Corvidae</b>								
7. Thick-billed crow ( <i>Corvus macrorhynchos</i> )	Moderate	✓	×	P	LC	LC	×	✓
<b>Family Dicaeidae</b>								
8. Crimson Sunbird ( <i>Dicaeum cruentatum</i> )	Low	✓	×	P	LC	LC	×	✓
<b>Family Dicruridae</b>								
9. Black Drongo ( <i>Dicrurus macrocercus</i> )	High	✓	✓	P	LC	LC	✓	✓
<b>Family Estrildidae</b>								
10. Scaly-breasted Munia ( <i>Lonchura punctulata</i> )	High	✓	×	P	LC	LC	✓	✓
11. Red Avadavat ( <i>Amandava amandava</i> )	Low	✓	×	P	LC	LC	✓	✓
<b>Family Hirundinidae</b>								
12. Barn Swallow ( <i>Hirundo rustica</i> )	Moderate	×	✓	P	LC	LC	✓	✓
<b>Family Laniidae</b>								
13. Brown Shrike ( <i>Lanius cristatus</i> )	Low	×	✓	P	LC	LC	✓	✓
14. Grey-backed shrike ( <i>Lanius tephronotus</i> )	Low	✓	✓	P	LC	LC	✓	✓
<b>Family Motacillidae</b>								
15. Paddyfield Pipit ( <i>Anthus rufulus</i> )	Moderate	✓	×	P	LC	LC	✓	✓
16. White Wagtail ( <i>Motacilla alba</i> )	Low	×	✓	-	LC	LC	×	✓

**TABLE 3.2-7**  
**LIST OF BIRD FOUND IN THE SURVEY AREA (CONT'D)**

Order/Family/Species	Abundance	Migration status		Status			Area of occurrence	
		Resident	Migration	1	2	3	1	2
<b>Family Muscicapidae</b>								
17. Stejneger's Stonechat ( <i>Saxicola stejnegeri</i> )	Low	×	✓	P	LC	LC	×	✓
<b>Family Nectariniidae</b>								
18. Olive-backed Sunbird ( <i>Cinnyris jugularis</i> )	High	✓	×	P	LC	LC	×	✓
<b>Family Passeridae</b>								
19. Eurasian Tree Sparrow ( <i>Passer montanus</i> )	High	✓	×	-	LC	LC	×	✓
20. Plain-backed Sparrow ( <i>Passer flaveolus</i> )	Moderate	✓	×	P	LC	LC	×	✓
21. House Sparrow ( <i>Passer domesticus</i> )	High	✓	×	P	LC	LC	×	✓
<b>Family Phylloscopidae</b>								
22. Dusky Warbler ( <i>Phylloscopus fuscatus</i> )	Low	×	✓	-	LC	LC	×	✓
<b>Family Pycnonotidae</b>								
23. Streak-eared Bulbul ( <i>Pycnonotus blanfordi</i> )	Moderate	✓	×	P	LC	LC	✓	✓
24. Yellow-vented Bulbul ( <i>Pycnonotus goiavier</i> )	Low	✓	×	P	LC	LC	×	✓
25. Sooty-headed Bulbul ( <i>Pycnonotus aurigaster</i> )	Moderate	✓	×	P	LC	LC	×	✓
26. Stripe-throated bulbul ( <i>Pycnonotus finlaysoni</i> )	Low	✓	×	P	LC	LC	✓	✓
<b>Family Rhipiduridae</b>								
27. Pied Fantail ( <i>Rhipidura javanica</i> )	High	✓	×	P	LC	LC	×	✓
<b>Family Sturnidae</b>								
28. Common Myna ( <i>Acridotheres tristis</i> )	High	✓	×	P	LC	LC	×	✓
29. White-vented Myna ( <i>Acridotheres grandis</i> )	High	✓	×	P	LC	LC	✓	✓
30. Black-collared Starling ( <i>Gracupica nigricollis</i> )	Low	✓	×	P	LC	LC	×	✓
<b>Order Columbiformes</b>								
<b>Family Columbidae</b>								
31. Red Collared Dove ( <i>Streptopelia tranquebarica</i> )	High	✓	✓	P	LC	LC	✓	✓
32. Eastern Spotted Dove ( <i>Spilopelia chinensis</i> )	High	✓	✓	-	LC	LC	✓	✓

**TABLE 3.2-7  
LIST OF BIRD FOUND IN THE SURVEY AREA (CONT'D)**

Order/Family/Species	Abundance	Migration status		Status			Area of occurrence	
		Resident	Migration	1	2	3	1	2
33. Zebra Dove ( <i>Geopelia striata</i> )	Moderate	✓	×	-	LC	LC	×	✓
34. Rock Pigeon ( <i>Columba livia</i> )	High	✓	×	-	LC	LC	✓	✓
<b>Order Coraciiformes</b>								
<b>Family Coraciidae</b>								
35. Indian Roller ( <i>Coracias benghalensis</i> )	Moderate	✓	×	P	LC	LC	✓	✓
<b>Family Meropidae</b>								
36. Asian Green Bee-eater ( <i>Melops orientalis</i> ) **	High	✓	×	P	LC	LC	✓	✓
<b>Family Muscicapidae</b>								
37. Red-throated Flycatcher ( <i>Ficedula albicilla</i> )	Low	×	✓	P	LC	LC	×	✓
38. Asian Brown Flycatcher ( <i>Muscicapa dauurica</i> )	Low	×	✓	P	LC	LC	×	✓
<b>Order Cuculiformes</b>								
<b>Family Cuculidae</b>								
39. Greater Couca ( <i>Centropus sinensis</i> )	High	✓	×	P	LC	LC	✓	✓
40. Chestnut-winged Cuckoo ( <i>Rhopodytes tristis</i> )	Low	✓	×	P	LC	LC	×	✓
41. Western Koel ( <i>Eudynamys scolopaceus</i> )	High	✓	✓	P	LC	LC	×	✓
<b>Order Piciformes</b>								
<b>Family Megalaimidae</b>								
42. Red-throated Barbet ( <i>Megalaima haemacephala</i> )	Low	✓	×	P	LC	LC	×	✓
43. Lineated Barbet ( <i>Megalaima lineata</i> )	Low	✓	×	P	LC	LC	×	✓
<b>Order Caprimulgiformes</b>								
<b>Family Apodidae</b>								
44. Asian Palm Swift ( <i>Cypsiurus balasiensis</i> )	Moderate	✓	×	P	LC	LC	✓	✓
<b>Order Ciconiiformes</b>								
<b>Family Ciconiidae</b>								
45. Asian Openbill ( <i>Anastomus oscitans</i> )	Moderate	✓	×	P	LC	LC	✓	✓
<b>Order Charadriiformes</b>								
<b>Family Charadriidae</b>								
46. Red-wattled Lapwing ( <i>Vanellus indicus</i> )	Moderate	✓	×	P	LC	LC	×	✓

**TABLE 3.2-7**  
**LIST OF BIRD FOUND IN THE SURVEY AREA (CONT'D)**

Order/Family/Species	Abundance	Migration status		Status			Area of occurrence	
		Resident	Migration	1	2	3	1	2
<b>Order Gruiformes</b>								
<b>Family Rallidae</b>								
47. White-breasted Waterhen ( <i>Amouronis phoenicurus</i> )	Moderate	✓	✓	P	LC	LC	×	✓
<b>Order Coraciiformes</b>								
<b>Family Alcedinidae</b>								
48. White-throated Kingfisher ( <i>Halcyon smyrnensis</i> )	Low	✓	×	P	LC	LC	✓	✓
49. Common Kingfisher ( <i>Alcedo atthis</i> )	Low	×	✓	P	LC	LC	×	✓
<b>Order Pelecaniformes</b>								
<b>Family Ardeidae</b>								
50. Chinese Pond-heron ( <i>Ardeola bacchus</i> )	High	✓	✓	P	LC	LC	✓	✓
51. Cattle Egret ( <i>Bubulcus ibis</i> )	High	✓	✓	P	LC	LC	✓	✓
52. Little Egret ( <i>Egretta garzetta</i> )	Moderate	✓	✓	P	LC	LC	×	✓
53. Great Egret ( <i>Ardea modesta</i> )	Low	✓	×	P	LC	LC	×	✓
<b>Order Suliformes</b>								
<b>Family Phalacrocoracidae</b>								
54. Little cormorant ( <i>Microcarbo niger</i> )	Moderate	✓	×	P	LC	LC	×	✓
<b>Order Strigiformes</b>								
<b>Family Strigidae</b>								
55. Collared Owlet ( <i>Glaucidium cuculoides</i> )	Low	✓	×	P	LC	LC	×	✓
<b>Order Accipitriformes</b>								
<b>Family Accipitridae</b>								
56. Brahminy Kite ( <i>Haliastur indus</i> )	Low	✓	×	P	LC	LC	×	✓
57. Shikra ( <i>Accipiter badius</i> )	Low	✓	✓	P	LC	LC	×	✓

**Remarks:** Areas of occurrence : 1 = project area      2 = a radius of 3 km of the project boundary  
 Status: 1 = the Wild Animal Reservation and Protection Act, B.E. 2562 (2019)  
 - = not protected by law    P = protected wildlife    R = reserved wildlife  
 2 = Natural Resources and Environmental Policy and Planning (2020)  
 CR = critically endangered animal    EN = endangered animal  
 VU = vulnerable animal                NT = near threatened animal  
 LC = least concern animal              - = no status  
 3 = IUCN (2022-2)  
 CR = critically endangered animal    EN = endangered animal  
 VU = vulnerable animal                NT = near threatened animal  
 LC = least concern animal              - = no status  
 \* = from inquiry  
 \*\* = source of identification is [https://www.bcst.or.th/wp-content/uploads/2022/07/Checklist\\_ThaiBirds\\_2022.xlsx](https://www.bcst.or.th/wp-content/uploads/2022/07/Checklist_ThaiBirds_2022.xlsx).

**TABLE 3.2-8**  
**LIST OF REPTILE FOUND IN THE SURVEY AREA**

Order/Family/Species	Abundance	Status			Area of occurrence	
		1	2	3	1	2
<b>Order Testudines</b>						
<b>Family Geoemydidae</b>						
1. Malayan snail-eating turtle ( <i>Malayemys macrocephala</i> )*	Low	P	LC	LC	×	✓
<b>Family Trionychidae</b>						
2. Asian softshell turtle ( <i>Amyda cartilaginea</i> )	Low	P	LC	VU	×	✓
<b>Order Squamata</b>						
<b>Family Agamidae</b>						
3. Changeable lizard ( <i>Calotes versicolor</i> )	High	P	LC	LC	✓	✓
4. Oriental garden lizard ( <i>Calotes mystaceus</i> )	Moderate	P	LC	LC	×	✓
5. Indo-chinese forest lizard ( <i>Calotes emma</i> )	Moderate	P	LC	LC	×	✓
6. Reeves's butterfly lizard ( <i>Leiolepis reevesii</i> )	Moderate	P	NT	LC	✓	✓
<b>Family Colubridae</b>						
7. Ornate flying snake ( <i>Chrysopelea ornata</i> )	Moderate	-	LC	LC	✓	✓
8. Red-necked Keelback ( <i>Rhabdophis subminiatus</i> )	Moderate	-	LC	LC	×	✓
9. Common wolf snake ( <i>Lycodon subcinctus</i> )	Low	-	LC	LC	×	✓
10. Indo-Chinese Rat snake ( <i>Ptyas korros</i> )*	Low	P	LC	NT	×	✓
11. Oriental Rat Snake ( <i>Ptyas mucosa</i> )*	Low	P	LC	LC	×	✓
12. Striped kukri snake ( <i>Oligodon dorsolateralis</i> )	Moderate	-	LC	LC	×	✓
<b>Family Elapidae</b>						
13. Monocled cobra ( <i>Naja kaouthia</i> )*	Low	-	LC	LC	×	✓
<b>Family Gekkonidae</b>						
14. Reticulated python ( <i>Gekko gecko</i> )	High	-	LC	LC	×	✓
15. Tokay gecko ( <i>Hemidactylus platyurus</i> )	High	-	LC	LC	✓	✓
16. Garnot's house gecko ( <i>Hemidactylus garnotii</i> )	Moderate	-	LC	LC	✓	✓
<b>Family Pythonidae</b>						
17. Flat-tailed house gecko ( <i>Malayopython reticulatus</i> )*	Low	P	LC	LC	×	✓
<b>Family Scincidae</b>						
18. Many-lined sun skink ( <i>Eutropis multifasciata</i> )	High	-	LC	LC	✓	✓
19. Variabled Skink ( <i>Eutropis macularius</i> )	High	-	LC	LC	×	✓
<b>Family Varanidae</b>						
20. Water Monitor ( <i>Varanus salvator</i> )*	Moderate	P	LC	LC	×	✓
21. Bengal Monitor ( <i>Varanus bengalensis</i> )*	Low	P	LC	NT	×	✓

**Remarks:** Areas of occurrence : 1 = project area      2 = a radius of 3 km of the project boundary

Status: 1 = Wild Animal Reservation and Protection Act, B.E.2562 (2019)

- = not protected by law    P = protected wildlife    R = reserved wildlife

2 = Natural Resources and Environmental Policy and Planning (2020)

CR = critically endangered animal    EN = endangered animal

VU = vulnerable animal    NT = near threatened animal

LC = least concern animal    - = no status

3 = IUCN (2022-2)

CR = critically endangered animal    EN = endangered animal

VU = vulnerable animal    NT = near threatened animal

LC = least concern animal    - = no status







\* = from inquiry

**TABLE 3.2-9  
LIST OF AMPHIBIAN FOUND IN THE SURVEY AREA**

Order/Family/Species	Abundance	Status			Area of occurrence	
		1	2	3	1	2
<b>Order Anura</b>						
<b>Family Bufonidae</b>						
1. Asian Common Toad ( <i>Duttaphrynus melanostictus</i> )	High	-	LC	LC	×	✓
<b>Family Dicroglossidae</b>						
2. Asian Grass Frog ( <i>Hoplobatrachus rugulosus</i> ) *	Moderate	-	LC	LC	×	✓
3. Rice Field Frog ( <i>Fejervarya limnocharis</i> )	High	-	LC	LC	✓	✓
4. Rocky Stream Frog ( <i>Fejervarya triora</i> )	Low	-	LC	LC	✓	✓
5. Lime Frog ( <i>Occidozyga lima</i> )	High	-	LC	LC	✓	✓
6. Marten's Frog ( <i>Occidozyga martensii</i> )	High	-	LC	LC	✓	✓
<b>Family Microhylidae</b>						
7. Ornate Chorus Frog ( <i>Microhyla fissipes</i> )	Moderate	-	LC	LC	✓	✓
8. Beautiful Pygmy Frog ( <i>Microhyla pulchra</i> )	Moderate	-	LC	LC	✓	✓
9. Asian Painted Bullfrog ( <i>Kaloula pulchra</i> )	Moderate	-	LC	LC	×	✓
10. Truncate-snouted spadefoot frog ( <i>Glyphoglossus molossus</i> ) *	Low	-	NT	NT	×	✓
<b>Family Ranidae</b>						
11. Red-eared Frog ( <i>Hylarana erythraea</i> ) *	Low	-	LC	LC	×	✓
12. Stripe-backed frog ( <i>Hylarana macrodactyla</i> ) *	Low	-	LC	LC	×	✓
<b>Family Rhacophoridae</b>						
13. Four-lined Tree Frog ( <i>Polypedates leucomystax</i> ) *	Moderate	-	LC	LC	×	✓

**Remarks:** Areas of occurrence : 1 = project area      2 = a radius of 3 km of the project boundary  
 Status: 1 = the Wild Animal Reservation and Protection Act, B.E. 2562(2019)  
 - = not protected by law    P = protected wildlife    R = reserved wildlife  
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 CR = critically endangered animal    EN = endangered animal  
 VU = vulnerable animal                NT = near threatened animal  
 LC = least concern animal            - = no status

\* = from inquiry

	
Asian Green Bee-eater ( <i>Melops orientalis</i> )	Indochinese Bushlark ( <i>Mirafra erythrocephala</i> )
	
Scaly-breasted Munia ( <i>Artamus fuscus</i> )	Brown Shrike ( <i>Scotophilus kuhlii</i> )
	
Finlayson's squirrel ( <i>Calotes versicolor</i> )	Rice Field Frog ( <i>Fejervarya limnocharis</i> )
<b>FIGURE 3.2-7 : THE EXAMPLE PHOTOS OF THE SPECIES FOUND FROM THE SURVEY</b>	

### 3) Wildlife Abundance

Each species in the study area cannot indicate the numbers per area because of the significant factors: the methods of wildlife assessment or indication are various, and the study period is short. Therefore, the expression of a number of each species of wildlife was assessed by dividing wildlife abundance into 3 levels of relative abundance. **Table 3.2-10** presents wildlife abundance, and the details of wildlife abundance are as follows:

**TABLE 3.2-10**  
**SPECIES OF WILDLIFE AND THEIR ABUNDANCE IN THE STUDY AREA**

Wildlife	Species	Abundance		
		High	Moderate	Low
Mammals	11	1	3	7
Birds	57	16	17	24
Reptiles	21	5	8	8
Amphibians	13	4	5	4
<b>Total</b>	<b>102</b>	<b>26</b>	<b>33</b>	<b>43</b>
<b>Percentage</b>	<b>100.0</b>	<b>25.5</b>	<b>32.3</b>	<b>42.2</b>

**3.1) High abundance level:** These species are easily observed through physical presence, traces, and evidence or by their high-frequency vocalizations. They are often small-bodied species that inhabit areas with desired environmental conditions and can adapt to different ecological needs over a wide range. They have a varied diet, which allows them to reproduce and maintain large populations. They are highly adaptable to disturbances, so they are not very secretive and are frequently encountered. This group consists of 4 wildlife groups, totaling 26 species, or 25.5% of the total number of wildlife species. They are categorized as follows:

- **Mammals:** 1 species—Finlayson's squirrel (*Callosciurus finlaysonii*)
- **Birds:** 16 species (see **Table 3.2-7**)
- **Reptiles:** 5 species are as follows:
  - Changeable lizard (*Calotes versicolor*)
  - Tokay gecko (*Gekko gekko*)
  - Flat-tailed house gecko (*Hemidactylus platyurus*)
  - Many-lined sun skink (*Eutropis multifasciata*)
  - Water monitor (*Varanus salvator*)



- **Amphibians:** 4 species are as follows:
  - Asian common toad (*Duttaphrynus melanostictus*)
  - Rice field frog (*Fejervarya limnocharis*)
  - Lime frog (*Occidozyga lima*)
  - Martens' frog (*Occidozyga martensii*)

**3.2) Intermediate abundance level:** This includes species frequently encountered, either through direct observation, traces, or by hearing their calls, but with lower frequency compared to highly abundant species. These species can adapt well to different environmental conditions or tolerate changes in the environment caused by human activities, which is why they are relatively common. There are 33 species belonging to 4 wildlife groups in this category, accounting for 32.3% of the total number of wildlife species. They are classified as follows:

- **Mammals:** There are 3 species of mammals, including Lesser asiatic yellow bat (*Scotophilus kuhlii*), Asian house rat (*Rattus tanezumi*), and Polynesian rat (*Rattus exulans*).
- **Birds:** There are 17 species of birds (see **Table 3.2-7**).
- **Reptiles:** There are 8 species of reptiles (see **Table 3.2-8**).
- **Amphibians:** There are 5 species of amphibians, including:
  - Asian grass frog (*Hoplobatrachus rugulosus*)
  - Ornate Chorus Frog (*Microhyla fissipes*)
  - Beautiful pygmy frog (*Microhyla pulchra*)
  - Asian painted frog (*Kaloula pulchra*)
  - Four-lined Tree Frog (*Polypedates leucomystax*)

**3.3) Low abundance level:** This includes species that are rarely encountered, either through direct observation, traces, or by hearing their calls, and each encounter has a small population or is not found through direct search but is based on survey data. There are 43 species belonging to 4 wildlife groups in this category, accounting for 42.2% of the total number of wildlife species. They are classified as follows:

- **Mammals:** There are 7 species of mammals (see **Table 3.2-6**).
- **Birds:** There are 24 species of birds (see **Table 3.2-7**).
- **Reptiles:** There are 8 species of reptiles (see **Table 3.2-8**).
- **Amphibians:** There are 4 species of amphibians, including:
  - Rocky field frog (*Fejervarya triora*)
  - Red-eared frog (*Hylarana erythraea*)
  - Truncat-snouted Spadefoot Frog (*Glyphoglossus molossus*)
  - Four-lined tree frog (*Polypedates leucomystax*)

#### 4) Wildlife Status

Conservation of wildlife requires the designation of the status of wildlife to serve as a basis for protecting species with small populations and species restricted to limited areas to prevent them from disappearing from the site or the world. Thailand has designated the status of wildlife for the abovementioned purpose, and 102 species of wildlife have been surveyed in the project area with their status listed in **Table 3.2-11**.

**TABLE 3.2-11  
THE NUMBER OF WILDLIFE SPECIES PROTECTED AND NOT PROTECTED  
BY WILDLIFE CONSERVATION LAWS**

Wildlife group	Number of Species	The number of species with designated status according to Wild Animal Conservation and Protection Act (2019)		
		Reserved wildlife	Protected wildlife	Non-protected wildlife
Mammals	11	-	2	9
Birds	57	-	53	4
Reptiles	21	-	11	10
Amphibians	13	-	-	13
<b>Total</b>	<b>102</b>	<b>0</b>	<b>66</b>	<b>36</b>
<b>Percentage</b>	<b>100.0</b>	<b>0.0</b>	<b>64.7</b>	<b>35.3</b>

**4.1) Protected status under the law:** There are 102 species of wildlife. When examining the status of this type, it was found that 66 species are designated as protected wildlife, accounting for 64.7% of the total number of wildlife species. The remaining 36 species of wildlife, or 35.3% of the total number of wildlife species, are not protected by law under the Wildlife Conservation Act of 2562. The number of species with this type of status for each group of wildlife is shown in **Table 3.2-11**. The 66 species of protected wildlife consist of three groups, including:

- Mammals, with two species: Lesser Asiatic yellow bat (*Scotophilus kuhlii*) and Lesser large-tooth bat (*Myotis horsfieldii*);
- Birds, with 53 species (see **Table 3.2-7**)
- Reptiles, with nine species (see **Table 3.2-8**)

The unprotected wildlife consists of 36 species, categorized into 4 groups. These groups include:

- Mammals, with 9 species (see **Table 3.2-6**)
- Birds, with 4 species: Eurasian tree sparrow (*Passer montanus*), Spotted dove (*Spilopelia chinensis*), Zebra dove (*Geopelia striata*), and Rock pigeon (*Columba livia*).
- Reptiles, with 8 species (see **Table 3.2-8**)
- Amphibians, with 13 species (see **Table 3.2-9**)

**(4.2) Conservation Status:** Among the wildlife found in the project study area, there are a total of 102 species. Upon examining their conservation status, it was found that the Office of Natural Resources and Environmental Policy and Planning (2020) designated 2 species, the Reeves' butterfly lizard (*Leiolepis reevesii*), and Blunt-headed burrowing frog (*Glyphogspissus molosus*), as Near Threatened (NT) species. The remaining 100 species of wildlife have the least concern (LC) conservation status.

However, when checking the IUCN conservation status (2022-2), it was found that one species, the Asian softshell turtle (*Amyda cartilaginea*), is classified as Vulnerable (VU), indicating a trend towards extinction. Additionally, 2 species, the Indo-chinese rat snake (*Ptyas korros*) and Blunt-headed burrowing frog (*Glyphoglossus molosus*), are classified as Near Threatened (NT). The remaining 99 species of wildlife have the least concern (LC) conservation status.

### **(2.2.2) Wildlife Found along the Transmission Line Route**

The transmission lines for the project will be laid from the project to the cut and turn points of the existing 115-kV transmission lines to Udon Thani 1 substation and Ban Phue substation, following the public road right of way for a total distance of 8.7 kilometers. A land use inspection was undertaken along the transmission line route, but no tree species were surveyed. However, a 3.4-kilometer section of the transmission line would pass through EAAA, where the wildlife survey has previously been conducted. For the remaining approximately 5.3 kilometers, most of the land is utilized for buildings and communities, areas with bush and trees, as well as unused land, with a small portion being agricultural areas (rice, eucalyptus, and rubber plantations). The land use types in these locations are also present in the segments that pass through EAAA, therefore the habitat along the transmission line route outside of EAAA are expected to be the same as those observed in the surveyed areas indicated above. As a result, the wildlife species that may be discovered in this area are similar to those found in the EAAA.

### **3.2.3 Identification of Habitat Types**

From the land use survey data encompassing the project footprint and its vicinity within a 3-kilometer radius from the project footprint boundary and along the transmission line route, there are no legally protected conservation areas or ecologically significant areas were identified, and three types of Modified Habitats have been categorized: agricultural areas, community and built-up areas, and other areas (such as roads and vacant lands). These areas have been impacted by various human activities or have been altered from their original state, resulting in a reduced diversity of plant and animal species. Moreover, these habitats play a critical role as living and foraging grounds for wildlife, although the distribution of plant species is relatively low.

Additionally, the consideration of Critical Habitat for the Saeng Thai Phalangngan Solar Power Plant Project, according to the criteria of IFC's Guidance Note 6: Biodiversity Conservation and Sustainable Management of Living Natural Resources (June 27, 2019), is detailed as follows:

### Criterion 1: Critically Endangered (CR)/ Endangered (EN) Species

Within the EAAA (project footprint and its proximity within a 3-kilometer radius from the project footprint boundary), no wildlife species classified as Endangered (EN) were found, but 1 species classified as Vulnerable (VU) was found—Asian softshell turtle (*Amyda cartilaginea*). This species can be found in Bangladesh, India, Vietnam, Malaysia, and Indonesia. It indicates that it has been introduced to locations outside of its natural range. Records have been found from Myanmar, Thailand, Cambodia, India, Indonesia, Laos, Singapore, Yunnan, and China. The distribution of *A. cartilaginea* in Southeast Asia is as shown in **Figure 3.2-8**. *A. cartilaginea* inhabits peaceful parts of stream up to altitudes of 400-600 m. or flowing waters and streams in northern and western Thailand. It lives in rivers, reservoirs, ponds, canals, and ditches in Thailand, where much appropriate habitat has long been transformed to agriculture and development (Auliya et al., 2016).

Due to the fact that the majority of land use in the project area is agricultural area and ponds scattering near the project boundary. Thus, the Ecologically Appropriate Areas of Assessment (EAAA) is defined as modified habitat. The site preparation will require filling the ponds bringing about the loss of EAAA. However, the Project has established measures that prevent construction and construction workers from harming wildlife or its nests, eggs, and larvae of the protected species. Consequently, the loss of *A. cartilaginea* due to the construction activities and workers seems unlikely. Furthermore, based on the survey *A. cartilaginea* has low abundance and from **Figure 3.2-8** shows that its distribution is primarily in central and western Thailand; thus, the loss of EAAA will not cause the shift in the IUCN Red List status to EN or CR.

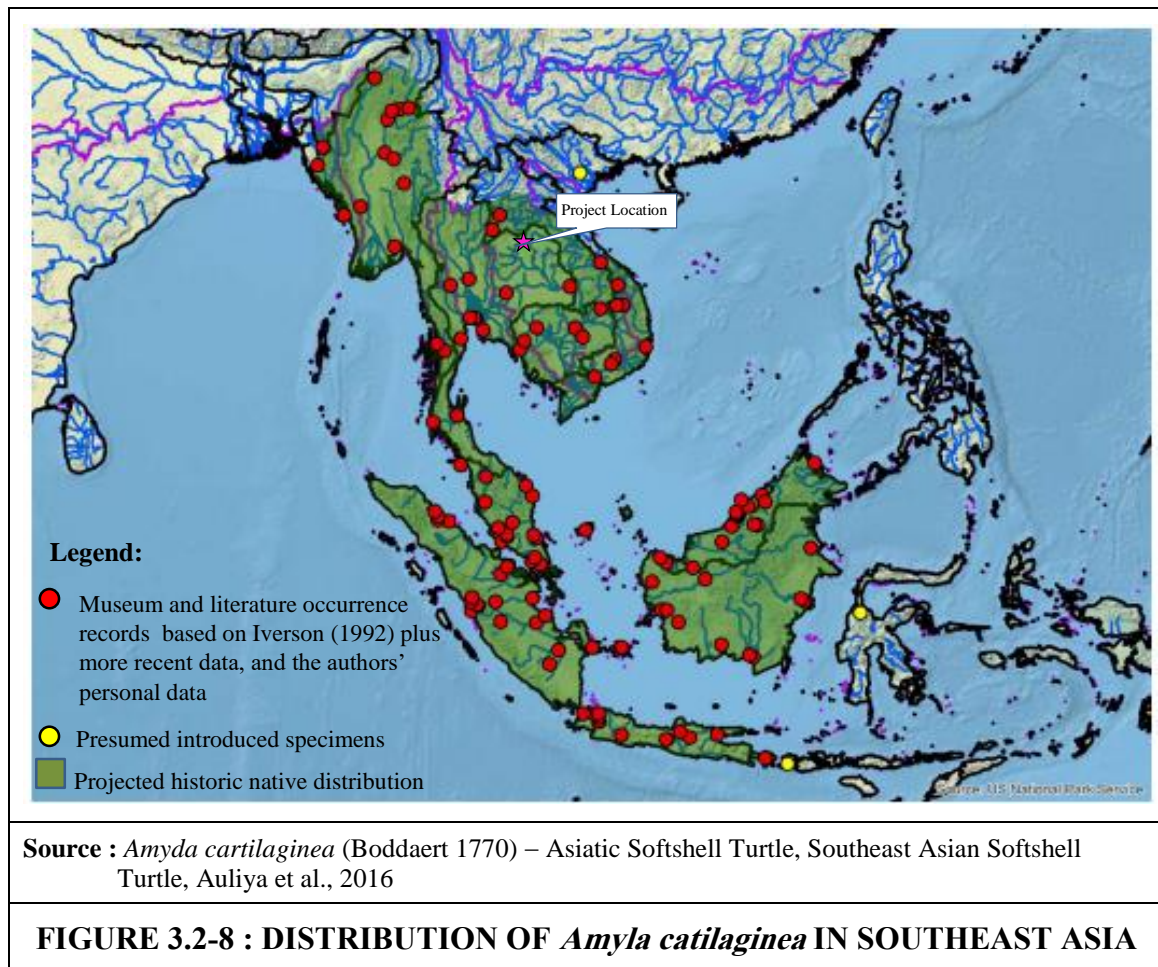
However, surveys within the project area have identified three species of plants classified as Endangered by the IUCN status: Burma Padauk (*Pterocarpus macrocarpus*), Teak (*Tectona grandis*), and Makha Mong (*Afzilia xylocorpa*). These species are cultivated in agricultural areas and occur in fallow lands, not in natural forests. As almost all EAAA are agricultural lands which owned by the project and other farmers, these species are not considered protected under any legal conservation status. Therefore, plant and animal species found within the project footprint do not qualify as critical habitat under Criterion 1, as detailed in **Table 3.2-12**.

Furthermore, a vulnerable species, Iron wood (*Hopea odorata*), was discovered during the study beyond the project footprint, where vegetation clearing prior to project construction will not occur. As a result, this species will not be cut off, and its status on the IUCN Res List will not be changed to EN or CR.

### Criterion 2: Endemic and Restricted-range Species

According to the IUCN assessment (2022), data on the population numbers and distribution of Burma Padauk (*Pterocarpus macrocarpus*) and Makha Mong (*Afzilia xylocorpa*) are insufficient to establish population sizes of these two species. Burma Padauk is found naturally throughout Indo-China, including Cambodia, Lao People's Democratic Republic, Myanmar, Thailand, and Vietnam. Burma Padauk is said to have a tiny population in Thailand and is only found around the borders of Myanmar and Laos. Only in protected locations the most trees were found. Makha Mong was found in dense forest, and in transitional areas between evergreen and dry open dipterocarp forest. However, both tree types are found in forested areas and are widely distributed throughout Thailand, mostly as economic plants. As a result, these two plant species are not unique to the project

geographical area or surrounding locations. As a result, no plant or animal species satisfying Criterion 2 were discovered.



**TABLE 3.2-12**  
**THE EXAMINATION OF SPECIES IDENTIFIED IN THE SURVEY**  
**ACCORDING TO THE REQUIREMENTS OF CRITERION 1**

Common Name and Scientific Name	Qualify as Critical Habitat under Criterion 1	Tree / Wildlife status					
		Thailand red data: Plant (2006)	Prohibited tree in Thailand (1987)	IUCN (2022)	Thailand red data: Vertebrates (2017)	Wildlife Law in Thailand (2019)	CITES (2022)
<b>I. FLORA</b>							
1. Burma padauk ( <i>Pterocarpus macrocarpus</i> )*	No	-	NTA	EN	-	-	-
2. Teak ( <i>Tectona grandis</i> )*	No	-	NTA	EN	-	-	-
3. Makha Mong ( <i>Azilia xylocorpa</i> )*	No	-	NTA	EN	-	-	-
4. Iron wood ( <i>Hopea odorata</i> )	No	-	NTA	VU	-	-	-
<b>II. FAUNA</b>							
1. Asian softshell turtle ( <i>Amyda cartilaginea</i> )	No	-	-	VU	LC	P	II

**Remark:** \* = The species of plants that have been cultivated are not those that naturally grow in wild forest areas.

Thailand Red Data: Plants (ONEP, 2006)

- = Not assigned status

The Royal Decree on Restricted Timber Species B.E. 2530 (1987)

PTA = Prohibited Tree Type A      PTB = Prohibited Tree Type B

NTA = Not Prohibited Tree Type

IUCN Red List, 2022

EN = Endangered Species

VU = Vulnerable Species

Thailand Red Data: Vertebrates (ONEP, 2017)

LC = Least Concern

- = Not in list

Wild Animal Conservation and Protection Act B.E.2562 (2019)

- = Not in list

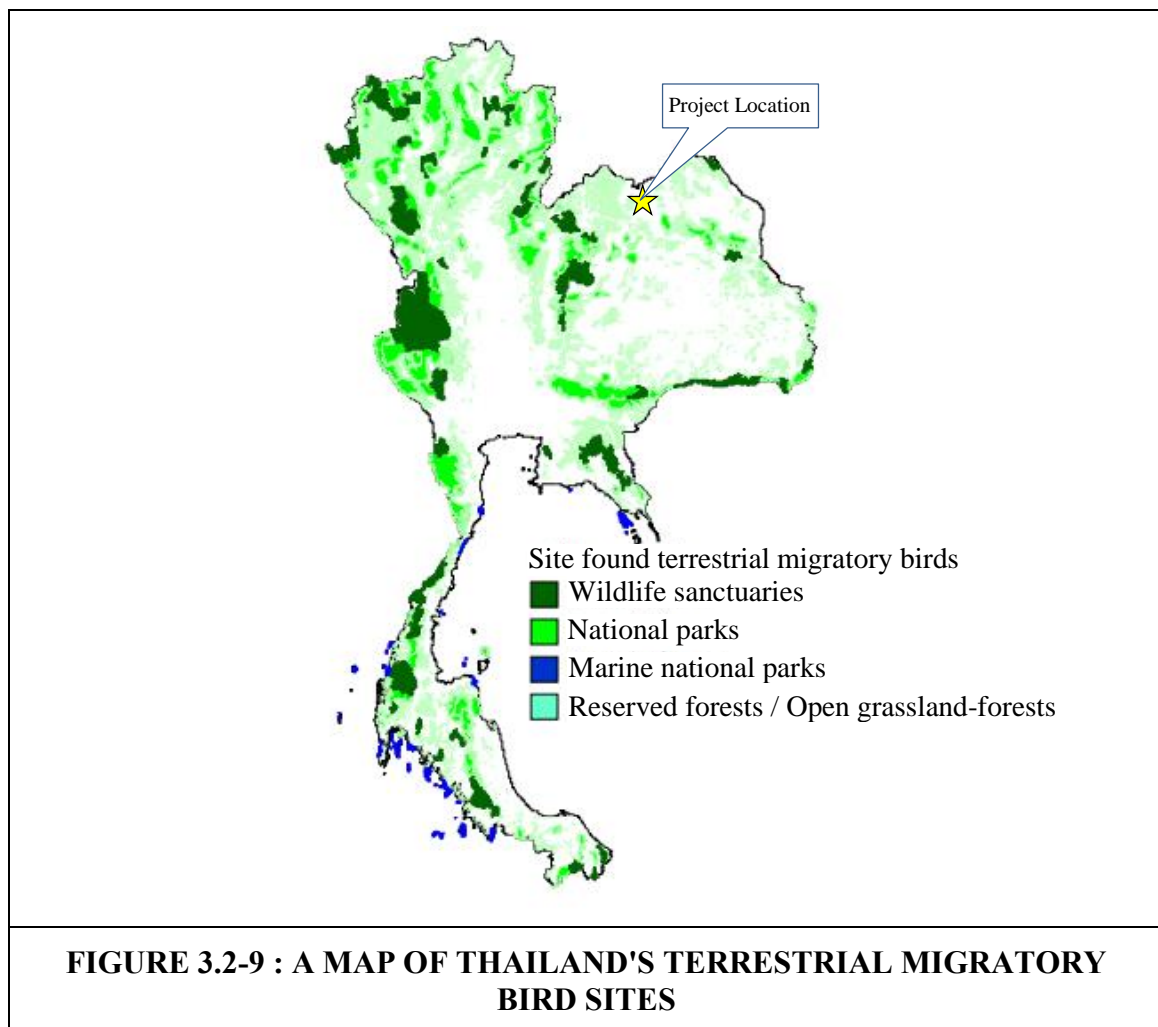
Convention on International Trade in Endangered Species of Wild Fauna and flora (CITES) (UNEP, 2022)

II = listed in Appendix II

- = Not in list

### Criterion 3: Migratory and Congregatory Species

There were no migratory species that form huge congregations or any major migratory pathways found within the project area or within a 3-kilometer radius of the project boundary. However, 16 species of tiny migratory birds were recorded within the project study area. Because they are not typically associated with large flocks during migration and there are survey reports of migratory birds that are terrestrial birds dispersed throughout the country (**Figure 3.2-9**), including in wildlife sanctuaries, national parks, marine national parks, reserved forests, and open grassland-forests, the project study area may have fewer migratory birds than the aforementioned conservation areas and less than 1% of the global population. Furthermore, all species are classified as Least Concern by the IUCN. As a result, as indicated in **Table 3.2-13**, they do not meet the criteria for Criterion 3.



**TABLE 3.2-13**  
**THE EXAMINATION OF SPECIES IDENTIFIED IN THE SURVEY**  
**ACCORDING TO THE REQUIREMENTS OF CRITERION 3**

Wildlife group	Species	Wild Animal Conservation and Protection Act (2019)	Thailand red list: vertebrates (2017)	IUCN (2022)	CITES (2022)	Abundance	Number of global population (individuals)	Qualify as Critical Habitat under Criterion 3
Bird	Ashy Woodswallow ( <i>Artamus fuscus</i> )	Protected	LC	LC	-	Moderate	Unknown	No
	Black Drongo ( <i>Dicrurus macrocercus</i> )	Protected	LC	LC	-	High	Unknown	No
	Barn Swallow ( <i>Hirundo rustica</i> )	Protected	LC	LC	-	Moderate	487,000,000	No
	Brown Shrike ( <i>Lanius cristatus</i> )	Protected	LC	LC	-	Low	Unknown	No
	Grey-backed Shrike ( <i>Lanius tephronotus</i> )	Protected	LC	LC	-	Low	Unknown	No
	White Wagtail ( <i>Motacilla alba</i> )	Protected	LC	LC	-	Low	221,000,000	No
	Stejneger's Stonechat ( <i>Saxicola stejnegeri</i> )	Protected	LC	LC	-	Low	Unknown	No
	Dusky Warbler ( <i>Phylloscopus fuscatus</i> )	-	LC	LC	-	Low	Unknown	No
	Red Collared Dove ( <i>Streptopelia tranquebarica</i> )	Protected	LC	LC	-	High	Unknown	No
	Eastern Spotted Dove ( <i>Spilopelia chinensis</i> )	-	LC	LC	-	High	Unknown	No
	Red-throated Flycatcher ( <i>Ficedula albicilla</i> )	Protected	LC	LC	-	Low	Unknown	No
	Asian Brown Flycatcher ( <i>Muscicapa dauurica</i> )	Protected	LC	LC	-	Low	Unknown	No
	Western Koel ( <i>Eudynamis scolopaceus</i> )	Protected	LC	LC	-	High	Unknown	No
	Common Kingfisher ( <i>Alcedo atthis</i> )	Protected	LC	LC	-	Low	700,000-1,399,999	No
	White-breasted Waterhen ( <i>Amaurornis phoenicurus</i> )	Protected	LC	LC	-	Moderate	Unknown	No
	Chinese Pond-heron ( <i>Ardeola bacchus</i> )	Protected	LC	LC	-	High	Unknown	No
	Cattle Egret ( <i>Bubulcus ibis</i> )	Protected	LC	LC	III	High	Unknown	No
	Little Egret ( <i>Egretta garzetta</i> )	Protected	LC	LC	III	Moderate	660,000-3,150,000	No
Shikra ( <i>Accipiter badius</i> )	Protected	LC	LC	-	Low	500,000-999,999	No	



#### **Criterion 4: Highly Threatened and/or Unique Ecosystems**

The project area, the area within a 3-kilometer radius of the project boundary, and the area along the transmission line route consist of agricultural lands, community areas, structures, and other modified habitats such as roads, water sources, and wastelands. These are commonly found modified habitats and do not contain any internationally, regionally, nationally, or locally significant areas that serve as habitat or foraging grounds for threatened wildlife or those with unique characteristics. The nearest conservation forest to the project area is Phu Kao-Phu Phan Kham National Park, covering two provinces: Nong Bua Lamphu and Khon Kaen, located approximately 68 kilometers southwest of the project area as shown in **Figure 3.2-10**. Hence, it does not qualify under Criterion 4.

#### **Criterion 5: Key Evolutionary Processes**

The project site is located in the northeastern part of Thailand and is characterized by slightly sloping hills and mostly flat terrain. The current land use includes agricultural areas and nearby urban community residential areas, water sources, and unused lands. No significant conservation forests were found within a 60-kilometer radius of the project site. Given that the area is a Modified Habitat with ecosystems that have been disturbed or altered from their original state due to ongoing human activities, it can be concluded that the mentioned area is not significant for key evolutionary processes.

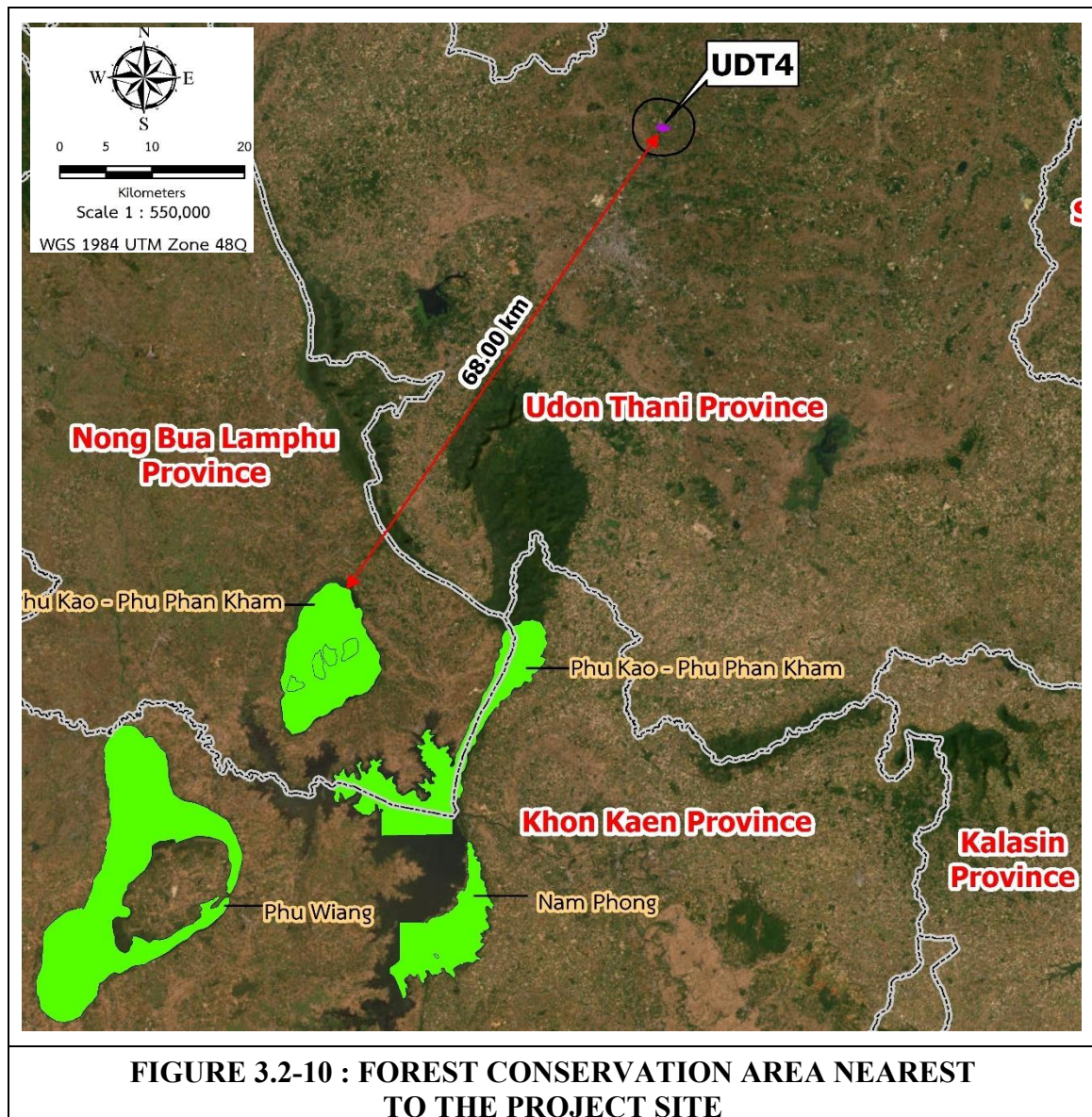
In summary, from the assessment of Critical Habitat according to the criteria of IFC's Guidance Note 6: Biodiversity Conservation and Sustainable Management of Living Natural Resources (June 27, 2019), it was found that the project area did not meet any of the requirements to be classified as Critical Habitat.

### **3.2.4 Aquatic Biological Resources**

The study on aquatic biological resources at the study area of Phalangngan Rungrueang Solar power plant project in Mueang Udon Thani District, Udon Thani Province includes aquatic ecology surveys and evaluation of diversity index of surface water sources. Three survey stations consist of a public waterway at the south of the project site (Bio1), a public waterway at a distance of 1 km at the south of the project site (Bio2), and a public waterway at a distance of 2 km at the south of the project site (Bio3) (**Figure 3.1-11**). Data were collected to serve as basic data and to study impacts on aquatic biodiversity. Indicators included phytoplankton, zooplankton, benthos, and aquatic flora and fauna. The methods of aquatic ecology sampling, sample analysis, and study result are as follows.

#### **(1) Sampling method**

**(a) Plankton:** Using a 5-L tube to scoop surface water (at a 30-cm depth below the water surface) for 20 liters and pour water into a 20-micron plankton net. Plankton samples were trapped on the filter and then preserved in a sample tube filled with 4-5% concentrated formalin. An analysis was carried out in a laboratory including species identifications, quantity density proportion between phyto and zoo plankton, and biodiversity index.



- **Species identification, density, and biodiversity of plankton**

Density of phytoplankton and zooplankton was reported in cell per square meters, and an analysis was done based on Ladda's manual (1999), Smith (1950), Carr and Whitton (1973), and Bold and Wynne (1978).

After species identification and density were determined at each station, the diversity index was calculated using the following equation.

$$H' = -\sum_{i=1}^s (n_i/n) \ln(n_i/n) \quad (\text{Shannon and Weaver, 1963})$$

- When  $H'$  = Biodiversity Index
- $s$  = Number of plankton species
- $n$  = Number of total plankton
- $n_i$  = Number of plankton in each species

**(b) Benthos:** Using the 0.0225- m<sup>2</sup> cross sectional area Ekman dredge to collect samples at each station with three replica. Put the samples on a 450-micron benthos sieve. Observed sediment at the water bed. Washed and disposed unwanted materials. Collected the samples with forcep and preserved them in a specimen bottle filled with 7% concentrated formalin. An analysis was carried out in a laboratory including species identifications and numbers. Data analysis is as follows.

- **Benthos abundance (density)**

Benthos abundance from sediment was calculated with numbers of benthos per square meter (m<sup>2</sup>). The species identifications referred to Prachuab's manual (1982), Saowapha (2015), Brinkhurst (1971), Brandt (1974), Cedhagen (1984), Merritt and Cummins (1984), Williams and Felmate (1992), and Swennen (2001).

**(c) Aquatic Flora** Observations were carried out at two sides of the stream, water surface, and beneath the water surface. Recorded aquatic plant species found at the sample collection sites. The observations were carried out during the sample collections of fish, plankton, and benthos. Within a 100-m<sup>2</sup> area, a density assessment was divided into three levels: high (66.67-100.00%), moderate (33.34-66.66%), and low (0.00-33.33%).

**(d) Fish** Fishing tools including a throw net and a gillnet were used to collect fish in all size and species. Fish specimens were preserved in 10% concentrated formalin and brought to a laboratory for species identifications and counts.

## (2) Sample Analysis Methods

**(a) Phytoplankton/ zooplankton and benthos** An analysis included species or family identifications, diversity index using Shannon-Weaver index, density in cells/m<sup>3</sup> or numbers of individual/m<sup>2</sup>, and proportions of phytoplankton to zooplankton.

**(b) aquatic plants.** An analysis consisted of species identifications and quantity from field observations and records at the sample collection stations around the project area and density per 100 m<sup>2</sup>, then converted into three levels as follows:

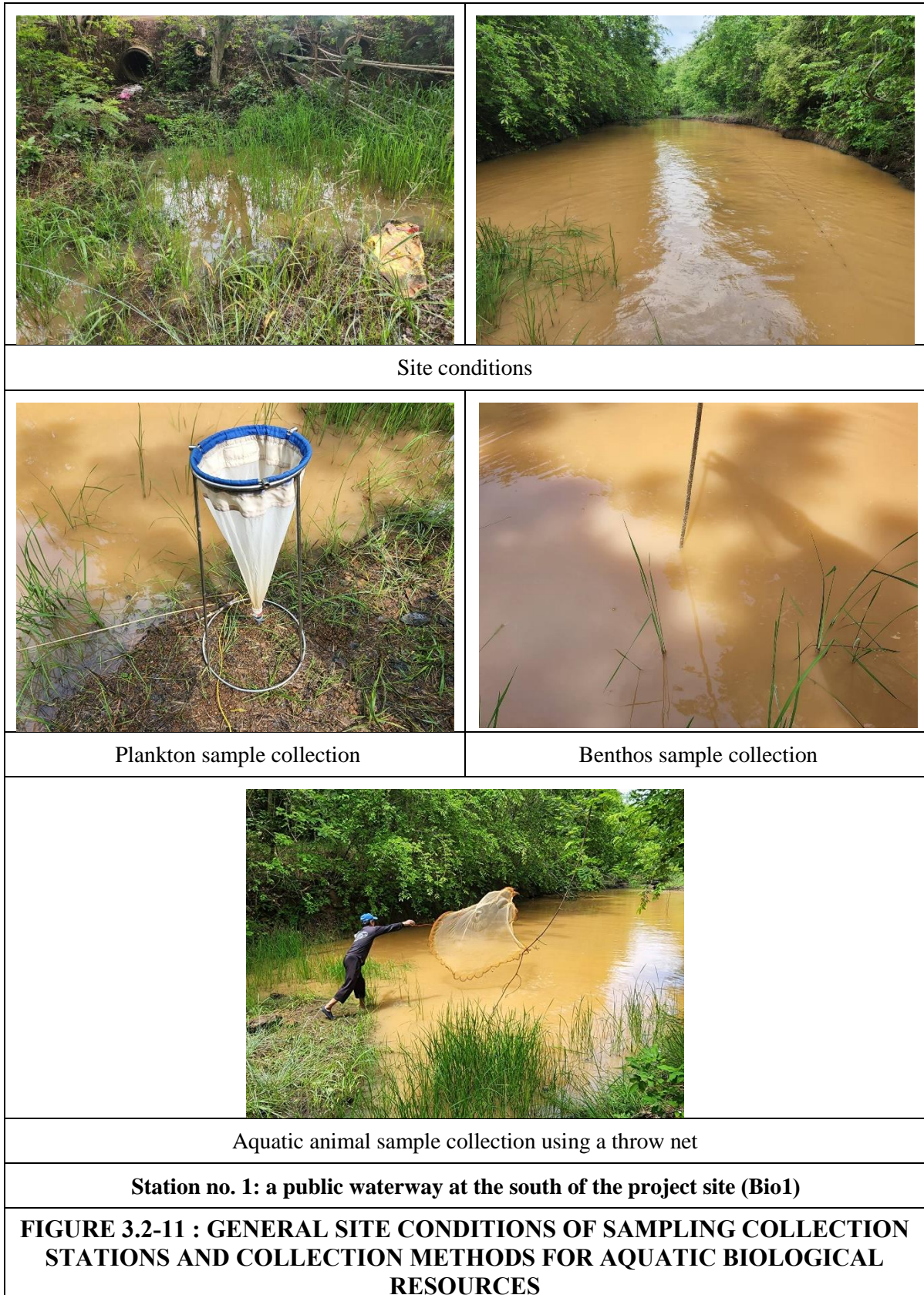
- High density = 66.67 – 100.00% (+++)
- Moderate density = 33.34-66.66% (++)
- Low density = 0.00-33.33% (+)

**(c) Fish and other aquatic animals** An analysis included identifications of fish species and groups based on their diet: forage species and carnivorous species, yield in kg/rai, proportion by weight of forage to carnivorous species (F/C ration = weight of forage species/weight of carnivorous species), and biodiversity index.

## (3) Study Results

The sample collection of phytoplankton, zooplankton, benthos, aquatic plant, and fish was carried out on 11 June 2023 in a public waterway for 3 stations. The results of sample identification were concluded as following.

**(a) A public waterway at the south of the project site (Bio1):** The width of the stream was approximately 28.00-30.00 m. Water depth was approximately 0.50-1.00 m. The stream bed was clay mixed with organic matter and no trace of hydrogen sulfide gas odor (see **Figure 3.2-11**). The aquatic organisms found at this sampling station are as follows:







Site conditions



Plankton sample collection



Benthos sample collection



Aquatic animal sample collection using a throw net

Station no. 3 : a public waterway at a distance of 2 km at the south of the project site (Bio3)

**FIGURE 3.2-11 : GENERAL SITE CONDITIONS OF SAMPLING COLLECTION STATIONS AND COLLECTION METHODS FOR AQUATIC BIOLOGICAL RESOURCES (CONT'D)**

- **Phytoplankton:** A total of 34 phytoplankton species was found consisting of 20 species of Division Chlorophyta, 13 species of Division Chromophyta, and 1 species of Division Cyanophyta. *Tarchelomonas hispida* is dominant species, with a density of 171,000 cells/m<sup>3</sup>. The diversity index is 3.14, which is ranked as moderate to good distribution (**Table 3.2-14**).

- **Zooplankton:** A total of 10 zooplankton species were found consisting of 4 species of Rotifera, 4 species of Protozoa, and 2 species of Arthropoda. The dominant species is *Polyarthra vulgaris* with a density of 187,000 individuals/m<sup>3</sup>. The diversity index is 1.56, which is ranked from low to moderate distribution (**Table 3.2-14**).

- **Diversity Index of Phytoplankton/Zooplankton** is 3.32. It indicates that the water quality ranges from moderate to good (**Table 3.2-14**).

- **Benthos:** There were 4 species found. They are *Chironomus* sp. with abundance of 60 individuals/m<sup>2</sup>, *Sayami* asp. with abundance of 30 individuals/m<sup>2</sup>, *Filopaludina* sp. with abundance of 89 individuals/m<sup>2</sup>, and *Trochotaia* sp. with abundance of 30 individuals/m<sup>2</sup>. The diversity index of benthos was 1.08 indicating poor environments or low food quantity at the stream bed as shown in **Table 3.2-15**.

- **Aquatic plant:** There were 8 species found from the survey, which is emerging plant, namely *Commelina diffusa*, *Cyperus pilosus*, *Scirpus grossus*, *Jussiaea linifolia*, *Brachiaria mutica*, *Leptochloa chinensis*, and *Polygonum tomentosum* (**Table 3.2-16**).

- **Fish** was caught at this station with 3 Families and 4 species identified from 7 individuals. A total weight was 51.00 g with length varied from 4.20 to 14.00 cm. The most caught were 3 *Puntius brevis*, 2 *Parambassis siamensis* and 1 each of *Anabas testudineus* and *Osteochilus lini* (**Table 3.2-17**). The diversity index was 1.28 as shown in **Table 3.2-18**.

**(b) A public waterway at a distance of 1 km at the south of the project site (Bio2):** The width of the stream was approximately 30.00-35.00 m. Water depth was approximately 0.10-0.30 m. The stream bed was sandy clay mixed with organic matter and no trace of hydrogen sulfide gas odor (see **Figure 3.2-11**). The aquatic organisms found at this sampling station are as follows.

- **Phytoplankton:** A total of 27 phytoplankton species was found consisting of 20 species of Division Chlorophyta, 5 species of Division Chromophyta, and 2 species of Division Cyanophyta. *Tarchelomonas hispida* is dominant species, with a density of 3,069,000 cells/m<sup>3</sup>. The diversity index is 2.15, which is ranked as moderate to good distribution (**Table 3.2-14**).

- **Zooplankton:** A total of 8 zooplankton species were found consisting of 5 species of Rotifera, 2 species of Arthropoda, and 1 species of Protozoa. The dominant species is *Polyarthra vulgaris* with a density of 7,068,000 individuals/m<sup>3</sup>. The diversity index is 0.41, which is ranked from moderate to good distribution (**Table 3.2-14**).

- **Diversity Index of Phytoplankton/Zooplankton** is 2.10. It indicates that the water quality ranges from moderate to good (**Table 3.2-14**).

- Benthos: There was 1 species found, which is *Chironomus* sp. with abundance of 30 individuals/m<sup>2</sup> as shown in **Table 3.2-15**.

- Aquatic plant: There were 12 species found from the survey comprising 1 species of floating plant–*Ludwigia adscendens*, and 11 species of emerging plant such as *Eclipta prostrata*, *Fimbristylis dichotoma*, *Marsilea crenata*, *Polygonum glabrum*. Some species are human's food such as *Ludwigia adscendens* and *Marsilea crenata* while others are used for animal feed and green manure such as *Polygonum glabrum* (**Table 3.2-16**).

- Fish caught at this station is *Anabas testudineus* with 1 individual. A total weight was 12.00 g with length of 8.50. (**Table 3.2-17**).

(c) **A public waterway at a distance of 2 km at the south of the project site (Bio3):** The width of the stream was approximately 28.00-30.00 m. Water depth was approximately 0.50-1.00 m. The stream bed was sandy clay mixed with organic matter and no trace of hydrogen sulfide gas odor (see **Figure 3.2-11**). The aquatic organisms found at this sampling station are as follows.

- Phytoplankton: A total of 45 phytoplankton species was found consisting of 30 species of Division Chlorophyta, 10 species of Division Chromophyta, and 5 species of Division Cyanophyta. *Euglena acus* is dominant species, with a density of 4,202,000 cells/m<sup>3</sup>. The diversity index is 3.03, which is ranked as moderate to good distribution (**Table 3.2-14**).

- Zooplankton: A total of 16 zooplankton species were found consisting of 12 species of Rotifera, 2 species of Arthropoda, and 2 species of Protozoa. The dominant species is *Polyarthra vulgaris* with a density of 325,000 individuals/m<sup>3</sup>. The diversity index is 2.03, which is ranked from low to moderate distribution (**Table 3.2-14**).

- Diversity Index of Phytoplankton/Zooplankton is 3.17. It indicates that the water quality ranges from moderate to good (**Table 3.2-14**).

- Benthos: There were 3 species found. They are *Chironomus* sp. with abundance of 30 individuals/m<sup>2</sup>, *Filopaludina* sp. with abundance of 89 individuals/m<sup>2</sup>, and *Trochotaia* sp. with abundance of 75 individuals/m<sup>2</sup>. The diversity index of benthos was 1.01 indicating poor environments or low food quantity at the stream bed as shown in **Table 3.2-15**.

- Aquatic plant: There were 8 species found from the survey comprising 1 species of floating plant–*Ludwigia adscendens*, and 7 species of emerging plant, namely *Alternanthera sessilis*, *Fimbristylis dichotoma*, *Marsilea crenata*, *Mimosa pigra*, *Brachiaria mutica*, *Brachiaria reptans*, and *Leptochloa chinensis*. Some species are human's food such as *Ludwigia adscendens* and *Marsilea crenata* while others are used for animal feed and green manure such as *Alternanthera sessilis* (**Table 3.2-16**).

- Fish was caught at this station with 3 Families and 5 species identified from 8 individuals. A total weight was 54.00 g with length varied from 4.10 to 10.30 cm. The most caught were 3 *Puntius brevis*, 2 *Mystus mysticetus* and 1 each of *Parambassis siamensis* and *Hemibagrus filamentus* (**Table 3.2-17**).



**TABLE 3.2-14**  
**SPECIES AND QUANTITY OF PLANKTON IN THE STUDY AREA**

Quantity of plankton: cells/m<sup>3</sup>

Plankton species	Survey station ( cells/m <sup>3</sup> )			Total
	Bio1 <sup>1/</sup>	Bio2 <sup>2/</sup>	Bio3 <sup>3/</sup>	
<b>PHYTOPLANKTON (61=74.39 %)</b>				
<b>Division Cyanophyta</b>				
<b>Class Cyanophyceae</b>				
<b>Order Chroococcales</b>				
<b>Family Chroococcaceae</b>				
<i>Merismopedia convoluta</i>	-	-	955,000	<b>955,000</b>
<b>Order Nostocales</b>				
<b>Family Oscillatoriaceae</b>				
<i>Lyngbya</i> sp.	-	-	38,000	<b>38,000</b>
<i>Oscillatoria</i> sp.	24,000	28,000	-	<b>52,000</b>
<i>Oscillatoria tenuis</i>	-	-	86,000	86,000
<i>Spirulina platensis</i>	-	9,000	38,000	47,000
<b>Family Rivulariaceae</b>				
<i>Calothrix</i> sp.	-	-	19,000	<b>19,000</b>
<b>Division Chlorophyta</b>				
<b>Class Chlorophyceae</b>				
<b>Order Volvocales</b>				
<b>Family Volvocaceae</b>				
<i>Eudorina elegans</i>	8,000	-	-	8,000
<b>Order Chlorococcales</b>				
<b>Family Hydrodictyaceae</b>				
<i>Pediastrum duplex</i>	-	-	19,000	<b>19,000</b>
<b>Family Coelastraceae</b>				
<i>Coelastrum</i> sp.	8,000	-	-	<b>8,000</b>
<b>Family Oocystaceae</b>				
<i>Ankistrodesmus falcatus</i>	-	-	19,000	<b>19,000</b>
<i>Tetraedron gracile</i>	-	-	287,000	<b>287,000</b>
<i>Tetraedron trigonum</i>	-	-	306,000	<b>306,000</b>
<b>Family Scenedesmaceae</b>				
<i>Scenedesmus armatus</i>	16,000	19,000	29,000	<b>64,000</b>
<b>Order Zygomatales</b>				
<b>Family Desmidiaceae</b>				
<i>Closterium acerosum</i>	90,000	74,000	48,000	<b>212,000</b>
<i>Closterium lineatum</i>	57,000	65,000	86,000	<b>208,000</b>
<i>Cosmarium nudum</i>	139,000	37,000	-	<b>176,000</b>
<i>Euastrum spinulosum</i>	8,000	9,000	-	<b>17,000</b>
<b>Class Euglenophyceae</b>				
<b>Order Euglenales</b>				
<b>Family Euglenaceae</b>				
<i>Euglena acus</i>	8,000	186,000	4,202,000	<b>4,396,000</b>
<i>Euglena oxyuris</i>	8,000	2,604,000	382,000	<b>2,994,000</b>
<i>Euglena</i> sp.	41,000	-	764,000	<b>805,000</b>
<i>Euglena viridis</i>	-	-	478,000	<b>478,000</b>
<i>Lepocinclis ovum</i>	139,000	1,116,000	669,000	<b>1,924,000</b>
<i>Phacus angulatus</i>	33,000	260,000	124,000	<b>417,000</b>
<i>Phacus circulatus</i>	41,000	47,000	-	<b>88,000</b>

**TABLE 3.2-14**  
**SPECIES AND QUANTITY OF PLANKTON IN THE STUDY AREA (CONT'D)**

Quantity of plankton: cells/m<sup>3</sup>

Plankton species	Survey station ( cells/m <sup>3</sup> )			Total
	Bio1 <sup>1/</sup>	Bio2 <sup>2/</sup>	Bio3 <sup>3/</sup>	
<i>Phacus hamatus</i>	90,000	37,000	1,146,000	<b>1,273,000</b>
<i>Phacus longicauda</i>	-	74,000	143,000	<b>217,000</b>
<i>Phacus myersi</i>	-	-	29,000	<b>29,000</b>
<i>Phacus pleuronectes</i>	-	28,000	86,000	<b>114,000</b>
<i>Phacus sp.</i>	82,000	-	172,000	<b>254,000</b>
<i>Phacus torta</i>	24,000	837,000	1,242,000	<b>2,103,000</b>
<i>Strombomonas australica</i>	-	-	344,000	<b>344,000</b>
<i>Strombomonas fluviatilis</i>	-	-	96,000	<b>96,000</b>
<i>Strombomonas gibberosa</i>	-	-	860,000	<b>860,000</b>
<i>Strombomonas girardiana</i>	-	-	1,337,000	<b>1,337,000</b>
<i>Strombomonas sp.</i>	8,000	47,000	688,000	<b>743,000</b>
<i>Trachelomonas conica</i>	8,000	-	-	<b>8,000</b>
<i>Trachelomonas crebea</i>	-	-	716,000	<b>716,000</b>
<i>Trachelomonas daugerdiana</i>	-	84,000	669,000	<b>753,000</b>
<i>Trachelomonas hispida</i>	171,000	3,069,000	191,000	<b>3,431,000</b>
<i>Trachelomonas mirabilis</i>	33,000	1,023,000	115,000	<b>1,171,000</b>
<i>Trachelomonas sp.</i>	-	74,000	-	<b>74,000</b>
<i>Trachelomonas superba</i>	-	550,00	67,000	<b>617,000</b>
<i>Trachelomonas volzii</i>	-	-	76,000	<b>76,000</b>
<b>Division Chromophyta</b>				
<b>Class Bacillariophyceae</b>				
<b>Order Biddulphales</b>				
<b>Suborder Coscinodiscineae</b>				
<b>Family Aulacoseiraceae</b>				
<i>Aulacoseira granulata</i>	106,000	-	-	<b>106,000</b>
<b>Order Bacillariales</b>				
<b>Suborder Fragilariineae</b>				
<b>Family Fragilariaceae</b>				
<i>Fragilaria capucina</i>	147,000	93,000	239,000	<b>479,000</b>
<b>Family Tabellariaceae</b>				
<i>Tabellaria fenestrata</i>	24,000	-	-	<b>24,000</b>
<b>Suborder Bacillariineae</b>				
<b>Family Eunotiaceae</b>				
<i>Eunotia pectinalis</i>	24,000	9,000	29,000	<b>62,000</b>
<b>Family Cymbellaceae</b>				
<i>Gomphonema parvulum</i>	-	-	57,000	<b>57,000</b>
<b>Family Naviculaceae</b>				
<i>Hantzschia amphioxys</i>	24,000	-	-	<b>24,000</b>
<i>Navicula cuspidata</i>	122,000	9,000	153,000	<b>284,000</b>
<i>Navicula lanceolata</i>	41,000	-	-	<b>41,000</b>
<i>Navicula sp.</i>	33,000	-	-	<b>33,000</b>
<i>Pinnularia braunii</i>	33,000	-	105,000	<b>138,000</b>
<i>Pinnularia gibba</i>	24,000	270,000	1,146,000	<b>1,440,000</b>
<i>Pinnularia grunowii</i>	33,000	-	267,000	<b>300,000</b>
<i>Pinnularia sp.</i>	-	37,000	-	<b>37,000</b>
<b>Family Bacillariaceae</b>				
<i>Nitzschia sp.</i>	8,000	-	-	<b>8,000</b>

**TABLE 3.2-14**  
**SPECIES AND QUANTITY OF PLANKTON IN THE STUDY AREA (CONT'D)**

Quantity of plankton: cells/m<sup>3</sup>

Plankton species	Survey station ( cells/m <sup>3</sup> )			Total
	Bio1 <sup>1/</sup>	Bio2 <sup>2/</sup>	Bio3 <sup>3/</sup>	
<b>Family Surirellaceae</b>				
<i>Surirella elegans</i>	-	-	10,000	<b>10,000</b>
<i>Surirella robusta</i>	-	-	10,000	<b>10,000</b>
<b>Class Dinophyceae</b>				
<b>Order Peridinales</b>				
<b>Family Peridiniaceae</b>				
<i>Peridinium</i> sp.	49,000	-	573,000	<b>622,000</b>
<b>ZOOPLANKTON (21=25.61%)</b>				
<b>Phylum Protozoa</b>				
<b>Subphylum Plasmodroma</b>				
<b>Class Sarcodina</b>				
<b>Subclass Rhizopoda</b>				
<b>Order Testacida</b>				
<b>Family Arcellidae</b>				
<i>Arcella vulgaris</i>	16,000	-	38,000	<b>54,000</b>
<b>Family Diffugiidae</b>				
<i>Diffugia lobostoma</i>	-	-	10,000	<b>10,000</b>
<b>Family Euglyphidae</b>				
<i>Euglypha acanthophora</i>	16,000	-	-	<b>16,000</b>
<b>Subclass Actinopoda</b>				
<b>Order Heliozoida</b>				
<b>Family Actinophryidae</b>				
<i>Actinosphaerium eichhorni</i>	24,000	-	-	<b>24,000</b>
<b>Subphylum Ciliophora</b>				
<b>Class Ciliata</b>				
<b>Subclass Holotricha</b>				
<b>Order Gymnostomatida</b>				
<i>Didinium</i> sp.	8,000	9,000	-	<b>17,000</b>
<b>Phylum Rotifera (Rotifer)</b>				
<b>Class Monogononta</b>				
<b>Order Ploima</b>				
<b>Family Brachionidae</b>				
<i>Anuraeopsis coelata</i>	-	-	10,000	<b>10,000</b>
<i>Anuraeopsis fissa</i>	16,000	-	181,000	<b>197,000</b>
<i>Brachionus bidentatus</i>	-	-	10,000	<b>10,000</b>
<i>Keratella vulga</i>	-	-	19,000	<b>19,000</b>
<b>Family Lecanidae</b>				
<i>Lecane inopinata</i>	-	-	10,000	<b>10,000</b>
<i>Lecane papuana</i>	-	-	38,000	<b>38,000</b>
<b>Family Notommatidae</b>				
<i>Cephalodella gibba</i>	-	9,000	29,000	<b>38,000</b>
<b>Family Tricercocidae</b>				
<i>Trichocerca pusilla</i>	8,000	19,000	29,000	<b>56,000</b>
<b>Family Asplanchnidae</b>				
<i>Asplanchna priodonta</i>	-	-	10,000	<b>10,000</b>

**TABLE 3.2-14**  
**SPECIES AND QUANTITY OF PLANKTON IN THE STUDY AREA (CONT'D)**

Quantity of plankton: cells/m<sup>3</sup>

Plankton species	Survey station ( cells/m <sup>3</sup> )			Total
	Bio1 <sup>1/</sup>	Bio2 <sup>2/</sup>	Bio3 <sup>3/</sup>	
<b>Family Synchaetidae</b>				
<i>Polyarthra dolichoptera</i>	16,000	65,000	29,000	<b>110,000</b>
<i>Polyarthra vulgaris</i>	187,000	7,068,000	325,000	<b>7,580,000</b>
<b>Order Flosculariacea</b>				
<b>Family Hexarthridae</b>				
<i>Hexarthra mira</i>	-	9,000	-	<b>9,000</b>
<b>Class Digononta</b>				
<b>Family Philodinidae</b>				
<i>Rotaria rotatoria</i>	-	-	19,000	<b>19,000</b>
<b>Phylum Arthropoda</b>				
<b>Class Crustacea (Crustaceans)</b>				
<b>Subclass Branchiopoda</b>				
<b>Order Diplostraca</b>				
<b>Family Moinidae</b>				
<i>Moina macrocopa</i>	8,000	-	-	<b>8,000</b>
<b>Subclass Copepoda (Copepods)</b>				
*Unidentified Copepods larvae nauplius	163,000	651,000	153,000	<b>967,000</b>
<b>Order Cyclopoida (Cyclopoids)</b>				
*Unidentified Cyclopoids copepods	-	47,000	10,000	<b>57,000</b>
<b>Total quantity</b>				
<b>Phytoplankton</b>	<b>1,704,000</b>	<b>10,695,000</b>	<b>19,115,000</b>	<b>31,514,000</b>
<b>Zooplankton</b>	<b>462,000</b>	<b>7,877,000</b>	<b>920,000</b>	<b>9,259,000</b>
<b>Total</b>	<b>2,166,000</b>	<b>18,572,000</b>	<b>20,035,000</b>	<b>40,773,000</b>
<b>Total species</b>				
<b>Phytoplankton</b>	<b>34</b>	<b>27</b>	<b>45</b>	<b>61</b>
<b>Zooplankton</b>	<b>10</b>	<b>8</b>	<b>16</b>	<b>21</b>
<b>Total</b>	<b>44</b>	<b>35</b>	<b>61</b>	<b>82</b>
<b>Ratio of Phytoplankton/Zooplankton</b>	<b>3.69</b>	<b>1.36</b>	<b>20.78</b>	$\bar{x} = 8.61$
<b>Diversity index of phytoplankton</b>	<b>3.14</b>	<b>2.15</b>	<b>3.03</b>	$\bar{x} = 2.77$
<b>Diversity index of zooplankton</b>	<b>1.56</b>	<b>0.41</b>	<b>2.03</b>	$\bar{x} = 1.33$
<b>Diversity index of phytoplankton and zooplankton</b>	<b>3.32</b>	<b>2.10</b>	<b>3.17</b>	$\bar{x} = 2.86$

Remarks : \* Unidentified

<sup>1/</sup> Station no.1: a public waterway in the south of the project site (Bio1)

<sup>2/</sup> Station no.2: a public waterway at a distance of 1 km. in the south of the project site (Bio2)

<sup>3/</sup> Station no.3: a public waterway at a distance of 2 km. in the south of the project site (Bio3)

Source : Fourtier Consultants Co., Ltd., 2023

**TABLE 3.2-15**  
**SPECIES AND QUANTITY OF BENTHOS IN THE STUDY AREA**

Abundance: numbers/m<sup>3</sup>

Benthos group/species	Survey station ( numbers/m <sup>3</sup> )			Total
	Bio1 <sup>1/</sup>	Bio2 <sup>2/</sup>	Bio3 <sup>3/</sup>	
<b>PHYLUM ARTHROPODA</b>				
Class Insecta				
Order Diptera				
Family Chironomidae				
<i>Chironomus</i> sp. (blood worm)	60	30	30	<b>120</b>
Class Malacostraca				
Order Decapoda				
Family Gecarcinucidae				
<i>Sayamia</i> sp. (Field Crab)	30	-	-	<b>30</b>
<b>PHYLUM MOLLUSCA</b>				
Class Gastropoda				
Order Architaenioglossa				
Family Viviparidae				
<i>Filopaludina</i> sp. (river snail)	89	-	89	<b>178</b>
<i>Trochotaia</i> sp. (river snail)	30	-	75	<b>90</b>
<b>Total quantity of benthos</b>	<b>4</b>	<b>1</b>	<b>3</b>	<b>5</b>
<b>Total species of benthos</b>	<b>209</b>	<b>30</b>	<b>194</b>	<b>433</b>
<b>Diversity index</b>	<b>1.28</b>	<b>0.00</b>	<b>1.01</b>	$\bar{x} = 0.76$

Remarks : <sup>1/</sup> Station no.1: a public waterway in the south of the project site (Bio1)

<sup>2/</sup> Station no.2: a public waterway at a distance of 1 km. in the south of the project site (Bio2)

<sup>3/</sup> Station no.3: a public waterway at a distance of 2 km. in the south of the project site (Bio3)

Source : Fourtier Consultants Co., Ltd., 2023

**TABLE 3.2-16  
AQUATIC PLANTS FOUND IN THE STUDY AREA**

Family	Scientific name	Common name	Survey station <sup>4/</sup>		
			Bio1 <sup>1/</sup>	Bio2 <sup>2/</sup>	Bio3 <sup>3/</sup>
<b><u>Floating plant</u></b>					
Onagraceae	<i>Ludwigia adscendens</i>	Sunrose willow	-	+	+
<b><u>Emergent plant</u></b>					
Amaranthaceae	<i>Alternanthera sessilis</i>	Sessile joyweed	-	-	+
Asteraceae	<i>Eclipta prostrata</i>	False daisy	-	+	-
Commelinaceae	<i>Commelina diffusa</i>	Spreading dayflower	+	+	-
Cyperaceae	<i>Cyperus pilosus</i>	Greater club rush	+	-	-
	<i>Fimbristylis dichotoma</i>	Tall fringe rush	-	+	+
	<i>Fimbristylis dipsacea</i>	Java tea	-	+	-
	<i>Scirpus grossus</i>	Bulrus	+	-	-
Marsileaceae	<i>Marsilea crenato</i>	Water clover	-	+	+
Mimosaceae	<i>Mimosa pigra</i>	Giant mimosa	-	+	+
Onagraceae	<i>Jussiaea linifolia</i>	Water primrose	+	+	-
Poaceae	<i>Brachiaria mutica</i>	Para grass	++	+	+
	<i>Brachiaria reptans</i>	Creeping panic grass	+	-	+
	<i>Leptochloa chinensis</i>	Chinese sprangletop	++	+	+
Polygonaceae	<i>Polygonum glabrum</i>	Dense flower knotweed	-	+	-
	<i>Polygonum tomentosum</i>	Pale smartweed	+	+	-
<b>Total 9 Families 16 species</b>			<b>8</b>	<b>12</b>	<b>8</b>

**Remarks :** <sup>1/</sup> Station no.1: a public waterway in the south of the project site (Bio1)  
<sup>2/</sup> Station no.2: a public waterway at a distance of 1 km. in the south of the project site (Bio2)  
<sup>3/</sup> Station no.3: a public waterway at a distance of 2 km. in the south of the project site (Bio3)  
<sup>4/</sup> Density in 100 m<sup>2</sup> evaluated and recorded into 3 levels  
 1) High density = 66.67-100.00% (+++)  
 2) Moderate density = 33.34-66.66% (++)  
 3) Low density = 0.00-33.33% (+)

**Source :** Fourtier Consultants Co., Ltd., 2023

**TABLE 3.2-17**  
**SPECIES AND NUMBERS OF FISH SAMPLES IN THE STUDY AREA**

Family	Scientific name	Common name	Numbers of fish	Size range (cm)	Total weight (g)
<b>Station no.1: Public waterway at the south of the project site (Bio1)<sup>1/</sup></b>					
Ambassidae	<i>Parambassis siamensis</i>	Siamese glass fish	2	4.20-5.20	2.00
Anabantidae	<i>Anabas testudineus</i>	Climbing perch	1	14.00	36.00
Cyprinidae	<i>Osteochilus lini</i>	Bony lipped carp	1	9.40	7.00
	<i>Puntius brevis</i>	Golden Little Barb	3	4.50-6.50	6.00
<b>Total 3 Families 4 species</b>			7	4.20-14.00	51.00
<b>Station no.2: Public waterway at distance 1 km. at the south of the project site (Bio2)<sup>2/</sup></b>					
Anabantidae	<i>Anabas testudineus</i>	Climbing perch	1	8.50	12.00
<b>Total 1 Families 1 species</b>			1	8.50	12.00
<b>Station no.3: Public waterway at distance 1 km. at the south of the project site (Bio3)<sup>3/</sup></b>					
Ambassidae	<i>Parambassis siamensis</i>	Siamese glass fish	1	4.10-4.20	2.00
Bagruidae	<i>Hemibagrus filamentus</i>	Green catfish	1	10.30	11.00
	<i>Mystus mysticetus</i>	Striped dwarf catfish	2	9.70-10.30	16.00
Cyprinidae	<i>Labiobarbus leptocheilus</i>	Barb	1	7.40	4.00
	<i>Puntius brevis</i>	Golden Little Barb	3	6.60-8.60	21.00
<b>Total 3 Families 4 species</b>			8	4.10-10.30	54.00

**Remarks:** <sup>1/</sup> Station no.1: a public waterway in the south of the project site (Bio1)

<sup>2/</sup> Station no.2: a public waterway at a distance of 1 km. in the south of the project site (Bio2)

<sup>3/</sup> Station no.3: a public waterway at a distance of 2 km. in the south of the project site (Bio3)

**Source:** Fourtier Consultants Co., Ltd., 2023

**TABLE 3.2-18  
DISTRIBUTION OF FISH SPECIES SAMPLES IN THE STUDY AREA**

Family	Scientific name	Common name	Station		
			Bio1 <sup>1/</sup>	Bio2 <sup>2/</sup>	Bio3 <sup>3/</sup>
Ambassidae	<i>Parambassis siamensis</i>	Siamese glass fish	+	-	+
Anabantidae	<i>Anabas testudineus</i>	Climbing perch	+	+	-
Bagruidae	<i>Hemibagrus filamentus</i>	Green catfish	-	-	+
	<i>Mystus mysticetus</i>	Striped dwarf catfish	-	-	+
Cyprinidae	<i>Labiobarbus leptocheilus</i>	Barb	-	-	+
	<i>Osteochilus lini</i>	Bony lipped carp	+	-	-
	<i>Puntius brevis</i>	Golden Little Barb	+	-	+
<b>Total 4 Families 7 species</b>			<b>4</b>	<b>1</b>	<b>5</b>
<b>Diversity index</b>			<b>1.28</b>	<b>0.00</b>	<b>1.49</b>

**Remarks:** <sup>1/</sup> Station no.1: a public waterway in the south of the project site (Bio1)  
<sup>2/</sup> Station no.2: a public waterway at a distance of 1 km. in the south of the project site (Bio2)  
<sup>3/</sup> Station no.3: a public waterway at a distance of 2 km. in the south of the project site (Bio3)

**Source:** Fourtier Consultants Co., Ltd., 2023

**TABLE 3.2-19  
PRODUCTIVITY, F/C, AND DIVERSITY INDEX OF FISH SAMPLES  
IN THE STUDY AREA**

Family	Numbers of species	Station	Productivity (kg./rai)	F/C
Ambassidae	1	<b>Bio1<sup>1/</sup></b>	0.16	1.36
Anabantidae	1	<b>Bio2<sup>2/</sup></b>	0.32	-
Bagruidae	2	<b>Bio3<sup>3/</sup></b>	1.44	0.08
Cyprinidae	3	<b>Bio1<sup>1/</sup> Bio3<sup>3/</sup></b>		1.38
		<b>Average</b>	<b>0.64</b>	<b>0.72</b>
<b>Total</b>	<b>7</b>			
<b>Diversity index</b>	<b>1.28</b>			

**Remarks:** <sup>1/</sup> Station no.1: a public waterway in the south of the project site (Bio1)  
<sup>2/</sup> Station no.2: a public waterway at a distance of 1 km. in the south of the project site (Bio2)  
<sup>3/</sup> Station no.3: a public waterway at a distance of 2 km. in the south of the project site (Bio3)

**Source:** Fourtier Consultants Co., Ltd., 2023



The fish surveys in public waterway in the south of the project at these three stations found four species of fish were caught at Station no. 1—a public waterway in the south of the project site (Bio1). Diversity index was 1.28. One species of fish were caught at Station no. 2— a public waterway at a distance of 1 km at the south of the project site (Bio2). Diversity index was 0.00. Five species of fish were caught at Station no. 3— a public waterway at a distance of 2 km at the south of the project site (Bio3). Diversity index was 1.49 as shown in **Table 3.2-18**.

As of the diversity index, productivity, and F/C, the results were able to show the diversity index of 1.28. However, this value shows low distribution in public waterway. The productivity varied from 0.64-0.72 kg./rai or average 0.64 kg./rai. This value shows low productivity when compare with general water resources. F/C ratio varied from 0.08-1.38 or average 0.72. This vaule shows more carnivorous fish than herbivorous fish (Values of F/C in the range of 3-6 were found by Swingle, 1953) as shown in **Table 3.2-19**. Due to the fact that water at Stations no. 2 is shallow and one of *Anabas testudineius*, which is carnivorous fish, was caught at this station. Thus, the productivity and the F/C were quite low value.

### 3.3 QUALITY OF LIFE

#### 3.3.1 Social Information

In the project's study area, there exist 3 local government organizations :Na Kha Subdistrict Administrative Organization (SAO) and Na Kha Subdistrict Municipality of Mueang District, and Chiang Wang SAO of Phen District, Udon Thani Province . Each of these entities exhibits distinct social conditions across various aspects, as delineated below:

##### (1) Demography and Population

The study area of the project encompasses a total of 10,354 households and a population of 28,111 people. Among these, 13,947 are males and 14,164 are females, resulting in a population density of 269.29 persons per square kilometer. The details can be categorized among local administrative organizations as follows:

##### *Na Kha SAO of Mueang District*

Na Kha SAO oversees 15 villages within its jurisdiction, delineated as follows: Village no. 1, 2, 4, 5, 6, 7, 8, 9, 10, 11, 13, 14, 15, 16, and 17 within the Na Kha Subdistrict, encompassing a total of 2,236 households. The combined population is 6,438 people, comprising 3,134 males and 3,304 females, resulting in a population density of approximately 181.35 persons per square kilometer. A comprehensive breakdown of these details can be found in **Table 3.3-1**.

##### *Na Kha Subdistrict Municipality of Mueang District*

Na Kha Subdistrict Municipality holds responsibility over a designated area comprising 8 villages, delineated as follows :Village no. 1, 3, 7, 8, 9, 10, 11, and 12 within Na Kha Subdistrict .The cumulative count of households within this jurisdiction amounted to 2,338 with a total population of 6,613 people .This populace comprises 3,254 males and 3,359 females, contributing to a population density of 495.36 persons per square kilometer. Detailed demographic data for each village is comprehensively presented in **Table 3.3-1**.

**TABLE 3.3-1  
NUMBER OF DEMOGRAPHY AND POPULATION  
IN THE PROJECT'S STUDY AREA**

Village no.	Village	Household	Population		
			Male	Female	Total
<b>Na Kha SAO</b>					
1	Ban Na Kha (partial)	99	85	75	160
2	Ban Ngoi	325	413	468	881
4	Ban Non Tum	229	353	369	722
5	Ban Don Ya Nang	162	260	252	516
6	Ban Na Kham Luang	257	401	441	842
7	Ban Thon Yai (partial)	36	27	24	51
8	Ban Don Taeng (partial)	43	26	33	59
9	Ban Dong Yuat	1	1	1	2
10	Ban Lao Si Chan (partial)	67	49	42	91
11	Ban Dong Rai (partial)	54	38	45	83
13	Ban Na Kham Kaeo	233	276	263	539
14	Ban Loeng Thong	161	274	288	562
15	Ban Na Kham Mun	85	150	137	287
16	Ban Mak Tum	284	413	437	850
17	Ban Na Kham Luang	200	368	425	793
<b>Total of Na Kha SAO</b>		<b>2,236</b>	<b>3,134</b>	<b>3,304</b>	<b>6,438</b>
<b>Na Kha Subdistrict Municipality</b>					
1	Ban Na Kha	740	833	816	1,652
3	Ban Thon Noi	115	167	181	348
7	Ban Thon Yai (partial)	311	593	574	1,167
8	Ban Don Taeng (partial)	154	255	255	510
9	Ban Dong Yuat	389	646	681	1,327
10	Ban Lao Si Chan (partial)	183	332	365	697
11	Ban Dong Rai (partial)	316	250	302	552
12	Ban Na Lao Kham	130	178	185	363
<b>Total of Na Kha Subdistrict Municipality</b>		<b>3,254</b>	<b>3,359</b>	<b>3,359</b>	<b>6,613</b>

**TABLE 3.3-1  
NUMBER OF DEMOGRAPHY AND POPULATION  
IN THE PROJECT'S STUDY AREA (CONT'D)**

Village no.	Village	Household	Population		
			Male	Female	Total
<b>Chiang Wang SAO</b>					
1	Ban Chiang Wang	371	557	574	1,131
2	Ban Sang Luang	278	417	440	857
3	Ban Dong Yai	264	432	404	836
4	Ban Na Di	189	287	276	563
5	Ban Dan	283	394	369	763
6	Ban Phon Than	180	303	338	641
7	Ban Phon Lao	214	317	326	643
8	Ban Don Kha	221	323	348	671
9	Ban Sang Lan	228	371	341	712
10	Ban Kham Phak Nam	253	392	358	750
11	Ban Sang Kham	341	579	556	1,135
12	Ban Dong Yai Phatthana	293	417	438	855
13	Ban Nong Sakhrui	207	296	313	609
14	Ban Khok Noi	39	192	212	404
15	Ban Dan Nakhon	188	298	289	587
16	Ban Dong Charoen	234	399	422	821
17	Ban Non Udom	256	358	336	694
18	Ban Sang Lan Phatthana	240	382	350	732
19	Ban Phon Than	130	382	350	732
20	Ban Phon Thong	160	306	327	633
21	Ban Dan Charoen	195	261	265	526
<b>Total of Chiang Wang SAO</b>		<b>4,864</b>	<b>7,454</b>	<b>7,501</b>	<b>14,805</b>
<b>Total of 3 local government organizations</b>		<b>10,354</b>	<b>13,947</b>	<b>14,164</b>	<b>28,111</b>

Source : Department of Provincial Administration, 2023

### *Chiang Wang SAO of Phen District*

Chiang Wang Subdistrict Municipality holds responsibility over a designated area encompassing 21 villages. These villages are numbered Village no. 1 to Village no. 21 within the Chiang Wang subdistrict. Within this jurisdiction, there are a total of 4,864 households, accommodating a population of 14,955 individuals. This populace consists of 7,454 males and 7,501 females, contributing to a population density of 131.18 persons per square kilometer. Detailed demographic data for each village is comprehensively presented in **Table 3.3-1**.

#### **(2) Education**

Regarding the education level of individuals in Na Kha Subdistrict, the findings indicate that 69.79% are elementary school graduates, followed by 18.20% who completed lower secondary school, 8.04% who graduated from high school, 2.33% with a diploma or equivalent, and 1.64% with a bachelor's or postgraduate degree, respectively (Na Kha SAO, 2021). However, no data were found in the survey for subdistrict in the remaining study areas.

#### **(3) Vulnerable Group**

Based on a survey conducted as part of the local development plan by the Na Kha SAO, utilizing data from a 2021 survey, it was determined that there are a total of 1,092 elderly individuals aged over 60 in the Na Kha Subdistrict area. This group is composed of 516 males and 576 females. Additionally, there are 150 individuals with disabilities and 6 AIDS patients. However, no data were found in the survey for subdistrict in the remaining study areas.

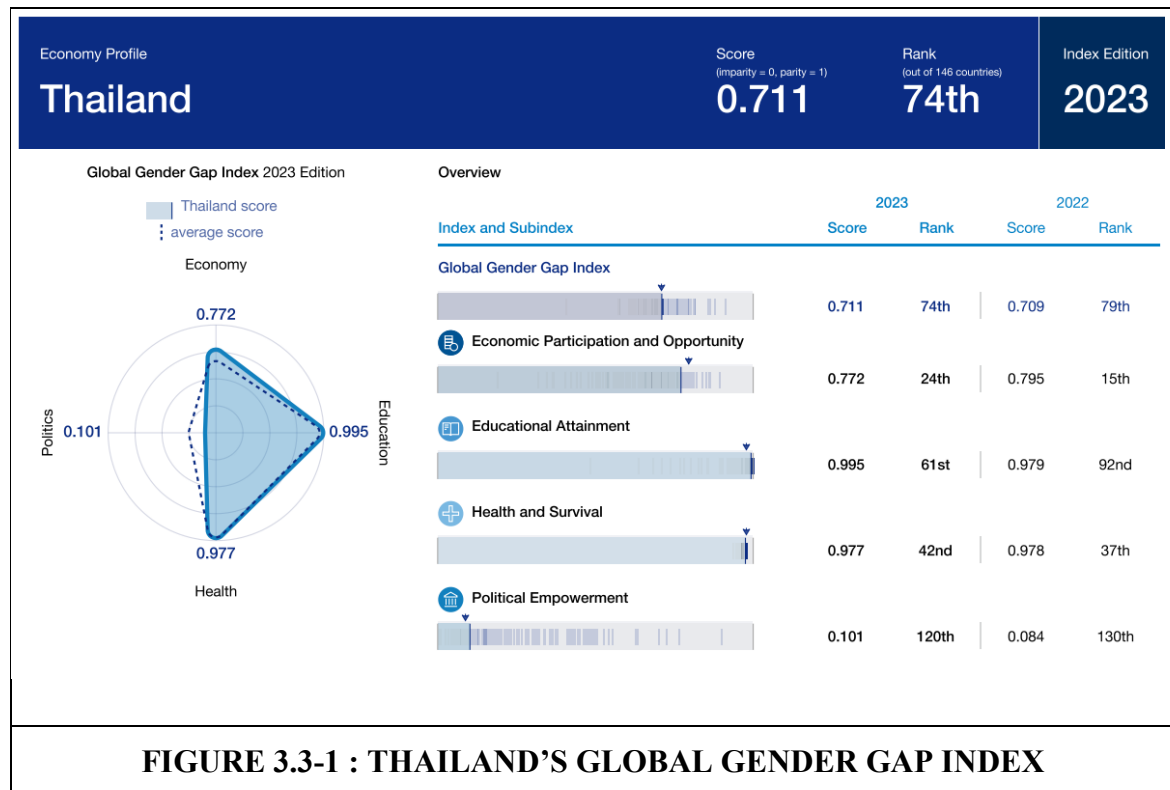
#### **(4) Gender Equality**

From the Global Gender Gap Report 2023, reports that in the year 2023, Thailand is ranked 74<sup>th</sup> out of 146 countries assessed in the index (**Figure 3.3-1**). The Global Gender Gap Index annually benchmarks the current state and evolution of gender parity across four key dimensions (Economic Participation and Opportunity, Educational Attainment, Health and Survival, and Political Empowerment).

#### **(5) Religion and Beliefs**

According to a review of village statistics from the study area's three-year development plan (2021-2023), 99 percent of people practice Buddhism, while 1 percent practice other religions such as Christianity and Islam.

The majority of people attend religious ceremonies and perform acts of merit-making according to numerous traditions such as the third-month merit, Sarat Day, Mahachart merit, fireball merit, Bun Khao Chi, and others.



### (6) Common community properties and resources

Important information can be summarized as follows based on a review of common community properties and resource data from the three-year local development plan (2021-2023) of local government entities in the study area:

*School* : There are a total of 31 schools in the study area, including 12 child development centers, 17 primary schools, 1 secondary schools, and 1 vocational education . The details of these schools can be found for each local administrative organization, as presented in **Table 3.3-2**.

*Heath Center* : In the study area, there are 4 community health promoting hospitals that cater to the needs of the local population . The details of these community health promoting hospitals can be found for each local administrative organization, as presented in **Table 3.3-2**.

*Religious Place* : There are 41temples and 1Christian churches. The details of these Religious places can be found for each local administrative organization, as presented in **Table 3.3-2**.

*Road* : The majority of the study areas are situated adjacent to Mittraphap Road (Udon-Nongkhai) on both sides. This road is a vital link connecting Udon Thani and Nong Khai provinces and also serves as a gateway route to Indochina. Furthermore, there exists a main road interconnecting the villages, which is largely paved and made of concrete. Nevertheless, certain roads are in a state of disrepair and require development. Most residents rely on private cars and motorbikes for transportation.

**TABLE 3.3-2  
NUMBER OF COMMON COMMUNITY PROPERTIES AND RESOURCES  
IN THE PROJECT'S STUDY AREA**

Common Community Properties and Resources	Na Kha SAO	Nakha Subdistrict Municipality	Chiang Wang SAO	Total
School	- 3 child development centers - 3 primary schools	- 2 child development centers - 6 primary schools	- 7 child development centers - 8 primary schools - 1 secondary schools - 1 vocational education	- 12 child development centers - 17 primary schools - 1 secondary school - 1 vocational education
Heath Center	- 1 community health promoting hospital	- 1 community health promoting hospital	- 2 community health promoting hospital	- 4 community health promoting hospital
Religious Place	- 9 temples	- 7 temples	- 25 temples - 1 christ church	- 41 temples - 1 christ church
Road	- 1 national highway - 15 village roads	- 1 national highway - 8 village roads	- 282 village roads	- 1 national highway - 305 village roads
Electricity	100% of household in the SAO.	100% of household in the subdistrict municipality	100% of household in the SAO.	100% of household in the study area
Water Resources For Agriculture	- 6 swamps	- 3 rivers	- 44 rivers - 1 swamps	- 47 rivers - 7 swamps
Water Sources For Consumption	- 6 swamps	- 3 rivers	- 44 rivers - 1 swamps	- 47 rivers - 7 swamps

**Source:** The 3-year local development plan )2021-2023 (of local government organizations in the study area

*Electricity* :All households in these areas have access to electricity, ensuring coverage throughout every village.

*Water resources for agriculture:* The majority of agricultural water sources in the study area depend on rainfall during the wet season. In some regions, water is sourced from swamps, ponds, and creeks. However, these sources are unable to retain water throughout the entire year due to the absence of substantial reservoirs. Notable rivers in the area include Bong Man river, Na Wa river, Wang Bua river, Prem river, and Wang Siao river.

*Water sources for consumption* : The majority of people utilize village tap water and groundwater. As for sources of water for consumption, the primary options are rainwater and bottled water.

### 3.3.2 Economic Information

Data for economic information was expected to be collected from relevant authorities' documents and via interviews with households within a 300-meter radius of the project boundaries.

The social information collected from relevant authorities is as follow:

### (1) Employment

The minimum pay for workers in Udon Thani province is set at 328 baht per day, according to the Notification of the pay Committee on Minimum Wage Rates (No. 11) 2022. Furthermore, a review of the 2021- 2023 development plan data from local government organizations in the study area revealed a significant working-age population (aged 15-60 years), comprising 66.37 % of the total population in the area .However, despite the substantial working-age population in the region, a prevailing issue is that most of this demographic must seek employment outside urban areas with industrial plants due to the lack of industrial factories providing substantial employment opportunities.

### (2) Occupation

In the study area, the occupation of the people is primarily farming, accounting for 84.59 %, followed by general contractors at 7.50 %, government officer at 3.69 %, private sector employees at 2.08 %, and self-employed individuals at 1.47 %, with the remaining 0.87 percent falling into other categories.

### (3) Household Income and Cost of Living

Based on an analysis of the Udon Thani Provincial Public Health Office's 2021 annual report, it was found that the average household income in Mueang district of Udon Thani province is around 286,556.33 baht/ household/ year, which equates to approximately 103,265.66 baht/person/ year. This income level exceeds the poverty line defined by the National Economic and Social Development Council in 2021, which is set at roughly 32,435.37 baht/person/year for residents of northeastern municipalities.

Regarding household expenditures, the review revealed that the average household expenditure in Mueang district of Udon Thani province was approximately 177,802.28 baht/household/year, or about 63,775.92 baht/person/year.

### (4) Local Economy

#### *Agriculture Activities*

**Crop Cultivation :** The majority of farmers in the study area are engaged in various agricultural activities, including rice farming, gardening, and cultivating crops.

**Livestock :** In the study area, households engaged in domestic animal husbandry, rearing animals such as cattle, buffaloes, pigs, ducks, and chickens. Additionally, in some instances, horses were kept for conservation and aesthetic reasons. Moreover, in terms of fisheries, the research identified households involved in raising fish for personal consumption, with any surplus being sold to neighbors or vendors in the market.

#### *Non-Agriculture Activities*

In the study area, there are 3 accommodations, 9 gas stations, 419 grocery stores, 68 mills, and 10 small factories .The details can be categorized by local government organization, as presented in **Table 3.3-3**.

**TABLE 3.3-3  
NON-AGRICULTURE ACTIVITIES IN THE STUDY AREA**

Non-Agriculture Activities in the Study Area	Na Kha SAO	Na Kha Subdistrict Municipality	Chiang Wang AO	Total
Accommodation	-	1	2	3
Gas station/	2	3	4	9
Grocery stores	47	172	200	419
Rice Mill	29	15	24	68
Factory	8	1	1	10

**Source:** The 3-year local development plan )2021-2023 (of local government organizations in the study area

The socio-economics survey of the household in the study area with a radius of 300 meters from the project boundary was implemented during 17-20 October 2023. The interview survey of 4 households with their illustrations are displayed in **Figure 3.3-2**. The results of the socio-economics survey are as follows:

**(1) The household socio-economic details**

Regarding the numbers of family members in the household, the average number of family members is 5 people, with the maximum of 20 people and the minimum of 1 people. The average male family members are 2 people, with the maximum of 14 people and the minimum of 1 person. The average female family members are 2 people, with the maximum of 6 people and the minimum of 1 person. The family members in the household have jobs or employed (76.1%). The family members are pre-school children, students and elderly (23.9%); therefore, they are unemployed.

The main occupation of the household is agriculturist (55.6%), which includes cassava, rice, sugar cane, and cattle farming. 22.2% of interviewees have trades, 11.11% are employees, and 5.6% are self-employed and work in factories. The interviewees (63.2%) have side jobs, such as agricultural activities and trading while the rest (36.8%) have no side jobs. All the interviewees have no obstacle in doing their career. The average household income is 21,167 Baht/month. The average household expenses is 19,417 Baht/month. The interviewees (52.6%) stated that their income is adequate but there is no money left over for saving, 31.6% have income left over for saving, and 15.8% do not have enough money, so they take out a loan from a financial institution or borrow from relatives or friends.

From the interviews regarding land ownership for agricultural purposes, it was found that 89.4% of the interviewees stated that they owned the land they cultivated, while 5.3% equally mentioned that they did not own the land and rented the land. When inquiring about participation in household committees and group activities, it was discovered that 78.9% of household members were not involved in any committees or group activities, while 21.1% were members of such committees or groups, such as village councils and village health volunteer. It is worth noting that the majority of people in the villages or communities live together as relatives and siblings.





**FIGURE 3.3-2 : THE ILLUSTRATIONS OF THE HOUSEHOLD INTERVIEW**

## **(2) The project recognition and opinion**

From the interviews regarding project awareness, it was found that all interviewees had just received information about the project through the interviews. As for the impact of project development, 73.7% of the interviewees believed that there was no impact on the project's development, both in the construction and operational phases. The remaining 26.3% believed that there was an impact on the project's development, such as dust (80.0%), traffic (20.0%), and noise (20.0%) during the construction phase, and water drainage (20.0%) during the operational phase. When asked about concerns regarding project development, 78.9% of the interviewees stated that they had no concerns, while 21.1% expressed concerns, such as dust (25.0%), water drainage (25.0%), odor (25.0%), and the impact on agricultural crops (25.0%).

Regarding the benefits to the community after project development, it was found that all interviewees reported receiving benefits from the project, such as stable electricity supply and support for social activities through corporate social responsibility (CSR) from the project owner. In terms of confidence in the project's environmental management measures, 68.4% of the interviewees reported moderate confidence, as the project had effective prevention measures in place. Meanwhile, 21.1% expressed uncertainty about the measures, as the project had not yet been implemented, and 10.5% did not express an opinion, as the project had not yet been developed and they needed to see how it would progress in the long term.

## **(3) Public participation and the project public relations**

From the interviews regarding community participation in monitoring and assessing the environmental impacts of project development, all interviewees stated that the public should be involved in all stages, including the pre-construction, construction, and operational phases. Regarding the return of benefits to the community, all interviewees emphasized the importance of providing benefits since the project is located in the community, which would lead to community development and benefit the residents. The forms of benefits mentioned included supporting budgets for health, education, people with disabilities, and religious institutions on a regular basis, as well as engaging in regular activities with the community, such as promoting traditions/culture, sports, and community livelihood activities. Additionally, prioritizing local employment was considered essential.

As for project communication, 78.9% of the interviewees stated that there should be additional communication efforts. They expressed the need for information on environmental impact prevention and mitigation measures, project safety systems, emergency response plans, knowledge about electricity generation, project details, the benefits and drawbacks of the project, and the timeline or work plan. Suitable communication methods mentioned included informing through community leaders, direct communication through notices to the public, posting announcements in the community area, conducting occasional explanatory meetings, and disseminating information through online media platforms such as Facebook and Line.

### 3.3.3 Public Health

The implementation of the project may cause an impact on public health service system. Some construction workers or project staff will receive services from public health services providers in the study areas. The secondary data on public health service for people in the study area and the health status of people in the study area was collected from relevant documents. The detail of gathered data is as follows:

#### (1) Public Health Services Providers

##### (a) Primary Care

There are 2 primary cares responsible for public health services in the area, i.e., Ban Non Tum Subdistrict Health Promotion Hospital and Ban Na Kha Subdistrict Health Promotion Hospital. The information of those primary cares are as follows:

**Ban Non Tum Subdistrict Health Promotion Hospital** is situated in Na Kha Subdistrict and classified as a medium size public health services provider which is responsible for 3,000-8,000. It is in charge of public health service for 5,112 people in Na Kha Subdistrict. The hospital is within a 7-kilometer range from the community following the central city planning criteria and standard (2006), so the hospital is appropriate and sufficient for providing people of the services. There were vulnerable groups of 1,217 people, i.e., the 0-5-year population of 261 people, the over 60-year population of 802 people, and disabled of 154 people in Na Kha Subdistrict. Ban Non Tum Subdistrict Health Promotion Hospital is approximately 19.71 km from Udon Thani Hospital (referral hospital cascade) with traveling time of about 30-40 minutes.

**Ban Na Kha Subdistrict Health Promotion Hospital** is classified as a medium size public health services provider which is responsible for 3,000-8,000. It is in charge of public health service for 5,078 people in Na Kha Subdistrict. The hospital is within a 7-kilometer range from the community following the central city planning criteria and standard (2006), so the hospital is appropriate and sufficient for providing people of the services. There were vulnerable groups of 1,431 people, i.e., the 0-5-year population of 288 people, the over 60-year population of 1,030 people, and disabled of 113 people in Na Kha Subdistrict. Ban Na Kha Subdistrict Health Promotion Hospital is approximately 20.0 km from Udon Thani Hospital (referral hospital cascade) with traveling time of about 30-40 minutes.

##### (b) Secondary Care

Within the study area, there are no a secondary care hospital and a tertiary care hospital. However, the nearest hospital to the project site is Udon Thani Hospital.

##### (c) Tertiary Care

Udon Thani Hospital is located in Mak Khaeng Subdistrict, Mueang Udon Thani District, and it is 162-bed size with occupancy rate of 68.83 beds, which is suitable for inpatient patients. The hospital is in charge of providing public health care services to people in Udon Thani Province.

The nearest public health service to the project location is Ban Na Kha Subdistrict Health Promotion Hospital, which is 6 kilometers away with travelling time of about 7 minutes.

## **(2) Healthcare Personnel in the Study Area**

### **(a) Ban Non Tum Subdistrict Health Promotion Hospital**

According to the data on healthcare personnel of primary care facilities in the study area as presented in **Table 3.3-4**, comparing it to healthcare personnel-to-patient ratio of the Ministry of Public Health, Ban Non Tum Subdistrict Health Promotion Hospital is adequate of healthcare personnel.

### **(b) Ban Na Kha Subdistrict Health Promotion Hospital**

According to the data on healthcare personnel of primary care facilities in the study area as presented in **Table 3.3-4**, comparing it to healthcare personnel-to-patient ratio of the Ministry of Public Health, Ban Na Kha Subdistrict Health Promotion Hospital is adequate of healthcare personnel.

### **(c) Udon Thani Hospital**

According to the data on proportion of healthcare personnel of Udon Thani Hospital as Presented In **Table 3.3-5**, it was found that the hospital is short on 1 physician and 1 dentist when compared to the criteria on number of healthcare personnel of the Twelfth National Economic and Social Development Plan. The criteria specify that physicians-population proportion should be 1:1,800, or equivalent to 222 physicians. Currently, there are 452 physicians, or equivalent to the physician-population proportion of 1:884. Therefore, there is a surplus of 1 physician. For the number of dentists, the criteria specify that proportion of dentists-population should be 1:1,800 or equivalent to 111 dentists. Currently, there are 21 dentists, or equivalent to the dentist-population proportion of 1:19,030, meaning that there is a shortage of 90 dentists. Moreover, the criteria specify that registered nurse-population proportion should be 1:300, or equivalent to 1,332 registered nurses. Currently, there are 1,237 registered nurses, or equivalent to the registered nurses-population proportion of 1:323, and the criteria specify that pharmacist-population proportion should be 1:2,300, or equivalent to 173 pharmacists. currently, there are 76 pharcists, or equivalent to the pharmacist-population proportion of 1:2,258.

**TABLE 3.3-4  
ADEQUACY OF HEALTHCARE PERSONNEL IN PRIMARY CARE FACILITIES**

Subdistrict	Responsible Health Facilities	Population	Registered Nurse		Public Health Technical Officer/ Public Health Officer		Thai Traditional Medical Doctor/ Public Health Officer (Thai Traditional Medicine)	
			Actual	Required (1:2,500) <sup>2/</sup>	Actual	Required (1:1,250) <sup>2/</sup>	Actual	Required (1:8,000) <sup>2/</sup>
Na Kha Subdistrict	Ban Non Tum Subdistrict Health Promotion Hospital	5,112 <sup>1/</sup>	/3 <sup>1</sup>	2 (Adequate: there is a surplus of 1 registered nurse)	3 <sup>1</sup>	3 (Adequate)	1 <sup>1</sup>	Not required
	Ban Na Kha Subdistrict Health Promotion Hospital	5,078 <sup>1/</sup>	/3 <sup>1</sup>	2 (Adequate: there is a surplus of 1 registered nurse)	/3 <sup>1</sup>	3 (Adequate)	/1 <sup>1</sup>	Not required

**Source :** 1/ HDC Report Ministry of Public Health, 2023 (Information retrieved on August 4th, 2023 from [www.hdcservice.moph.go.th](http://www.hdcservice.moph.go.th))

2/ Healthcare Personnel-to-patient ratio on Ministry of Public Health, 2022 (Registered Nurse (1:2,500), Public Health Technical Officer/Public Health Officer (1:1,250), Thai Traditional Medical Doctor/ Public Health Officer (Thai Traditional Medicine) (1:8,000), Public Health Technical Officer (Pharmacy)/ Pharmacy Technician (1:8,000))

**TABLE 3.3-5  
PROPORTION OF HEALTHCARE PERSONNEL TO POPULATION OF  
UDON THANI HOSPITAL OF THE YEAR 2022**

Personnel	Proportion of Healthcare Personnel to Population of the Year 2022			Sufficiency of Medical Personnel	
	Number (person) <sup>2/</sup>	Proportion to Population	Target of National Strategy <sup>1/</sup>	Required	Shortage/ Surplus
Population	399,642 <sup>3/</sup>	-	-	-	-
Physician	452	1:884	1: 1,800	222	Surplus 230
Dentist	21	1:19,030	1:3,600	111	Shortage 90
Registered Nurse	1,237	1:323	1:300	1,332	Shortage 95
Pharmacist	76	1:2,258	1:2,300	173	Shortage 97

**Source :** <sup>1/</sup> The National Strategy (2018-2037)  
<sup>2/</sup> Office of the Permanent Secretary, Ministry of Public Health, 2023 (Information retrieved on August, 4<sup>th</sup> 2023 from [www.hrold.moph.go.th](http://www.hrold.moph.go.th))  
<sup>3/</sup> HDC Report, Ministry of Public Health, 2023 (Information retrieved on August, 4<sup>th</sup> 2023 from [www.hdcservice.moph.go.th/](http://www.hdcservice.moph.go.th/))

### (3) Medical Durable Article List

**Udon Thani Hospital** (Tertiary care) According To The Data On Medical Durable Article List Of Udon Thani Hospital (GIS Health, Ministry of Public Health, 2023) Information Retrieved On August, 4<sup>th</sup> 2023 (from [www.gishealth.moph.go.th/](http://www.gishealth.moph.go.th/)) as follows:

- 4 CT Scans
- 2 MRIs
- 2 ESWLs
- 48 Ultrasounds
- 17 APDs
- 13 Ambulances

### (4) Health Status of People in the Study Area

- Cause of diseases and morbidity rate of outpatient visit data of subdistrict health promotion hospitals in the study area during 2018-2022, the top three diseases are (1) upper respiratory tract infection, (2) diseases of the circulatory system, and (3) diseases of connective tissue.

- Cause of diseases and morbidity rate of outpatient visit data of hospital in the study area during 2018-2022, the top three diseases are (1) diseases of the circulatory system, (2) upper respiratory tract infection, and (3) diabetes.

- The top three cause of diseases and morbidity rate of inpatients of hospital in the study area during 2018-2022 are (1) anemia or anaemia, (2) lens and cataract disorder, and (3) pneumonitis.

### 3.3.4 Indigenous People

Udon Thani Province was founded in 1893, and a large section of its population came from other regions to create towns. With the exception of the Ti Yor people, who settled in Wang Sam Mo and Si That Districts, and the Tai Puan people, who established a presence in Ban Phue District, indigenous populations are essentially non-existent.

The majority of the people of Mueang District, Udon Thani Province, are Thai, accounting for around 95% of the population. A small minority, on the other hand, consists of foreigners, including people of Chinese and Vietnamese descent, among others. (From "The Political Curtain Behind the Origin of "Udon Thani," Art and Culture, November 24, 2021. Retrieved August 18, 2023).

### 3.3.5 Physical and Cultural Heritage

Based on a site survey of archaeological sites, ancient monuments, and historical records in the project area and its surrounding areas, it has been identified that there are fourteen temples in close proximity. These temples are named as follows: Sangkhathaworn Temple, Pa Luang Temple, Khok Si Samran Temple, Pho Chai Temple (Ban Don Taeng), Pho Si Amphon Temple, Pa Kok Tan Temple, Amphanwan Temple, Pa Yan Kittikhum Temple, Pho Chai Temple, Phra That Suwannaram Temple, Malai Thong Suwannaram Temple, Tum Kham Temple, Patthanaram Temple, and Pa Nabun Chai Mongkhon Temple. All of these temples are located within a 3-kilometer radius from the project boundary.

## 3.4 HUMAN USE VALUE

### 3.4.1 Land Use

The secondary data on land use was collected from the Land Development Department, which was updated on 2022 and conclude data on the type and size of areas for each land use in the study area. For the land use along the Project's transmission line use was surveyed within 100-meter radius from the line during 13-16 October 2023.

#### (1) Land Use within the Study Area

The land use data within the study was divided in to 2 areas, namely within 300-meter radius and a radius of 0.3-3 kilometers of the project boundary that cover a total area of 2.73 and 4.25 square kilometers respectively. The details of land use within the study area are as follow:

- **Within a Radius of 300 Meters of the Project Boundary**

The collected data shows that the land use within a radius of 300 meters of the project boundary is divided into 4 main types: 1.88 km<sup>2</sup> of agricultural area, 0.13 km<sup>2</sup> of residential and community area, 0.08 km<sup>2</sup> of forest area and 0.64 km<sup>2</sup> of other area, as shown in **Figure 3.4-1** and **Table 3.4-1**. Details are as follows:

- Agricultural area is approximately 1.88 km<sup>2</sup>, representing 68.89% of the study area. It is the most common land use type in the study area. The agricultural area comprises paddy field with 1.66 km<sup>2</sup> (60.57%), field crop (corn) with 0.19 km<sup>2</sup>

(7.02%), perennial plant (para rubber) with 0.00 km<sup>2</sup> (0.16%), and livestock farm (poultry farm house) with 0.61 km<sup>2</sup> (22.34%).

- Forest area, which is disturbed deciduous forest, is approximately 0.08 km<sup>2</sup>, representing 2.89% of the study area.

- Residential and community area, which is institutional area, is approximately 0.13 km<sup>2</sup>, representing 4.67% of the study area.

- Other area is approximately 0.64 km<sup>2</sup>, representing 23.55% of the study area. There are idle land with 0.61 km<sup>2</sup> (22.34%), and water bodies with 0.03 km<sup>2</sup> (1.21%).

- **Within a Radius of 0.3-3 Kilometers of the Project Boundary**

The gathered data shows that the land use within a radius of 0.3-3 kilometers of the project boundary is divided into 4 main types: 27.21 km<sup>2</sup> of agricultural area, 4.91 km<sup>2</sup> of forest area, 3.41 km<sup>2</sup> of residential and community area and 4.72 km<sup>2</sup> of other land use, as shown in **Figure 3.4-1** and **Table 3.4-1**. Details are as follows.

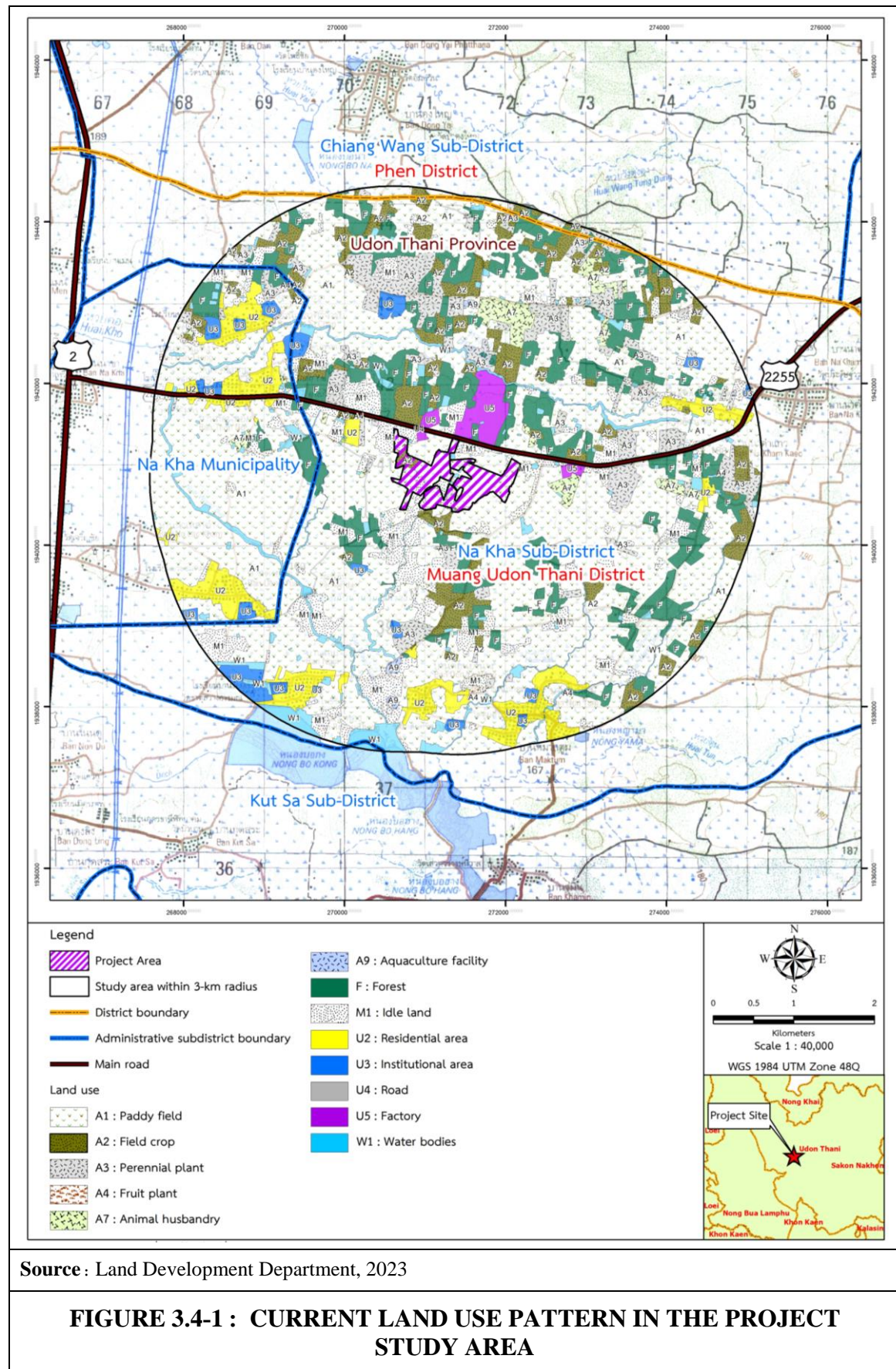
- Agricultural area is approximately 27.21 km<sup>2</sup>, representing 67.60% of the study area. It is the most common land use type in the study area. The agricultural area consists of paddy field with 21.19 km<sup>2</sup> (52.64%), field crop (corn) with 2.55 km<sup>2</sup> (6.33%), perennial plant (para rubber) with 2.75 km<sup>2</sup> (6.82%), Orchard with 0.05 km<sup>2</sup> (0.13%), livestock farm (poultry farm house) with 0.62 km<sup>2</sup> (1.54%), and aquaculture facility (Abandoned aquaculture land) with 0.05 km<sup>2</sup> (0.13%).

- Forest area, which is disturbed deciduous forest, is approximately 4.91 km<sup>2</sup> representing 12.20% of the study area.

- Residential and community area is approximately 3.41 km<sup>2</sup>, representing 8.46% of the study area, which comprises residential area with 2.23 km<sup>2</sup> (5.55%), institutional area with 0.75 km<sup>2</sup> (1.86%), road with 0.07 km<sup>2</sup> (0.17%), and factory with 0.36 km<sup>2</sup> (0.89%).

- Other area is approximately 4.72 km<sup>2</sup>, representing 11.73% of the study area. There are idle land with 3.19 km<sup>2</sup> (7.92%), and water bodies with 1.54 km<sup>2</sup> (3.82%).





**TABLE 3.4-1  
LAND USE IN THE STUDY AREA**

Land Use	Symbol	The study area	
		Square kilometer	Percentage
<b>Within a radius of 300 meters of the project boundary</b>			
<b>Agricultural area</b>	<b>A</b>		
- Paddy field	A1	21.19	52.64
- Field crop	A2	2.55	6.33
- Perennial plant	A3	2.75	6.82
- Livestock farm	A7	0.05	0.13
<b>Forest</b>	<b>F</b>		
- Forest	F	0.08	2.89
<b>Residential and community area</b>	<b>U</b>		
- Road	U4	0.02	0.84
- Factory	U5	0.10	3.83
<b>Other area</b>			
- Idle land	M1	0.61	22.34
- Water bodies	W1	0.03	1.21
<b>Total</b>		<b>2.73</b>	<b>100.00</b>
<b>Within a radius of 0.3-3 kilometers of the project boundary</b>			
<b>Agricultural area</b>	<b>A</b>		
- Paddy field	A1	21.19	52.64
- Field crop	A2	2.55	6.33
- Perennial plant	A3	2.75	6.82
- Orchard	A4	0.05	0.13
- Livestock farm	A7	0.62	1.54
- Aquaculture facility	A9	0.05	0.13
<b>Forest</b>	<b>F</b>		
- Forest	F2	4.91	12.20
<b>Residential and community area</b>	<b>U</b>		
- Residential area	U2	2.23	5.55
- Institutional area	U3	0.75	1.86
- Road	U4	0.07	0.17
- Factory	U5	0.36	0.89
<b>Other area</b>			
- Idle land	M1	3.19	7.92
- Water bodies	W1	1.54	3.82
<b>Total</b>		<b>40.25</b>	<b>100.00</b>

Source : Land Development Department, 2023

## (2) Land Use within 100-meter Radius from the Transmission Line Route

The survey result shows that the current land use along the 100-meter radius of the transmission line route is divided into 3 main types: (1) agricultural area (a total area of 0.307 km<sup>2</sup>), (2) residential and community area (a total area of 0.758 km<sup>2</sup>), and (3) other area (a total area of 0.991 km<sup>2</sup>), as shown in **Figure 3.4-2** and **Table 3.4-2**. Details are as follows.

- Agricultural area is approximately 0.307 km<sup>2</sup>, representing 14.94% of the study area. It is the most common land use type along the transmission line. The agricultural area consists of paddy field with 0.248 km<sup>2</sup> (12.04%), perennial plant (para rubber) with 0.026 km<sup>2</sup> (1.25%), orchard with 0.005 km<sup>2</sup> (0.24%), and Aquaculture facility with 0.029 km<sup>2</sup> (1.41%).

- Residential and community area is approximately 0.758 km<sup>2</sup>, representing 36.88% along the transmission line, which comprises commercial area with 0.400 km<sup>2</sup> (19.43%), residential area with 0.178 km<sup>2</sup> (8.65%), government office with 0.016 km<sup>2</sup> (0.76%), educational institution with 0.044 km<sup>2</sup> (2.16%), medical facilities with 0.020 km<sup>2</sup> (0.96%) and industrial area with 0.057 km<sup>2</sup> (2.75%).

- Other area is approximately 0.991 km<sup>2</sup>, representing 48.18% along the transmission line. There are idle land with 0.216 km<sup>2</sup> (10.52%), Wetland with 0.016 km<sup>2</sup> (0.76%), grove wood and shrub with 0.528 km<sup>2</sup> (25.69%), road with 0.193 km<sup>2</sup> (9.37%), and water bodies with 0.038 km<sup>2</sup> (1.85%).

According to the project's land use along the transmission line, most of the area are grove wood and shrub, commercial area, paddy field, and idle land. The land use with the proprietary rights along the project's transmission line is for temporary agriculture and building. There is no forest.

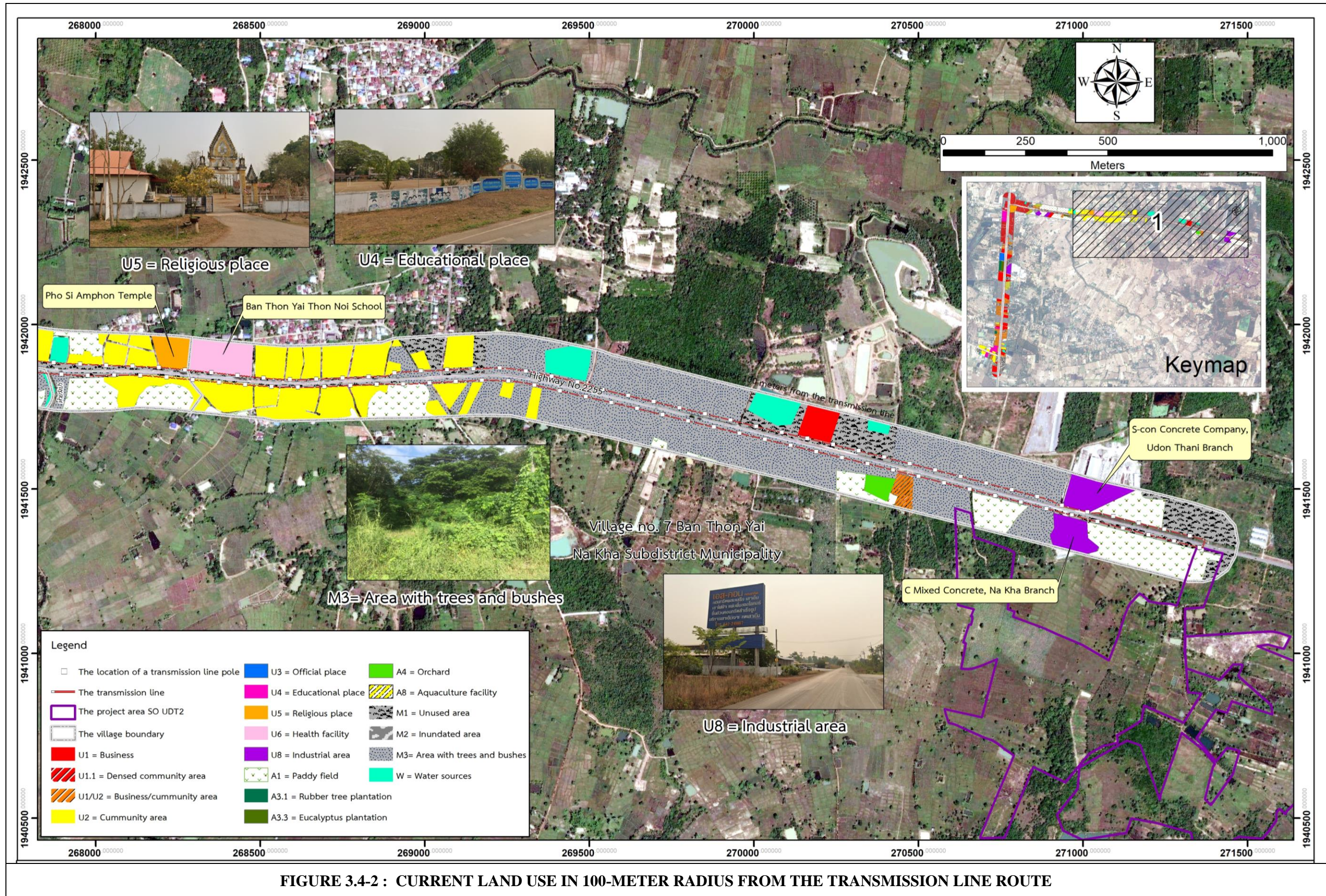
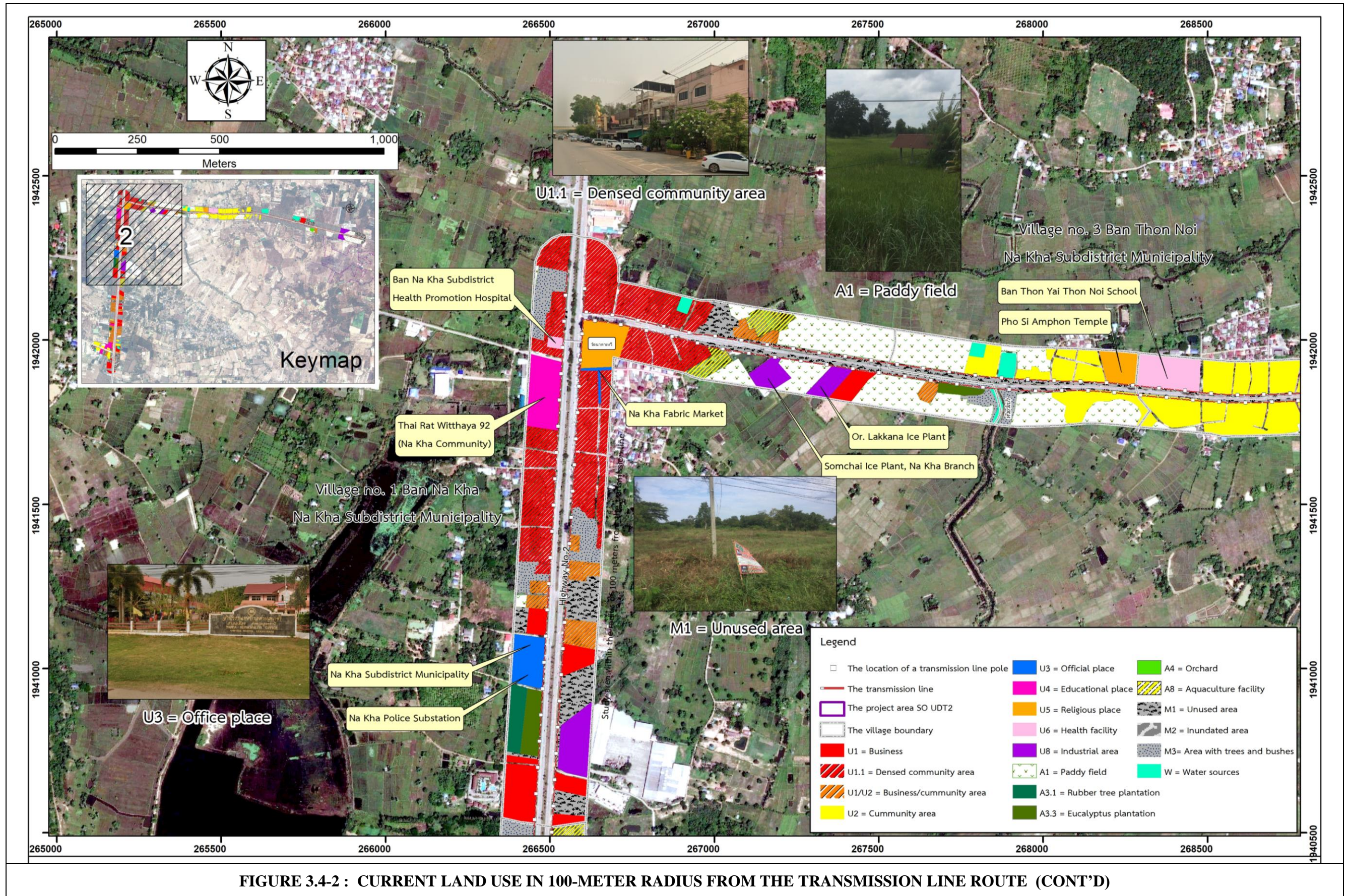


FIGURE 3.4-2 : CURRENT LAND USE IN 100-METER RADIUS FROM THE TRANSMISSION LINE ROUTE



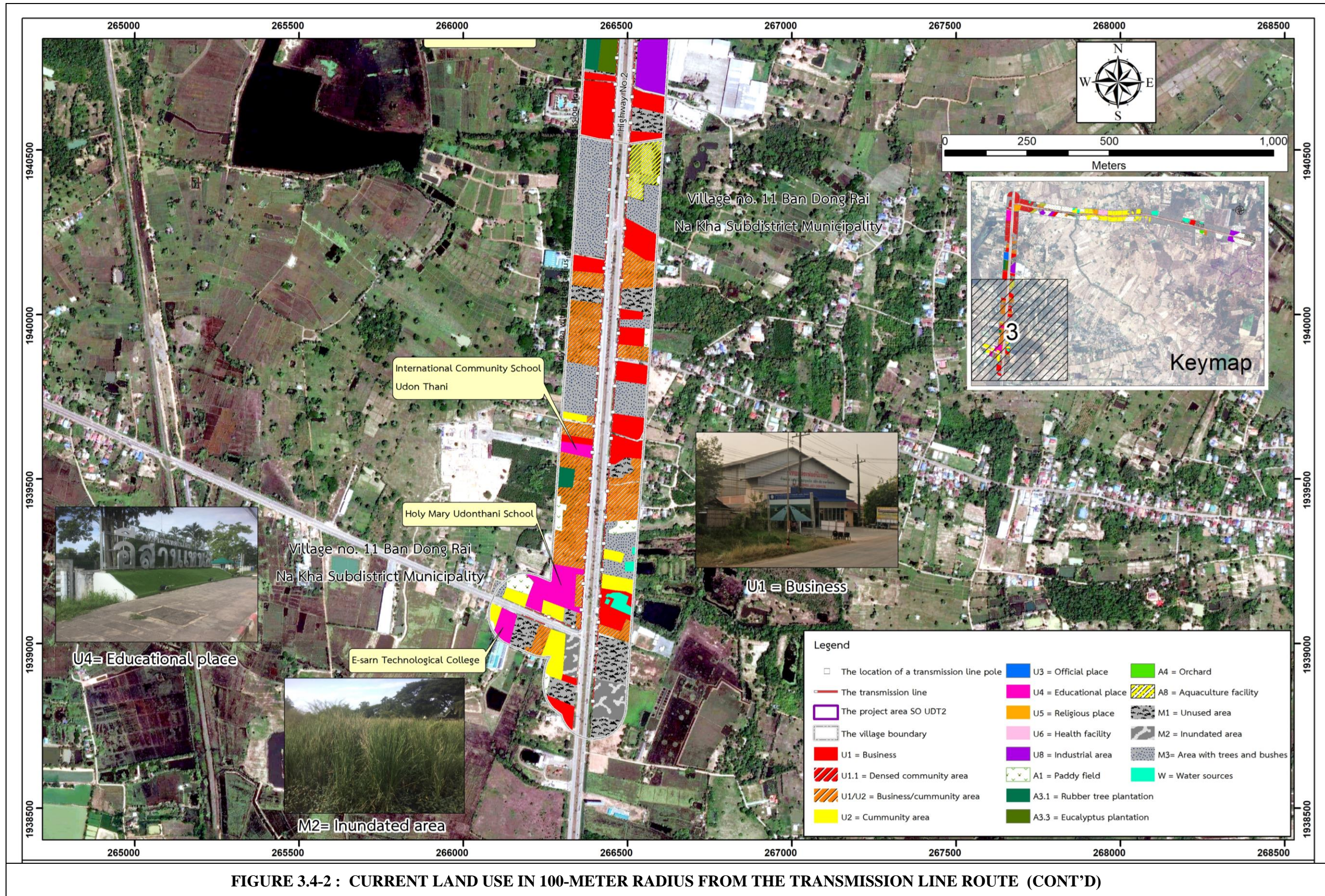


FIGURE 3.4-2 : CURRENT LAND USE IN 100-METER RADIUS FROM THE TRANSMISSION LINE ROUTE (CONT'D)

**TABLE 3.4-2**  
**LAND USE IN THE 100-METER RADIUS FROM**  
**THE TRANSMISSION LINE ROUTE**

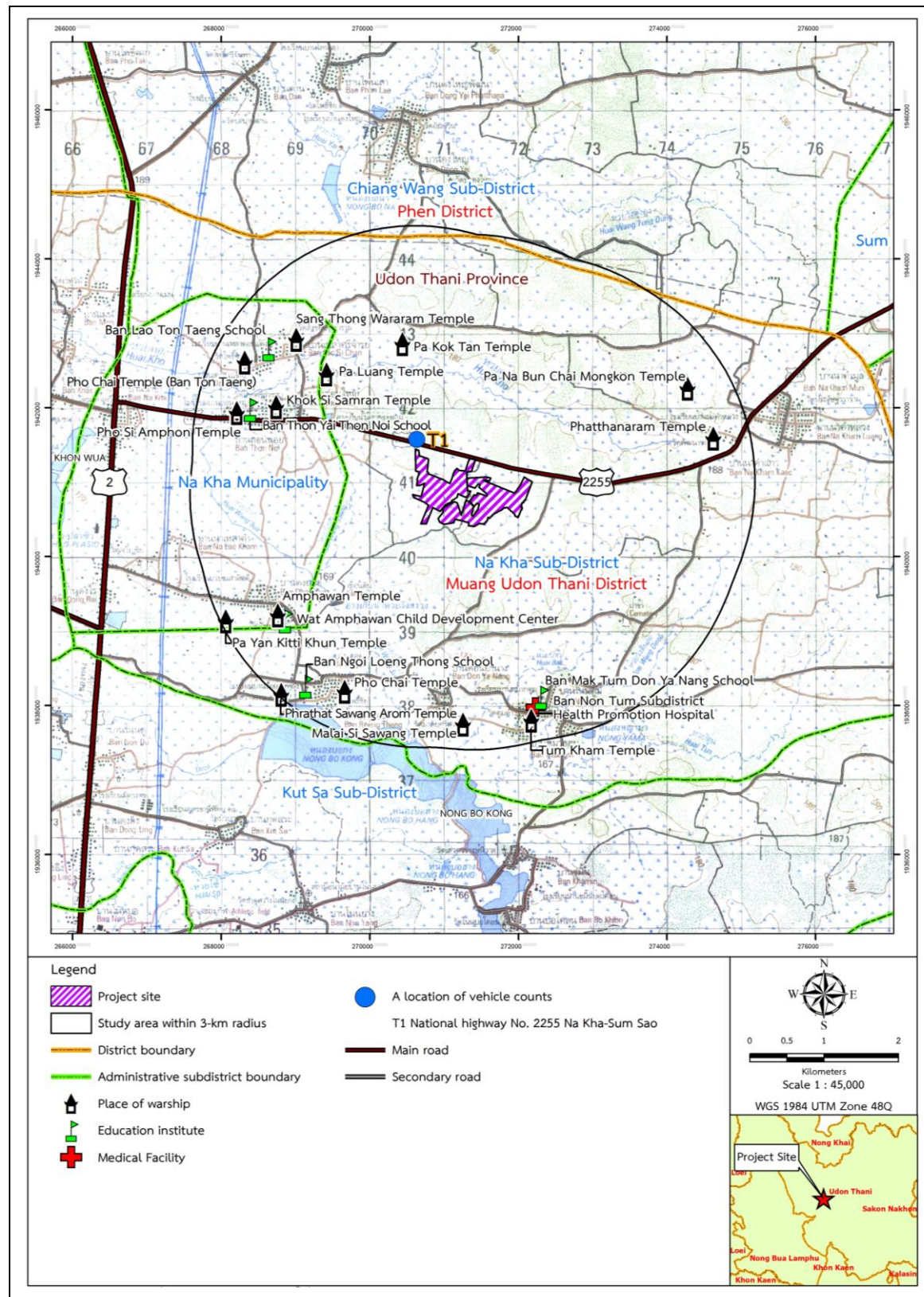
Land Use	Symbol	The study area	
		Square kilometer	Percentage
<b>Agricultural area</b>	<b>A</b>		
- Paddy field	A1	0.248	12.04
- Perennial plant	A3	0.026	1.25
- Orchard	A4	0.005	0.24
- Aquaculture facility	A8	0.029	1.41
<b>Residential and community area</b>	<b>U</b>		
- Commercial area	U1	0.400	19.43
- Residential area	U2	0.178	8.65
- Government office	U3	0.016	0.76
- Educational institute	U4	0.044	2.16
- Religious place	U5	0.044	2.16
- Medical facilities	U6	0.020	0.96
- Industrial area	U8	0.057	2.75
<b>Other area</b>			
- Idle land	M1	0.216	10.52
- Wetland	M2	0.016	0.76
- Grove wood, shrub	M3	0.528	25.69
- Road	R	0.193	9.37
- Water bodies	W	0.038	1.85
<b>Total</b>		<b>2.056</b>	<b>100.00</b>

### 3.4.2 Land Transportation

Transportation is focused on a land transportation network to facilitate travel convenience. Based on the study and survey access routes to the project site, the main transportation route is National Highway No. 2255 as shown in **Figure 3.4-3** with details as follows.

#### (1) National Highway No. 2255

Highway number 2255, Nakha-Sumsao road, is a major highway in Udon Thani province. It starts at Highway number 2, near Mu 1, Ban Nakha, Nakha sub-district, Mueang Udon Thani District, and ends at Highway number 2020, near Mu 1, Ban Sumsao, Sumsao sub-district, Phen District. The total distance is 22.031 kilometers. The road surface is asphalt and it has two lanes, one for each direction, with a width of 3.5 meters per lane.



Source : Base map is topographic map of the Royal Thai Survey Department, 2009

**FIGURE 3.4-3 : TRANSPORTATION ROUTES AT PHALANGAN RUNGREANG SOLAR POWER PLANT PROJECT**



## (2) Traffic quantity

Bureau of Highway Safety, Department of Highways, has classified vehicles into 12 types: (1) bicycle and tricycle, (2) heavy bus, (3) motorcycle and motor-tricycle, (4) light truck or pick up (4-wheel), (5) passenger car (<7 person), (6) medium truck (6 wheels), (7) passenger car with more than 7 persons, (8) heavy truck (10 wheels), (9) light bus, (10) semi trailer truck (more than 3 axles), (11) medium bus, and (12) full trailer truck (more than 3 axles). Each type of vehicles creates different impacts toward traffic. Thus, the sum of vehicle quantities of these 12 types is from a modification of vehicle units so they can be compared. The modification uses a passenger vehicle as a reference. An Amount of each vehicle types are converted from numbers of car/day to PCU/day, then multiply by a constant as shown in **Table 3.4-3**.

The traffic quantity data by the Bureau of Highway Safety, Department of Highways indicated statistics of the traffic volume of the Highway number 2255 (Nakha-Sumsao) in 2018-2022 from vehicle counts at a kilometer marker 9+500 location (as shown in **Figure 3.4-3**) as shown in **Table 3.4-4**.

A total of the traffic quantity at the Highway number 2255 (Nakha-Sumsao) between 2018 and 2022 was 4,544 3,969 4,651 4,328 and 5,278 cars/day, respectively. Three highest proportions of the vehicles were a light truck or pick up, passenger car (<7 person), and motorcycle.

**TABLE 3.4-3**  
**UNIT CONVERTER OR PASSENGER CAR EQUIVALENTS (PCES)**  
**FOR EACH TYPE OF VEHICLES**

Vehicle type	Passenger Car Equivalents (PCEs)
Motorcycle	0.33
Bi+Tri Cycle	0.25
Passenger Car < 7 Person	1.0
Passenger Car > 7 Person	1.0
Light Bus	1.5
Medium Bus	1.5
Heavy Bus	2.1
Light Truck or Pick up	1.0
Medium Truck (6 wheels)	1.5
Heavy Truck (10 wheels)	2.5
Full Trailer	2.5
Semi Trailer	2.5

**Source :** A report on an analysis of traffic congestion index calculation and traffic density in 2020. Bureau of Highway Safety, Department of Highways, 2021

**TABLE 3.4-4**  
**TRAFFIC QUANTITY ON THE NATIONAL HIGHWAY NO. 2255 AT A KILOMETER MARKER 9+500**  
**(NAKHA-SUMSAO) IN 2018-2022**

Type	PCEs	Traffic quantity									
		2018		2019		2020		2021		2022	
		Cars/ day	PCU/ day	Cars/ day	PCU/ day	Cars/ day	PCU/ day	Cars/ day	PCU/ day	Cars/ day	PCU/ day
Passenger Car (< 7 Person)	1.00	1,057	1,057	852	852	956	956	867	867	1,151	1,151
Passenger Car > 7 Person)	1.00	380	380	367	367	229	229	190	190	492	492
Light Bus	1.50	17	26	12	18	37	56	28	42	48	72
Medium Bus	1.50	19	29	8	12	22	33	26	39	11	17
Heavy Bus	2.10	48	101	44	95	29	61	43	90	18	38
Light Truck or Pick up	1.00	1,945	1,945	1,691	1,691	2,101	2,101	1,918	1,918	2,060	2,060
Medium Truck	1.50	186	279	151	227	162	243	195	293	216	324
Heavy Truck	2.50	98	245	80	200	91	228	127	318	129	323
Full Trailer	2.50	103	258	58	145	66	165	74	185	72	180
Semi Trailer	2.50	58	145	60	150	40	100	43	108	12	30
Bi+Tri Cycle	0.25	37	9	40	10	20	5	41	10	16	4
Motorcycle	0.33	596	197	606	200	898	296	776	256	1,053	347
<b>Total</b>		<b>4,544</b>	<b>4,669</b>	<b>3,969</b>	<b>1,964</b>	<b>4,651</b>	<b>4,472</b>	<b>4,328</b>	<b>4,315</b>	<b>5,278</b>	<b>5,037</b>

**Remark :** Traffic quantity (cars/day) based on 12-hour continuous counting

**Source :** A report on traffic quantity 2018-2022, Bureau of Highway Safety, Department of Highways

### (3) Traffic Conditions

An assessment of existing traffic quantity on the National Highway No. 2255 (Nakha-Sumsao) at a kilometer marker 9+500 location is shown as **Table 3.4-5** with following summaries.

- Rush hours. The 2018-2022 traffic quantity was 467 397 448 432 and 504 PCU/hr respectively and the traffic flow was excellent (V/C ratio was 0.21 0.18 0.20 0.19 and 0.23, respectively).
- Regular hours. The 2018-2022 traffic quantity was 409 232 261 252 and 294 PCU/hr respectively and the traffic flow was excellent (V/C ratio was 0.18 0.10 0.12 0.11 and 0.13, respectively).

**TABLE 3.4-5**  
**ESTIMATION OF EXISTING TRAFFIC CONDITION ON THE NATIONAL**  
**HIGHWAY NO. 2255 AT A KILOMETER MARKER 9+500**  
**(NAKHA-SUMSAO)**

Road	Year	Vehicle quantity (PCU/hr)	Traffic condition	
			V/C Ratio <sup>1/</sup>	Traffic condition
<b>Rush hours</b>				
<b>National Highway No. 2255</b>	2018	467	0.21	Excellent flow
	2019	397	0.18	Excellent flow
	2020	448	0.20	Excellent flow
	2021	432	0.19	Excellent flow
	2022	504	0.23	Excellent flow
<b>Regular hours</b>				
<b>National Highway No. 2255</b>	2018	409	0.18	Excellent flow
	2019	232	0.10	Excellent flow
	2020	261	0.12	Excellent flow
	2021	252	0.11	Excellent flow
	2022	294	0.13	Excellent flow

**Remark :** 1/ V/C Ratio is vehicle quantity divided by roadway carrying capacity to accommodate vehicles at one time  
**Source :** Fourtier Consultants Co., Ltd., 2023

### 3.4.3 Water Use

Collect secondary data from related documents or reports, such as data from the Udon Thani Provincial Waterworks Authority, Development Plan Fiscal year 2022-2023, local development plan (2023-2027) of Nihom Songkhro and Khok Sa-at Sub-districts, Mueang Udon Thani District, Udon Thani Province.

The Udon Thani Provincial Waterworks Authority has 4 offices, consisting of the Udon Thani Provincial Waterworks Authority, Provincial Waterworks Authority-Kumphawapi Branch, Provincial Waterworks Authority-Ban Phue Branch and the Provincial Waterworks Authority-Ban Dung Branch. They are in the responsibility area of the Provincial Waterworks Authority Region 7. The information on water users can be summarized as follows:

- Provincial Waterworks Authority, Udon Thani Branch - in 2023, there were a total of 88,639 tap water users, of which active capacity 93,600 cubic meters/day. The amount of water produced was 3,334,110 cubic meters/month.
- Provincial Waterworks Authority, Kumphawapi Branch - in 2023, there were a total of 16,883 tap water users, of which active capacity 22,560 cubic meters/day. The amount of water produced was 358,036 cubic meters/month.
- Provincial Waterworks Authority, Ban Phue Branch - in 2023, there were a total of 9,568 tap water users, of which active capacity 8,568 cubic meters/day. The amount of water produced was 203,676 cubic meters/month.
- Provincial Waterworks Authority, Ban Dung Branch - in 2023, there were a total of 10,797 tap water users, of which active capacity 11,750 cubic meters/day. The amount of water produced was 219,587 cubic meters/month.

The project area is located in Na Kha Subdistricts, Mueang Udon Thani District, Udon Thani Province.

Within the Nakha Sub-district Administrative Organization, there are a total of 23 water sources, including streams, ponds, canals, and marshes. There are also 35 public wells. The important water sources include Bor Kong pond, Bor Kob pond, Dong Rai tributary, Don Wua pond, Phak tributary, and Sang Phrai pond. The water supply services in the village rely on the community water supply, but the water is not sufficient, so they need to use water from other sources such as reservoirs or small-sized water sources that have not been properly filtered. Additionally, there are some households that use regional water supply, with water pipes passing through various villages, including Ban Ngoy, Village no. 2, Ban Leung Thong, Village no. 14, Ban Don Yanang, Village no. 5, Ban Notum, Village no. 4, and Ban Mak Tum, Village no. 16, which are located along the main road.

In Nakha Subdistrict Municipality, there are important water sources include Don Voa pond, Sok Kayom pond, Sa Luang pond, Bong Man tributary, Na Wha tributary, Wang Bua tributary, Pram tributary and Wang Saew tributary. These water sources often problems of drought or become stagnant during the dry season, making them unable to be used for agricultural purposes. Natural surface water sources and man-made water sources, such as public ponds, public wells, household surface water ponds, and community water supply systems, are still insufficient to meet the needs of the population. Nakha Sub-district Municipality has a water supply system that serves all villages. However, it issues regarding

the quantity of water during the dry season and the water quality is not up to par in terms of taste, such as having a salty taste. Except for some communities that receive services from the regional water supply, which ensures an adequate and standardized quantity and quality of water for consumption.

#### 3.4.4 Electricity Use

The Provincial Electricity Authority (PEA), Udon Thani Province, is responsible for Provincial Electricity Authority Main Branch as follows.

- Provincial Electricity Authority, Phen District Branch
- Provincial Electricity Authority, Phanom Thuan District Branch
- Provincial Electricity Authority, Ban Phue District Branch
- Provincial Electricity Authority, Nong Wua So District Branch
- Provincial Electricity Authority, Kut Chap District Branch
- Provincial Electricity Authority, Udon Thani Branch

The total capacity of electricity distribution for all PEA branches is 69.77 MW/day, serving 77,235 people. The majority of users are households (67,941 total). Electricity is available to 100% of households in Na Kha Subdistrict Municipality, where the Project is located.

#### 3.4.5 Solid Waste and Wastewater Management

According to data on community trash management in Udon Thani Province in 2021, 1,830,419 tons of waste are produced annually in the province. 1,221,034 tons were recycled or utilized, leaving 609,386 tons for disposal. Incorrect disposal procedures were employed for 51% of the waste intended for disposal, with only 49% properly disposed of. The total amount of waste correctly landfilled was 177,054 tons, with 61,174 tons and 44,676 tons processed into compost and RDF (Refuse-Derived Fuel), respectively.

Solid waste management reported in Udon Thani Provincial Development Plan Fiscal year 2023-2027, Udon Thani province has a total of 73 waste disposal sites. The amount of waste entering these sites is 581 tons/day. There were 4 waste disposal sites that properly operated, with a waste input of 360 tons/day. However, there were 69 waste disposal sites that dispose of waste improperly, with a waste input of 221 tons/day. The accumulated amount of waste remaining at the waste disposal sites in the year 2020 was 1,613 tons.

The Project is located in Na Kha Subdistrict does not currently have a waste disposal system in place. The predominant method used for waste management is landfill. The subdistricts manage waste by transporting it to a municipal waste disposal center of the Udon Thani City Municipality located in Nong Na Kham Subdistrict, Mueang Udon Thani District, covering an area of 296 rai (approximately 118.4 acres) for waste disposal and 60 rai (approximately 24 acres) for waste landfilling. In 2021, 51 local government organizations and private sector entities are bringing their waste to this disposal site for processing.

### 3.4.6 Disaster Prevention and Mitigation

There are 3 organizations responsible for disaster prevention and mitigation near the study area. Based on the study of disaster prevention and mitigation data from local administrative organizations in the area, can be summarized as the following:

(1) Na Kha Sub-district Administrative Organization is approximately 2.71 kilometers away from the Project area. Currently, there are 2 general employees, 44 civil defense volunteers. They possess 1 water truck with a capacity of 6,000 liters and 1 fire pump.

(2) Na Kha Subdistrict Municipality is approximately 4.14 kilometers away from the Project area. Currently, there are 1 disaster prevention officer, 1 employee employed by the mission, 8 general employees, 27 civil defense volunteers. They possess 2 water trucks with a capacity of 8,000 liters and 12,000 liters and 1 fire fighting truck with water nozzle, a capacity of 4,000 liters.

(3) Chiang Wang Sub-district Administrative Organization is approximately 10.82 kilometers away from the Project area. Currently, there are 2 disaster prevention officers, 2 employee employed by the mission, 4 general employees, 52 civil defense volunteers. They possess 2 water trucks with a capacity of each 8,000 liters.

## **CHAPTER 4**

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# **ASSESSMENT OF ENVIRONMENTAL AND SOCIAL IMPACT AND RISKS**

## CHAPTER 4

### ASSESSMENT OF ENVIRONMENTAL AND SOCIAL IMPACT AND RISKS

#### 4.1 SCOPE AND METHODOLOGY OF IMPACT ASSESSMENT

##### 4.1.1 Scope

All components located in the project area and associated facility as transmission line installed from the project to the specified substation, are included in the project components that define the range of environmental and social factors assessed in IEE. Furthermore, the following environmental resource/value impacts were analyzed for each step of project implementation:

##### (1) Construction Phase

During the construction phase, there will be land clearing, construction of utilities and offices. The construction of all project components will be done according to construction schedule that takes seasonal constraint into consideration. Major impact will be those associated with construction activities.

##### (2) Operation Phase

After construction works finish, all equipment will be installed and commissioning will be conducted, then, commercial operation of project starts.

##### 4.1.2 Methodology for Impact Assessment and Evaluation

The approach used to assess environmental and social impacts of the project determines the intensity, extent, and duration of the anticipated potential positive or negative impact. These three qualifiers are grouped under one synthesis indicator, the significance of the impact.

The generic definitions which will be used for determination of impact significance are as follows;

- **Insignificant:** At this level, the activities or outcomes from the project development do not cause changes or effects, both directly and indirectly, on natural resources or environment and social. The environmental condition continues with normal function.
- **Low:** At this level, the activities or outcomes from the project development cause effects or benefits to the environment and social for a short time and the scope of the impacts is limited to only some areas of the project. The effect time is short and reversible naturally, or the changes are within the standard or naturally acceptable level. The impact may cause psychological effects on people, such as disturbance. This level of



environmental and social impact may be corrected with certain mitigation measures or require no measures at all.

- **Moderate:** At this level, the activities or outcomes from the project development cause moderate impacts or benefits to the environment compared to the standard. The affected area is relatively wide, but limited within the project area. The activities occur at several stages of the project and the effects take a long time, yet impermanently. Some activities affect natural resources, people's health, and social, but not at the life-threatening level. Certain mitigation measures can reduce the impact.

- **High:** At this level, the activities or outcomes from the project development cause impacts or benefits to the environment at a greater level than the standard or cause changes to natural resources, environment, and social severely or permanently. The effects are widespread to people outside at a life-threatening level. Mitigation measures cannot reduce the impact or make such affected natural resources to their original condition.

It should be noted that the environmental impact from the project can be either positive or negative. The results will be compared to the standard or normal value to identify that the level is high, moderate, low, or no / insignificant impact.

## 4.2 SOLAR POWER PLANT

### 4.2.1 Physical Conditions

#### 4.2.1.1 Air Quality

##### (1) Construction Phase

The activities during the construction phase that cause air pollution in the form of particulate matter include preparing the area for solar panel installation, constructing buildings, and various public utility systems, as well as transportation activities. Assessing the quantity of particulate matter generated involves several factors, including weather conditions, soil composition, construction practices, wind speed, and more.

Based on the study in the document, AP-42: Compilation of Air Pollution Emissions Factors (U.S. EPA, 1995). It was found that construction work on soil with a moderate activity level, containing 30% silt, and having a precipitation evaporation index of approximately 50%, will have an emission rate of particulate matter averaging 1.2 tons/acre/month, or 9.88 g/m<sup>2</sup>/day.

Therefore, consulting companies use this data to estimate the dispersion of particulate matter from construction activities during the project's construction phase. This estimation can be determined using a Box Model to calculate the particulate matter concentration.

$$C = Q/dWM$$

Where; C = The concentration of particulate matter (mg/m<sup>3</sup>)

Q = The emission of particulate matter (mg/s)

- d = The width of the construction area (perpendicular to the direction of the wind is 80 m)
- W = Wind speed (m/s), the minimum average wind speed selected from the meteorological monitoring station in Udon Thani during the 30-year period from 1993-2022 is 1.7 knots or 0.87 m/s.
- M = The mixing height, which is the height of the atmosphere where pollutants are mixed with the air. According to the study by Tachai Sumittra (1984), the Mixing Height is equal to 1,419 m.

To estimate the particulate matter (PM) emissions based on the given values of Q, which is approximately 1.2 tons per acre per month or 9.88 g/m<sup>2</sup>/day, for an area of approximately 3,867.3 m<sup>2</sup>, and considering 8 hours of work per day for construction activities related to buildings, public utility systems, and other areas, the calculation as follows:

$$Q = \frac{9.88 \text{ g/m}^2/\text{day} \times 3,867.3 \text{ m}^2 \times 1,000 \text{ mg}}{8 \text{ hr/day} \times 60 \text{ s} \times 60 \text{ s}}$$

$$= 1,326.70 \text{ mg/s}$$

Therefore, the particulate matter emissions (Q) is 1,326.70 mg/s that used to estimate the concentration of particulate matter from construction activities related to buildings, public utility systems, and other areas, the calculation as follows:

$$C = \frac{1,326.70 \text{ mg/s}}{80 \text{ m} \times 0.87 \text{ m/s} \times 1,419 \text{ m}}$$

$$= 0.013 \text{ mg/m}^3$$

The quantity of particulate matter (PM) generated from the construction activities of the project is approximately 0.013 mg/m<sup>3</sup>, which is within the air quality standards specified by the National Environmental Committee's Announcement No. 24 (B.E. 2547). This announcement sets the limit for the average 24-hour total suspended particulate (TSP) concentration at not exceeding 0.33 mg/m<sup>3</sup>.

Moreover, the characteristics of PM emissions indicate that they occur within a short time frame, primarily falling near the source or within a range of 6-9 m from the construction area. To mitigate the dispersion of particulate matter and reduce its impact on nearby residential areas, the project has implemented measures such as spraying water on the construction area and the entrance road. As a result, the impact on air quality due to construction activities is at a low level.

## (2) Operation Phase

During the implementation of the solar power generation project, there will be no sources of continuous air pollution from the project operations. No air pollution impact during operation phase is anticipated.

#### 4.2.1.2 Noise

##### (1) Construction Phase

###### (a) Noise Sources

Construction is divided into two parts: solar panel installation activities and construction activities within the electrical substation area. The details of the noise sources are as follows:

- **The solar panel installation activities** will utilize an area of approximately 452,533.1 square meters, which is equivalent to 62.07% of the project area. For this part of the project, a screw pile foundation method will be employed, using an excavator pile driver to drive the steel piles into the ground, with each pile being driven to a depth of approximately 2 meters. The noise generated during this process will be short-lived and temporary.

- **The construction activities in the power station building area:** The electrical control building, storage area for parts/equipment, maintenance area, switchyard, substation, and other areas (pond, existing drain) collectively cover an area of approximately 3,867.3 square meters, which represents 0.53% of the total project area

The construction activities are divided into three main activities: 1) Site preparation, 2) Foundation and pile construction, and 3) Building and public utility system construction.

The construction of the project will mainly occur in different activities, and they will not take place simultaneously in each area. However, when assessing the impact of noise during the construction phase of the project, the evaluation will consider the types of machinery used in the construction activities in each specific area. It will also summarize the categories of machinery and equipment and their maximum noise levels at a distance of 10 meters from the machinery and equipment. These categories will be classified based on the construction activities of the project. Detailed information is provided in **Table 4.2-1**.

###### (b) Sensitive Area and Results of Noise Level Measurements

The surrounding area of the project site is predominantly agricultural land. Upon inspection of the environmentally sensitive areas within the study area, it was found that there are 38 residential houses located within 300 meters from the project site boundary. The consulting company has selected the houses located to the southwest and east, which are closest to the project area, as representative receptors of noise impacts. The details are as follows:

- **The Houses Located to the Southwest**

The houses located to the southwest are situated adjacent to the project area to the southwest. They are approximately 20 meters away from the construction activity of the solar panel installation (pile driving). Furthermore, they are approximately 996 meters away from the construction activity in the power station building area.

**TABLE 4.2-1**  
**THE NOISE LEVELS OF MACHINERY AND EQUIPMENT USED IN**  
**CONSTRUCTION ACTIVITIES**

Noise sources	Maximum noise levels at a distance of 10 meters from the machinery dB(A) <sup>1/</sup>	The number of main machinery used
1. The construction activity of solar panel installation		
- Excavator Pile Driver	79.0	1
- Generator (4.5 KW)	66.0	1
2. The construction activity in the area of the power station building		
2.1 Site preparation		
- Tracked Excavator	79.0	1
- Dozer	80.0	1
- Compactor	78.0	1
- Dump Truck	81.0	1
2.2 Foundation and pile construction		
- Hydraulic Hammer Rig	89.0	1
- Concrete Mixer Truck	80.0	1
2.3 Building and public utility system construction		
- Tracked Excavator	79.0	1
- Concrete Mixer Truck	80.0	1
- Cranes	82.0	1
- Dump Truck	81.0	1

**Remark :** <sup>1/</sup> The noise levels of machinery and equipment at a distance of 10 meters from the source are referenced from Department of Environment Food and Rural Affairs, Update of Noise Database for Prediction of Noise on Construction and Open sites, 2005

- **The Houses Located to the East**

The houses located to the east are situated adjacent to the project area to the east. They are approximately 43 meters away from the construction activity of the solar panel installation (pile driving). Furthermore, they are approximately 870 meters away from the construction activity in the power station building area.

**(c) The assessment of the noise impact from the construction activities of the project**

The activities that generate loud noise of the project are scheduled to be carried out between 08:00-17:00. During the entire working hours, the machinery and equipment that produce the loud noise do not operate continuously. The noise level assessment is based on the average working time of machinery and equipment, which is only 4 hours. Therefore, the calculated noise level is adjusted to the average noise level during the desired time period, as shown in **Equation (1)**.

$$Leq_T = L_p + 10 \log \frac{t}{T} \quad \text{_____ (1)}$$

Where;  $Leq_T$  = Noise level occurring at a time (T), dB(A)  
 $L_p$  = Noise level from the source, dB(A)  
 $t$  = Duration of noise from noise source, hr.  
 $T$  = Duration of noise needed to be known, hr.

Once the noise levels from the machinery operation are known, they will be used to calculate the noise levels at the receptors, which is the cumulative noise level from the project's operations added to the current noise level. In this assessment, the maximum 24-hour average noise level ( $Leq_{24 \text{ hr}}$ ) measured in the vicinity of the project area will be used as a representative value for the noise level at community.

For combining noise levels, the energy-based summation equation will be used in the calculations as shown in **Equation (2)**:

$$L_{p_{Total}} = 10 \log \left( \sum_{i=1}^n 10^{L_{p_i}/10} \right) \quad \text{_____ (2)}$$

Where;  $L_{p_{Total}}$  = Total noise level, dB(A)  
 $L_{p_i}$  = Noise level from each source, dB(A)  
 $n$  = The number of noise sources

The noise level generated from the Project's construction activities attenuated through various distances can be calculated by using **Equation (3)**.

$$L_{p_2} = L_{p_1} - 20 \log (r_2/r_1)$$

Where,  $L_{p_1}$  = Noise level measured at the distance  $r_1$  from the source, dB(A)  
 $L_{p_2}$  = Noise level measured at the distance  $r_2$  from the

source, dB(A)

$r_1, r_2$  = Distance from the source measured at  $L_{p1}$  and  $L_{p2}$  respectively

The assessment of noise levels from the construction activities of solar panel installation and the construction activities in the power station building area is detailed as follows:

**(i) The construction activity of solar panel installation.**

The main activity that generates noise is the act of driving steel piles, which involves using a pile driver with a sound level of 79.0 dB(A). While a generator is used for areas without electricity and for short periods, such as providing power for electric cutting or welding machines with a sound level of 70.0 dB(A). Thus, the main machine that generates noise is the excavator pile driver. The machine is used at each pile-driving point, and the average maximum duration of machine use at each point does not exceed 1 hour. When calculating the average noise level over an 8-hour working day using **Equation (1)**, it will have a value of 70.0 dB(A).

When considering the impact of noise over a 24-hour average period, the calculation for the 24-hour average noise level (Leq 24 hr) as follows:

$$L_p \text{ solar panel installation} = 70.0 + 10 \log (8/24) = 56.2 \text{ dB(A)}.$$

Therefore, the 24-hour average noise level (Leq 24 hr) from the solar panel installation activity (the pile driving) is 56.2 dB(A).

**(ii) The construction activity in the area of the power station building** is divided into three phases: 1) Site preparation, 2) Foundation and pile driving construction, and 3) Building and public utility systems construction. Summarizing the noise levels for each activity:

- **Site preparation;** The machinery used consists of four types: excavator, bulldozer, grader, and dump truck, with noise levels of 79.0, 80.0, 78.0, and 81.0 dB(A), respectively. These machines are each used for an average of approximately 4 hours in each activity. When calculating the average noise level over an 8-hour working day using Equation (1), the values are 76.0, 77.0, 75.0, and 78.0 dB(A), respectively.

Combining the noise levels of all the machinery operating for 8 hours simultaneously, calculated using **Equation (2)**, will result in a value of 82.7 dB(A). When considering the impact of noise over a 24-hour average period, the calculation for the 24-hour average noise level (Leq 24 hr) using **Equation (1)**, as follows:

$$L_p \text{ Site preparation} = 82.7 + 10 \log (8/24) = 77.9 \text{ dB(A)}$$

Therefore, the 24-hour average noise level (Leq 24 hr) from site preparation is 77.9 dB(A).

- **Foundation and pile construction;** The machinery used consists of two types: a pile driver truck and a concrete mixer truck, with noise levels of 89.0 and 80.0 dB(A), respectively. These machines are each used for an average of approximately 4 hours in each activity. When calculating the average noise level over an 8-hour working day using **Equation (1)**, the values are 86.0 and 77.0 dB(A), respectively.

Combining the noise levels of all the machinery operating for 8 hours simultaneously, calculated using **Equation (2)**, will result in a value of 86.5 dB(A). When considering the impact of noise over a 24-hour average period, the calculation for the 24-hour average noise level (Leq 24 hr) using Equation (1), as follows:

$$L_p \text{ Foundation and pile construction} = 86.5 + 10 \log (8/24) = 81.7 \text{ dB(A)}$$

Therefore, the 24-hour average noise level (Leq 24 hr) from foundation and pile construction is 81.7 dB(A).

- **Building and public utility system construction;** The machinery used consists of four types: an excavator, a concrete mixer truck, a crane, and a truck, with noise levels of 79.0, 80.0, 82.0, and 81.0 dB(A), respectively. These machines are each used for an average of approximately 4 hours in each activity. When calculating the average noise level over an 8-hour working day using **Equation (1)**, the values are 76.0, 77.0, 79.0 and 78.0 dB(A), respectively.

Combining the noise levels of all the machinery operating for 8 hours simultaneously, calculated using **Equation (2)**, will result in a value of 83.7 dB(A). When considering the impact of noise over a 24-hour average period, the calculation for the 24-hour average noise level (Leq 24 hr) using **Equation (1)**, as follows:

$$L_p \text{ Building and public utility system construction} = 83.7 + 10 \log (8/24) = 78.9 \text{ dB(A)}$$

Therefore, the 24-hour average noise level (Leq 24 hr) from building and public utility system construction is 78.9 dB(A).

### **(iii) Summarizing the assessment of the expected noise levels from the overall construction activities**

From the results of the noise level predictions from all construction activities, it is found that the maximum sound level at a distance of 10 meters from the construction site during an 8-hour working period ranges from 75.0 to 86.5 dB(A). Meanwhile, the 24-hour average noise level (Leq 24 hr) at a distance of 10 meters from the noise source ranges from 71.2 to 81.7 dB(A). Details are presented in **Table 4.2-2**.

For the construction activities in the area of the power station building, the consulting company has used the noise levels from the foundation and pile activities, with an average noise level over 24 hours reaching a maximum of 81.7 dB(A), and the noise levels from the construction activities of solar panel installation (pile driving), with an average noise level over 24 hours reaching 56.2 dB(A), as representatives of the noise levels for each construction activity. These values are used for assessing the noise impacts.

**TABLE 4.2-2  
NOISE LEVEL PREDICTIONS FROM CONSTRUCTION ACTIVITIES  
OF THE PROJECT**

Construction activities	Noise level at 10 m from the noise sources (dB(A))	
	Leq 8 hr	Leq 24 hr
1. The construction activity of solar panel installation	70.0	<b>56.2</b>
2. The construction activity in the area of the power station building		
2.1 Site preparation	82.7	77.9
2.2 Foundation and pile construction	86.5	<b>81.7</b>
2.3 Building and public utility system construction	83.7	78.9

**(iv) Predicting the sound levels from construction activities at various distances.**

The assessment of noise impact from construction activities using the 24-hour average noise level (Leq 24 hr) that attenuates with various distances, as calculated according to **Equation (3)**. Subsequently, this noise level is combined with the maximum noise level measured at sensitive areas between 6-11 June 2023 and 2-9 November 2023, calculated using **Equation (2)**. The summarizing of the noise levels from construction activities, which are added to the results of the 24-hour average noise level measurements (Leq 24 hr), as presented in **Table 4.2-3** and **Table 4.2-4**.

- **24-hour average noise level**

**The houses located in the southwest direction**, is impacted by noise levels from the construction activity of solar panel installation (pile driving) at a distance of 20 meters from the source to the community, with a maximum level of 50.2 dB(A). When combined with the measured noise levels, the highest overall noise level is 61.3 dB(A). Additionally, the noise impact from construction activities in the area of the power station building at a distance of 996 meters from the source to the community reaches a maximum level of 41.7 dB(A). When combined with the measured noise levels, the highest overall noise level is 61.1 dB(A).

**The houses located in the east direction**, is impacted by noise levels from the construction activity of solar panel installation (pile driving) at a distance of 43 meters from the source to the community, with a maximum level of 43.5 dB(A). When combined with the measured noise levels, the highest overall noise level is 61.1 dB(A). Additionally, the noise impact from construction activities in the area of the power station building at a distance of 870 meters from the source to the community reaches a maximum level of 42.9 dB(A). When combined with the measured noise levels, the highest overall noise level is 61.1 dB(A).



**TABLE 4.2-3**  
**THE PREDICTION OF THE 24-HOUR AVERAGE NOISE LEVEL FROM**  
**CONSTRUCTION ACTIVITIES AT DIFFERENT DISTANCES**

Distance (m)	The construction activity of solar panel installation		The construction activity in the area of the power station building	
	Noise level from construction activity <sup>1/</sup>	Total Noise Level <sup>2/</sup>	Noise level from construction activity <sup>1/</sup>	Total Noise Level <sup>2/</sup>
10	65.2	66.6	81.7	81.7
20*	59.2	63.2	75.7	75.8
43**	52.5	61.6	69.0	69.7
50	51.2	61.4	67.7	68.6
100	45.2	61.1	61.7	64.4
150	41.7	61.1	58.2	62.8
200	39.2	61.0	55.7	62.1
500	31.2	61.0	47.7	61.2
870 ***	26.4	61.0	42.9	61.1
996 ****	25.2	61.0	41.7	61.1
1,000	25.2	61.0	41.7	61.1
1,300	22.9	61.0	39.4	61.0
1,500	21.7	61.0	38.2	61.0

- Remarks:**
- <sup>1/</sup> The noise levels generated by construction activities at various distances, averaged over 24 hours, are calculated according to Equation (3).
  - <sup>2/</sup> The total noise levels from project construction and the maximum noise level measured at sensitive areas, houses located to the east between 6-11 June 2023 and 2-9 November 2023 (61.0 dB(A)), averaged over 24 hours, are calculated according to Equation (2).
  - \* The houses to the southwest is approximately 20 meters away from the solar panel installation activity (pile driving).
  - \*\* The houses to the east is approximately 43 meters away from the solar panel installation activity (pile driving).
  - \*\*\* The houses to the east is approximately 870 meters away from the construction area of the power station building.
  - \*\*\*\* The houses to the southwest is approximately 996 meters away from the construction area of the power station building.

**TABLE 4.2-4  
THE FORECAST RESULTS OF NOISE LEVEL IN THE CONSTRUCTION PHASE**

Sensitive receptors	Distance from construction area (m)	Leq 24 hr (dB(A))				Leq 1 hr (Daytime)				
		Noise level at 10 m from the noise sources	Noise level from the construction activities at receptor	Highest noise level from monitoring <sup>1/</sup>	Total noise level <sup>2/</sup>	Noise level at 10 m from the noise sources	Noise level from the construction activities at receptor	Noise level from monitoring <sup>1/</sup>	Total noise level <sup>2/</sup>	Differential noise level <sup>3/</sup>
<b>The construction activity of solar panel installation (pile driving)</b>										
1. Houses located to the southwest	20	65.2	59.2	61.0	63.2	70.0	64.0	41.3-63.7	64.0-66.9	3.2-22.7
2. Houses located to the east	43	65.2	52.5	61.0	61.6	70.0	57.3	41.3-63.7	57.4-64.6	0.9-16.1
<b>The construction activity in the area of the power station building (Foundation and pile construction)</b>										
1. Houses located to the southwest	996	81.7	41.7	61.0	61.1	86.5	46.5	41.3-63.7	47.6-63.8	0.1-6.3
2. Houses located to the east	870	81.7	42.9	61.0	61.1	86.5	47.7	41.3-63.7	48.6-63.8	0.1-7.3
<b>National Standard value<sup>4/</sup></b>				<b>≤70</b>			-	-	-	-
<b>WHO Guideline<sup>5/</sup></b>	<b>Residential; institutional; education</b>			<b>≤70</b>			<b>≤55</b>		<b>≤3</b>	

- Remarks:**
- 1/ The noise level measured at houses located to the east between 6-11 June 2023 and 2-9 November 2023
  - 2/ Calculated from the sound energy summation as in Equation (2)
  - 3/ Difference of noise levels, or the noise level from the project that is increased from the present noise level = total noise level (noise from the sources at receptors plus the monitored noise) minus the monitored noise level
  - 4/ Refer to the ambient noise standard per the Notification of the National Environmental Board No. 15, B.E. 2540
  - 5/ Guidelines for Community Noise, World Health Organization (WHO), 1999.

From the results of the noise impact assessment during the construction phase of the project, it can be observed that the noise levels from the construction activity of solar panel installation (pile driving) and from the construction activities in the power station building area have resulted in a slight increase in the noise levels for both sensitive areas. However, these noise levels are within the standards set by the 15<sup>th</sup> National Environmental Committee Announcement (BE 2540), which specifies a general 24-hour average noise level standard not exceeding 70 dB(A).

- **Comparison of Noise Level Results and International Standard**

The assessment of the noise level from the project construction was done only daytime (08.00-17.00 excepted lunch time, 12.00-13.00). Total noise level at the receptors, Dhammapuneti Vipassana Meditation Center and houses located to the northeast will increase in background level over 3 dB(A). Therefore, incremental noise from construction activities at those receptors exceeded IFC noise level guidelines as show in **Table 4.2-4**.

Therefore, preventive measures are needed to minimize the impact from noise on those receptors near the construction area.

- (v) **Noise impact mitigation measures in the construction phase**

All forecast results of noise disturbance in the receptors exceed the standard. Therefore, in order to reduce the noise impact from construction activities of the project that may affect the nearby community, the project has prepared measures to prevent and mitigate noise impacts during the construction phase by reducing noise levels at the source and along the pathways of noise to the receptors, as follows:

- **Reducing noise levels at the sources**

Reducing noise levels at the source by using pile cap cushion on the top of steel piles during pile driving to reduce noise, for example, based on construction data in Singapore, they initially used sandbag cushions on the top of steel piles during the early stages of pile driving to enhance energy transmission efficiency, resulting in faster pile driving and increased use of softwood cushions on the top of steel piles during the challenging phases of pile driving, helping to reduce the impact of pile driving and reduce noise levels by approximately 5 decibels (dB) (Source : EBRC - CELR Noise and Vibration Assessment, ATS Consulting, 2018).

- **Reducing noise levels along the pathways to the receptors**

To minimize noise impact from construction activities on the surrounding communities, the Project has prepared noise impact mitigation measures in the construction phase by installing a U-shaped noise barrier at the construction area of solar panel installation (pile driving) and the power station building (foundation and pile construction). Initially, the noise barrier will be 2.0-2.1 meters height from the ground, made of steel with a minimum thickness of 0.64 mm or other material with a minimum noise absorbability of 18 dB(A). More details are presented in **Table 4.2-5**.

**TABLE 4.2-5**  
**TRANSMISSION LOSS FROM USING DIFFERENT NOISE ABSORBENTS**

Material	Thickness (mm)	Surface Density (kg/m <sup>2</sup> )	Transmission Loss* (dB)
Polycarbonate	8-12	10-14	30-33
Acrylic (Poly-Methyl-Meta-Acrylate (PPMA))	15	18	32
Concrete block (200x200x400 light weight)	200	151	34
Dense concrete	100	244	40
Light concrete	150	244	39
Light concrete	100	161	36
Brick	150	288	40
Steel, 18 ga	1.27	9.8	25
Steel, 20 ga	0.95	7.3	22
Steel, 22 ga	0.79	6.1	20
<b>Steel, 24 ga</b>	<b>0.64</b>	<b>4.9</b>	<b>18</b>
Aluminum sheet	1.59	4.4	23
Aluminum sheet	3.18	8.8	25
Aluminum sheet	6.35	17.1	27
Wood	25	18	21
Plywood	13	8.3	20
Plywood	25	16.1	23
Absorptive panels with Polyester film backed by sheet	50-125	20-30	30-47

**Remark:** \*Values assuming no openings or gaps in the barriers

**Source:** Environmental Protection Department and Highways Department, Government of the Hong Kong SAR., 2003

The calculation of noise level with insertion loss to a receptor is based on the equation of the relationship between the Fresnel number (N) and the insertion loss formula by Maekawa as in **Equation (4)**. The Fresnel number (N) can be calculated in **Equation (5)**, with the following variables.

$$\Delta L = 10 \log (3+20N) \quad \text{_____} (4)$$

When  $\Delta L =$  Insertion Loss (dB(A))

N = Fresnel Number

$$\text{When } N = \frac{2(a+b-c)}{\lambda} \quad \text{_____} (5)$$

a = Displacement distance from the noise source to the top edge of the wall

b = Displacement distance from the top edge of the wall to the receptor

c = Displacement distance from the noise source to the receptor

$\lambda$  = Sound wave length = V/F

V = Sound wave velocity at a temperature ( $V_0 [1+(t^\circ\text{C}/273.2)]^{1/2}$ )

$V_0$  = Sound wave velocity at 0 °C = 331.4 m/sec

$t^{\circ}\text{C}$  = Atmospheric temperature (°C) (Climate statistics for the 30-year period during 1993-2022, Udon Thani Meteorological Station of the Meteorological Department = 27.0°C)

$F$  = Sound wave frequency = 550 Hz

Calculation details of noise level reduced by insertion loss to the receptors are presented in **Table 4.2-6**. Calculation variables are shown in **Figure 4.2-1**. It was found that the noise levels from construction activities would be reduced by 17.6-18.0 dB(A).

The noise impact assessment results at the receptors after installing the noise barrier at the construction site are explained below.

- **24-hour average noise level**

The forecast results of Leq 24 hr at the receptors after installing the noise barrier range from 19.1-36.2 dB(A). Details are shown in **Table 4.2-7**. Combined with the maximum value of Leq 24 hr from monitoring, the total noise level will be 61.0 dB(A), which is within the standard of ambient sound per the Notification of National Environment Board No. 15 B.E. 2540 (1997), specifying that Leq 24 hr shall not exceed 70 dB(A).

- **Comparison of Noise Level Results and International Standard**

An installation of a noise barrier at the construction area of solar panel installation (pile driving) and the power station building (Foundation and pile construction) near the receptors, Dhammapuneti Vipassana Meditation Center and houses located to the northeast will help reduce the noise level from construction activities. The total noise level at those receptors will increase in background level less than 3 dB(A) in accordance with IFC noise level guidelines (**Table 4.2-7**).

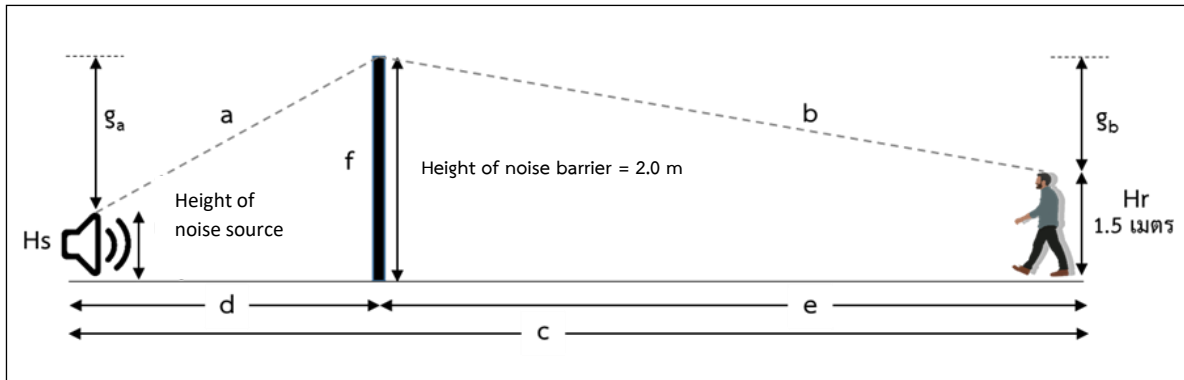
Apart from installing the noise barrier at the construction site, the Project also determines other mitigation measures. For example;

- Reducing noise levels at the source by using pile cap cushion on the top of steel piles during pile driving to reduce noise.
- Construction activities with noise impact on surrounding communities and lives shall be performed during the day. However, if the activities must be completed, local community leaders must be informed at least 7 days in advance.
- The project has specified that the contracting company should choose equipment and machinery for construction with lower noise levels.
- Machines and equipment shall receive regular maintenance to ensure good condition.

In addition, the noise impact in the construction activities only occurs for a short time. Therefore, the noise impact during the construction phase remains at a moderate level.

**TABLE 4.2-6**  
**CALCULATION DETAILS OF NOISE LEVEL REDUCED BY INSERTION**  
**LOSS TO RECEPTORS**

Details		The construction area of solar panel installation (pile driving)		The construction area of the power station building (Foundation and pile construction)	
		Houses to the southwest	Houses to the east	Houses to the southwest	Houses to the east
Displacement distance from source to top edge of the wall (m)	a	1.9	1.8	1.8	1.8
Displacement distance from top edge of the wall to receptors (m)	b	19.0	42.0	995.0	869.0
Displacement distance from source to receptors (m)	c	20.0	43.0	996.0	870.0
Displacement distance from source to wall (m)	d	1.0	1.0	1.0	1.0
Distance from wall to receptors (m)	e	19.0	42.0	995.0	869.0
Height of wall (m)	f	2.1	2.0	2.0	2.0
Height of noise source (m)	H <sub>s</sub>	0.5	0.5	0.5	0.5
Height of receptors (m)	H <sub>r</sub>	1.5	1.5	1.5	1.5
Height from source to top edge of the wall (m)	g <sub>a</sub> = (f-H <sub>s</sub> )	1.6	1.5	1.5	1.5
Height from receptor to top edge of the wall (m)	g <sub>b</sub> = (f- H <sub>r</sub> )	0.6	0.5	0.5	0.5
Average atmospheric temperature	t°C	27.0	27.0	27.0	27.0
Sound wave velocity (m/sect)	$V = (331.4 [1 + (t^{\circ}C/273.2)]^{1/2})$	347.4	347.4	347.4	347.4
Sound wave frequency (Hz)	F	550.0	550.0	550.0	550.0
Sound wave length (m)	$\lambda = (V/F)$	0.6	0.6	0.6	0.6
Fresnel number	$N = 2(a+b-c)/\lambda$	3.0	2.7	2.7	2.7
<b>Insertion Loss</b>	<b>10log (3+20N)</b>	<b>18.0</b>	<b>17.6</b>	<b>17.6</b>	<b>17.6</b>



**FIGURE 4.2-1 : REFERENCE DISTANCE USED FOR CALCULATING THE FRESNEL NUMBER**

**(vi) Impact on construction workers and employees operating in the construction site**

The calculation of noise impact on people working in the construction is based on the noise level from the construction activities that generate the highest noise: foundation and pile construction, with the maximum noise at 10 m from source = 86.5 dB(A). It is the loudest activity (**Table 4.2-2**), so it will be used to represent noise from construction of the Project throughout the 8 working hours as the worst-case scenario. The 8-hr average noise level can be calculated using **Equation (3)** as follows:

$$\begin{aligned} \text{Leq } 8 \text{ hr} &= 86.5 + 10 \log (8/8) \\ &= 86.5 \text{ dB(A)} \end{aligned}$$

Considering the impact on construction workers and employees working in the construction site, it was found that the noise exposure from the construction activities would be 86.5 dB(A), which passes the standard per the Notification of the Ministry of Industry on the Notification of Ministry of Industry on Safety Protection in Industrial Factories Related to the Working Environment, B.E. 2546 (2003), specifying that the average noise throughout the 8 working hours shall not exceed 90 dB(A). However, the project has prepared personal protective equipment (PPE) such as earplugs and earmuffs to reduce noise exposure, helping to prevent potential hazards to employees or construction workers working in the area. Therefore, the noise impact on operators in the construction site is moderate.

**(2) Operation Phase**

The power generating process of the Project generates power from solar energy using photovoltaic technology or solar cells. There is no source of noise that affects the community and sensitive receptors. Therefore, there is no impact on the surrounding communities in anyway.

**TABLE 4.2-7**  
**THE FORECAST RESULTS OF NOISE LEVEL IN THE CONSTRUCTION PHASE OF THE PROJECT AFTER DETERMINING NOISE IMPACT MITIGATION MEASURES IN THE CONSTRUCTION PHASE**

Sensitive receptors	Distance from construction area (m)	Noise level reduced from measures <sup>1/</sup>	Leq 24 hr (dB(A))			Leq 1 hr (Daytime)			
			Noise level from the construction activities at receptor	Highest noise level from monitoring <sup>2/</sup>	Total noise level <sup>3/</sup>	Noise level from the construction activities at receptor	Noise level from monitoring <sup>2/</sup>	Total noise level <sup>3/</sup>	Differential noise level <sup>4/</sup>
			(1)	(2)	(1)+(2)	(3)	(4)	(3)+(4)	(3)+(4)-(4)
<b>The construction activity of solar panel installation (pile driving)</b>									
1. Houses located to the southwest	20	23.0 (18.0+5.0)	36.2	61.0	61.0	41.0	41.3-63.7	44.2-63.7	0.0-2.9
2. Houses located to the east	43	22.6 (17.6+5.0)	29.9	61.0	61.0	34.7	41.3-63.7	42.2-63.7	0.0-0.9
<b>The construction activity in the area of the power station building (Foundation and pile construction)</b>									
1. Houses located to the southwest	996	22.6 (17.6+5.0)	19.1	61.0	61.0	23.9	41.3-63.7	41.4-63.7	0.0-0.1
2. Houses located to the east	870	22.6 (17.6+5.0)	20.3	61.0	61.0	25.1	41.3-63.7	41.4-63.7	0.0-0.1
<b>National Standard value<sup>5/</sup></b>			<b>≤70</b>			-	-	-	-
<b>WHO Guideline<sup>6/</sup></b>	<b>Residential; institutional; education</b>		<b>≤70</b>			<b>≤55</b>			<b>≤3</b>

- Remarks:**
- 1/ Noise level reduced from measures included noise level reduced by insertion loss to receptors (17.6-18.0 dB(A)) and noise level reduced by using pile cap cushion on the top of steel piles during pile driving (5.0 dB(A))
  - 2/ The noise level measured at houses located to the east between 6-11 June 2023 and 2-9 November 2023
  - 3/ Calculated from the sound energy summation as in Equation (2)
  - 4/ Difference of noise levels, or the noise level from the project that is increased from the present noise level = total noise level (noise from the sources at receptors plus the monitored noise) minus the monitored noise level
  - 5/ Refer to the ambient noise standard per the Notification of the National Environmental Board No. 15, B.E. 2540
  - 6/ Guidelines for Community Noise, World Health Organization (WHO), 1999.



### 4.2.1.3 Reflection and Heat

#### (1) Construction Phase

The project is designed to use PV panels that are coated with an anti-reflective coating to reduce the amount of light that is reflected away from the panel's surface, which is also help increase the efficiency of the solar cells. Additionally, the project includes a layout design that clusters panels in a way that minimizes reflective surfaces, which can also reduce glare. Therefore, the project design contributes to reducing reflections from the PV panels, minimizing the impact on nearby residents.

#### (2) Operation Phase

Regarding the impact of light reflection during the operation phase, factors that contribute to this impact include the direction of light impact angles and the type of solar panels used. Current solar panel manufacturing technologies have improved significantly, with external coatings that reduce light reflection. According to the report "PV Systems: Low Levels of Glare and Reflectance vs. Surrounding Environment" by Mark Shields in 2010, which studied light reflection when impacting various materials (details in **Table 4.2-8**), it was found that the light reflection coefficient of solar glass is lower than that of other materials

However, when an Anti-Reflection coating is applied, the light reflection coefficient is further reduced. Therefore, there will be no impact on the community. Furthermore, the project specifies that solar panels be installed at an angle of approximately 10 degrees to the ground, preventing light reflection towards the surrounding area. Hence, it is expected that light reflection and heat from the solar panels will not have any significant impact.

**TABLE 4.2-8**  
**REFLECTION PERCENTAGE OF LIGHT AT DIFFERENT INTERMEDIARY MATERIAL**

Intermediary Material	Reflection Percentage of Light *
Anti Reflection (w/AR coating)	3
Solar glass	4
Smooth water	4
Plastic	7
Plexiglass	4
Standard glass	9
Snow	23
Steel	39

**Remark:** \* Reflection percentage at an angle of 15 degrees.

**Source:** PV Systems: Low Levels of Glare and Reflectance vs. Surrounding Environment; Mark Shields, 2010

## 4.2.2 Biological Conditions

### 4.2.2.1 Biodiversity

#### (1) Construction Phase

The primary activities that have an influence on flora and wildlife during the construction phase include site preparation and various construction operations inside the project area. These activities, which can have an effect on both flora and wildlife, include:

- Plants and wildlife habitats in the construction project area may be lost as a result of clearing the land. A land use survey revealed that the project area is agricultural land, totaling roughly 72.91 hectares. The survey discovered two endangered species (EN), Makha Mong (*Afzelia xylocarpa*) and Burma padauk (*Pterocarpus macrocarpus*), which do not grow naturally but are cultivated in agricultural areas. These tree species have a high reproduction capability and are found throughout the country. Furthermore, clearing these regions may result in the loss of wildlife habitats, nesting sites, and food sources. The wildlife found in these places, however, is not endangered, and majority of wildlife in the area is comprised of birds that rely on grasslands, farms, and water bodies for feeding and breeding. These birds are capable of relocating their habitats and establishing breeding sites. However, the impact of land preparation for construction will be low because it will only occur for a limited period of time inside the project area and the pole construction area.

- The project's construction will cause noise and vibration, which may disturb the wildlife. Since the project area is agricultural land, the wildlife that inhabits it has evolved to live in disturbed agricultural environments as a consequence of long-term human activity. As a result, the construction will mainly cause noise-sensitive species to relocate away from the source of the disturbance. Nonetheless, the disruption time will be short, so the impact will be low.

- In the project study area, wildlife commonly hunted for food has been identified, including the Asiatic softshell turtle (*Amyda cartilaginea*), the butterfly lizard (*Leiolepis reevesii*), and the Indo-Chinese rat snake (*Ptyas korros*). These species are protected under the Wildlife Preservation and Protection Act, B.E. 2562 (2019), and are classified as species with a conservation status of Vulnerable (VU) and Near Threatened (NT) according to the criteria of the Office of Natural Resources and Environmental Policy and Planning (ONEP) (2020) and the International Union for Conservation of Nature (IUCN) (2022-2). Therefore, it is crucial to establish measures that prevent construction workers from harming the nests, eggs, and larvae of the protected species under the Wildlife Preservation and Protection Act, B.E. 2562 (2019), which are species with a conservation status of Vulnerable (VU) and Near Threatened (NT) according to ONEP (2020) and IUCN (2022-2), in order to reduce the impact on these wildlife species.

#### (2) Operation Phase

During the implementation of the solar power generation project, there is no contribution to biodiversity.

#### 4.2.2.2 Aquatic Ecology

##### (1) Construction phase

The nearest water source to the Project site is a public canal. It is situated on the south of the Project with the approximate distance of 125 meters. Its average diversity index of phytoplankton and zooplankton is 2.86, which indicates their distribution levels ranging from moderate to good. The project construction will generate wastewater at a maximum of approximately 53.26 m<sup>3</sup>/day from consumption of construction workers and washing construction machine and equipment. Wastewater will be treated by a septic tank provided by the contractor. Regarding treated wastewater and sewage, the contractor will contact local agencies for proper disposal according to the guidelines specified in the Public Health Act B.E.2535 (1991) and the Ministerial Regulations on Sewage Management Hygiene B.E.2561 (2018). Also, effluent from construction machinery and equipment washing will be collected at the clarifier to separate water and grease before sending it to be disposed of outside the Project by agencies authorized by government agencies. Therefore, the effluent or sewage from the project will not be directly discharged into a public canal. As a result, there will be no impact on aquatic ecology during the construction phase.

##### (2) Operation phase

The amount of wastewater generated during operation phase is 5.08 m<sup>3</sup>/day from restrooms and washing of solar module. The sewage will be treated by septic tank with anaerobic filters and removed by an authorized agency for appropriate treatment. In addition, effluent from solar module washing will be contaminated with only dust particles on the surface of the solar panels which contain no toxicity or impurity. It will be left to be evaporate or seep into the ground naturally. Thus, there will be no effluent directly discharging into a public canal. As a result, there will be no impact on aquatic ecology in the operation phase.

#### 4.2.3 Socio-economic conditions

##### 4.2.3.1 Socio-economics

##### (1) Construction Phase

##### (a) Potential Positive Impacts from the Project

- **Employment of Local People**

The Project has a policy of using non-skilled labor throughout the construction period, such as gardeners, maids, and security guards. The Project requires the contractor to prioritize hiring locals. Local workers will be prioritized for jobs that require unique credentials, expertise, and abilities for the Company's demands, such as installation and electrical systems. However, hiring staff with specialized talents necessitates training to ensure job safety and efficiency of work and employees will be trained on a regular basis in accordance with the Project's policy. Therefore, during the construction phase, there will be limited and temporary positive impact in terms of development of local people and improvement of the quality of life for people in the community.

- **Local Economic Promotion**

The Project estimates that the construction and installation phase will last approximately 12 months and will employ a maximum of 618 workers each day. More individuals from this Project will boost cash flow and boost the local economy. However, the economic stimulus will only endure a limited time. As a result, the level of impact is low.

**(b) Potential Negative Impacts from the Project**

- **Disturbance and annoyance to the community from construction activities**

Construction operations may cause noise disturbance during the construction process. Construction supplies, machinery, and employees will be transported, which may temporarily increase traffic flow on the road utilized for project transportation at particular times of the day. This may result in traffic congestion, road damage, road obstruction, and accidents. This activities will disturb the peace and safety of the surrounding communities. However, environmental impact mitigation measures during the construction phase have been determined by the Project. The effect will only last a short time. As a result, the level of impact is low.

**(2) Operation Phase**

**(a) Potential Positive Impacts from the Project**

- **Local Development and Improvement of the Quality of Life for Local People**

Local administrative entities will collect taxes from the Project during the operating phase, such as local maintenance tax, building and land tax, and a share of value-added tax. This revenue can be used for local development and to improve people's quality of life. Furthermore, the Project has various community relations projects in place to foster healthy relations and give back to the community. Throughout the operation period, the Project will also assist local activities. As a result, there will be overall positive effects in terms of local growth and improved quality of life for local residents. The level of beneficial effect is moderate.

- **Employment of Local People**

During the operation phase, there will be staff to manage the solar power generation system as well as security guards (5 people in total), an inspector, and maintenance personnel (2 people in total). The Project recognizes that local communities desire their people to collaborate on the Project. To meet this demand, the Project will prioritize hiring workers from local communities whose qualifications match the Project's standards, particularly during the two times of solar panel cleaning per year. As a result, the total impact of local employment is positive, with a modest impact level.

- **Activities Promoting Community Relations**

The Project has public relations campaigns on its operations on a regular basis in order to build an accurate knowledge and alleviate worries among those

who live nearby. Various activities are also supported by the Project. (1) environmental conservation plans, such as the School in Power Plant Project, the Environmental Field Visit Project, or funding community environmental activities. (2) Social, children's, and youth-related programs, such as funding activities of local educational institutions and sports activities in local communities, (3) Health plans, such as public health volunteer capacity building projects, and (4) cultural plans, such as sponsorship of the Thot Kathin Charity and the Songkran Festival. The goal is to build a positive relationship between the Project and the neighborhood, allowing both sides to collaborate in a sustainable manner. All of these activities will be carried out throughout the operation phase. As a result, efforts boosting community interactions have a moderately good impact.

### **(b) Potential Negative Impacts from the Project**

- **Concerns over the Project Operation**

During the operation phase, the community surrounding the Project may be concerned about its operations. However, the Project manages the concerns by designing and installing machinery as far away from communities and sensitive receptors as possible in order to alleviate the concerns of communities surrounding the Project. Furthermore, the Project has numerous plans in place to ensure an accurate understanding. These plans will instill trust in the Project development. There are channels to receive complaints and resolve the impacts from the Project development and hear suggestions from relevant parties. Therefore, the impact is low.

#### **4.2.3.2 Gender Related Impacts**

Gender impacts refer to the diverse ways in which project initiatives can affect individuals, communities, and societies through the lens of gender identity and roles. Understanding these impacts is crucial not only for ensuring equitable development but also for fostering sustainable and inclusive practices at the project level, as well as at the corporate level and within the renewable energy / solar power sector.

Historically, projects and their impacts have been predominantly viewed from a gender-blind perspective, failing to acknowledge the nuanced ways in which the project activities and impacts intersect with gender dynamics. However, recent discourse and research have shed light on the ways projects have impacts and implications for different genders.

Gender impacts in the renewable energy sector encompass a wide array of considerations, ranging from workforce participation to access to energy resources and decision-making roles within the industry. Understanding these impacts is crucial for promoting gender equality and ensuring that the benefits of Gulf's renewable energy project are distributed equitably across genders. From employment opportunities and labor conditions to access to infrastructure and urban spaces, gender impacts permeate various facets of the projects, influencing societal outcomes at both micro and macro levels.

As part of this IEE, a gender assessment entailed review of national legislation and institutions, summarized with key findings below. Gender engagement in consultation is also summarized, followed by assessment of potential gender impacts associated with the Project. Project commitments to avoid and/or mitigate these impacts are included in Chapter 5. A

review of gender equality at the national and local levels can provide the following information:

### **(1) Gender Equality at the National Level**

On B.E. 2558 (2015), Thailand enacted the Gender Equality Act with the aim of protecting everyone, including males, females, and individuals who express themselves differently from their inborn gender, from gender-based discrimination. The Act mandates the establishment of two committees:

1) The Committee for the Promotion of Gender Equality (Committee for the PGE), which is empowered to formulate policies, mitigation measures, and action plans for promoting gender equality in all sectors. It also outlines guidelines for providing assistance, compensation, and remedies to individuals who have experienced unfair gender discrimination.

2) The Committee on the Determination of Unfair Gender Discrimination and the Department of Women's Affairs and Family Development (Committee on DUGD), which is tasked with considering issues submitted by petitions claiming unfair gender discrimination.

Based on the Gender Gap Index, Thailand scored 0.711 in B.E. 2566 (2023), increase from 0.706 in B.E. 2558 (2015), primarily due to improvements in education attainment and political empowerment dimensions.

### **(2) Gender Equality at the Local Level**

From the two public meetings held by Fourtier Consultants Co., Ltd., there were 61 female participants and 46 male participants during the pre-engagement, and 209 female participants and 130 male participants during the public meeting. All are allowed to express their opinion as per their willingness. This indicates that gender discrimination is not an obvious problem among the locals. Additionally, during the public meeting of the project, a representative from the women's group in the area also participated, and no concerns were raised about project gender impacts.

Following are some key gender impacts in the renewable energy sector, considered and identified as potentially present for this project:

1) Workforce Participation: Women are underrepresented in the renewable energy workforce in Thailand, particularly in technical and leadership roles. Although Gulf's Sustainability Policy has a commitment to "Provide a safe and healthy work environment that promotes non-discrimination, gender equality, personal development and well-being", the Project does not have gender targets for its workforce participation levels. It can be predicted that there will be an underrepresentation of women in the Project workforce, which results from various factors, including lack of access to education and training opportunities, gender stereotypes, and biases in hiring and promotion practices.

2) Income and Economic Empowerment: By providing women with opportunities for employment and entrepreneurship in the project or to support the project (through supply chain opportunities), projects, it is possible that the Project could enhance

their income-generating capabilities, increase womens’ empowerment and strengthen local economies.

3) **Community Engagement and Benefits Sharing:** Project approaches to community engagement and benefits sharing may disproportionately benefit men unless there is awareness, guidelines and targets for gender participation in community relations and community development activities. These are essential for maximizing the social and economic benefits of the project and ensuring that women are equally involved. Gender balanced targeting and participation by the project can conversely have a positive impact, providing example to other stakeholders locally. Targeting womens’ involvement in program decision-making processes, ensuring that their voices are heard, and that they have equitable access to project benefits can enhance the project sustainability and contribute to positive social outcomes.

4) **Gender-Based Violence and Safety:** Depending on contractor workforce accommodation plans, some women working in the project or in the nearby communities may face gender-based violence, harassment, and safety risks. This can be avoided by designing facilities, transport and HR mechanisms to prevent the potential impacts. Examples for prevention strategies include creating safe and supportive working environments, implementing gender-sensitive security measures, and providing training on gender equality and workplace conduct, to help address these challenges and ensuring the well-being of all workers.

Regarding the construction of the project, the first priority for labor will be given to local people for both skilled and non-skilled workers. However, a substantial number of workers will come from outside. As such, GBVH risks and issues may arise most specifically from labor influx, as set out below.

Risk Factor	Why This Increase GBVH Risk
<p><b>Workforce</b></p> <ul style="list-style-type: none"> <li>• Labor Influx</li> </ul> <hr/> <ul style="list-style-type: none"> <li>• Worker Accommodation</li> </ul>	<ul style="list-style-type: none"> <li>• The sudden increase in a temporary workforce can strain local resources and exacerbate tensions between local communities and workers, increasing the risk of GBVH both within the workplace and in the surrounding community.</li> </ul> <hr/> <ul style="list-style-type: none"> <li>• Inadequately segregated and secured accommodations can increase the risk of GBVH. Poorly designed living spaces may lack privacy and safety measures, making some workers more vulnerable to abuse.</li> </ul>
<p><b>Discrimination</b></p> <ul style="list-style-type: none"> <li>• Labor and working conditions</li> </ul> <hr/> <ul style="list-style-type: none"> <li>• Local recruitment</li> </ul>	<ul style="list-style-type: none"> <li>• Unsafe or discriminatory working conditions can increase the vulnerability of workers to GBVH, particularly for women and marginalized genders. Power imbalances between supervisors and workers can lead to exploitation and harassment.</li> </ul> <hr/> <ul style="list-style-type: none"> <li>• Discriminatory recruitment practices can exacerbate gender inequalities and create environments conducive to GBVH. Lack of equal opportunity for local women and marginalized groups in employment can lead to economic disparities and increased vulnerability.</li> </ul>

Risk Factor	Why This Increase GBVH Risk
<p><b>Service Provision</b></p> <ul style="list-style-type: none"> <li>• Community Health and Safety</li> </ul>	<ul style="list-style-type: none"> <li>• Projects can negatively impact community health and safety, increasing GBVH risks. For example, disruption of social structures and increased stress on community resources can lead to heightened domestic violence and community conflict.</li> </ul>
<p><b>Security Personnel</b></p> <ul style="list-style-type: none"> <li>• Security Arrangement</li> </ul>	<ul style="list-style-type: none"> <li>• Overly militarized or untrained security forces may themselves become perpetrators of GBVH, especially if they lack awareness and training on gender sensitivity and human rights.</li> </ul>

**Source:** Addressing Gender-Based Violence and Harassment by IFC, 2020.

Overall, addressing potential Project gender impacts requires a holistic approach that considers the intersecting factors of gender, social norms, economic structures, and institutional arrangements. By mainstreaming gender equality principles across all aspects of the Project development and implementation, it is possible to avoid and effectively mitigate potential negative impacts. Furthermore, it is possible for Gulf solar projects gender strategies to help lead the way and harness the sector's potential to advance gender equality, social inclusion, and sustainable development.

To prevent and mitigate GBVH risk, the Project mandates the following measures;

1) Establish policies on GBVH to safeguard workers and nearby community of the Project.

2) Ensure gender-sensitive policies are in place, promoting equal opportunities for employment, training, and advancement.

3) Make a project-specific commitment to provide employment and supply chain opportunities for local women. For example, in service cleaning contracts, no gender specific within local content requirements to ensure the inclusion and participation of women in these opportunities.

4) Establish Corporate Social Responsibility (CSR) activities to ensure that all genders can be involved.

5) Ensure that all facilities (restrooms, changing rooms) are safe, accessible, and respectful of privacy for all genders.

6) Conduct gender sensitivity training for all project work teams, managers, and contractors. This training aims to increase awareness of gender issues, promote inclusivity, and enhance understanding of the importance of gender equality in project implementation.



### 4.2.3.3 Influx Management

#### (1) Construction Phase

The influx of construction workers during this phase could be caused adverse health impacts on the construction workers and potential environmental impact to surrounding communities. The impact assessment related to influx of construction workers on issues mentioned as follows:

#### 1.1) Impact within the Construction Worker's Camp

##### (a) Sanitation

There are 618 construction workers (Maximum) during construction phase. Potential workers' camp location has not yet finalized at this stage however, it is expected to be located near the construction area. The contractor will provide the workers' camp with proper welfare and utilities comply with the Notification of the Labor Welfare Committee on Standards of Residence as Labor Welfare for Employees in the Type of Construction Business B.E. 2559 (2016) and relevant laws or international standards, including recommendations and suggestions from ADB, as well as the Project developer's own experiences include; surrounding environment, accommodation, bathrooms and toilets, electricity system and equipment, drinking water, wastewater management, solid waste management, rainwater drainage, health management and fire prevention. Details are shown in *Section 2.4.1*. Based on the welfare and utilities mentioned above, the Project provides the properly and sanitary accommodation and utilities. Therefore, the health impacts on the construction workers will be low.

##### (b) Medical Welfare Provision

The construction workers may be at risk from contagious diseases or epidemic among construction workers due to the high density of living in workers' camps, and also be facing personal hygiene problems. For example, sexually transmitted diseases, diarrhea, respiratory diseases, and diseases that are carried by insects, such as dengue fever.

However, the provision of proper utilities as mentioned in *Section 2.4-1* including accommodation, bathrooms and toilets, electricity system and equipment, drinking water, wastewater management, solid waste management, rainwater drainage, health management, and fire prevention; and the provision of proper medical welfare, e.g., first aid equipment and medical supplies, according to the Ministry of Labor Regulations on the provision of welfare in business establishments B.E. 2548 (2005) can avoid burdening the health care services.

#### 1.2) Impact to the Surrounding Communities

##### (a) Pollution and environmental impacts

##### 1. Wastewater Management

At the workers' camp, the contractor shall provide a septic tank or a prefabricated wastewater treatment systems at suitable size with the number of workers to treat wastewater from worker consumption include toilets and bathrooms.

Waste or sewage that is generated from the prefabricated wastewater treatment systems will be disposed of according to sanitary principles by a local authority. The septic tanks/treatment systems must be located at least 30 meters away from rivers or public water sources. If the contractor discharges treated waste or sewage outside into natural water sources or private areas, the contractor must obtain permission from relevant government agencies or landowner to ensuring that the discharged sewage will not have adverse environmental impacts in the future. In addition, the contractor shall provide a retention pond at workers' camp and conduct water quality monitoring once a month to ascertain the water quality before discharging.

## **2. Noise level**

Noise impact from workers' camp may disturb the communities at nighttime because of high number of workers. This could cause conflict with local people. The Project and the contractors shall strictly implement preventive and mitigative measures to control and monitor the workers so that they do not create problems to surrounding communities at nighttime.

## **3. Transportation**

Another majority of impacts may arise from accidents during the logistics of construction equipment. This is one of the concerns expressed by the community at the hearing meeting. Construction equipment will be transported from Laem Chabang Port to the Project area. The main highway for transportation nearest to the Project site is Highway No. 2255 (Na Kha-Sum Sao). Transportation activity may cause traffic problem, road damage, road obstruction, and accidents. This activity will disturb the serenity and safety of communities near the construction site.

There will be 20 medium trucks and 16 light trucks provided for transportation during the construction phase. According to the assessment in **Section 4.2.4.2**, the results showed that the project's transportation activities during the construction phase do not significantly impact the service level of Highway no. 2255. The road's level of service remains the same (Level A), allowing vehicles to move freely at free-flow speed.

However, the Project has determined environmental and social impact mitigation measures for the construction phase. The impact will last for a short time. Therefore, the impact on the surrounding communities related to the pollution and environmental impacts from the construction activities will be low.

### **(b) Impact on public health services and public infrastructure**

With a large number of construction workers, if there is a communicable disease or epidemic occurs in the workers' camp, there is a chance that the disease may spread to the surrounding communities. Communicable diseases such as sexually transmitted diseases, hepatitis, pneumonia, diarrhea, and diseases that are carried by insects, such as dengue fever could be areas of concern. Common cold and flu caused by probably new strains are very well possible, as well as respiratory tract diseases.

Even though the agricultural area is the majority in the area with a radius of 3 kilometers surrounding the project, there are places where the people gather for community activities (temples and schools). There are vulnerable groups that need to be given importance in monitoring the impacts of communicable disease outbreaks. In addition, there are also other communities surrounding the project area. If illness occurs, it will increase the service burden on the local primary health care unit, namely, Ban Na

Kha Subdistrict Health Promotion Hospital. It is necessary that the Project and the contractors strictly comply with the relevant laws and regulations.

The nearest medical health service to the construction area is Ban Na Kha Subdistrict Health Promotion Hospital (SHPH), located 6 kilometers away from the Project site. It is a primary-level healthcare facility with a mission to promote health, restore health, prevent disease, and provide medical treatment services for outpatients (OPD). The Ban Na Kha SHPH serves for 5,078 population in Na Kha Subdistrict with limited number of healthcare personnel. In the event of illness or injury that exceeds the capability of the local facility, the patient can be transferred to another public facility or private hospital for further treatment. The Project and the contractors can avoid burdening the health service by strictly comply with the Notification of the Labor Welfare Committee regarding standards for residential welfare for construction labor, B.E. 2559 (2016), and provide first aid equipment and medical supplies within the construction area, including a medical shuttle, according to the Ministry of Labor Regulations on the provision of welfare in business establishments B.E. 2548 (2005).

### **(c) Conflict with the local people**

Construction workers from other areas, including foreign workers, could have conflicts with local people within the surrounding communities due to differences in culture, value and ways of life. The influx of workers may result in social problems such as crime, gambling, theft, drugs, etc. This is in line with the comments from the hearing meeting where the participants gave their opinion on the social impact that there are concerns about employment. However, the project has given priority to hiring local workers.

However, the Project gives the first priority to qualified local people to be hired and worked with the project, and in case of necessary to hire other or foreign workers. The Project has established prevention and mitigation measures such as periodically visit nearby communities throughout the construction phase to inquire and listen to opinions about environmental impacts from the project construction activities, set up the coordination center to receive recommendations and complaints about disturbances from the project construction, immediately investigate and take remedial action, in case of complaints by people about impacts from the project construction activities. Therefore, the impacts on the surrounding communities related to the conflict with the local communities will be low.

### **(d) Economic impact from influx of workers**

The potential influx of people to the project area may create economic opportunity but may also cause negative social impacts such as increased competition for resources and social services, distortion in property values and changes in social dynamics. These potential impacts are elaborated below.

Population influx and general interest in the development of the Project can give rise to speculative investment in the area, especially at construction stage, with possible positive or negative outcomes. Given the relatively low number of operations employment opportunities and few, long-term spin off economic effects, any over-investment by the community or outsiders at the early stage may result in heavy economic losses.

Population influx as well as the presence of sizeable outsider workforce can disturb social dynamics, for example with the increased demand or pressure on services and resources such as housing, education, health services. Differences in social

norms as well as income levels can create social jealousy. Artificial inflation of prices locally can also create potential tension.

Changes in land use will affect the previous land owners as well as the users such as farmers and related off-taking entrepreneurs, possibly reducing individuals' incomes or agricultural employment opportunities. However, with the availability of other arable land in the wider area at this time, the immediate impacts on landowners and land users seems negligible, in the longer term, land acquisition contributes to land conversion patterns, with increased pressure for resources and conflicts over competing land use.

## **(2) Operation Phase**

There are only 5 permanent employees at the normal operation work in the Project area during this phase, 2 persons as an inspector and a maintenance staff, and additionally, approximately 20 individuals, who are expected to be local residents, will be hired occasionally for cleaning solar panels. This will not significantly increase to cause influx situation. Therefore, the health impacts on both project employees and nearby communities will be low and negligible.

### **4.2.3.4 Occupational Health Impact Assessment**

#### **(1) Construction Phase**

The construction activities may cause occupational diseases. For instance, working in open areas and/or in conditions with sweltering heat, the body will try to adjust its temperature to a normal level all the time by eliminating heat from the body. In case that the heat elimination in a timely manner is unable, it will affect the body such as rashes on the skin, itching, sweat ducts blocked, muscle cramps, headaches, dizziness, muscle spasms, fatigue, and possibly loss of consciousness.

The occupational health risk such as fall of objects, hit on head, electric shock, traffic accident, etc. may be occurred by various causes such as the carelessness on the part of workers, improper planning and wrong sequence of operations, inadequate training with respect to handling of the machinery and equipment, and etc. could be effect to the personal health of construction worker and damage to the project properties. Therefore, the project determined the mitigation and prevention measures and adequate training program in occupational health and safety to minimize the occupational health impact.

Moreover, the contractor will provide first aid equipment and medical supplies within the construction area, including a medical shuttle, according to the Ministry of Labor Regulations on the provision of welfare in business establishments B.E. 2548 (2005). Therefore, the occupational health impacts on the construction workers will be low.

Dust (Particulate Matter) and noise from the construction activities include land clearance for the construction of the power generation control building, the storage areas of spare parts, equipment and materials, solid waste, and maintenance area, the switchyard or substation area, and the supporting areas related to power generation and could be caused adverse health impact to the construction workers. Besides, the high noise level may interfere with communication and conversation, impact on workers' hearing ability and further causing errors while working.

However, the project spraying water at the area with topsoil stripping, material stacking, and entrance of the construction site, and keeping construction materials tidily to minimizes the dust dispersion and provide personal protective equipment (PPE), consisting of safety helmets, safety shoes, goggles, and task-specific personal safety equipment appropriate to working conditions and risks that may arise from work. Therefore, the occupational health impacts on the construction workers will be low.

## (2) Operation Phase

The Project's activities involve generating electricity from solar panels, with 5 employees responsible for monitoring and controlling the electrical systems and for security as guards, as well as 2 persons as inspector and maintenance staff. Risks associated with the Project's operations include field inspections, safety maintenance, and cleaning of the solar panels. If employees perform maintenance work without proper caution in tool usage, it may pose potential dangers. The project determined the mitigation and prevention measures and adequate training program in occupational health and safety associated with the Project's operations include field inspections, safety maintenance, and cleaning of the solar panels. Regularly inspection and safety shall be carried out in accordance with the criteria prescribed by relevant law and guideline to minimize the occupational health impact. Therefore, the occupational health impacts on the project staff will be low. As a result, the impact on occupational health and safety for employees is considered low.

### 4.2.3.5 Health Impact Assessment

#### (1) Construction Phase

Considering the Project Descriptions in Chapter 2, existing environmental conditions in Chapter 3 ,and environmental impact assessment in Chapter 4, the identification of activities that may cause health impacts, health hazards, vulnerable groups that are expected to be affected In the construction phase including construction workers and the public as presented in **Table 4.2-9**, where the consultant used the qualitative risk assessment approach to evaluate the health impact assessment with a health risk matrix as presented in **Table 4.2-10**, It has a score depending on the likelihood of health impact in **Table 4.2-11**, and a score depending on severity of consequences in **Table 4.2-12**. The definition of overall impact level between the likelihood and severity of consequences using the risk matrix as presented in **Table 4.2-13**. In the construction phase, the health assessment can be summarized by using the health risk matrix assessment are presented in **Table 4.2-14**.

**TABLE 4.2-9**  
**HEALTH IMPACT, HEALTH HAZARDS, AND VULNERABLE GROUPS**

Health impact	Phase		Health hazards	Vulnerable Groups
	Construction	Operation		
Air quality	√		- Dust from land clearing - Operations of machinery - Pollutants from transportation	- Construction workers - The public
Noise	√		- Loud noise, disturbance noise, and vibration from natural gas pipeline and block valve station construction activities - Stress and panic about noise and vibration	- Construction workers - The public
Solid Waste	√		- Waste accumulation may attract disease carriers.	- Construction workers - The public
		√		- The Project staff - The public
	√		- Environmental contamination	- The public
Transportation	√		- Accidents from transporting construction workers, pipes, and machines - Obstruction to traffic	- The public
		√		
Occupational health and safety	√		- Accidents caused by unsafe working environment - Accidents caused by unsafe act - Safety concerns	- Construction workers - The Project staff
		√		
Sharing public health services	√		- Sharing public health services caused by illnesses or accidents of workers - Communicable diseases that come with migrant workers	- The public

**TABLE 4.2-10**  
**THE RISK MATRIX FOR HEALTH IMPACT ASSESSMENT**

Likelihood	Severity of Consequences				
	Very low (1)	Low (2)	Moderate (3)	High (4)	Very high (5)
Very low (1)	1	2	3	4	5
Low (2)	2	4	6	8	10
Moderate (3)	3	6	9	12	15
High (4)	4	8	12	16	20
Very high (5)	5	10	15	20	25

**Remark :** The definition of risk levels in **Table 5.16-5** can be summarized below.

	1-2 points = low impact
	3-9 points = moderate impact
	10-16 points = high impact
	20-25 points = very high impact

**Source :** Adapted from the Health Impact Assessment Guidelines, Office of Natural Resources and Environmental Policy and Planning, March 2022

**TABLE 4.2-11  
DEFINITION AND SCORING PRINCIPLES FOR THE LIKELIHOOD OF  
HEALTH IMPACT**

Likelihood		Definition
Level of impact	Score	
Very low	1	No evidence / low possibility to have happened / no possibility of stress.
Low	2	Theoretically possible, but no report of occurrence / very low possibility of stress.
Moderate	3	There are statistics from the available data to support the prediction of the likelihood that this may happen. / Stressful at times.
High	4	This event occurred during the operation of a similar project. / Stress happens often.
Very high	5	This event is happening during the operation of a similar project, or it has occurred more than once in the past 5 years. Stressful all the time.

**Source :** Adapted from the Health Impact Assessment Guidelines, Office of Natural Resources and Environmental Policy and Planning, March 2022

**TABLE 4.2-12  
SCORING PRINCIPLES FOR THE SEVERITY OF CONSEQUENCES**

Severity of Consequence		Definition
Level of impact	Score	
Very low	1	No injury/no illness/no stress
Low	2	Minor injury/illness/stress
Moderate	3	Moderate injury/illness/stress
High	4	Severe injury/illness/stress
Very high	5	Very severe injury/illness/stress

**Source :** Adapted from the Health Impact Assessment Guidelines, Office of Natural Resources and Environmental Policy and Planning, March 2022

**TABLE 4.2-13**  
**DEFINITION OF RISK LEVEL CRITERIA FOR IMPACT ASSESSMENT**  
**USING THE RISK MATRIX**

Score from Risk Matrix	Impact level	Definition
1-2	Low	<b>Not causing negative effects on health status</b>
3-9	Moderate	<b>Increasing illness rate, injury, stress, or concerns:</b> It may affect the budget and need to monitor whether the existing mitigation measures are adequate and appropriate.
10-16	High	<b>Having widespread impact on health status, chronic diseases, severe mental health, or prolonged stress:</b> It may need more budget and mitigation measures. If unavoidable, changes of operation method may be needed.
20-25	Very high	<b>Having very widespread impact on health status, disabilities, loss of lives, severe mental health or stress to the level of mental care, prolonged stress to the suicidal level:</b> Immediate budget required. Specific mitigation measures required. Change of operation method required. Immediate care of a consultant needed.

**Source :** Adapted from the Health Impact Assessment Guidelines, Office of Natural Resources and Environmental Policy and Planning, March 2022

**(2) Operation phase**

Considering the Project Descriptions in Chapter 2, existing environmental conditions in Chapter 3, and environmental impact assessment in Chapter 4, the identification of activities that may cause health impacts, health hazards, vulnerable groups that are expected to be affected in the operation phase including the Project staff and the public as presented in **Table 4.2-9**, where the consultant used the qualitative risk assessment approach to evaluate the health impact assessment with a health risk matrix as presented in **Table 4.2-10**, it has a score depending on the likelihood of health impact in **Table 4.2-11**, and a score depending on severity of consequences in **Table 4.2-12**. The definition of overall impact level between the likelihood and severity of consequences using the risk matrix as presented in **Table 4.2-13**. In the construction phase, the health assessment can be summarized by using the health risk matrix assessment are presented in **Table 4.2-15**.



**TABLE 4.2-14  
ASSESSMENT AND SIGNIFICANCE LEVELS OF HEALTH IMPACTS, AND MITIGATION MEASURES FOR  
HEALTH IMPACT ON THE PUBLIC IN THE CONSTRUCTION PHASE**

Impact issues	Health Risk Matrix			Mitigation measures / Monitoring Measures (presented in Chapter 5)
	Likelihood	Severity	Health impact level	
<b>Air quality</b> - Construction workers - The public	high (4) moderate (3)	low (2) low (2)	moderate (8) (4×2) moderate (6) (3×2)	<b>Environmental Impact Preventive and Correction Measures</b> - Measure on Air Quality - Measure on Social Economic and Public Participation
<b>Noise</b> - Construction workers - The public	high (4) moderate (3)	low (2) low (2)	moderate (8) (4×2) moderate (6) (3×2)	<b>Environmental Impact Preventive and Correction Measures</b> - Measure on Noise - Measure on Social Economic and Public Participation
<b>Solid Waste</b> - Construction workers - The public	moderate (3) moderate (3)	moderate (3) moderate (3)	moderate (9) (3×3) moderate (9) (3×3)	<b>Environmental Impact Preventive and Correction Measures</b> - Measure on Solid Waste and Waste - Measure on Social Economic and Public Participation

**TABLE 4.2-14  
ASSESSMENT AND SIGNIFICANCE LEVELS OF HEALTH IMPACTS, AND MITIGATION MEASURES FOR  
HEALTH IMPACT ON THE PUBLIC IN THE CONSTRUCTION PHASE (CONT'D)**

Impact issues	Health Risk Matrix			Mitigation measures / Monitoring Measures (presented in Chapter 5)
	Likelihood	Severity	Health impact level	
<b>Transportation</b> - The public	low (2)	high (4)	moderate (8) (2×4)	<b>Environmental Impact Preventive and Correction Measures</b> - Measure on Transportation - Measure on Social Economic and Public Participation
<b>Occupational health and safety</b> - Construction workers	moderate (3)	high (4)	high (12) (3×4)	<b>Environmental Impact Preventive and Correction Measures</b> - Measures on Occupational Health and Safety <b>Environmental Impact Monitoring Measures</b> - Measures on Occupational Health and Safety

**TABLE 4.2-15  
ASSESSMENT AND SIGNIFICANCE LEVELS OF HEALTH IMPACTS, AND MITIGATION MEASURES FOR HEALTH  
IMPACT ON THE PUBLIC IN THE OPERATION PHASE**

Impact issues	Health Risk Matrix			Mitigation measures / Monitoring Measures (presented in Chapter 5)
	Likelihood	Severity	Health impact level	
<b>Solid Waste</b> - The Project staff - The public	low (2) low (2)	moderate (3) moderate (3)	moderate (6) (3×2) moderate (6) (3×2)	<b>Environmental Impact Preventive and Correction Measures</b> - Measure on Solid Waste and Waste - Measure on Social Economic and Public Participation
<b>Transportation</b> - The public	low (2)	high (4)	moderate (8) (2×4)	<b>Environmental Impact Preventive and Correction Measures</b> - Measure on Transportation - Measure on Social Economic and Public Participation
<b>Occupational health and safety</b> - The Project staff	moderate (3)	very high (5)	high (15) (3×5)	<b>Environmental Impact Preventive and Correction Measures</b> - Measures On Occupational Health and Safety <b>Environmental Impact Monitoring Measures</b> - Measures On Occupational Health and Safety

## 4.2.4 Human Use Values

### 4.2.4.1 Land Use

The Project area is predominantly devoted to agriculture, specifically the cultivation of paddy field. The Project acquired land tenure through agreements and land purchases from private landowners, with the purchase price being mutually determined by the Project and the previous landowners. Presently, the land in the Project area is owned by Phalangngan Rungrueang Co., Ltd. Consequently, there are no issues related to either physical or economic displacement to be concerned.

#### (1) Construction Phase

The construction of the Project will directly impact the land-use pattern in the Project area. Originally an agricultural area, it will be transformed into an area with solar panels. The construction activities are planned to take place on prepared ground. It is expected that these Project activities during the construction phase will result in a low-level impact on land use.

#### (2) Operation Phase

Once the Project is operational, the utilization of land will change from its previous agricultural use to an area with solar panels. The solar power plant will generate electricity using clean energy, supporting the country's greenhouse gas reduction policies. Additionally, it will serve as an educational and renewable energy tourism destination. Therefore, it is anticipated that the project activities during the operation phase will have a moderately positive impact on land use.

### 4.2.4.2 Land Transportation

#### (1) Construction phase

The construction phase of the Project involves transportation of construction materials, machinery, and workers. The scope of assessing the impact will cover the road capacity for the increased traffic, traffic obstruction during the construction, and accident from falling of construction materials. The study details are elaborated below.

##### (a) Transportation routes and traffic volume

– Transportation of construction materials and workers will use main roads which is Highway no. 2255.

– The increased traffic volume from the construction activities will be about 37 vehicles/day (**Table 4.2-16**) below.

- Transportation of construction materials 10 trips/day
- Transportation of garbage 10 trips/day
- Transportation of construction workers 32 trips/day
- Water truck 20 trips/day

**TABLE 4.2-16**  
**TRAFFIC VOLUME IN THE CONSTRUCTION PHASE OF THE PROJECT**

Activity	Vehicle	PCE	Number of vehicles (vehicles/day)	Number of trips (trips/day)	PCU/day	PCU/hr
Transportation of construction materials	Heavy truck (10-wheel)	2.5	5	10	25.0	4.00 <sup>2/</sup>
Transportation of garbage	Heavy truck (10-wheel)	2.5	5	10	25.0	4.00 <sup>2/</sup>
Transportation of workers	Medium truck (6-wheel)	1.5	16	32	48.0	12.00 <sup>1/</sup>
Water truck	Heavy truck (10-wheel)	2.5	10	20	50.0	7.00 <sup>2/</sup>
<b>Total</b>			<b>36</b>	<b>72</b>	<b>148.0</b>	<b>27.00</b>

**Remark:** 1/ PCU/hr calculated from daily traffic in the morning – evening for 4 hours

2/ PCU/hr calculated from daily traffic during 8 business hours

**Source:** Phalangan Rungrueang Co., Ltd., 2023

### (b) The Study Principles and Methods

The increased traffic volume from the Project can be calculated in terms of the V/C ratio as follows:

- Vehicles are divided into 12 types. Each type has a multiplier of Passenger Car Equivalents (PCE) into passenger car unit (PCU) to convert as shown in **Table 4.2-17**.

- V is the traffic volume (from the max PCU / hr.) and is used to calculate the V/C Ratio to compare with the standard of the Traffic Engineering Division to be not more than 0.8 (80%).

The V/C Ratio is calculated from the equation below.

$$V/C \text{ ratio} = \frac{\text{Increased traffic from the Project} + \text{baseline traffic}}{\text{Traffic capacity of each highway}}$$

The resulted V/C Ratio will be used to compare with the standard of traffic condition in the future, as in **Table 4.2-18**.

**TABLE 4.2-17**  
**WEIGHTED VALUE OF EACH VEHICLE TYPE**

Type of vehicle	Passenger Car Equivalents Factor (PCE)
Passenger car ≤ 7 seats	1.00
Passenger car > 7 seats	1.00
Light bus	1.50
Medium bus	1.50
Heavy bus	2.10
Light truck (4-wheel)	1.00
Medium truck (6-wheel)	1.50
Large truck (10 wheel)	2.50
Full trailer	2.50
Semi-trailer truck	2.50
Bicycle and tricycle	0.25
Motorcycle and motor tricycle	0.33

Source : Bureau of Safety, Department of Highways, 2021

**TABLE 4.2-18**  
**STANDARD FOR CLASSIFYING TRAFFIC CONDITION IN THE FUTURE**

Level of service	Traffic congestion index (V/C Ratio)	Meaning
A	0.00-0.60	- Free-flow conditions with unimpeded maneuverability.
B	0.61-0.70	- Reasonably unimpeded operations with slightly restricted maneuverability
C	0.71-0.80	- Stable operations with somewhat more restrictions in making mid-block lane changes
D	0.81-0.90	- Approaching unstable operations where small increases in volume produce substantial increases in delay and decreases in speed.
E	0.91-1.00	- Operations with significant intersection approach delays and low average speeds.
F	> 1.00	- Operations with extremely low speeds

Source : Transportation Research Board (1994), as cited in the Department of Highway, 2013

**(c) Baseline Traffic Volume**

The traffic volume data used to assess the highway's impact will be derived from the Office of Traffic Safety, Department of Highways' traffic volume report on the national highway for the years 2018-2022. **Table 3.4-4** shows the traffic counts on National Highway No. 210 (Udon Thani - Nikhom Chiang Phin). During peak and average traffic conditions from 2018 to 2022, traffic flow was considered to be excellent (**Table 3.4-5**).

**(d) Forecasting of Vehicle Volume**

An estimate of vehicle traffic on National Highway No. 2255 is divided into two phases: construction in 2024 and operation from 2025 onwards. The calculation used the Department of Land Transport's statistical data on cumulative registered cars in Udon Thani Province from 2017 to 2022 to establish the vehicle volume growth rate. It was discovered that there is an average rise of 2.8%. **Table 4.2-19** contains the summarized details, which were then utilized to anticipate vehicle quantities for the years 2023-2026, as shown in **Table 4.2-20**.

**TABLE 4.2-19**  
**STATISTIC DATA ON CUMULATIVE REGISTERED CARS**  
**IN UDON THANI PROVINCE FROM 2017 TO 2022**

<b>Year</b>	<b>Traffic volume (PCU/day)</b>	<b>Vehicle growth rate (%)</b>
2017	645,722	-
2018	665,044	3.0
2019	682,686	2.7
2020	695,014	1.8
2021	714,857	2.9
2022	714,292	3.7
<b>Average vehicle growth rate (%)</b>		<b>2.8</b>

Source : Department of Land Transportation, 2023

**TABLE 4.2-20  
FORECASTING OF INCREASE TRAFFIC VOLUME  
ON NATIONAL HIGHWAY NO. 2255**

Year	Traffic volume		
	Total daily (PCU/day) <sup>1/</sup>	Normal period (PCU/hr) <sup>2/</sup>	Peak period (PCU/hr) <sup>3/</sup>
2022	5,037	294	504
2023	5,178	303	518
2024	5,323	311	533
2025	5,472	320	548
2026	5,626	329	563
2027	5,783	338	579

**Remarks :** <sup>1/</sup> Traffic volume forecast for the years 2022-2025 with an estimated annual increase in traffic volume of 2.8 percent.

<sup>2/</sup> The vehicle volume during normal periods (PCU/hr) = 0.7x the whole day vehicle volume (PCU/day)/12.

<sup>3/</sup> The vehicle volume during peak periods (PCU/hr) = 10% of the total daily traffic volume (PCU/day).

(Referencing "Guideline for traffic impact studies and air quality in Jefferson County", Kentucky, 1990)

**Source :** Fourtier Consultants Co., Ltd., 2023

### (e) Results

Construction activities that affect public transportation are the transportation of construction machinery and workers. The scope of assessing the impact will cover the road capacity for the increased traffic, traffic obstruction during the construction, and accident from falling of construction materials. The study details are elaborated below.

- **Road capacity to the increased traffic volume**

The impact assessment of traffic density to the V/C ratio concerns the traffic volume increased from the current condition. It will forecast the road capacity and traffic density in the construction phase (**Table 4.2-21**) on the main roads that the Project will use for transporting construction machinery and workers, which is National Highway No. 2255. It can be summarized below.

– In the current traffic condition, the V/C Ratio from the highway traffic data by the Department of Highway from 2018-2022 was 0.07 for peak period and 0.04 for normal period. Compared to the standard of traffic classification (Transportation Research Board (1994), as cited in the Department of Highway, 2023), it is classified as the free-flow condition with unimpeded maneuverability (level of service: LOS = A).



– The traffic condition in the construction from the highway traffic data by the Department of Highway from 2018-2022 combined with the traffic volume in the construction phase has the V/C Ratio for peak period of 0.07, and for normal period of 0.04, which equals to the current traffic condition. Compared to the standard of traffic classification (Transportation Research Board (1994), as cited in the Department of Highway, 2023), it is classified as the free-flow condition with unimpeded maneuverability (level of service: LOS = A). Therefore, the traffic in the construction phase does not increase the traffic volume, and the impact level is low.

**TABLE 4.2-21**  
**TRAFFIC CONDITION FROM USING HIGHWAY NO. 2255**  
**IN THE CONSTRUCTION PHASE OF THE PROJECT**

Details		Peak period	Normal period
1. Current traffic volume (PCU/hr)		533	311
2. Traffic volume of the Project (PCU/hr)		12	15
3. Current traffic condition + traffic volume in the construction (PCU/hr)		545	326
4. Road capacity (PCU/hr)		2,236	2,236
<b>Existing</b>	<b>V/C Ratio</b>	<b>0.07</b>	<b>0.04</b>
	<b>Level of Service (LOS) *</b>	<b>A</b>	<b>A</b>
<b>Construction phase</b>	<b>V/C Ratio</b>	<b>0.07</b>	<b>0.04</b>
	<b>Level of Service (LOS)*</b>	<b>A</b>	<b>A</b>

**Remark :** \* Level of Service (LOS) A refers to the free-flow condition with unimpeded maneuverability

**Source :** Fourtier Consultants Co., Ltd., 2023

- **Traffic obstruction during the construction**

The transportation of construction materials and workers might cause inconvenience for road users, especially when transporting large materials with heavy trucks. This might cause a delay in traffic. To minimize the impact, the Project requires this activity to avoid rush hours in the morning and the evening and coordinate with local agencies to facilitate the traffic flow and avoid the obstruction. However, the impact is temporarily limited to the transportation time. When the transportation of large machinery is complete, the impact will be lower. Therefore, the impact on traffic obstruction is low.

- **Accident from falling of construction materials**

The transportation of construction materials and workers uses heavy trucks (10-wheel truck) and 6-wheel trucks. If the vehicles are not covered, the materials might fall on the road and may harm road users and properties. Therefore, the impact level is moderate.

The assessment results can be concluded that the construction phase will not change the traffic condition from before the Project. More precisely, the main roads that the Project uses can adequately support the increased traffic. However, the

increase of large vehicle in the construction phase may affect the traffic flow. Therefore, the transportation impact in the construction phase is low.

## (2) Operation Phase

In the operation phase, traffic in the Project is limited only in the Project premises. Only authorized vehicles are allowed to enter only authorized areas. The traffic increase from the Project is shown in **Table 4.2-22**. The maximum transportation traffic is about 11 vehicles/day, including the vehicle of staff administering the power generating system 2 vehicles/day (4 trips/day), vehicle of maintenance staff 1 vehicles/day (2 trips/day), vehicles transporting solar panel cleaners 5 vehicle/day (10 trips/day), a septic truck 1 vehicle/day (2 trips/day), a garbage truck to collect waste for disposal 1 truck/day (2 trips/day), and a water truck 1 truck/day (2 trips/day).

- **The road capacity to the increased traffic volume**

The assessment of traffic density to the road capacity (V/C ratio) concerns the impact on the road capacity and traffic density of the operation phase increased traffic from the current condition as shown in **Table 4.2-23**. The assessment is based on the worst-case scenario of the increased traffic volume on National Highway No. 2255 in the operation phase. The results can be summarized below.

- In the current traffic condition, the V/C Ratio from the highway traffic data by the Department of Highway from 2018-2022 was 0.07 for peak period and 0.04 for normal period. Compared to the standard of traffic classification (Transportation Research Board (1994), as cited in the Department of Highway, 2023), it is classified as the free-flow condition with unimpeded maneuverability (level of service: LOS = A).

- The traffic condition in the construction from the highway traffic data by the Department of Highway from 2018-2022 combined with the traffic volume in the construction phase has the V/C Ratio for peak and normal period of 0.07 and 0.04 respectively, which equals to the current traffic condition. Compared to the standard of traffic classification (Transportation Research Board (1994), as cited in the Department of Highway, 2023), it is classified as the free-flow condition with unimpeded maneuverability (level of service: LOS = A). Therefore, the traffic in the operation phase does not increase the traffic volume, and the impact level is low.

**TABLE 4.2-22**  
**TYPES AND NUMBER OF VEHICLES EXPECTED TO INCREASE**  
**IN THE OPERATION PHASE**

Activity	Type	PCE	Number of vehicles		PCU/day	PCU/hr.
			vehicles/day	trips/day (out-back)		
Vehicle of staff administering power generating system	Passenger car	1.0	2	4	4.0	1.00 <sup>1/</sup>
Vehicle of a maintenance staff	Passenger car	1.0	1	2	2.0	1.00 <sup>1/</sup>
Transporting solar panel cleaners	Passenger car	1.0	5	10	10.0	3.00 <sup>1/</sup>
Septic truck	10-wheel truck	2.5	1	2	5.0	1.00 <sup>1/</sup>
Garbage truck	10-wheel truck	2.5	1	2	5.0	1.00 <sup>1/</sup>
Water truck	10-wheel truck	2.5	1	2	5.0	1.00 <sup>1/</sup>
<b>Total</b>				<b>22</b>	<b>31.0</b>	<b>8.00</b>

**Remark:** <sup>1/</sup> PCU/hr calculated from daily traffic volume for four hours in the morning and evening

**TABLE 4.2-23**  
**TRAFFIC CONDITION FROM USING NATIONAL HIGHWAY NO. 2255**  
**IN THE OPERATION PHASE**

Details		Peak period	Normal period
1. Current traffic volume (PCU/hr)		547	319
2. Traffic volume of the Project (PCU/hr)		5	3
3. Current traffic condition + traffic volume in the operation phase (PCU/hr)		552	322
4. Road capacity (PCU/hr)		2,236	2,236
<b>Existing</b>	<b>V/C Ratio</b>	<b>0.07</b>	<b>0.04</b>
	<b>Level of Service (LOS) *</b>	<b>A</b>	<b>A</b>
<b>Construction phase</b>	<b>V/C Ratio</b>	<b>0.07</b>	<b>0.04</b>
	<b>Level of Service (LOS)*</b>	<b>A</b>	<b>A</b>

**Remark :** \* Level of Service (LOS) A refers to the free-flow condition with unimpeded maneuverability

**Source :** Fourtier Consultants Co., Ltd., 2023

### 4.2.4.3 Solid Waste Management

#### (1) Construction phase

Most waste and discarded materials in the construction phase are caused by two main activities.

- Waste from the consumption of a maximum of 618 construction workers, such as food waste, plastic bags, and paper scraps with the expected quantity of 525.3 kg/day (waste generation rate of 0.85 kg per person per day (Kriengsak Udomsinrot, 1993)). The Project will prepare an adequate number of trash bins at several spots so that authorized agencies can collect it for disposal outside of the Project area.

- Waste generated from construction activities is mostly packaging scrap, wood, and steel with the total amount of approximately 26 tons/year. Some of the waste will be separated for sale or reuse while the rest of the waste will be stored before coordinating with authorized agencies for appropriate disposal.

Therefore, the impact on solid waste management during construction phase will be low.

#### (2) Operation phase

Waste generated during project operation can be classified into 2 types as follows.

- Waste generated from the consumption of the Project staff and solar panel cleaners, which make a maximum of 27 persons a day. Most are in the form of general waste, such as food waste, plastic bags, and paper scraps. It is expected to add up to 22.95 kg/day (waste generation rate of 0.85 kg/day (Kriengsak Udomsinrot, 1994)). The Project will prepare sufficient trash bins at various points to store the waste before further disposal by authorized agencies.

- Waste from scheduled maintenance, such as scraps of electronic wires, electronic parts from maintenance activities, which is expected to reach about 3.20 tons/year and 267 kg/month. This type of waste will be kept in tightly closed container and collected in an area of 20 sq.m. in the office and material storage building, waiting for a waste disposer authorized by the Department of Industrial Works for disposal outside the Project area.

- Solar panels used in this Project have a lifespan of about 25 years, in case of damage or deterioration, the Project will call a waste disposer authorized by the Department of Industrial Works for disposal outside the Project area.

Therefore, the impact on solid waste management during operation phase will be low.

#### 4.2.4.4 Wastewater Management

##### (1) Construction phase

During the construction phase, the wastewater will be generated at a maximum of approximately 53.26 m<sup>3</sup>/day. Its sources are as follow:

- Wastewater from the consumption of construction workers or from washrooms with expected generation rate of approximately 43.26 m<sup>3</sup>/day; and
- Effluent from construction machinery and equipment washing with generation rate of approximately 10.00 m<sup>3</sup>/day.

The project will treat wastewater from workers' consumption using a septic tank provided by the contractor. Regarding treated wastewater and sewage, the contractor will contact local agencies for proper disposal according to the guidelines specified in the Public Health Act B.E.2535 (1991) and the Ministerial Regulations on Sewage Management Hygiene B.E.2561 (2018). Also, effluent from construction machinery and equipment washing will be collected at the clarifier to separate water and grease before sending it to be disposed of outside the Project by agencies authorized by government agencies. Therefore, the impact on wastewater management during the construction phase will be low.

##### (2) Operation phase

During the operation phase, wastewater will be generated from the following activities.

- Wastewater from consumption of staff or washrooms with expected generation rate of approximately 1.89 m<sup>3</sup>/day.
- Effluent from solar modules washing of approximately 3.19 m<sup>3</sup>/day will be generated in dry season.

The wastewater from washrooms will be treated by septic tank with anaerobic filters and removed by an authorized agency for appropriate treatment. In addition, effluent from solar module washing will be contaminated with only dust particles on the surface of the solar panels which contain no toxicity or impurity in the form of organic compounds. It will be left to be evaporate or seep into the ground naturally without affecting the quality of surface water. As a result, the impact on wastewater management in the operation phase will be low.

#### 4.2.4.5 Water Drainage

##### (1) Construction phase

Prior to project development, the area was an agricultural area. There will be minor site adjustment to consolidate installation of ground-mounted solar modules and minor land use for building construction. The water drainage condition during construction phase will remain the same as the existing condition. Therefore, the impact on drainage during the construction phase will be low.

## **(2) Operation phase**

Most of the project area is occupied with solar modules, roads, and empty space. These areas are still the ground area and still have the same drainage condition compared to prior the project development. However, the condition of 1,935 square meters area which will be transformed into a power station, control building, storage building, etc., will be changed. The project has designed drainage gutter to collect rainfall from those area into a 500 cubic meters retention pond to collect rainwater near the building in the Project area. It is capable of collecting rainwater that falls continuously at least three hours before draining water out of the project area to a natural waterway with a flow rate lower or equal to pre-project development flow. Therefore, the operation phase of this Project will not have any impact of water drainage on the surrounding areas.

### **4.2.5 Major Hazard**

#### **4.2.5.1 Guideline of Risk and Hazard Assessment**

The guidelines of risk and hazard assessment will follow the regulations of Department of Industrial Works: Criteria of hazard indication, risk assessment and risk management plan, B.E. 2543 (2000). The study starts with the analysis and review of implementation in order to indicate the risk activities. Then, the hazard identification will be indicated to display the hazard activities and the results. The level of risk will be assessed by indicating the frequent opportunities of that hazard, and the level of impact to the people, communities, environment and property. The level of risk will be analyzed, and the risk management plan and risk reduction plan will be prepared later.

The technique of hazard study in the project consists of 3 parts as follow:

#### **(1) The Technique of Hazard Identification**

The study will identify the potential risk of hazard. The analysis starts from the production procedure and electricity distribution. The results will be analyzed in collaboration with the hazard identification of international standard, emphasizing the opportunities that lead to the error that is able to develop into the hazard impact.

#### **(2) Hazard Identification**

When the hazard can be identified, the consultant will study the consequences of activities to the hazard, employing the Checklist, one of the methods in the regulations of Department of Industrial Works: Criteria of hazard indication, risk assessment and risk management plan, B.E. 2543 (2000) to be the criteria of cause and effect from the error of activities. The hypothesis of equipment fault or failure, regulation-fault or error and human error will be analyzed and assess the risk in the concerning issues.

#### **(3) The Technique of Risk Assessment**

The technique of risk assessment consists of hazard probability and severity of consequences. The quality analysis will be employed in assessing the severity of the impact. The results from the assessments will be categorized into the levels of risk.

#### 4.2.5.2 Hazard Identification

The hazard identification depends on related factors, especially the availability of the project details. The decision to identify the part or unit of production with potential to hazard will be taken into consideration before prioritizing the significance of hazard to be particularly considered.

The study of the project details shows that the solar cell production will be less complicated than other types of power plant. The potential hazards that may occur include the following:

(1) The risk of fire can occur due to non-standard equipment installation or the absence of electrical circuit protection devices. The equipment that has the potential to be hazardous includes:

- Solar panels (PV Module)
- The electrical current inverter along with electrical circuit control devices for direct current (DC) and alternating current (AC) circuit interruption control devices.
- Materials and components include electrical wires, conduit pipes for electrical wires, and electrical junction boxes.

(2) Electrical shocks occur due to factors such as the absence of electrical insulation, lack of grounding, overloaded circuits, and situations where individuals or equipment come into contact with electricity while wet. Equipment at risk of such dangers in this context includes various electrical devices and electrical wiring.

(3) The occurrence of an electric arc is the flow of electrical charge through gas or air, which happens when there is an overvoltage or when the air surrounding a conductor is at a high temperature. This typically occurs when a high electrical current passes through a point of contact or when there is a separation between electrical conductors. In these situations, the electrical current can generate significant heat, leading to the formation of an electric arc. The intense heat generated by an electric arc can cause injuries such as burns and can even be fatal. Equipment that is at risk of such dangers in this context includes various electrical devices, especially voltage transformers.

From assessing the positions where severe danger could potentially occur, it is evident that the areas at risk of severe danger are those with electrical equipment installations. The causes of severe danger that may occur can result from equipment and tool defects or from operational errors by workers (Operability Problems). To identify potential severe dangers as described above, a checklist approach will be used, comparing them with various relevant standards. The details of the identification process, as shown in **Table 4.2-24**.

**TABLE 4.2-24  
HAZARD IDENTIFICATION USING THE CHECKLIST METHOD**

**Area/Machinery** .. Electricity generation area/ solar panels/ Inverter and auxiliary equipment/

..Solar electricity generation from ground-mounted photovoltaic technology

No.	Checklist	Inspection results			Important remarks
		Yes	No	N/A	
<b>1.</b>	<b>Inspect the standard of the electrical equipment installed in the project.</b>				
<b>1.1</b>	<b>Inspect the standard of the electrical equipment installed in the project.</b>				
1.1.1	<b>Solar modules (Monocrystalline Silicon type) and supporting structures</b> Has the equipment been verified or certified by the following standard?				
	- TIS.1843 or IEC 61215 standard (Crystalline Silicon Terrestrial Photovoltaic (PV) Modules-Design Qualification and Type Approval)	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
	- TIS.2580 or IEC 61730 standard (Photovoltaic (PV) Module Safety Qualification)	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
1.1.2	The material of the structure is hot dip galvanizing according to ASTM Standard or stainless metal	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
1.1.3	The support structure can hold up solar panels stably and firmly.	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
1.1.4	Structural components can be assembled and disassembled easily.	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
1.1.5	The solar modules and structure fixers are in appropriate size and made of stainless steel or stainless metal.	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
1.1.6	The structure can support the weight and withstand the wind at least 30 meters/second.	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	



**TABLE 4.2-24  
HAZARD IDENTIFICATION USING THE CHECKLIST METHOD (CONT'D)**

**Area/Machinery** Electricity generation area/ solar panels/ Inverter and auxiliary equipment/

Solar electricity generation from ground-mounted photovoltaic technology

No.	Checklist	Inspection results			Important remarks
		Yes	No	N/A	
<b>1.2</b>	<b>Inverter</b>				
1.2.1	Has the equipment been verified or certified by the following standard?	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
	- IEC 61727 standard (Photovoltaic (PV) System- Characteristics of the Utility interface)	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
	- IEC 62116 standard (Test Procedure of Islanding Prevention Measures for Utility-interconnected Photovoltaic Inverters)	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
	- IEC 62109 standard (Safety of Power Converters for Use in Photovoltaic Power Systems)	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
1.2.2	Has the surge protection device been installed?	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
1.2.3	DC overvoltage protection device is available.	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
1.2.4	DC short-circuit protection is available.	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
1.2.5	Insulation monitoring system is available.	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Device inspection plan has been prepared.
1.2.6	AC overvoltage protection device is available.	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	

**TABLE 4.2-24  
HAZARD IDENTIFICATION USING THE CHECKLIST METHOD (CONT'D)**

**Area/Machinery** ..Electricity generation area/ solar panels/ Inverter and auxiliary equipment/.....

..Solar electricity generation from ground-mounted photovoltaic technology.....

No.	Checklist	Inspection results			Important remarks
		Yes	No	N/A	
1.2.7	Ground monitoring system is available.	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Device inspection plan has been prepared.
1.2.8	Over temperature protection system is available.	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
<b>1.3</b>	<b>Auxiliary equipment</b>				
<b>1.3.1</b>	<b>Electric wire</b>				
1.3.1.1	The electric wire is a photovoltaic with a temperature tolerance at least 80 degrees Celsius or is a 0.6/1 KV CV wire according to the IEC 60502 standard or other wires with better properties.	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Use XLPO wires that can withstand temperatures up to 120 degrees Celsius
1.3.1.2	For DC, the wire has a maximum current tolerance at least 1.25 times of the short-circuit current of the solar panel set (I <sub>sc</sub> ) at STC condition.	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
1.3.1.3	For AC, the wire has a maximum current tolerance at least 1.25 times of the rated power at the unity power factor of the electrical equipment.	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
<b>1.3.2</b>	<b>Electrical conduit</b>				
1.3.2.1	Polyethylene conduit should be high density polyethylene (HDPE) pipe with a PN8 quality class or higher and have TIS.982 certification.	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
1.3.2.2	Metal pipe should be EMT metal conduit or those with higher quality.	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	

**TABLE 4.2-24  
HAZARD IDENTIFICATION USING THE CHECKLIST METHOD (CONT'D)**

**Area/Machinery** Electricity generation area/ solar panels/ Inverter and auxiliary equipment/  
Solar electricity generation from ground-mounted photovoltaic technology

No.	Checklist	Inspection results			Important remarks
		Yes	No	N/A	
<b>1.3.3</b>	<b>DC Junction Box</b>				
1.3.3.1	The box is outdoor type.	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
1.3.3.2	Has Ingress Protection (IP) rated IP45 or higher quality.	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
1.3.3.3	Electrical wire connectors inside the junction box are installed appropriately, orderly, securely and safely.	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
<b>2.</b>	<b>Inspection of equipment design and installation methods</b>				
2.1	The detail design and the system installation must be carried out and certified by an engineer who has a license to practice professional engineering from the Council of Engineers.	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
2.2	Circuit connection of solar modules must be technically appropriate and have good safety protection with reference to TIS 2572 standard (Electrical Installation - Solar Power Distribution System) or IEC 60364- 7-712 standard (Requirements for Special Installations or locations – Solar Photovoltaic (PV) Power Supply System) or the manufacturer's PV installation manual (if applicable).	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
2.3	The electrical wires used for electrical wiring between solar modules must be the wires come with the terminal box of the solar modules. The circuit must be connected correctly or using photovoltaic wire or CV type 0.6/1 KV wire or higher quality. PV connector or other types of connectors that is not less stable should be selected.	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	

**TABLE 4.2-24  
HAZARD IDENTIFICATION USING THE CHECKLIST METHOD (CONT'D)**

**Area/Machinery** Electricity generation area/ solar panels/ Inverter and auxiliary equipment/

Solar electricity generation from ground-mounted photovoltaic technology

No.	Checklist	Inspection results			Important remarks
		Yes	No	N/A	
2.4	For all modules and system equipment with metallic construction and/or equipment specified to be wired, the grounding circuit must be in accordance with technical principles or the installation standards Electricity for Thailand B.E. 2545 (2002) (Revision in B.E. 2551(2008)) of the Engineering Institute of Thailand	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
2.5	The electrical wires must have a current rating at least 1.25 times of the maximum current in the circuit.	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
2.6	Electrical wiring must be in accordance with the relevant regulations and requirements of the Electricity Authority, regulations and academic principles referring to the Electrical Installation Standards for Thailand B.E. 2545 2545 (2002) (Revision in B.E. 2551(2008)) of the Engineering Institute of Thailand or according to the regulations prescribed by the Electricity Authority.	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
2.7	When the installation of the system is completed, there must be an inspection by engineer licensed to practice professional engineering from the Engineering Council to ensure that the system is installed correctly and safely according to technical principles.	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
2.8	There is a monitoring for the efficiency of electricity generation equipment and protection devices and Preventive Maintenance (PM) plan to ensure that all equipment is in good condition with the	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	

**TABLE 4.2-24  
HAZARD IDENTIFICATION USING THE CHECKLIST METHOD (CONT'D)**

**Area/Machinery** ..Electricity generation area/ solar panels/ Inverter and auxiliary equipment/.....

.....Solar electricity generation from ground-mounted photovoltaic technology.....

No.	Checklist	Inspection results			Important remarks
		Yes	No	N/A	
<b>3.</b>	<b>Training and provision of Personal Protective Equipment (PPE)</b>				
3.1	Employees are trained to understand the potential hazard from electricity generation.	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
3.2	There is training for administrators and relevant staff to understand the operation of systems/equipment.	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
3.3	Provide Personal Protective equipment (PPE) that is suitable for the tasks to ensure safety operation.	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
3.4	Provide sufficient fire suppression equipment in various areas and trainings to ensure that the staff can suppress the fire correctly in case of incident.	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	

### 4.2.5.3 Risk Assessment of Hazard Probability

#### (1) Hazard Probability

The Checklist (details in **Table 4.2-24**) show that the project installed the dielectric and equipment inspection plan, overvoltage system and equipment inspection plan, and the system to prevent the over temperature in the system. These systems prevent the electrical shock and electrical arc. However, the human error can happen in the project, such as, electrical shock because of the employee or the equipment are in the wet condition. From the review of factory accidents of Safety Technology Office, Departments of Industrial Works, during 2016-2022 (7 years), there are no records of the accidents in the factory of photovoltaic production. The statistics of Department of labour protection and welfare : Establishments of business that do not comply with the safety law in the factory of electricity, gas and water supply during 2013-2021 (9 years), there are no records of report concerning illegal operations according to the safety law (electricity). However, in 2019, the reports of illegal operations according to the safety law were reported. When compared with the level of risk, according to the regulations of Department of Industrial Works : criteria of hazard indication, risk assessment and risk management plan, B.E. 2543 (2000) (**Table 4.2-25**), the level 2 (low risk probability) can happen once in 5-10 years.

The project have installed the standard equipment, namely, the lightning and surge protection device and DC short-circuit protection. Therefore, the risk of fire is minimized. From the review of factory accidents of Safety Technology Office, Departments of Industrial Works, during 2016-2022 (7 years), there are no records of the accidents in the factory of photovoltaic production. The statistics of Department of labour protection and welfare : Establishments of business that do not comply with the safety law in the factory of electricity, gas and water supply (fire) during 2013-2021 (9 years), there are no records of report concerning illegal operations according to the safety law (electricity). However, in 2019, the reports of illegal operations according to the safety law (fire) were reported. When compared with the level of risk, according to the regulations of Department of Industrial Works : criteria of hazard indication, risk assessment and risk management plan, B.E. 2543 (2000) (**Table 4.2-25**), the level 2 (low risk probability) can happen once in 5-10 years.

#### (2) Severity of Consequences

The consideration of impact of electric shock because of the employee or the equipment are in the wet condition, with the criteria of severity level to the people, communities, environment and property, according to the criteria of hazard indication, risk assessment and risk management plan, B.E. 2543 (2000) (**Table 4.2-26**), shows that the electric shock because of the employee or the equipment are in the wet condition will cause the impact of level 4 to the employee: the disability or death. However, the employees do not work with the solar module, except the employees who are responsible for the cleaning of solar module. The procedure of of cleaning is as follows:

- 1) The temperature during the time or date of the cleaning should not be too high to prevent the crack of glass from the repid change of temperature.
- 2) Turn off the electric distribution before cleaning for safety. Do not touch the back of the module to minimize the opportunities of short circuit or electric shock.

3) Use fresh water in cleaning and mop with sponge to wipe the module to prevent the scratch and avoid the chemical residue.

4) The employee should wear the personal protective equipment (PPE) and follow the indicated instruction of work.

The impact to the communities is level 1 : no impact, because the people cannot approach the project's electricity generator. Only the employees who are authorized can enter the production area. The impact to the environment is level 1 : minor impact or no impact. The impact to the property is level 3 : severe impact and parts of production must be halted.

The short circuit and fire in the equipment cause the impact of level 2 to the employee : injury that needs the medical treatment. However, the project employees do not work in the area of the risky electric equipment, such as, solar module, inverter, transformer and electrical wire. The impact to the community is level 1 : no impact to the nearby communities, since the project location is not in the community area. The impact to the environment is level 2 : moderate, the hazard or accident can be solved in a short period of time. The impact to the property is level 3 : severe impact and parts of production must be halted.

**TABLE 4.2-25**  
**LEVEL OF LIKELIHOOD FOR THE OCCURRENCE**  
**OF VARIOUS EVENTS**

Level	Description
1	There is a rare chance of occurrence e.g., no occurrence in a period of 10 years or more.
2	There is a low chance of occurrence e.g., 1 occurrence in a period of 5 - 10 years.
3	There is a moderate chance of occurrence e.g., 1 occurrence in a period of 1 - 5 years.
4	There is a high chance of occurrence e.g., more than once occurrence in a period of 1 year.

**Source:** The Regulation of Department of Industrial Works on Criteria for Hazard Identification, Risk Assessment, and Establishment of Risk Management Plan, B.E. (2000) 2543

**TABLE 4.2-26**  
**CLASSIFICATION OF IMPACTS ON INDIVIDUAL, COMMUNITY,**  
**ENVIRONMENTAL AND PROPERTY**

Level	Severity	Description			
		Individual impact	Community impact	Environmental impact	Property impact
1	Minor	Minor injuries, only first aid level required	Have no or minor impact on nearby communities.	Have minor, controllable and correctable environmental impacts	Have no or minor impact on property.
2	Moderate	Medical treatment required	Have impacts on nearby communities but can be resolved in short period of time.	Have moderate environmental impacts	The property is moderately damaged, and the operation can be resumed.
3	High	Severe injuries or sickness	Have impacts on nearby communities which take time to resolve.	Have environmental impacts which take time to resolve	The property is heavily damaged, and some operation must be paused.
4	Extreme	Disability or death	Have severe impacts on communities in wide area. The government agencies must perform corrective actions.	Have severe environmental impacts which take long time and resources to resolve.	The property is severely damaged, and all operation must be paused.

**Source :** The Regulation of Department of Industrial Works on Criteria for Hazard Identification, Risk Assessment, and Establishment of Risk Management Plan, B.E.(2000) 2543

### 3. The Risk Level

The results of assessment in terms of frequency of impact and severity of impact to the people, environment and property as mentioned above can be evaluated for the output for hazard level as follows:

<p style="text-align: center;"><b>Consideration output =      frequency of impact x severity of impact .....(1)</b> <b>(to the people, communities, environment, property)</b></p>
--

If the level of risk to the people, communities, environment or property is different, select the highest risk level. Then compare the output with the **Table 4.2-27**.



**TABLE 4.2-27**  
**RISK LEVEL CLASSIFICATION**

Levels	Results	Definition
1	1-2	Low risk
2	3-6	Acceptable risk, controlling measures must be review.
3	8-9	High risk, mitigation measures must be applied.
4	12-16	Unacceptable risk, operation must be paused and the risks must be mitigated immediately.

**Source :** The Regulation of Department of Industrial Works on Criteria for Hazard Identification, Risk Assessment, and Establishment of Risk Management Plan, B.E. 2543 (2000).

In case the employee or the equipment are in the wet condition, then touch the equipment with electricity and cause electric shock, this risk probability of incident is considered level 2. The highest severity is level 4. Then the consideration outcome is  $2 \times 4 = 8$ . When compared to the level of risk in **Table 4.2-27**, the risk of hazard from electric shock because of the wet condition of employee or equipment is level 3 : high risk, the action must be done to minimize the risk (details of assessment is in **Table 4.2-28**).

In case the short circuit of equipment and fire, the risk probability of incident is level 2. The highest severity to the property is level 3. Then the consideration outcome is  $2 \times 3 = 6$ . When compared to the level of risk in **Table 4.2-27**, the risk of hazard from short circuit of equipment and cause fire is level 2 : the risk is acceptable and the review of control measures is needed. (details of assessment is in **Table 4.2-28**).

#### 4.2.5.4 The Safety Management System

Due to the installation of dielectric and equipment inspection plan, the overvoltage system, ground connection and equipment inspection plan and over temperature protection, these systems will minimize the electrical shock and electrical arc. However, the project implementation can cause the hazard due to the human error, such as electrical shock because of the wet condition of the employees and equipment. The risk of electrical shock because of the wet condition of the employees and equipment is acceptable but the measures of control must be taken into consideration. Therefore, to prevent and minimize the impact, the project should prepare the measures to control, prevent and reduce the impact, prepare the management system and risk management during the operation and annually inspect the safety of the operation to ensure the safety for the personnel, communities and environment. Details are displayed in **Table 4.2-29**.

Additionally, the project have installed the standard equipment, namely, the lightning and surge protection device and DC short-circuit protection. Therefore, the risk of fire is minimized. The measures to prevent and minimize the impact for the safety of personnel, communities and environment are taking into consideration, such as, apply international standard equipment, prepare the maintenance plan and regularly test of the fire equipment, and hold the basic fire drill for the operators in case of emergency incidents. Details are displayed in **Table 4.2-29**.

**TABLE 4.2-28**  
**THE RESULTS OF THE STUDY, ANALYSIS AND REVIEW OF THE PROJECT IMPLEMENTATION FOR HAZARD IDENTIFICATION AND RISK ASSESSMENT BY THE CHECKLIST METHOD**

**Area/Machinery** ..Electricity generation area/ solar panels/ Inverter and auxiliary equipment/.....

..Solar electricity generation from ground-mounted photovoltaic technology.....

Results from Checklist method	Hazard or consequences	Preventive and controlling measures	Suggestion	Risk assessment			
				Probability	Severity	Results	Risk level
Personnel/equipment being in wet conditions contacts with electrical equipment (Human Error)	The staff, especially solar panels cleaner have electric shock.	<ul style="list-style-type: none"> <li>- Arrange appropriate solar panels washing plan and encourage the staff to strictly follow the prescribed procedures.</li> <li>- Personal Protective Equipment, e.g., helmets, safety gloves, safety shoes, etc., must always be used in the operation and must always be kept in ready to use condition.</li> <li>- Establish clear operational procedure for panels washing to ensure that the electricity is turned off before panel washing.</li> </ul>	-	2	4	2x 4 = 8	3 High risk. Mitigation measures are required.

**TABLE 4.2-28**  
**THE RESULTS OF THE STUDY, ANALYSIS AND REVIEW OF THE PROJECT IMPLEMENTATION FOR HAZARD IDENTIFICATION AND RISK ASSESSMENT YY THE CHECKLIST METHOD (CONT'D)**

**Area/Machinery** ..Electricity generation area/ solar panels/ Inverter and auxiliary equipment/.....

.....Solar electricity generation from ground-mounted photovoltaic technology.....

Results from Checklist method	Hazard or consequences	Preventive and controlling measures	Suggestion	Risk assessment			
				Probability	Severity	Results	Risk level
In the case of electrical short circuit equipment	Electrical hazards can occur in the vicinity of electrical equipment, including: <ul style="list-style-type: none"> <li>- Solar panels</li> <li>- Electrical current transformers</li> <li>- Electrical transformers</li> <li>- Electrical wires</li> </ul>	<ul style="list-style-type: none"> <li>- Use equipment that meets international standards.</li> <li>- Install a short-circuit protection system.</li> <li>- Install fire suppression equipment in accordance with specified standards.</li> <li>- Establish a regular maintenance and inspection plan for fire suppression equipment to ensure readiness for use.</li> <li>- Provide basic fire safety training to workers to ensure they have the knowledge and understanding to respond effectively and promptly.</li> </ul>	-	2	3	2 x 3 = 6	2  The acceptable level of risk requires a review of control measures.

**TABLE 4.2-29**  
**SAFETY MANAGEMENT PLAN (RISK MITIGATION PLAN)**

**Project** ..... Phalangan Rungrueang Solar Power Plant with photovoltaic technology or solar cells ground mounted type.....

**Objective** ..... To mitigate the risk from electricity generation from solar cells.....

**Applied area** ..... Electricity generation area of the project.....

No.	Risk mitigation measures / activities / operations	Responsible by	Implementing period	Monitored by	Remarks
<b>1</b>	<b>Operational safety</b>				
1.1	Personal Protective Equipment, e.g., helmets, safety gloves, safety shoes, etc., must always be used in the operation and must always be kept in ready-to-use condition.	Project staff	Throughout operation phase	Project's safety officer	-
1.2	Establish clear operational procedure for modules washing to ensure that the electricity is turned off before modules washing.	Assigned staff	Throughout operation phase	Project's safety officer	-
1.3	Organize a monitoring system for efficiency of electricity generation equipment and machinery as stated in the manufacturer's manual.	Assigned staff	Throughout operation phase	Engineer	-
1.4	Inspect performance and the availability of equipment used in both direct current and alternating current circuit breakers and the grounding system of various devices to ensure that the equipment is always be in good condition.	Assigned staff	Throughout operation phase	Engineer	-

**TABLE 4.2-29  
SAFETY MANAGEMENT PLAN (RISK MITIGATION PLAN) (CONT'D)**

**Project** ..... Phalangngan Rungrueang Solar Power Plant with photovoltaic technology or solar cells ground mounted type  
**Objective** ..... To mitigate the risk from electricity generation from solar cells  
**Applied area** ..... Electricity generation area of the project

No.	Risk mitigation measures / activities / operations	Responsible by	Implementing period	Monitored by	Remarks
1.5	Prepare a maintenance plan for equipment and machinery for safety operation throughout the period according to the manufacturer's specifications which are aligned with technical engineering and safety standards.	Assigned staff	Throughout operation phase	Engineer	-
1.6	Organize training about safety and the environment including safety and the environment practices for relevant staff as follows. <ul style="list-style-type: none"> <li>- Safety system in workplace</li> <li>- Electrical and thermal hazard protection</li> <li>- Personal Protective Equipment utilizing</li> <li>- Safety procedure for each operational task</li> </ul>	Project's safety officer	Throughout operation phase	Project's safety officer	-
1.7	Keep the workplace to be in safe environment by removing the obstructions and organize the workplace orderly to reduce the probability of critical hazards.	Assigned staff	Throughout operation phase	Project's safety officer	-

**TABLE 4.2-29**  
**SAFETY MANAGEMENT PLAN (RISK MITIGATION PLAN) (CONT'D)**

**Project** ..... Phalangngan Rungrueang Solar Power Plant with photovoltaic technology or solar cells ground mounted type  
**Objective** ..... To mitigate the risk from electricity generation from solar cells  
**Applied area** ..... Electricity generation area of the project

No.	Risk mitigation measures / activities / operations	Responsible by	Implementing period	Monitored by	Remarks
1.8	Organize activities to promote understanding in occupational health and safety.	Project's safety officer	Throughout operation phase	Project's safety officer	-
1.9	Investigate the root causes of the accident. Record the accident and root cause for further prevention and correction.	Assigned staff	Throughout operation phase	Project's safety officer	-
<b>2</b>	<b>Fire prevention measures</b>				
2.1	Inspect the availability of fire suppression equipment regularly. The equipment must always be in a ready-to-use condition.	Assigned staff	Throughout operation phase	Project's safety officer	-
2.2	Organize a fire drill so that staff can act appropriately in the case of an incident.	Assigned staff	Throughout operation phase	Project's safety officer	-

## 4.2.6 Climate Change Risk Assessment

### (1) Overview of Climate Change and Related Risks

Climate change refers to a change of climate which is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and which is in addition to natural climate variability observed over comparable time periods (*Article 1, UNFCCC*). It is directly related to Greenhouse gas (GHG). GHG are those gaseous constituents of the atmosphere, both natural and anthropogenic, that absorb and emit radiation at specific wave-lengths within the spectrum of thermal infrared radiation emitted by the earth surface, the atmosphere itself, and by clouds causing greenhouse effect. The six main GHG emissions are Carbon dioxide (CO<sub>2</sub>), Methane (CH<sub>4</sub>), Nitrous oxide (N<sub>2</sub>O), Hydro fluorocarbons (HFCs), Per fluorocarbons (PFCs), and Sulphur hexafluoride (SF<sub>6</sub>).

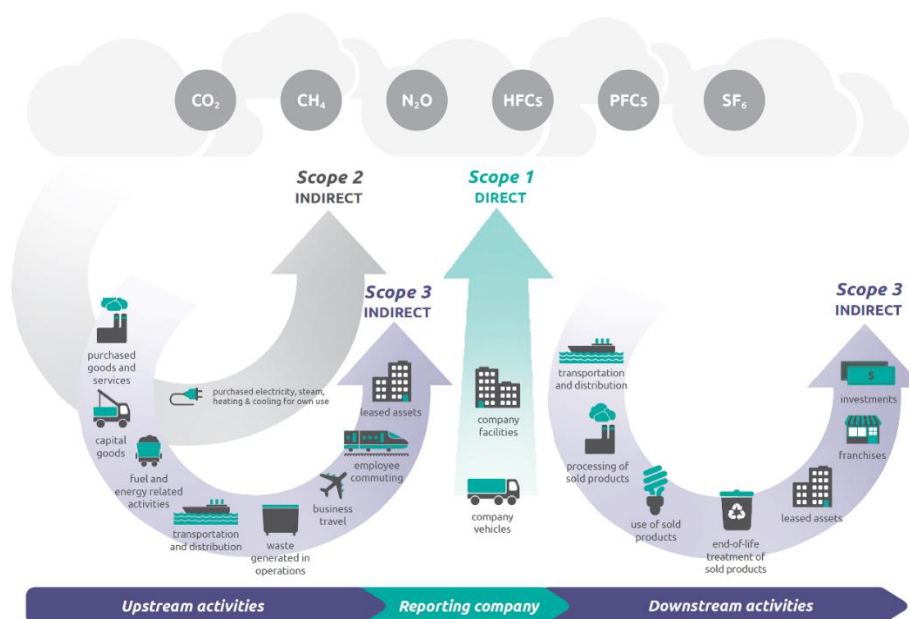
According to the GHG Protocol Corporate Standard, a company's greenhouse gas emissions are classified into three scopes are;

**Scope 1: Direct GHG Emissions** are direct emissions from owned or controlled sources.

**Scope 2: Indirect GHG Emissions** are indirect emissions from the generation of purchased energy.

**Scope 3: Other indirect GHG Emissions** are all indirect emissions (not included in scope 2) that occur in the value chain of the reporting company, including both upstream and downstream emissions.

The overview of scope and emission across a value chain are shown in **Figure 4.2-2**.



**FIGURE 4.2-2 : OVERVIEW OF SCOPES AND EMISSIONS ACROSS A VALUE CHAIN**

## (2) Methodology of Climate Change Risk Assessment

The Climate Change Risk Assessment (CCRA) is the assessment of the probability or likelihood the climate change risks and their potential consequences or impacts with aims to prioritize the appropriate climate action and adaptation for the proposed project or development.

As stated in the Guidance Note on Climate Change Risk Assessment, May 2023, the Client should align the CCRA with Climate Physical Risk and Climate Transition Risk categories of the TCFD<sup>1</sup> as part of the ESIA or other Assessment.

The implementation of the Phalangan Rungrueang Power Plant Project is categorized as “Category B” (Projects with potential limited adverse environmental and social risks and/or impacts that are few in number, generally site-specific, largely reversible and readily addressed through mitigation measures), a CCRA required under EP4 Principle 2 are as follows:

- Physical CCRA - For all Category A and, as appropriate, Category B Projects, and will include consideration of relevant physical risks.
- Transition CCRA and alternatives analysis - For all Projects, in all locations, when combined Scope 1 and Scope 2 emissions are expected to be more than 100,000 tonnes of CO<sub>2</sub> equivalent annually (100 ktpa CO<sub>2</sub>-eq). Consideration must be given to relevant Climate Transition Risks (as defined by the TCFD) and an alternatives analysis completed which evaluates lower GHG intensive alternative.

The Climate Change Risk Assessment matrix has been adopted from the *AZ 5334 – 2013: Climate Change Adaptation for Settlements and Infrastructure – A Risk Based Approach*, which followed the *ISO 31000: 2009, Risk Management Principle and Guideline*. The 5×5 Risk Analysis Matrix has been used to estimate the level of the identified climate change risk, where the x-axis is the consequences impact and y-axis is the likelihood (**Table 4.2-30**).

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<sup>1</sup> The climate change risk as recommended in the Task Force on Climate Related Financial Disclosures (TCFD) can be divided into 2 categories as following:

- 1) Physical Risks; those resulting from climate change can be event driven (acute) or longer-term shifts (chronic) in climate patterns.
- 2) Transitional Risks; that is a risk related to transitioning to a lower-carbon economy may entail extensive policy, legal, technology, reputation and market changes to address mitigation and adaptation requirements related to climate change.



**TABLE 4.2-30  
CLIMATE CHANGE RISK ASSESSMENT MATRIX**

Likelihood	Consequence				
	Insignificant	Minor	Moderate	Major	Catastrophic
Almost Certain	L	M	H	E	E
Likely	L	M	M	H	E
Moderate	L	L	H	H	E
Unlikely	L	L	M	M	H
Very Unlikely	L	L	L	M	M

**Risk Consequence Ranking:**

- E = Extreme Risk, requiring immediate action.
- H = High risk, requiring detailed research and planning at senior management level.
- M = Moderate risk, requiring change to design standards and maintenance of assets.
- L = Low risk, requiring action through routine maintenance of assets.

**Source :** Adopted from AS5334:2013 Climate change adaptation for settlements and infrastructure

The description of likelihood and consequences impacts are shown in **Table 4.2-31** and **Table 4.2-32**, respectively.

**TABLE 4.2-31  
THE DESCRIPTION OF LIKELIHOOD OF OCCURRENCES  
ON RECURRENT AND FREQUENCY**

Likelihood of Occurrences	Description	Recurrent or Event Risks	Long Term Risks
Almost Certain	Could occur several times per year	Has happened several times in the past year and in each of the previous 5 years; or could occur several times per year	Has a greater than 90% chance of occurring in the identified time period if the risk is not mitigated
Likely	May arise about once per year	Has happened at least once in the past year and in each of the previous 5 years, or may arise about once per year	Has a 60 – 90% chance of occurring in the identified time period if the risk is not mitigated
Moderate	Maybe a couple of times in a generation	Has happened during the past 5 years but not in every year, or May arise once in 25 years	Has a 40 – 60% chance of occurring in the identified time period if the risk is not mitigated
Unlikely	Maybe once in a generation	May have occurred once in the last 5 years, or may arise once in 25 to 50 years	Has a 10 – 30% chance of occurring in the future if the risk is not mitigated
Rare	Maybe once in a lifetime	Has not occurred in the past 5 years; or unlikely during the next 50 years	May occur in exceptional circumstances, i.e. less than 10% chance of occurring in the identified time period if the risk is not mitigated

**Source :** Adopted from AS5334:2013 Climate change adaptation for settlements and infrastructure

**TABLE 4.2-32**  
**THE DESCRIPTION OF LEVEL OF CONSEQUENCES ON**  
**CONCERNED SECTORS**

Level Consequence	Infrastructure, Service	Social / Cultural	Environmental
Insignificant	No infrastructure damage, no change to service.	No adverse human health effects.	No adverse effects on natural environment
Minor	Localized infrastructure service disruption. No permanent damage. Some minor restoration work required. Early renewal of infra-structure by 10 - 20%. Need for new/modified ancillary equipment.	Short-term disruption to employees, customers or neighbors. Slight adverse human health effects or general amenity issues.	Minimal effects on the natural environment.
Moderate	Limited infrastructure damage and loss of service. Damage recoverable by maintenance and minor repair. Early renewal of infrastructure by 20 - 50%.	Frequent disruptions to employees, customers, or neighbours. Adverse human health effects.	Some damage to the environment, including local ecosystems. Some remedial action may be required.
Major	Extensive infrastructure damage requiring major repair. Major loss of infrastructure service. Early renewal of infrastructure by 50 - 90%.	Permanent physical injuries and fatalities may occur. Severe disruptions to employees, customers or neighbours.	Significant effect on the environment and local ecosystems. Remedial action likely to be required.
Catastrophic	Significant permanent damage and/or complete loss of the infrastructure and the infrastructure service. Loss of infrastructure support and translocation of service to other sites. Early renewal of infrastructure by 90%.	Severe adverse human health effects, leading to multiple events of total disability or fatalities. Total disruption to employees, customers or neighbours. Emergency response at a major level.	Very significant loss to the environment. May include localized loss of species, habitats or ecosystems. Extensive remedial action essential to prevent further degradation. Restoration likely to be required.

**Source :** Adopted from AS5334:2013 Climate change adaptation for settlements and infrastructure

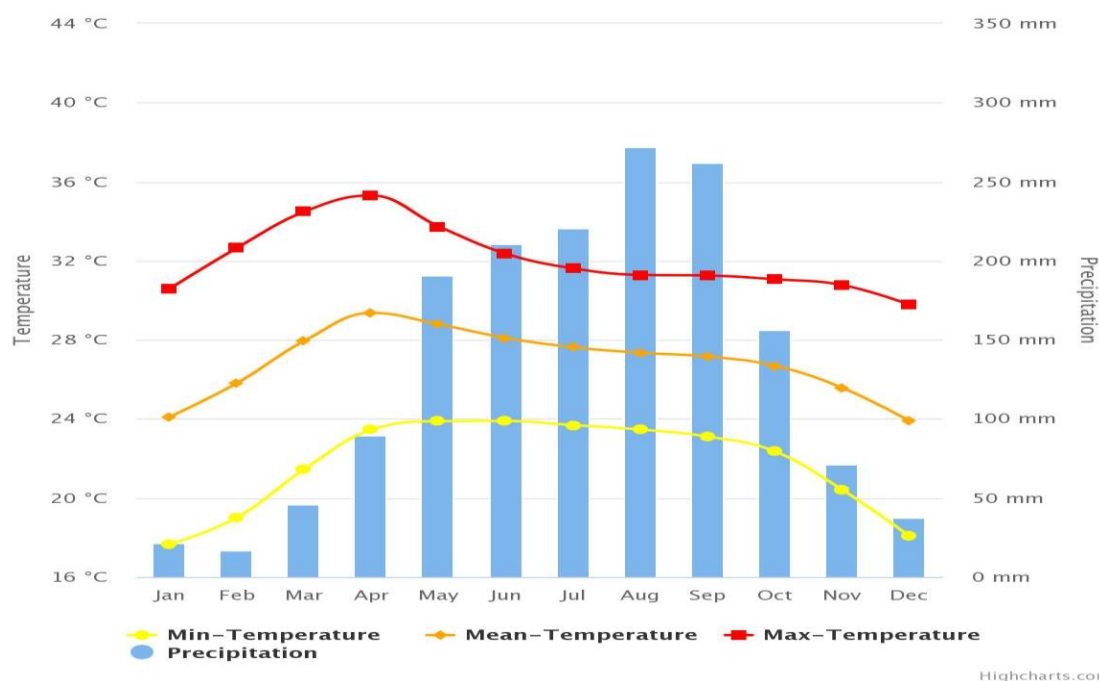
### (3) Baseline Climate Change Data of Thailand

Thailand has a tropical climate influenced by the southwest (SW) and Northeast (NE) monsoons. There are 2 distinct seasons are; *Rainy Season*: normally from May to October and *Dry Season*: normally from November to April.

During rainy season, the SW monsoon brings warm and humidity air from the Indian Ocean towards Thailand, causing abundant rainfall over the country. The average annual rainfall is approximately 1,500 mm. intense rainfall usually occurs during August to September, which correspond to the final period of the SW monsoon, cyclones, and also typhoons, with approximately 250-270 mm rainfall recorded during these months.

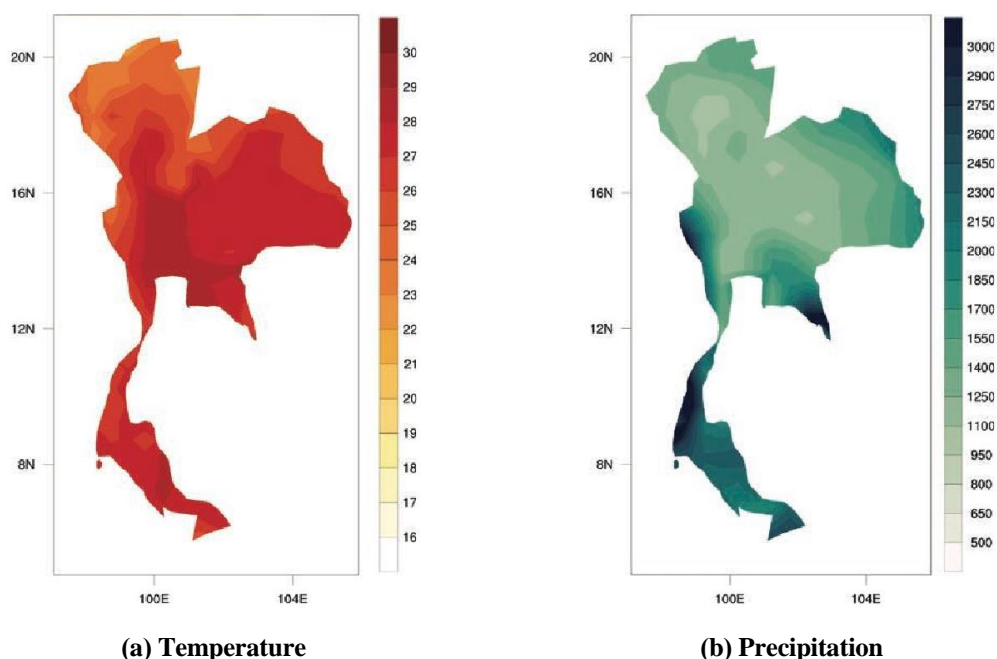
During dry season, the NE monsoon, brings cold and dry air from the anticyclone in China over Thailand. The weather condition is relatively dry and cool. The coolest temperature is found in January. During March to May, the transitional period from the NE monsoon to SW monsoon, the air mass movements bring warm air to the Thailand from a southeast direction, the weather is relatively warm and humid. The hottest temperature is found in April.

The monthly climatology of Thailand during 1991-2020 is shown in **Figure 4.2-3**, the mean annual temperature is approximately 26.3 °C. The mean monthly temperature ranged from 23.9-29.4 °C, the min-monthly temperature ranged from 17.7-23.9 °C, and the max-monthly temperature ranged from 29.8-35.3°C, approximately. The annual rainfall is approximately 1,500 mm. and the average monthly rainfall ranged from 16.6-271.5 mm. The spatial differences of observed historical temperature and rainfall in Thailand is shown in **Figure 4.2-4**.



Source : Climate Risk Country Profile: Thailand (Asian Development Bank, 2021)

**FIGURE 4.2-3 : AVERAGE MONTHLY TEMPERATURE AND MONTHLY RAINFALL IN THAILAND DURING 1991–2020**



Source : Climate Risk Country Profile: Thailand (Asian Development Bank, 2021)

**FIGURE 4.2-4 : THE VARIATION OF TEMPERATURE AND PRECIPITATION ACROSS THAILAND**

#### (4) Projected Climate Change Data

The Intergovernmental Panel on Climate Change (IPCC) has developed four Representative Concentration Pathways (RCP) (i.e. RCP2.6, RCP4.5, RCP6.0, and RCP8.5) used for climate modeling and research for the IPCC Fifth Assessment Report (AR5) in 2014. The pathways describe the different future climate depending on the volume of GHG emitted in the coming year. In this report, RCP2.6 and RCP8.5, the extremes of low and high emissions pathways, are the primary focus RCP2.6 represents a very strong mitigation scenario, whereas RCP8.5 assumes business-as-usual scenario.

The results from IPCC modelled show a trend of consistent warming and an increase in the intensity of heavy precipitation periods and extreme events in Thailand. The projected temperature under RCP 2.6 and RCP 8.5 are shown in **Table 4.2-33** to **Table 4.2-34**.

*In terms of Temperature Scenario*, under the RCP2.6 and RCP8.5, the average daily temperatures are projected to increase by 1.1 and 3.8°C by the 2080s, respectively (See **Table 4.2-33**). Increasing of the average monthly temperature is lower than average daily temperature, under the RCP8.5 by the 2080s, the average monthly temperatures are projected to increase by 3.5-3.8 °C, and approximately 1.0-1.1 °C under the RCP2.6 (See **Table 4.2-34**).

**Figures 4.2- 5** show the annual average temperature projections under RCP2.6 and RCP8.5, the rises in annual temperature is expected to be slower than the daily and monthly temperature. The projected temperature under RCP2.6 and RCP8.5 are expected to 27.4 and 30.0 °C, approximately. (Increase by 1.1 and 3.7 °C under RCP2.6 and RCP8.5).

**TABLE 4.2-33**  
**PROJECTED ANOMALY FOR DAILY TEMPERATURES IN THAILAND**  
**DURING 2040–2059 AND 2080–2099 FOR RCP 2.6 AND RCP 8.5**

Unit: °C

Scenario	Average Daily Maximum Temperature		Average Daily Temperature		Average Daily Minimum Temperature	
	2040-2059	2080-2099	2040-2059	2080-2099	2040-2059	2080-2099
RCP2.6 (Atmospheric concentration of CO <sub>2</sub> projected at approx. 420 ppm by 2100)	1.0 (-0.6-2.9)	1.1 (-0.6-3.0)	1.0 (-0.3-2.4)	1.1 (-0.2-2.5)	1.0 (-0.1-2.2)	1.1 (-0.2-2.4)
RCP8.5 (Atmospheric concentration of CO <sub>2</sub> projected at approx. 940 ppm by 2100 and continuing to increase.)	1.7 (0.0-3.6)	3.6 (1.6-6.1)	1.8 (0.4-3.2)	3.8 (2.0-5.8)	1.9 (0.5-3.2)	3.9 (2.2-5.9)

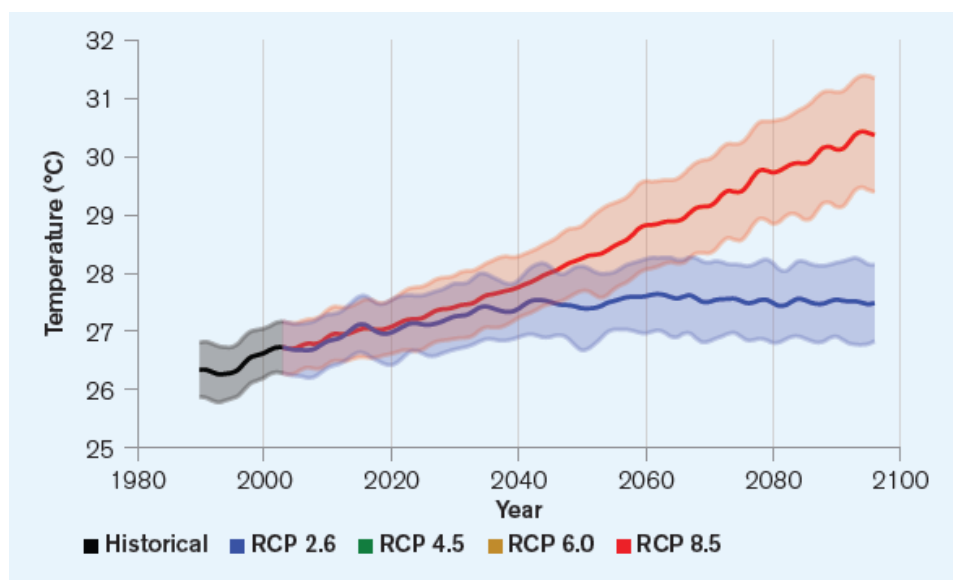
Source : Climate Risk Country Profile: Thailand (Asian Development Bank, 2021)

**TABLE 4.2-34**  
**PROJECTED ANOMALY FOR AVERAGE MONTHLY TEMPERATURE**  
**IN THAILAND DURING 2040–2059 AND 2080–2099 FOR RCP 2.6 AND RCP 8.5**

Unit: °C

Scenario	2040–2059		2080–2099	
	Jun-Aug	Dec-Feb	Jun-Aug	Dec-Feb
RCP2.6 (Atmospheric concentration of CO <sub>2</sub> projected at approx. 420 ppm by 2100)	1.0 (0.2-2.0)	1.0 (-0.6-2.6)	1.0 (0.1-2.0)	1.1 (-0.4-2.6)
RCP8.5 (Atmospheric concentration of CO <sub>2</sub> projected at approx. 940 ppm by 2100 and continuing to increase.)	1.6 (0.6-2.8)	1.9 (0.1-3.4)	3.5 (2.4-5.4)	3.8 (1.4-6.1)

Source : Climate Risk Country Profile: Thailand (Asian Development Bank, 2021)



Source : Climate Risk Country Profile: Thailand (Asian Development Bank, 2021)

**FIGURE 4.2-5 : HISTOTIC AND PROJECTED AVERAGE ANNUAL MEAN**  
**TEMPERAURE3 IN THAILAND UNDER RCP2.6 (BULE) AND RCP8.5 (RED)**  
**SCENARIOS**

***In terms of Cyclones, Storm Surge, and Coastal Zone***

Climate change is expected to interact with cyclone hazard in complex ways. Climate change caused the sea-level rise and coastal inundation to enhance the cyclone and induced storm surge, and possible to increasing wind speed and rainfall or precipitation intensity. Moreover, the extreme rainfall events (greater than 100 mm/day) are likely to more frequent, the typhoons reaching Thailand in between 2013-2043 are expected to be increased, but the number of monsoon storms are projected to stay relatively stable.

***In terms of Flood***

Paltan et al. (2018) demonstrate that even under lower emissions pathways coherent with the Paris Climate Agreement almost all Asian countries face an increase in the frequency of extreme river flows. What would historically have been a 1 in 100-year flow, could become a 1 in 50-year or 1 in 25-year event in most of South, Southeast, and East Asia.

**(5) Projected GHG Emissions from Project Implementation**

The GHG emissions related to the Project as defined in *Scope 1* and *Scope 2* of each implementation phase can be calculated as following.

**A. Projected GHG Emissions during Construction Phase**

The source of GHG emission during this phase are

**1) The Fossil Fuel Combustion for Construction Equipment/Machine**

The operation of diesel combustion engine of construction equipment/ machine such as backhoe, vibrator roller, grader, tractor, and, etc. covering 14 months during construction phase would be emitted GHG emission including carbon dioxide (CO<sub>2</sub>) and methane (CH<sub>4</sub>). The quantities of GHGs emissions could be estimated from information on the number, diesel consumption rate, their operation hours, and Emission Factor by using the equation as follows;

$$GHG = E \times C \dots\dots\dots (1)$$

- Where GHG = GHGs Emissions (kg CO<sub>2</sub>e/year)
- E = Emission factor (kg CO<sub>2</sub>e/litre)
- = 2.9793 kg CO<sub>2</sub>e/liter (Off-road (Emission Factor for Mobile Combustion (Off road) from TGO (IPCC Vol.2 table 3.3.1, DEDE)
- C = Fuel consumption rate (liter/year)

The construction equipment/ machines used in the construction activities and their number, operation hour, fuel type, fuel consumption rate, and amount of fuel consumed are summarized in **Table 4.2-35**.

Using Equation (1) and amount of fuel consumed in **Table 4.2-35**, the GHG emissions from the diesel combustion of construction equipment/machine in 2023 to 2024 is approximately 246,414-1,944,219 kg CO<sub>2</sub>e/year or 246.41-1,944.22 tonne CO<sub>2</sub>e/year.

**TABLE 4.2-35  
DETAILS OF CONSTRUCTION EQUIPMENT/MACHINE USED IN PROJECT CONSTRUCTION PHASE**

Item	Description	HP	Fuel Consumption Rate (L/hp/hr)	Loading Factor (%)	Working Hour (hr/day)	Number of Construction Equipment (Unit)														Total Working Hour (hr.) <sup>1/</sup>		Fuel Consumed (L)		
						2023			2024											2023	2024	2023	2024	
						Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov					Dec
1	Truck & Crane 5 T	240	0.1814	0.50	8	-	1	2	2	4	4	4	4	4	4	4	3	3	3	2	528	7,216	11,494	157,078
2	Rough terrain Crane 25 T.	250	0.1814	0.50	8	-	-	1	1	1	1	1	1	1	1	1	1	1	1	1	176	2,112	3,991	47,890
3	Rough terrain Crane 60 T.	350	0.1814	0.50	8	-	-	-	-	-	-	-	1	1	1	-	-	-	-	-	0	528	0	16,761
4	Rough terrain Crane 200 T.	450	0.1814	0.50	8	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	0	176	0	7,183
5	Fork Lift 2.5-3 T.	100	0.1814	0.50	8	-	-	-	-	-	4	4	4	4	4	4	2	-	-	-	0	4,576	0	41,504
7	Excavator PC 20-60	28	0.1814	0.70	8	-	2	2	2	6	6	6	6	6	6	6	3	3	2	2	704	9,504	2,503	33,791
8	Excavator PC 100-120	90	0.1814	0.70	8	-	-	1	2	2	2	2	2	2	2	2	1	1	-	-	176	3,168	2,011	36,205
9	Excavator PC 200	158	0.1814	0.70	8	-	3	4	4	4	4	4	2	2	2	2	2	2	-	-	1,232	4,928	24,717	98,870
10	Back Hoe Loader	92	0.1814	0.70	8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0	0	0	0
11	Vibrator Roller 10T	112	0.1814	0.70	8	-	-	1	1	1	1	1	1	1	1	1	1	1	1	-	176	1,936	2,503	27,533
12	Grader	230	0.1814	0.70	8	-	-	2	4	4	4	3	3	3	3	-	-	-	-	-	352	4,224	10,280	123,364
13	Tractor (D2)	100	0.1814	0.70	8	-	1	1	2	2	2	2	2	2	2	-	-	-	-	-	352	2,464	4,470	31,288
14	Farm Tractor	90	0.1814	0.70	8	-	2	2	2	2	2	-	-	-	-	-	-	-	-	-	704	1,056	8,045	12,068
15	Pile Driving Machine	284	0.1814	0.70	8	-	1	1	1	1	1	-	-	-	-	-	-	-	-	-	352	528	12,694	19,041
<b>Total</b>																				<b>4,752</b>	<b>42,416</b>	<b>82,709</b>	<b>652,576</b>	

Remark : 1/ Assumed working day is 22 day/month

## 2) The Fossil Fuel Combustion for Vehicle Transportation

Transportation activities during the construction phase mainly are transportation of construction material, water, and construction workers. The number of transportation during this phase are summarized in **Table 4.2-36**. The quantities of GHGs emissions could be estimated by using the equation (2) and (3) as follows;

$$\text{GHG} = E \times \text{TVM} \dots\dots\dots (2)$$

Where

- GHG = GHGs Emissions (kg CO<sub>2e</sub> /year)
- E = Emission factor (kg CO<sub>2e</sub>/TKM)
- TKM = Tonne-kilometer in transport

$$\text{GHG} = E \times \text{km} \dots\dots\dots (3)$$

Where

- GHG = GHGs Emissions (kg CO<sub>2e</sub> /year)
- E = Emission factor (kg CO<sub>2e</sub>/km)
- km = kilometer in transport for empty vehicle

Using Equation (2) and (3), and assumed the working day of 22 day/month, the GHG emissions from the diesel combustion of transportation vehicle during construction phase is approximately 19,025-225,455 kg CO<sub>2e</sub>/year or 19.03-225.46 tonne CO<sub>2e</sub>/year. Details are shown in **Table 4.2-36**.

## 3) Electricity Consumption

Electricity consumption during the construction phase is approximately 119,520 kWh/year which supplied from the Provincial Electricity Authority. Therefore, the GHG emissions from the electric consumption in construction site and worker campsite could be calculated by using equation (4) as follow;

$$\text{GHG} = E \times C \dots\dots\dots (4)$$

Where;

- GHG = GHG emissions (kg CO<sub>2e</sub>/year)
- E = Emission factor (kg CO<sub>2e</sub>/kWh)
- = 0.4999 kg CO<sub>2e</sub>/kWh (Emission factor for electricity generation of grid mix from Thai National LCI Database, TIIS-MTEC-NSTDA (with TGO electricity 2016-2018)
- C = Electricity consumption (kWh/year)

Thus;

- GHG = 0.4999 kg CO<sub>2e</sub>/kWh × 112,320 kWh/year
- = 56,149 kg CO<sub>2e</sub>/year
- = 56.15 tonne CO<sub>2e</sub>/year



**TABLE 4.2-36  
GHG EMISSIONS FROM DIESEL COMBUSTION OF TRANSPORTATION VEHICLE**

Item	Description	Weight (T)	Distance (km/day)	TKM at 100 % Load	Emission Factor		2023			2024												GHG Emitted (kg CO <sub>2</sub> e/year)		
					100 % Load Truck kgCO <sub>2</sub> e /tkm	Empty Truck kgCO <sub>2</sub> e /km	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	2023	2024	Total
1	Truck 6 wheels	8.5	60	510	0.0653	0.4069	-	-	1	1	3	4	4	4	4	4	4	4	3	2	1	635	24,126	24,761
2	Dump Truck 10 wheels	16.0	60	960	0.0454	0.5747	-	3	4	5	5	4	4	4	3	3	1	1	1	1	1	6,011	28,338	34,349
3	Truck 22 wheels	32.0	60	1,920	0.0459	1.0206	-	-	-	-	-	-	1	1	1	1	-	-	-	-	-	-	6,572	6,572
4	Water Truck 10 wheels	16.0	60	960	0.0454	0.5747	-	1	1	1	2	2	2	2	2	2	2	2	2	2	1	1,717	18,892	20,609
5	Light Truck 4 wheels	1.5	250	375	0.2706	0.2415	-	-	2	3	3	3	3	3	3	3	3	3	3	3	2	3,561	62,312	65,873
6	Light Truck 4 wheels	1.5	250	375	0.2706	0.2415	-	-	2	2	2	2	2	2	2	2	2	2	2	2	2	3,561	42,728	46,289
7	Light Truck 4 wheels	1.5	200	300	0.2706	0.2415	-	-	1	1	1	1	1	1	1	1	1	1	1	1	1	1,424	17,091	18,516
8	Minibus 6 wheels	8.5	200	1,700	0.0653	0.4069	-	-	1	1	1	1	1	1	1	1	1	1	1	1	1	2,116	25,395	27,512
<b>Total</b>																					<b>19,025</b>	<b>225,455</b>	<b>244,481</b>	

Remark : 1/ Assumed working day is 22 day/month

#### 4) Wastewater Treatment System

The wastewater generated from the consumption of construction workers (Maximum at 618 workers) during this phase is 43.26 m<sup>3</sup>/ day. The Project will treat wastewater using a septic tank provided by the contractor.

The related GHG emission from the septic tank are CO<sub>2</sub> and CH<sub>4</sub>. However, CO<sub>2</sub>, a biogenic origin which is not considered in the IPCC Guidelines, therefore, the GHG emission relevant to domestic wastewater is only CH<sub>4</sub>.

The calculation of CH<sub>4</sub> emission could be adopted *Equation 6.1* to *Equation 6.3* in the IPCC 2006 Guidelines as follows;

$$\text{CH}_4 = [\sum_{ij} (U_i \times T_{ij} \times EF_j)] \times (\text{TOW} - \text{S}) - \text{R} \dots\dots (5)$$

- Where;
- CH<sub>4</sub> = CH<sub>4</sub> emissions in inventory year, kg CH<sub>4</sub>/year
  - TOW = Total organics in wastewater removed in inventory year, kg BOD/year
  - S = Organic component removed as sludge in inventory year, kg BOD/year  
= 0 (No removed)
  - EF<sub>j</sub> = Emission factor, kg CH<sub>4</sub> / kg BOD
  - R = Amount of CH<sub>4</sub> recovered in inventory year, kg CH<sub>4</sub>/year  
= 0 (No recovered)

However, above equation is employed for country or national context, and considered in fraction of population in income group (U<sub>i</sub>) and degree of utilization of treatment/discharge pathway or system (T<sub>i,j</sub>). For this Project, the temporary wastewater treatment system will provided for treat wastewater from worker consumption and canteen. Therefore, U<sub>i</sub> and T<sub>i,j</sub> equal to 100% or 1.

$$EF_j = B_0 \times MCF_j \dots\dots\dots (6)$$

- Where
- EF<sub>j</sub> = Emission factor, kg CH<sub>4</sub>/kg BOD
  - B<sub>0</sub> = maximum CH<sub>4</sub> producing capacity, kg CH<sub>4</sub>/kg BOD  
= 0.60 CH<sub>4</sub>/kg BOD or 0.25 kg CH<sub>4</sub>/kg COD
  - MCF<sub>j</sub> = Methane correction factor (fraction)  
= 0.50

Therefore,  $EF_j = 0.60 \text{ CH}_4/\text{kg BOD} \times 0.50$   
 $= 0.30 \text{ CH}_4/\text{kg BOD}$

$TOW = P \times BOD \times 0.001 \times I \times 264^2 \dots \dots \dots (7)$

Where;

TOW = Total organics in wastewater in inventory year, kg BOD/year

$P^3$  = Country population in inventory year, (person)

P = 618 persons (Construction phases)

BOD = Country-specific per capita BOD in inventory year, g/person/day, See Table 6.4 in IPCC2006 Guideline.

P = 40 g/person/day

0.001 = Conversion from grams BOD to kg BOD

I = Correction factor for additional industrial BOD discharged into sewers (for collected the default is 1.25, for uncollected the default is 1.00.)

Therefore,  $TOW = 618 \text{ persons} \times 40 \text{ g/person/day} \times 0.001 \times 1.00 \times 264$   
 $= 6,526.08 \text{ kg BOD/year}$

Using Equation (2), the CH<sub>4</sub> emissions in inventory year is

$CH_4 = [\sum_{i,j} (1 \times 1 \times 0.30)] \times (7,032.96 - 0) - 0$   
 $= 0.30 \times 6,526.08$   
 $= 1,957.82 \text{ kg CH}_4/\text{year}$

According to the IPCC Fifth Assessment Report (AR6), the 100-year Global Warming Potential (GWP) of methane gas from non-fossil origin is 27.2. Therefore, the CH<sub>4</sub> emissions from the wastewater treatment system could be report in CO<sub>2</sub> equivalent (CO<sub>2</sub>-eq) term as 53,253 kg CO<sub>2</sub>-eq /year or 53.25 tonne CO<sub>2</sub>-eq /year.

<sup>2</sup> Based on Project working day during construction phase  
<sup>3</sup> P in above equation is employed for country or national context. For this Project, P is the number of construction workers during construction phase and project staffs during operation phase.

## B. Projected GHG Emissions during Operation Phase

The source of GHG emission during this phase are

### 1) The Fossil Fuel Combustion :

During this phase, it expected that approximately 5 full-time working staff, 2 staff for inspection and maintenance, while 20 persons will work for PV module cleaning twice a year. A few of van, passenger car, and pick-up truck may be used for plant visit, operation and maintenance. Therefore, the GHG emission from the fossil fuel combustion of transportation vehicle could be very limited and negligible.

### 2) Electricity Consumption :

Electricity consumption during the operation phase is approximately 816,000 kWh/year which supplied from the Provincial Electricity Authority. It used for lighting and office area. Therefore, the GHG emissions from the electric consumption in construction site and worker campsite could be calculated by using equation (4) as follow;

$$\begin{aligned} \text{GHG} &= 0.4999 \text{ kg CO}_2\text{e/kWh} \times 816,000 \text{ kWh/year} \\ &= 407,918 \text{ kg CO}_2\text{e/year} \\ &= 407.92 \text{ tonne CO}_2\text{e/year} \end{aligned}$$

### 3) Wastewater Treatment System

The wastewater generated from the consumption of project staff (Maximum at 25 staff included 5 full-time staff, and 20 PV solar cleaner) during this phase is 1.89 m<sup>3</sup>/day. The Project will treat wastewater using a septic tank.

The calculation of CH<sub>4</sub> emission could be adopted Equation (5) to (7) similar to construction phase. Therefore;

$$\text{CH}_4 = [\sum_{i,j} (U_i \times T_{i,j} \times EF_j)] \times (\text{TOW-S}) - R \dots \dots (5)$$

Where;

$$\begin{aligned} \text{TOW}_1 &= \text{Total organics in wastewater removed in inventory} \\ &\quad \text{year, kg BOD/year} \\ &= 5 \text{ persons} \times 40 \text{ g/person/day} \times 0.001 \times 1.00 \times 365 \\ &= 73 \text{ kg BOD/year} \\ \text{TOW}_2 &= \text{Total organics in wastewater removed in inventory} \\ &\quad \text{year, kg BOD/year} \\ &= 20 \text{ persons} \times 40 \text{ g/person/day} \times 0.001 \times 1.00 \times 60^4 \\ &= 48 \text{ kg BOD/year} \end{aligned}$$

<sup>4</sup> Assumed the PV solar cleaner and cleaning activities for 2 time/year and 60 day/time, and inspector and a maintenance activities is 2 time/month and 1 day/time.

$$\begin{aligned}
 S &= \text{Organic component removed as sludge in inventory} \\
 &\quad \text{year, kg BOD/year} \\
 &= 0 \text{ (No removed)} \\
 EF_j &= \text{Emission factor, kg CH}_4 \text{ / kg BOD} \\
 &= 0.60 \text{ CH}_4\text{/kg BOD} \times 0.50 \\
 &= 0.30 \text{ CH}_4\text{/kg BOD} \\
 R &= \text{Amount of CH}_4 \text{ recovered in inventory year, kg} \\
 &\quad \text{CH}_4\text{/year} \\
 &= 0 \text{ (No recovered)} \\
 \text{Thus, CH}_4 &= [\sum_{i,j} (1 \times 1 \times 0.30)] \times ((73+1.9+48)-0)-0 \\
 &= 0.30 \times 121 \\
 &= 36.30 \text{ kg CH}_4\text{/year} \\
 \text{And, GHG} &= 987 \text{ kg CO}_2\text{-eq /year} \\
 &= 0.99 \text{ tonne CO}_2\text{-eq /year.}
 \end{aligned}$$

#### 4) Avoided GHG Emissions

The Phalangnan Rungrueang Power Plant Project is a non-combustion power plant that generates electric power from solar energy using photovoltaic technology or solar cells installed on the ground with an energy storage system. It generate electricity from the renewable energy sources that will substitute the electricity generated from the fossil fuel combustion. The installed capacity is 77.281 MW with an average annual energy output of 126.428 GWh or 126.428×10<sup>6</sup> kWh. All generated electricity is expected to sell to EGAT. Under 25 year-agreement. The total avoided GHG emission could be calculated by using equation (5) as follows;

$$\begin{aligned}
 \text{Where;} \quad \text{GHG} &= E \times C \quad \dots\dots\dots(8) \\
 \text{GHG} &= \text{GHG emissions (kg CO}_2\text{e/year)} \\
 E &= \text{Emission factor (kg CO}_2\text{e/kWh)} \\
 &= 0.5986 \text{ kg CO}_2\text{e/kWh (Emission factor for electricity} \\
 &\quad \text{generation of grid mix from Thai National LCI} \\
 &\quad \text{Database, TIIS-MTEC-NSTDA (with TGO electricity} \\
 &\quad \text{2016-2018)} \\
 C &= \text{Electricity consumption (kWh/year)} \\
 &= 126.428 \times 10^6 \text{ kWh} \\
 \text{Thus;} \quad \text{GHG} &= 0.5986 \text{ kg CO}_2\text{e/kWh} \times 126.428 \times 10^6 \text{ kWh/year} \\
 &= 75,679,800.80 \text{ kg CO}_2\text{e/year} \\
 &= 75,679.800 \text{ tonne CO}_2\text{e/year}
 \end{aligned}$$

### C. Net GHG Emissions

Net annual GHG emissions during construction and operation phases are summarized in **Table 4.2-37**, the highest GHG emitted is estimated at 2,279.08 tonne CO<sub>2</sub>-eq/year during construction phase, while the avoided GHG is estimated at -75,679.80 tonne CO<sub>2</sub>-eq/year throughout the operation phase. Therefore, the project caused the positive impact to climate change and the “Transition Risks” is no need to consider.

**TABLE 4.2-37**  
**NET GHG EMISSIONS FROM PHALANGNGAN RUNGRUEANG POWER PLANT PROJECT DURING CONSTRUCTION AND OPERATION PHASES**

Year	GHG Emission in Scope 1 and 2 (CO <sub>2</sub> e/year)					
	Fossil Fuel Combustion		Electricity Consumption	Wastewater Treatment	Avoided GHG Emissions	Total
	Construction Equipment	Transportation Vehicle				
<b>Construction Phase</b>						
1	246.41	19.03	0.00	0.00	0.00	265.44
2	1,944.22	225.46	56.15	53.25	0.00	2,279.08
<b>Operation Phase</b>						
1	0.00	0.00	407.92	0.99	-75,679.80	-75,270.90
2	0.00	0.00	407.92	0.99	-75,679.80	-75,270.90
3	0.00	0.00	407.92	0.99	-75,679.80	-75,270.90
4	0.00	0.00	407.92	0.99	-75,679.80	-75,270.90
5	0.00	0.00	407.92	0.99	-75,679.80	-75,270.90
6	0.00	0.00	407.92	0.99	-75,679.80	-75,270.90
7	0.00	0.00	407.92	0.99	-75,679.80	-75,270.90
8	0.00	0.00	407.92	0.99	-75,679.80	-75,270.90
9	0.00	0.00	407.92	0.99	-75,679.80	-75,270.90
10	0.00	0.00	407.92	0.99	-75,679.80	-75,270.90
11	0.00	0.00	407.92	0.99	-75,679.80	-75,270.90
12	0.00	0.00	407.92	0.99	-75,679.80	-75,270.90
13	0.00	0.00	407.92	0.99	-75,679.80	-75,270.90
14	0.00	0.00	407.92	0.99	-75,679.80	-75,270.90
15	0.00	0.00	407.92	0.99	-75,679.80	-75,270.90
16	0.00	0.00	407.92	0.99	-75,679.80	-75,270.90
17	0.00	0.00	407.92	0.99	-75,679.80	-75,270.90
18	0.00	0.00	407.92	0.99	-75,679.80	-75,270.90
19	0.00	0.00	407.92	0.99	-75,679.80	-75,270.90
20	0.00	0.00	407.92	0.99	-75,679.80	-75,270.90
21	0.00	0.00	407.92	0.99	-75,679.80	-75,270.90
22	0.00	0.00	407.92	0.99	-75,679.80	-75,270.90
23	0.00	0.00	407.92	0.99	-75,679.80	-75,270.90
24	0.00	0.00	407.92	0.99	-75,679.80	-75,270.90
25	0.00	0.00	407.92	0.99	-75,679.80	-75,270.90
<b>Total</b>	2,190.63	244.48	10,254.11	77.94	-1,891,995.02	-1,879,227.86

## (6) Results of Climate Change Risk Assessment

The results of physicals climate change risk assessment include: storms, and floods are shown in **Table 4.2-38**.

**TABLE 4.2-38**  
**RESULT OF CLIMATE CHANGE RISK ASSESSMENT**

NO.	Potential Risk/ Potential Causes	Risk Evaluation		
		Likelihood	Severity	Risk
1	<p>Storm and Heavy Rain</p> <ul style="list-style-type: none"> <li>- Climate change expected to enhance the cyclone, and possible to increasing wind speed and rainfall or precipitation intensity. Moreover, the extreme rainfall events are likely to more frequent</li> <li>- The typhoons reaching Thailand in between 2013-2043 are expected to be increased, but the number of monsoon storms are projected to stay relatively stable.</li> <li>- The structure of PV Solar structure is design in accordance with DPT. 1311-50 standard, and could be tolerate for wind speed at 30 m/s or 108 km/hr. (the wind speed of storm is range from 89-102 km/hr.)</li> </ul>	Unlikely	Minor	Low
2	<p>Flood</p> <ul style="list-style-type: none"> <li>- Under lower emissions pathways coherent with the Paris Climate Agreement almost all Asian countries face an increase in the frequency of extreme river flows. What would historically have been a 1 in 100-year flow, could become a 1 in 50-year or 1 in 25-year event in most of South, Southeast, and East Asia. (Paltan et al. (2018))</li> <li>- Based on the secondary data collection from the Natural Disaster Prevention and Agricultural Risk Group, Land Use Policy and Planning Department, Department of Land Development (2013), the Project area locate in non-flooding risk area</li> </ul>	Unlikely	Minor	Low

#### 4.2.7 HUMAN RIGHTS RISK AND IMPACT ASSESSMENT

Inherent human right risk assessment specifies the Human Rights risks to which the project is connected based on severity and likelihood, noting where risks intersect or are interrelated, and emphasizing which vulnerable people/ groups may be at risk ( e. g. , indigenous peoples; women; national persons with disabilities; and migrant workers and their families). The methods used to conduct the human rights impact assessment (HRIA) are set out in **Appendix 4A**. The assessment of inherent right risk shows in **Table 4.2-39**.

There is a possibility of human rights implications arising from the development of the project, particularly during the construction phase. The workers have direct association with risk issue such as occupational health and safety, discrimination, wages and working hours. Residual risk assessment evaluates the potential risks with mitigation measures that project have in place. The result of assessment of residual risk is show in **Table 4.2-40**.

As a summary or conclusion of the HRIA, the project includes both inherent and residual human rights impacts, which are assessed as low and medium in nature after mitigation. The key risk area is related to community and worker safety, which is addressed comprehensively as part of the mitigation plans in this IEE (see **Chapter 5**).

**TABLE 4.2-39**  
**THE PROJECT INHERENT HUMAN RIGHTS RISK ASSESSMENT**

Effectors	Human Right Risk	Severity Scores				Likelihood Scores	Risk Scores (Severity Scores X Likelihood Scores)	Risk Level	Receptors	
		Scale	Scope	Remediability	Absolute scores				Employees	Local community
• Project Developer	(1) Occupational health and safety	3	2	2	3	2	6	High	✓	
• Contractors	(2) Discrimination	1	2	1	2	2	4	Medium	✓	
	(3) Working Hours	2	2	1	2	2	4	Medium	✓	
• Project Developer	(4) Community Safety & Standard of Living	3	2	2	3	2	6	High		✓



**TABLE 4.2-40  
THE PROJECT RESIDUAL HUMAN RIGHT RISK ASSESSMENT**

Project Activity	Effectors	Human Right Risk	Description of Impact	Mitigation/ Control	Severity Scores				Likelihood Scores	Risk Scores (Severity Scores X Likelihood Scores)	Risk Level	Receptors	
					Scale	Scope	Remediability	Absolute scores				Employees	Local community
Employment of staff and workers (full time and part time)	<ul style="list-style-type: none"> <li>• Project Developer</li> <li>• Contractors</li> </ul>	(1) Occupational health and safety	Risk that workers will face occupational accident during the project construction and operation period.	<ul style="list-style-type: none"> <li>➢ Occupational safety management shall be arranged in a systematical and efficient manner in conformity with the requirements of occupational safety, health and environment law relating to construction.</li> <li>➢ Warning signs indicating the perimeter of the project construction zones shall be installed in clearly visible and easily recognizable places.</li> <li>➢ The construction site shall be proportionally divided into construction zone, daytime rest zone, machinery and equipment storage zone, and unused material and equipment storage zone</li> <li>➢ First aid kits including an ambulance or contact number of nearby medical facilities having an ambulance for emergency shall be provided. In addition, first aiders shall be routinely provided at the construction site and ready for transporting an injured person to nearby hospitals at all time; and</li> <li>➢ Assign employees who are exposed to occupational hazards. The company may consider granting them time off as necessary, without affecting their leave entitlement.</li> </ul>	1	2	1	2	1	2	Low	✓	

**TABLE 4.2-40  
THE PROJECT RESIDUAL HUMAN RIGHTS RISK ASSESSMENT (CONT'D)**

Project Activity	Effectors	Human Right Risk	Description of Impact	Mitigation/ Control	Severity Scores				Likelihood Scores	Risk Scores (Severity Scores X Likelihood Scores)	Risk Level	Receptors	
					Scale	Scope	Remediability	Absolute scores				Employees	Local community
Employment of staff and workers (full time and part time (Cont'd)		(2) Discrimination	Risk that workers may be treated unfairly	<ul style="list-style-type: none"> <li>➤ The Company has established a process for monitoring and assessing human rights impacts. This human rights due diligence process engages with stakeholders to identify, assess, manage, and prevent or mitigate human rights risks and related issues. The process covers three main areas: within the Company, within the Company's projects, and within local communities in the areas where the Company operates.</li> <li>➤ The Company will treat all stakeholders equally and fairly, respecting diversity and emphasizing non-discrimination based on gender, age, race, ethnicity, nationality, or other attribute unrelated to work ability.</li> <li>➤ The Company will communicate its commitment and expectations regarding human rights to stakeholders through relevant and appropriate channels.</li> <li>➤ The Company provides reporting and whistleblowing channels, including a mechanism for receiving conflicting complaints, which establishes equitable and fair solutions as necessary and appropriate.</li> <li>➤ The company supports gender equality and women's rights, including the promotion of equal pay for equal work through the use of a fair and non-discriminatory evaluation system.</li> </ul>	1	2	1	2	1	2	Low	✓	

**TABLE 4.2-40  
THE PROJECT RESIDUAL HUMAN RIGHTS RISK ASSESSMENT (CONT'D)**

Project Activity	Effectors	Human Right Risk	Description of Impact	Mitigation/ Control	Severity Scores				Likelihood Scores	Risk Scores (Severity Scores X Likelihood Scores)	Risk Level	Receptors	
					Scale	Scope	Remediability	Absolute scores				Employees	Local community
Employment of staff and workers (full time and part time (Cont'd)		(3) Working Hours	Mandating unreasonable working hours for employees that are inconsistent with ILO standards	<ul style="list-style-type: none"> <li>➢ Regular employees are required to work from Monday to Friday, with working hours from 8:00 a.m. to 5:00 p.m. Shift employees are required to work no more than 12 hours per day or a maximum of 48 hours per week.</li> <li>➢ There should be a minimum of 13 traditional holidays per year.</li> <li>➢ The company respects labor rights and adheres to labor laws, including compliance with regulations regarding working hours and proper working conditions. It also acknowledges related freedoms and collective rights as appropriate, while supporting the determination of employee welfare and compensation that exceeds the minimum required by law.</li> </ul>	1	2	1	2	1	2	Low	✓	
Construction of the project	<ul style="list-style-type: none"> <li>• Project Developer</li> </ul>	(4) Community Safety & Standard of Living	<ul style="list-style-type: none"> <li>➢ Risk that project transportation incurs road accident;</li> <li>➢ Impact of pollution that is affected by the project construction, such as noise and vibration, and waste</li> </ul>	<ul style="list-style-type: none"> <li>➢ Transportation mitigation measures</li> <li>➢ Noise, vibration, and, waste management measures.</li> </ul>	1	2	1	2	2	4	Medium		✓

**TABLE 4.2-40  
THE PROJECT RESIDUAL HUMAN RIGHTS RISK ASSESSMENT (CONT'D)**

Project Activity	Effectors	Human Right Risk	Description of Impact	Mitigation/ Control	Severity Scores				Likelihood Scores	Risk Scores (Severity Scores X Likelihood Scores)	Risk Level	Receptors	
					Scale	Scope	Remediability	Absolute scores				Employees	Local community
Construction of the project (Cont'd)			<ul style="list-style-type: none"> <li>➤ The conflict between migrant workers and the local people;</li> <li>➤ Utilization of public infra- structures affected by migrant workers are inadequate to the local people.</li> </ul>	<ul style="list-style-type: none"> <li>➤ The local labour will be given first priority to be chosen for employment.</li> <li>➤ Rules shall be established to control and supervise migrant workers' behavior to prevent creating disturbance/ problems to communities.</li> <li>➤ The provision of worker camp site, sufficient basic infrastructure for workers living in the camp site,</li> <li>➤ The Company shall support a human rights due diligence process to engage with its stakeholders to identify, assess, manage, and, where applicable, prevent or mitigate human rights risks and related issues in key areas including within the company, in its projects, and within the local communities where the company operates.</li> <li>➤ The Company shall support corporate social responsibility programs and initiatives that promote human rights, with a focus on education, health, work and environmental protection, for children, local communities and the general society.</li> </ul>									

**TABLE 4.2-40  
THE PROJECT RESIDUAL HUMAN RIGHTS RISK ASSESSMENT (CONT'D)**

Project Activity	Effectors	Human Right Risk	Description of Impact	Mitigation/ Control	Severity Scores				Likelihood Scores	Risk Scores (Severity Scores X Likelihood Scores)	Risk Level	Receptors	
					Scale	Scope	Remediability	Absolute scores				Employees	Local community
Operation activity	Project Developer	(5) Community Safty & Standard of Living	<ul style="list-style-type: none"> <li>➢ Risk that project transportation incurs road accident</li> <li>➢ Contamination to the environment</li> <li>➢ Infestation of disease carriers</li> </ul>	<ul style="list-style-type: none"> <li>➢ The local labor will be given first priority to be chosen for employment.</li> <li>➢ Human rights due diligence process to engage with its stakeholders to identify, assess, manage, and, where applicable, prevent or mitigate human rights risks and related issues in key areas including within the company, in its projects, and within the local communities where the company operates.</li> <li>➢ The Company shall support corporate social responsibility programs and initiatives that promote human rights, with a focus on education, health, work and environmental protection, for children, local communities and the general society.</li> </ul>	1	1	1	1	1	1	Low		✓

### 4.3 TRANSMISSION LINE

PEA has the authority to set standards for its electrical equipment and fuel, to maintain technical and economic efficiency, and to control electricity generation within its facilities, according to the Provincial Electricity jurisdiction Act (Version 4) B.E. 2542 (1999). The implications of the installation and operation of these power lines are also managed by the PEA. As a result, Phalangngan Rungrueang Co., Ltd. (PRR) is not permitted to intervene in PEA's operations. However, during the construction of the transmission line, personnel from the Phalangngan Rungrueang Solar Power Plant Project can collaborate with PEA's officials in communicating with local people to observe the transmission line construction.

PRR and TLT Consultants Co., Ltd. obtained information about the construction and operation processes of power transmission lines for potential impact assessment from PEA activities. The following is an assessment of the primary impacts of power transmission lines, both during construction and operation:

#### (1) Construction Phase

Impact sources during the construction phase are the pole installation activities which will take 5-7 days for each pole construction by not over 10 workers. The potential impacts from the construction include:

- **Air quality:** the excavation for pole foundation and pole installation can release dust and exhaust gases into the air; however, these activities will last only a few days. The impact on air quality will be localized and short-term; hence, the level is considered low.
- **Noise:** noise will be generated by construction machinery and equipment such as cranes and backhoes. Given the proximity to communities, this could be disruptive. However, the construction will take place over a short period of time, and the impact will be limited to a close proximity. As a result, the impact will be low.
- **Vibration:** the use of heavy machinery for digging and compacting soil can cause vibrations that may be felt by nearby residents and can affect structures in close proximity to the construction site. Given the size of the operation, vibrations are likely to be minimal and localized.
- **Biodiversity:** the project's construction will cause noise and vibration, which may disturb the wildlife. Since the construction of transmission line will take place within the right-of-way of public roads where the land use is agricultural land, communities, and establishments, the wildlife that inhabits it has evolved to live in disturbed agricultural environments as a consequence of long-term human activity. As a result, the construction will mainly cause noise-sensitive species to relocate away from the source of the disturbance. Nonetheless, the disruption time will be short, so the impact will be low.
- **Occupational Health and Safety / Community Health and Safety:** PEA choose the contractor from an approved list of PEA and will include relevant laws regarding environmental, occupational health, and safety regulations in contract terms to ensure the compliance with requirements in those regulations. In addition, in cases where

damage is caused by a tortious act of PEA or arises from the performance of duties by its employees or workers, the following procedures should be undertaken:

- In the event that an external party's property is damaged, consideration should be given to deducting depreciation according to the condition of the property or using the market price at the time of the incident as part of the assessment before proposing to the authorized person to approve the payment of damages.

- In cases where an external party is deceased and the heirs make a claim for damages from PEA, the authorized person should provisionally approve an initial payment of damages to the heirs of the deceased not exceeding 50,000 baht. Subsequently, a fact-finding committee shall consider determining the damages, taking into account the status and actual damages incurred by the individual concerned.

- In cases where an external party sustains injuries or disabilities, or loses their capacity, a fact-finding committee shall consider determining the damages by comparing guidelines for considering compensation payments as specified in the annex of these regulations. However, this does not include medical expenses and other damages such as loss of earnings or loss of support.

In addition, communities can complain about impacts from PEA's operations can be made through the following channels:

- Hotline 1129
- Complaints via electricity billing officers or local electricity offices
- The website of the Provincial Electricity Authority

When the PEA receives a complaint, they will respond within 30 days, and the complainant can track the progress of the complaint resolution on the PEA's website.

- **Land Use:** although PEA's power transmission line construction is inside the Right-of-Way (RoW) of public roadways, an inspection of land use along the power transmission lines indicated agricultural operations such as rice, sugarcane, and cassava, production. If power transmission poles are built in agricultural areas, that land will be converted into pole construction sites, which require approximately 5 square meters apiece. Furthermore, the PEA has a policy that allows farmers to harvest crops in areas where power transmission poles will be built as early as possible in accordance with the building timetable. As a result, the influence on land use for farmers constructing areas is regarded as low.

- **Transportation:** partial or full lane closures may be necessary to provide space for construction activities. This could disrupt normal traffic flow. However, the regular PEA practices will be followed, including providing adequate signage to inform drivers of construction work ahead or lane closures and keeping local communities informed about construction schedules. Hence, the impact on traffic will be low.

## (2) Operation Phase

During the operation phase, the only activity is to deliver electricity to the substation via power transmission lines. The following are the potential consequences that may be arisen from this operation:

- **Electromagnetic field:** design and construction of transmission line will be in accordance with EGAT Operation Code for Transmission Line System. There is requirement of electric field and magnetic field of international commission on non-ionizing radiation protection (ICNIRP) on electromagnetic radiation (**Table 4.3-1**). To check the compliance with the requirement, EGAT has designed the value of electric field, magnetic field, radio interference, audible noise and short circuit current density by selecting type and clearance of transmission line. The expected results of impact are as shown in **Table 4.3-2** that calculated by BVCORONA program. All quantities are not exceeded the standard. It can be assured that the construction of transmission line by EGAT will not pose impact of electric field and magnetic field to people living near the line.

**TABLE 4.3-1  
REQUIREMENT OF ELECTRIC FIELD AND MAGNETIC FIELD OF  
INTERNATIONAL COMMISSION ON NON-IONIZING RADIATION  
PROTECTION (ICNIRP) ON ELECTROMAGNETIC RADIATION**

Exposure	Electric Field (kV/m)	Magnetic Field (mG)
Working related to magnetic field		
- All day exposure	10	5000
- Short time exposure	30	50000
- Only arms and legs exposing to magnetic field	-	250000
People		
- 24 hrs/day	5	1000
- 2 - 3 hrs/day	10	10000

**Remark:** Summation of electric field should not exceed 80 kV/m for all day work.

**TABLE 4.3-2  
RESULTS CALCULATED BY BVCORONA PROGRAM**

Quantity	Unit	Quantity at the boundary of R.O.W.	
		Standard	Calculated value
Electric Field	kV/m	2	1.125
Magnetic Field	mG	200	112.68
Radio Interference	dB	40	28.8
Audible Noise	dBA	55	35.8

**Source:** Electricity Generating Authority of Thailand, 2012

- **Biodiversity:** During the project's operation phase, the transmission line may have an impact on birds due to collisions during migration. The project's 115-kv transmission lines will be built on 22-meter-high concrete poles, similar to the electrical poles seen throughout Thailand, and will run alongside a public road right-of-way. The transmission lines are not located in areas that serve as food sources for birds, such as large transmission lines that frequently cross agricultural areas, and the right-of-way along public roads do not constitute the primary landing areas for birds. Additionally, the birds found in the project area are 16 migratory species classified as least concern (LC). They are little birds



that can shift direction faster than larger birds and most of them migrate alone or in small groups. Based on this data, it is possible to conclude that the project's location, the species of migratory birds present in the area, and the size of their migratory groups, which are common causes of collisions with transmission lines, present a low risk of collision. As a result, the potential impact of the TL on migrating birds is considered low.

- **Transportation:** regular maintenance can disturb traffic flow as partial or full lane closures for maintenance activities. However, the regular PEA practices will be followed, including as providing adequate signage to inform drivers of construction work ahead or lane closures and keeping local communities informed about construction schedules. Hence, the impact on traffic will be low.

#### 4.4 SUMMARY AND DISCUSSION

Overview of project implementation and impact assessment in relation to the ADB's Safeguard Requirement, ADB's Social Protection, and IFC Performance Standards as illustrated in **Table 4.4-1**.

**TABLE 4.4-1  
OVERVIEW OF PROJECT IMPLEMENTATION AND IMPACT ASSESSMENT IN RELATION TO THE ADB AND  
IFC PERFORMANCE STANDARDS**

ADB's Requirements	IFC's Requirements	Project Implementation
<p><b>ADB's Safeguard Requirement 1 : Environment Assessment and Environmental Planning and Management</b></p> <p>These requirements include assessing impacts, planning and managing impact mitigations, preparing environmental assessment reports, disclosing information and undertaking consultation, establishing a grievance mechanism, and monitoring and reporting. The document also includes particular environmental safeguard requirements pertaining to biodiversity conservation and sustainable management of natural resources, pollution prevention and abatement, occupational and community health and safety, and conservation of physical cultural resources. The applicability of particular requirements is established through the environmental assessment process and compliance with the requirements is achieved through implementation of environmental management plans agreed to by ADB and the borrower/client.</p> <p>The borrower/client will prepare an environmental management plan (EMP) that addresses the potential impacts and risks identified by the environmental assessment. The EMP will include the proposed mitigation measures, environmental monitoring and reporting requirements, emergency response procedures, related institutional or organizational arrangements, capacity development and training measures, implementation schedule, cost estimates, and performance indicators.</p>	<p><b>PS 1: Assessment and Management of Environmental and Social Risk and Impact</b></p> <p>The Project shall conduct a process of environmental and social assessment, and establish an Environmental and Social Assessment and Management System (ESMS) which will incorporate the following elements:</p> <ol style="list-style-type: none"> <li>1) Policy: Defining the environmental and social objectives and principles that guide the project to achieve environmental and social performance.</li> <li>2) Identification of risks and impacts: Environmental and social risks and impacts will be identified in the context of the project's area of influence.</li> <li>3) Management programs: Describe the mitigation and performance improvement measures and actions that address the identified ES risks and impacts.</li> <li>4) Organizational capacity and competency: Establish, maintain, and strengthen as necessary an organizational structure that defines roles, responsibilities, and authority to implement the ESMS.</li> <li>5) Emergency preparedness and response</li> <li>6) Monitoring and review: Establish procedures to monitor and measure the effectiveness of the management program, as well as compliance with any related legal and/or contractual obligations and regulatory requirements.</li> <li>7) Stakeholder engagement</li> <li>8) External communications and grievance mechanisms.</li> <li>9) Ongoing reporting to affected communities: Provide periodic reports to the affected communities that describe progress with implementation of the project action plans.</li> </ol>	<p>GULF Energy Development (GED) has established its own Environmental and Social Management System (ESMS) in alignment with various international policies, standards, and management practices to which GED is committed.</p> <p>It is the responsibility of every individual within GED to achieve the objectives of the ESMS.</p> <p>Since Phalangngan Rungrueang Co., Ltd. is a subsidiary of GED, it also bears the responsibility of adhering to GED's system and policies.</p> <p>Furthermore, Phalangngan Rungrueang Co., Ltd. has developed its own ESMS tailored to the specific characteristics of its project. This includes:</p> <ul style="list-style-type: none"> <li>– ESMS Programme ( as discussed in Chapter 1 of this report),</li> <li>– Identification of risks and impacts (as discussed in Chapter 4 of this report),</li> <li>– Management program, Emergency preparedness and response, Monitoring and review (as discussed in Chapter 5 of this report),</li> <li>– Stakeholder engagement (as discussed in Chapter 6 of this report), and</li> <li>– External communications and grievance mechanisms (as discussed in Chapter 7 of this report).</li> </ul>

**TABLE 4.4-1  
OVERVIEW OF PROJECT IMPLEMENTATION AND IMPACT ASSESSMENT IN RELATION TO THE ADB AND  
IFC PERFORMANCE STANDARDS (CONT'D)**

ADB's Requirements	IFC's Requirements	Project Implementation
<p><b>ADB's Safeguard Requirement 1 : Biodiversity Conservation and Sustainable Natural Resource Management</b></p> <p>The borrower/client will assess the significance of project impacts and risks on biodiversity and natural resources as an integral part of the environmental assessment process. The assessment will focus on the major threats to biodiversity, which include destruction of habitat and introduction of invasive alien species, and on the use of natural resources in an unsustainable manner. The borrower/client will need to identify measures to avoid, minimize, or mitigate potentially adverse impacts and risks and, as a last resort, propose compensatory measures, such as biodiversity offsets, to achieve no net loss or a net gain of the affected biodiversity. The focus on Modified Habitats, Natural Habitats, Critical Habitats and Legally Protected Areas.</p>	<p><b>PS 4: Community Health, Safety and Security</b></p> <p>3) Ecosystem services: The project shall identify risks and potential impacts on priority ecosystem services that may be exacerbated by climate change. Adverse impacts should be avoided, and if these impacts are unavoidable, the client will implement mitigation measures.</p> <p><b>PS 6: Biodiversity Conservation and Sustainable Management of Living Natural Resources</b></p> <p>The implementation of the actions necessary to meet the requirements of this Performance Standard is managed through the client's Environmental and Social Management System (ESMS), the elements of which are outlined in Performance Standard 1.</p>	<p>A land use survey revealed that the project area is agricultural land, totaling roughly 72.91 hectares. The construction of electrical transmission line will take place within the right-of-way of public roads where the land use is agricultural land, communities, and establishments potentially affected. The conservation status according to IUCN (2022-2), which considers the global threat status (IUCN Red List of Threatened Species), two plant species were identified as endangered (EN). These species are Makha Mong (<i>Azelia xylocarpa</i>) and Burma padauk (<i>Pterocarpus macrocarpus</i>). However, both of these plant species still maintain natural populations at safe levels, exhibit high reproductive capabilities, and have a widespread distribution throughout the country. Therefore, forest resources have experienced negative impacts or disadvantages because both the structural and functional aspects of the environment have changed due to construction projects.</p> <p>However, the impact of land preparation for construction will be low because it will only occur for a limited period of time inside the project area and the pole construction area.</p> <p>In the study area of the project, animals with conservation statuses according to Wildlife Animal Reservation and Protection (2019), Thailand red data: vertebrates (2020) and IUCN (2022-2) have been identified including the Asiatic softshell turtle (<i>Amyda cartilaginea</i>), the butterfly</p>

**TABLE 4.4-1  
OVERVIEW OF PROJECT IMPLEMENTATION AND IMPACT ASSESSMENT IN RELATION TO THE ADB AND  
IFC PERFORMANCE STANDARDS (CONT'D)**

ADB's Requirements	IFC's Requirements	Project Implementation
		<p>lizard (<i>Leiolepis reevesii</i>), and the Indo-Chinese rat snake (<i>Ptyas korros</i>).</p> <p>These species are protected under the Wildlife Preservation and Protection Act, B.E. 2562 (2019), and are classified as species with a conservation status of Vulnerable (VU) and Near Threatened (NT).</p> <p>Therefore, it is crucial to establish measures that prevent construction workers from harming the nests, eggs, and larvae of the protected species under the Wildlife Preservation and Protection Act, B.E. 2562 (2019), which are species with a conservation status of Vulnerable (VU) and Near Threatened (NT) according to ONEP (2020) and IUCN (2022-2), in order to reduce the impact on these wildlife species.</p>
<p><b>ADB's Safeguard Requirement 1 : Pollution Prevention and Abatement</b></p> <p>During the design, construction, and operation of the project the borrower/client will apply pollution prevention and control technologies and practices consistent with international good practice, as reflected in internationally recognized standards such as the World Bank Group's Environment, Health and Safety Guidelines. These standards contain performance levels and measures that are normally acceptable and applicable to projects. When host country regulations differ from these levels and measures, the borrower/client will achieve whichever is more stringent. If less stringent levels or measures are appropriate in view of specific project circumstances, the borrower/client will provide full and detailed justification for any proposed</p>	<p><b>PS 3: Resource Efficiency and Pollution Preventive</b> <u>Resource Efficiency</u></p> <ol style="list-style-type: none"> <li>1) Greenhouse gases: Consider alternatives and implement technically and financially feasible and cost-effective options to reduce project-related GHG emissions during the design and operation of the project.</li> <li>2) Water consumption: The project shall adopt measures that avoid or reduce water usage.</li> </ol> <p><u>Pollution Prevention</u></p> <ol style="list-style-type: none"> <li>1) Wastes: The project shall reduce the generation of waste, and recover and reuse waste or treat, destroy, or dispose of it in an environmentally sound manner.</li> </ol>	<p>The Project utilizes photovoltaic (PV) solar panel technology in line with the policy to promote electricity production from alternative and renewable energy sources. This form of power generation is considered one of the cleanest energy sources developed in recent years.</p> <p>During the construction phase of the Project, some pollutants may arise, including air pollution from site preparation. This can be mitigated by regularly watering the construction area to prevent dust dispersion. Wastewater generated from worker consumption will be managed through the provision of toilets with septic tanks by the contractor. Solid waste and construction waste will be systematically collected within the construction area and then handed over to authorized agencies for proper disposal.</p>

**TABLE 4.4-1  
OVERVIEW OF PROJECT IMPLEMENTATION AND IMPACT ASSESSMENT IN RELATION TO THE ADB AND  
IFC PERFORMANCE STANDARDS (CONT'D)**

ADB's Requirements	IFC's Requirements	Project Implementation
<p>alternatives that are consistent with the requirements presented in this document.</p> <p><u>Pollution Prevention, Resource Conservation, and Energy Efficiency</u></p> <p>The borrower/client will avoid, or where avoidance is impossible, will minimize or control the intensity or load of pollutant emission and discharge. In addition the borrower/client will incorporate in its operations resource conservation and energy efficiency measures consistent with the principles of cleaner production. When the project has the potential to constitute a significant source of emissions in an already degraded area, strategies that help improve ambient conditions, such as evaluating alternative project locations and considering emissions offsets, will be introduced.</p> <p><u>Wastes</u></p> <p>The borrower/client will avoid, or where avoidance is not possible, will minimize or control the generation of hazardous and nonhazardous wastes and the release of hazardous materials resulting from project activities. Where waste cannot be recovered or reused, it will be treated, destroyed, and disposed of in an environmentally sound manner. If the generated waste is considered hazardous, the client will explore reasonable alternatives for its environmentally sound disposal considering the limitations applicable to its transboundary movement. When waste disposal is conducted by third parties, the borrower/client will use contractors that are reputable and legitimate enterprises licensed by the relevant regulatory agencies.</p>	<p>2) Hazardous waste: The project shall adopt GIIP alternatives, adhere to the limitations applicable to its trans-boundary movement, use contractors that are reputable and licensed, develop their own recovery or disposal facilities at the project site.</p> <p>3) Hazardous materials management: The project shall avoid or, when avoidance is not possible, minimize and control the release of hazardous materials.</p> <p>4) Pesticide use and management</p> <p><b>PS 4: Community Health, Safety and Security</b></p> <p><u>Community Health and Safety</u></p> <p>2) Hazardous materials management and safety: The project shall avoid or minimize the potential for community exposure to hazardous materials and substances that may be released by the project.</p>	<p>In the operation phase, the only pollutants generated will be from worker consumption, specifically wastewater and solid waste. Wastewater from cleaning solar panels may occur occasionally to maintain production efficiency by preventing dust accumulation. However, it's important to note that this cleaning process will exclusively use tap water without any added chemical substances. Therefore, it can be assumed that the solar panel cleaning process will not produce any harmful pollutants.</p> <p>Environmental and social prevention and mitigation measures of the Project for both construction phase and operation phase are as shown in Chapter 5 of this report.</p> <p>For waste management, the project is required to follow the guidelines set forth in the Ministry of Industry's announcement regarding the management of pollutants and unused materials in B.E. 2566 (2023). Authorized agencies are responsible for the proper disposal of these materials. The Project should establish procedures for the safe separation and disposal of hazardous waste and provide training to relevant personnel to ensure they understand the importance of not discharging waste into drainage systems, gutters, waterways, or water sources in proximity to the construction site. As well as the management of defective solar panels. This includes following the guidelines:</p> <ul style="list-style-type: none"> <li>– In the case of exporting for disposal abroad, compliance must be observed according to the</li> </ul>

**TABLE 4.4-1  
OVERVIEW OF PROJECT IMPLEMENTATION AND IMPACT ASSESSMENT IN RELATION TO THE ADB AND  
IFC PERFORMANCE STANDARDS (CONT'D)**

ADB's Requirements	IFC's Requirements	Project Implementation
<p><u>Hazardous Materials</u></p> <p>The borrower/client will avoid the manufacture, trade, and use of hazardous substances and materials subject to international bans or phaseouts because of their high toxicity to living organisms, environmental persistence, potential for bioaccumulation, or potential for depletion of the ozone layer and will consider the use of less hazardous substitutes for such chemicals and materials.</p> <p><u>Greenhouse Gas Emissions</u></p> <p>The borrower/client will promote the reduction of project-related anthropogenic greenhouse gas emissions in a manner appropriate to the nature and scale of project operations and impacts. During the development or operation of projects that are expected to or currently produce significant quantities of greenhouse gases, the borrower/client will quantify direct emissions from the facilities within the physical project boundary and indirect emissions associated with the off-site production of power used by the project. The borrower/client will conduct quantification and monitoring of greenhouse gas emissions annually in accordance with internationally recognized methodologies. In addition, the borrower/client will evaluate technically and financially feasible and cost-effective options to reduce or offset project-related greenhouse gas emissions during project design and operation, and pursue appropriate options.</p>		<p>laws and regulations concerning hazardous substances and international requirements. After the process is completed, notification to the Office of Energy Regulatory Commission must be submitted within 30 days from the date of export for disposal.</p> <ul style="list-style-type: none"> <li>– For domestic disposal, it must be conducted by burying in secure licensed landfill or incineration in a dedicated hazardous waste incinerator.</li> </ul> <p>For GHG emission, The Project is a non-combustion power plant that generates electric power from solar energy using photovoltaic technology or solar cells installed on the ground with an energy storage system. It generate electricity from the renewable energy sources that will substitute the electricity generated from the fossil fuel combustion. Net annual GHG emissions during construction and operation phases, the highest GHG emitted is estimated at 2,279.08 tonne CO<sub>2</sub>-eq/year during construction phase, while the avoided GHG is estimated at -75,679.80 tonne CO<sub>2</sub>-eq/year throughout the operation phase. Therefore, the project caused the positive impact to climate change.</p>

**TABLE 4.4-1  
OVERVIEW OF PROJECT IMPLEMENTATION AND IMPACT ASSESSMENT IN RELATION TO THE ADB AND  
IFC PERFORMANCE STANDARDS (CONT'D)**

ADB's Requirements	IFC's Requirements	Project Implementation
<p><b>ADB's Safeguard Requirement 1 : Health and Safety</b></p> <p><u>Occupational Health and Safety</u></p> <p>The borrower/client will provide workers with a safe and healthy working environment, taking into account risks inherent to the particular sector and specific classes of hazards in the borrower's/client's work areas, including physical, chemical, biological, and radiological hazards. The borrower/client will take steps to prevent accidents, injury, and disease arising from, associated with, or occurring during the course of work by (i) identifying and minimizing, so far as reasonably practicable, the causes of potential hazards to workers; (ii) providing preventive and protective measures, including modification, substitution, or elimination of hazardous conditions or substances; (iii) providing appropriate equipment to minimize risks and requiring and enforcing its use; (iv) training workers and providing them with appropriate incentives to use and comply with health and safety procedures and protective equipment; (v) documenting and reporting occupational accidents, diseases, and incidents; and (vi) having emergency prevention, preparedness, and response arrangements in place.</p> <p><u>Community Health and Safety</u></p> <p>The borrower/client will identify and assess the risks to, and potential impacts on, the safety of affected communities during the design, construction, operation, and decommissioning of the project, and will establish preventive measures and plans to address</p>	<p><b>PS 2: Labor and Working Conditions</b></p> <p><u>Working Conditions and Management of Worker Relationship</u></p> <ol style="list-style-type: none"> <li>1) Human resources policies and procedures: Implement human resources policies and procedures consistent with the requirements of this performance standard and national law.</li> <li>2) Working conditions and terms of employment: Provide reasonable working conditions and terms of employment.</li> <li>3) Workers' organizations: Comply with national law recognizes workers' rights to form and to join workers' organizations.</li> <li>4) Non-discrimination and equal opportunity: Base the employment relationship on the principle of equal opportunity and fair treatment, and will not discriminate to any aspects of the employment relationship.</li> <li>5) Retrenchment: Carry out an analysis of alternatives to retrenchment or retrenchment plan will be developed and implemented to reduce the adverse impacts of retrenchment on workers.</li> <li>6) Grievance mechanism: Provide a grievance mechanism for workers to raise workplace concerns.</li> </ol> <p><u>Protecting the Work Force</u></p> <ol style="list-style-type: none"> <li>1) Child labor: The project will not employ children in any manner that is economically exploitative.</li> </ol>	<p>Phalangngan Rungrueang Co., Ltd. is obligated to fully comply with the national laws and regulations pertaining to working conditions and management of worker relationship. Furthermore, the Project shall exercise strict oversight over all contractors within its supply chain who are involved in the Project's development, including the supervision of subcontractors.</p> <p>The Project also establishes policies and frameworks related to non-discrimination, grievance mechanisms, and occupational health and safety that are specifically tailored to the Project's implementation.</p> <p>As of necessary welfare to employees, the Project shall adhere to Ministerial Regulation Concerning Labour Welfare Provision in an Establishment B.E. 2548 (2005) such as drinking water not less than one station for not exceeding forty employees, bathrooms and toilets with the layout and number, maintenance of cleanliness and hygiene, and provision of necessary kits for first aid and medical service in an adequate quantity for employees in the workplace.</p> <p>As for workforce protection, the Project shall strictly adhere to national law. Regarding child labor, the project shall strictly comply with the Thai Labor Protection Act B.E. 2541 (1998), Chapter 4, Employment of Young Workers, section 44, including but not limited to the following:</p> <ul style="list-style-type: none"> <li>– Prohibiting the employment of children under 15 as employees.</li> </ul>

**TABLE 4.4-1  
OVERVIEW OF PROJECT IMPLEMENTATION AND IMPACT ASSESSMENT IN RELATION TO THE ADB AND  
IFC PERFORMANCE STANDARDS (CONT'D)**

ADB's Requirements	IFC's Requirements	Project Implementation
<p>them in a manner commensurate with the identified risks and impacts. These measures will favor the prevention or avoidance of risks and impacts over their minimization and reduction. Consideration will be given to potential exposure to both accidental and natural hazards, especially where the structural elements of the project are accessible to members of the affected community or where their failure could result in injury to the community. The borrower/client will avoid or minimize the exacerbation of impacts caused by natural hazards, such as landslides or floods, that could result from land use changes due to project activities</p> <p><b>ADB's Social Protection Strategy</b></p> <p>Aims to contribute to poverty reduction, social inclusion, and sustainable development by strengthening social protection systems in its member countries.</p>	<p>2) Forced labor: The project will not employ forced labor.</p> <p><u>Occupational Health and Safety</u></p> <p>The client will take steps to prevent accidents, injury, and disease arising from, associated with, or occurring in the course of work by minimizing, as far as reasonably practicable, the causes of hazards. In a manner consistent with good international industry practice.</p> <p><b>PS 4: Community Health, Safety and Security</b></p> <p><u>Community Health and Safety</u></p> <p>1) Infrastructure and equipment design and safety: The project shall design, construct, operate, and decommission the structural elements or components of the project in accordance with good international industry practice (GIIP).</p> <p>4) Community exposure to disease: The project shall avoid or minimize the potential for community exposure to water-borne, water-based, water-related, and vector-borne diseases, and communicable diseases that could result from project activities.</p> <p>5) Emergency preparedness and response: The project shall assist and collaborate with the affected communities, local government agencies, and other relevant parties, in their preparations to respond effectively to emergency situations.</p>	<ul style="list-style-type: none"> <li>- Prohibiting the use of child employees under the age of 18 to work between 22:00 and 06:00 hours unless permitted.</li> <li>- Prohibiting the use of child employees under the age of 18 for overtime work.</li> </ul> <p>Forced labor is strictly prohibited, and the project shall adhere to the Thai Anti-Trafficking in Persons Act B.E. 2551 (2008), Section 6 and Section 7, which address the use of forced labor or services by compelling employees to work or provide services under the threat of injury to life, body, reputation, or property, including but not limited to the following measures:</p> <ul style="list-style-type: none"> <li>- Ensuring that workers have the freedom to terminate their employment at any time.</li> <li>- Ensuring that workers receive fair wages.</li> <li>- Ensuring that workers retain control over their personal documents.</li> </ul> <p>In addition, the Project shall also strictly comply with International Labor Organization (ILO) Convention No. 138 that is to establish a minimum age for admission to employment or work.</p> <p>Specifically, it aims to set the minimum age at which young people can legally be employed, taking into consideration the need for their physical and psychological development.</p>



**TABLE 4.4-1  
OVERVIEW OF PROJECT IMPLEMENTATION AND IMPACT ASSESSMENT IN RELATION TO THE ADB AND  
IFC PERFORMANCE STANDARDS (CONT'D)**

ADB's Requirements	IFC's Requirements	Project Implementation
	<p><u>Security Personnel</u></p> <ul style="list-style-type: none"> <li>- Assess risk posed by its security arrangements to those within and outside the project site.</li> </ul>	<p>Under Convention No. 138, the minimum age for admission to employment or work should not be less than the age of completion of compulsory schooling and, in any case, not less than 15 years old. However, it does allow for some exceptions in certain circumstances.</p> <p>However, the prevent diseases that may arise due to the migration of workers, especially during the construction phase, the Project is obligated to adhere to the measures outlined by the Ministry of Public Health and other relevant laws pertaining to stringent epidemic control.</p> <p>For emergency preparedness and response, the Project is required to practice emergency response plans within the project area, dividing the plans into three levels according to the severity of emergencies. Establish communication channels for seeking assistance from external organizations. Plans must outline clear steps and responsibilities and comply with legal training frequency requirements.</p>
<p><b>ADB's Safeguard Requirement 1 : Physical Cultural Resources</b></p> <p>The borrower/client is responsible for siting and designing the project to avoid significant damage to physical cultural resources. Such resources likely to be affected by the project will be identified, and qualified and experienced experts will assess the project's potential impacts on these resources using field-based surveys as an integral part of the environmental assessment process</p>	<p><b>PS 8: Cultural Heritage</b></p> <p>The implementation of the actions necessary to meet the requirements of this Performance Standard is managed through the client's Environmental and Social Management System (ESMS), the elements of which are outlined in Performance Standard 1. During the project life-cycle, the client will consider potential project impacts to cultural heritage and will apply the provisions of this Performance Standard.</p>	<p>Within a radius of 3 kilometers from the Project boundary, there are no registered archaeological sites or historical sites as stipulated by relevant legislation, pertaining to archaeological sites, antiquities, cultural artifacts, and national heritage sites.</p>

**TABLE 4.4-1  
OVERVIEW OF PROJECT IMPLEMENTATION AND IMPACT ASSESSMENT IN RELATION TO THE ADB AND  
IFC PERFORMANCE STANDARDS (CONT'D)**

ADB's Requirements	IFC's Requirements	Project Implementation
<p><b>ADB's Safeguard Requirement 2 : Involuntary resettlement.</b></p> <p>The objectives are to avoid involuntary resettlement wherever possible; to minimize involuntary resettlement by exploring project and design alternatives; to enhance, or at least restore, the livelihoods of all displaced persons in real terms relative to pre-project levels; and to improve the standards of living of the displaced poor and other vulnerable groups. Compliance with Safeguard Requirement 2 involves conducting a Resettlement Plan and implementing measures to provide adequate compensation, assistance, and livelihood restoration for affected individuals or communities. The goal is to minimize adverse impacts on displaced persons and support their socio-economic well-being.</p>	<p><b>PS 5: Land Acquisition and Involuntary Resettlement</b></p> <ol style="list-style-type: none"> <li>1) Land rights or land use rights acquired through expropriation or other compulsory procedures in accordance with the legal system of the host country,</li> <li>2) Land rights or land use rights acquired through negotiated settlements with property owners or those with legal rights to the land if failure to reach settlement would have resulted in expropriation or other compulsory procedures,</li> <li>3) Project situations where involuntary restrictions on land use and access to natural resources cause a community or groups within a community to lose access to resource usage where they have traditional or recognizable usage rights,</li> <li>4) Certain project situations requiring evictions of people occupying land without formal, traditional, or recognizable usage rights, or</li> <li>5) Restriction on access to land or use of other resources including communal property and natural resources such as marine and aquatic resources, timber and non-timber forest products, freshwater, medicinal plants, hunting and gathering grounds and grazing and cropping areas.</li> </ol> <p>Nevertheless, this performance standard does not apply to resettlement resulting from voluntary land transactions. It also does not apply to impacts on livelihoods where the project is not changing the land use of the affected groups or communities.</p>	<p>The Project area is predominantly devoted to agriculture, specifically the cultivation of rice. The Project acquired land tenure through agreements and land purchases from private landowners, with the purchase price being mutually determined by the Project and the previous landowners. Presently, the land in the Project area is owned by the Project developer, Phalangngan Rungrueang Co., Ltd. Consequently, there are no issues related to either physical or economic displacement to be concerned.</p>

**TABLE 4.4-1  
OVERVIEW OF PROJECT IMPLEMENTATION AND IMPACT ASSESSMENT IN RELATION TO THE ADB AND  
IFC PERFORMANCE STANDARDS (CONT'D)**

ADB's Requirements	IFC's Requirements	Project Implementation
<p><b>ADB's Safeguard Requirement 3 : Indigenous Peoples.</b></p> <p>The objective is to design and implement projects in a way that fosters full respect for Indigenous Peoples' identity, dignity, human rights, livelihood systems, and cultural uniqueness as defined by the Indigenous Peoples themselves so that they (i) receive culturally appropriate social and economic benefits, (ii) do not suffer adverse impacts as a result of projects, and (iii) can participate actively in projects that affect them. Compliance with Safeguard Requirement 3 entails conducting a Free, Prior, and Informed Consent (FPIC) process, involving meaningful consultations with Indigenous Peoples to obtain their consent before implementing projects that may impact them. The aim is to promote the active participation of Indigenous Peoples in project decision-making and protect their rights throughout the project lifecycle.</p>	<p><b>PS 7: Indigenous Peoples</b></p> <p>The implementation of the actions necessary to meet the requirements of this Performance Standard is managed through the client's Environmental and Social Management System, the elements of which are outlined in Performance Standard 1. However, there is no universally accepted definition of "Indigenous Peoples." The client may be required to seek inputs from competent professionals to ascertain whether a particular group is considered as Indigenous Peoples.</p>	<p>From the social information from the local authorities, there was no ethnic group in Nikhom Songkhro and Khok Sa-at Subdistrict.</p>

**CHAPTER 5**

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**ENVIRONMENTAL AND SOCIAL MANAGEMENT PLAN  
AND SYSTEM**

## CHAPTER 5 ENVIRONMENTAL AND SOCIAL MANAGEMENT PLAN AND SYSTEM

### 5.1 ENVIRONMENTAL AND SOCIAL MANAGEMENT PLAN

According to the result of Environmental and Social Impact Assessment discussed in the previous chapter, the project development have some impacts during construction and operation phases. Phalanggan Rungrueng Co., Ltd. will be responsible for implementation of corresponding mitigation measures and monitoring programs set out for Phalanggan Rungrueng Solar Power Plant in the Report in order to ensure that the project development during construction and operation phases will have impacts within an acceptable level.

The proposed measures and programs comprise the followings:

(1) General measures, which are the mandatory measures established by Lenders to ensure that the Project implementation will comply with the proposed measure and be reported to the relevant authorities; as well as the mitigation measures and monitoring programs will be as a condition in a contract to be implemented by a contractor, are presented in **Table 5.1-1**.

(2) Environmental and social impact prevention and correction measures for construction and operation phases as presented in **Table 5.1-2** to **Table 5.1-3**. The measures proposed cover the following environmental and social aspect:

- Air quality
- Noise level
- Water quality and drainage
- Reflection and heat
- Biodiversity
- Socio-economics and public participation
- Gender-based violence and harassment (GBVH)
- Public health and safety
- Occupational health and safety
- Transportation
- Solid waste management
- Major hazard and emergency
- Land access/maintenance
- Green area and aesthetics

(3) Environmental and social impact monitoring program that are required to follow up the implementation of environmental impact mitigation measures during construction and operation phases are presented in **Table 5.1-4** to **Table 5.1-5**. The following are aspects that need to be monitored, namely;

- Air quality
- Noise level
- Water use and effluent quality
- Socio-economics and public participation
- Occupational health and safety
- Transportation
- Solid waste management

**TABLE 5.1-1  
GENERAL MEASURES OF PHALANGNGAN RUNGRUENG SOLAR POWER PLANT**

Environmental Parameters	Environmental Impact Prevention and Correction Measures	Location	Duration	Responsible Party
General measures	1. Phalangngan Rungrueng Solar Power Plant shall stringently comply with the environmental impact prevention and correction measures and environmental impact monitoring measures in the IEE report.	Project area and nearby communities	Throughout project operation	Phalangngan Rungrueng Co., Ltd.
	2. The measures in this IEE report shall be incorporated as the minimum requirements into the contractor contract and strictly implemented to ensure operational effectiveness.	Project area	Throughout project operation	Phalangngan Rungrueng Co., Ltd.
	3. In case the results of environmental impact monitoring identify potential problems including community complaints due to the project implementation, the project shall report to lender.	Project area and nearby communities	Throughout project operation	Phalangngan Rungrueng Co., Ltd.
	4. In case of any change in the project details resulting in changes to the measures, a request for changes shall be submitted prior to making any changes by submitting an addendum report presenting the details of specific parts which are relevant or impacted by such changes including justifications, a summary of the overall project implementation at present in comparison with the implementation after change, and a summary of the measure implementation in the past 3 years at the minimum (if any) for overall understanding and supporting the report consideration.	Project area	Throughout project operation	Phalangngan Rungrueng Co., Ltd.

**TABLE 5.1-2**  
**ENVIRONMENTAL AND SOCIAL IMPACT PREVENTION AND CORRECTION MEASURES OF**  
**PHALANGGAN RUNGRUENG SOLAR POWER PLANT FOR CONSTRUCTION PHASE**

Environmental Parameters	Environmental Impact Prevention and Correction Measures	Location	Duration	Responsible Party
1. Air quality	1. Water shall be sprayed over the construction area where topsoil is excavated, piles of construction materials, and access road to the construction site, at least twice a day (morning-afternoon) or as deemed appropriate for the weather conditions to maintain the ground surface moisture in order to prevent dust diffusion and reduce impacts on nearby communities.	Construction area	Throughout construction phase	Phalanggan Rungrueng Co., Ltd.
	2. Construction materials and equipment shall be orderly stored and any part which may cause dust diffusion shall be covered.	Construction area	Throughout construction phase	Phalanggan Rungrueng Co., Ltd.
	3. Regular inspection and maintenance shall be carried out for machinery and equipment used in the project to be in good condition and to reduce air pollution emissions.	Construction area	Throughout construction phase	Phalanggan Rungrueng Co., Ltd.
	4. Truck and wheels shall be washed and cleaned before the trucks leave the construction site so as to remove stone/gravel, mud or sand which may cause hazards and dirtiness on the road.	Construction area	Throughout construction phase	Phalanggan Rungrueng Co., Ltd.
	5. Limit vehicle speed on site to 30 km/h to assist reduce dust emissions caused by vehicle movement.	Construction area	Throughout construction phase	Phalanggan Rungrueng Co., Ltd.
	6. Waste burning on construction sites should be strictly prohibited.	Construction area	Throughout construction phase	Phalanggan Rungrueng Co., Ltd.
2. Noise level	1. The construction plan with activities which may be noisy shall be publicized to inform communities at least 2 weeks prior to construction.	Construction area and nearby communities	Throughout construction phase	Phalanggan Rungrueng Co., Ltd.
	2. Construction activities that may create noise impacts on the communities and living things in the surrounding area shall be only carried out during daytime, except those requiring continuous operations to complete. The community leaders in the area shall be informed at least 7 days prior to undertaking such activities.	Construction area and nearby communities	Throughout construction phase	Phalanggan Rungrueng Co., Ltd.

**TABLE 5.1-2  
ENVIRONMENTAL AND SOCIAL IMPACT PREVENTION AND CORRECTION MEASURES OF  
PHALANGNGAN RUNGRUEANG SOLAR POWER PLANT FOR CONSTRUCTION PHASE (CONT'D)**

<b>Environmental Parameters</b>	<b>Environmental Impact Prevention and Correction Measures</b>	<b>Location</b>	<b>Duration</b>	<b>Responsible Party</b>
2. Noise (Cont'd)	3. A noise barrier composed of steel with a thickness of 0.64 mm or more and a height of 2.1 and 2.0 meters, or other materials with equal efficacy, shall be installed along the fence line of a construction site near House to the southwest, 167 meters and House to the east, 341 meters, as close to the noise source as practicable.	Construction area	Throughout construction phase	Phalangngan Rungrueng Co., Ltd.
	4. Low-noise construction equipment and machines shall be used and maintained to always be in good working condition.	Construction area	Throughout construction phase	Phalangngan Rungrueng Co., Ltd.
	5. Reducing noise levels at the source by using pile cushion on the top of steel piles during pile driving to reduce noise.	Construction area	Throughout construction phase	Phalangngan Rungrueng Co., Ltd.
	6. Hearing protection equipment shall be provided for workers working in noisy areas and the general noise level shall be controlled to be within the standard value.	Construction area	Throughout construction phase	Phalangngan Rungrueng Co., Ltd.
3. Water quality and drainage	1. A temporary site office and workers' camp, bathrooms and sanitary toilets shall be adequately provided for construction workers and shall be located at least 30 meters away from water bodies in order to prevent contamination by wastewater from activities in the temporary site office and workers' camp flowing into nearby water bodies.	Construction area and worker camp	Throughout construction phase	Phalangngan Rungrueng Co., Ltd.
	2. Package onsite wastewater treatment system shall be installed for treating wastewater to meet the effluent standard prescribed by the authority before being discharged to the outside area. Discharge of untreated waste into receiving water bodies shall be prohibited and such wastewater or waste shall be pumped out for disposal or treatment in accordance with the Government Agency.	Construction area	Throughout construction phase	Phalangngan Rungrueng Co., Ltd.



**TABLE 5.1-2**  
**ENVIRONMENTAL AND SOCIAL IMPACT PREVENTION AND CORRECTION MEASURES OF**  
**PHALANGNGAN RUNGRUEANG SOLAR POWER PLANT FOR CONSTRUCTION PHASE (CONT'D)**

Environmental Parameters	Environmental Impact Prevention and Correction Measures	Location	Duration	Responsible Party
3. Water quality and drainage (Cont'd)	3. The wastewater treatment system should be capable of treating wastewater to meet the quality standards according to the announcement of the Ministry of Natural Resources and Environment regarding the standards for controlling the discharge of wastewater from certain types and sizes of buildings, B.E. 2548 (2005) before discharge to environment.	Construction workers' camp	Throughout construction phase	Phalangngan Rungrueng Co., Ltd.
	4. If the contractor discharges treated waste or sewage outside into natural water sources or private areas, the contractor must obtain permission from relevant government agencies or landowner to ensuring that the discharged sewage will not have adverse environmental impacts in the future. In addition, the contractor shall provide a retention pond at worker's camp and conduct water quality monitoring once a month to ascertain the water quality before discharging.	Construction workers' camp	Throughout construction phase	Phalangngan Rungrueng Co., Ltd.
	5. Temporary drain ditches and a settling pond shall be constructed and completed within the first month of construction period so as to control wastewater discharge from construction activities and prevent impacts on the surrounding areas. The efficiency of temporary drain ditches shall be regularly inspected. If any damage is found, it shall be quickly repaired to be in good working condition.	Construction area	Throughout construction phase	Phalangngan Rungrueng Co., Ltd.
	6. Rainwater drainage channels must surround the worker accommodation area to prevent overflow into surrounding areas and they must be able to accommodate the volume of runoff.	Construction workers' camp	Throughout construction phase	Phalangngan Rungrueng Co., Ltd.
	7. The direction of the rainwater drainage channels must flow towards a rainwater retention pit before being discharged into public water sources and should not flow into adjacent areas.	Construction workers' camp	Throughout construction phase	Phalangngan Rungrueng Co., Ltd.
	8. Dumping of garbage or construction debris into drain pipes or public water sources shall be strictly prohibited.	Construction area and nearby communities	Throughout construction phase	Phalangngan Rungrueng Co., Ltd.

**TABLE 5.1-2**  
**ENVIRONMENTAL AND SOCIAL IMPACT PREVENTION AND CORRECTION MEASURES OF**  
**PHALANGNGAN RUNGRUEANG SOLAR POWER PLANT FOR CONSTRUCTION PHASE (CONT'D)**

Environmental Parameters	Environmental Impact Prevention and Correction Measures	Location	Duration	Responsible Party
4. Reflection and heat	1. Use anti-reflective coating on solar panels to reduce glare and minimize heat reflection	Construction area	Throughout construction phase	Phalangngan Rungrueng Co., Ltd.
	2. Implement ground-mounted solar panels at angles that minimize direct reflection towards neighboring communities or aviation paths.	Construction area	Throughout construction phase	Phalangngan Rungrueng Co., Ltd.
5. Biodiversity	1. Prevent construction workers from harming the nests, eggs, and larvae of the protected species under the Wildlife Preservation and Protection Act, B.E. 2562 (2019), which are species with a conservation status of Vulnerable (VU) and Near Threatened (NT) according to ONEP (2020) and IUCN (2022-2)	Construction area	Throughout construction phase	Phalangngan Rungrueng Co., Ltd.
6. Socio-economic and public participation	1. Information relating to the construction plan shall be publicized and disseminated by installing publicity boards in the project site or other appropriate models in order to inform all the public and stakeholders at least 7 days prior to construction.	Construction area and nearby communities	Throughout construction phase	Phalangngan Rungrueng Co., Ltd.
	2. The project staff shall periodically visit nearby communities throughout the construction phase to inquire and listen to opinions about environmental impacts from the project construction activities so as to determine a guideline for mitigating impacts which may arise.	Construction area and nearby communities	Throughout construction phase	Phalangngan Rungrueng Co., Ltd.
	3. A coordination center shall be set up to receive recommendations and complaints about disturbances from the project construction.	Construction area	Throughout construction phase	Phalangngan Rungrueng Co., Ltd.
	4. In case of complaints by people about impacts from the project construction activities, the project shall immediately investigate and take remedial action.	Construction area and nearby communities	Throughout construction phase	Phalangngan Rungrueng Co., Ltd.
	5. A joint committee shall be set up so that communities can participate in the project implementation and community and environmental development in joint cooperation with the project. The joint committee membership shall, at least, comprise representatives of people, local government agencies, local educational institutes or academics, and the project owner. The number of committee members from the people sector shall be, at least,	Construction area and nearby communities	Throughout construction phase	Phalangngan Rungrueng Co., Ltd.

**TABLE 5.1-2**  
**ENVIRONMENTAL AND SOCIAL IMPACT PREVENTION AND CORRECTION MEASURES OF**  
**PHALANGNGAN RUNGRUEANG SOLAR POWER PLANT FOR CONSTRUCTION PHASE (CONT'D)**

Environmental Parameters	Environmental Impact Prevention and Correction Measures	Location	Duration	Responsible Party
6. Socio-economic and public participation (Cont'd)	<p>more than half of the total number of the committee members. In establishing the aforesaid committee, the committee structure and composition shall be specified together with number of committee members, power and duties, term of office, type of meeting, frequency of meeting, etc. Moreover, the committee's work will be linked to the project management. The committee's power and duties include, for example, receipt of complaints and consideration of compliance with the project's measures, etc. In addition, the committee may carry on its duties in the operation phase.</p> <p>The appointment of a joint committee shall be completed prior to commencing the project construction. If there is any constraint to the establishment of a joint committee in cooperation with communities and the committee cannot be set up according to the specified proportion, the project shall notify the OERC and set out measures to build good understanding and communicate the results of project implementation to the communities and the project's stakeholders in the surrounding area via various public relations media such as documents, printed matter, personal media or information system, etc., and records of the project implementation throughout the project construction phase.</p>			
	6. Qualified local people shall be given first priority to be hired by posting job recruitment in front of the project area and camp site and coordinating with local leaders and village headmen to publicize job positions.	Construction area and nearby communities	Throughout construction phase	Phalangngan Rungrueng Co., Ltd.
	7. Establish Stakeholder Engagement Plan before the construction begins. The SEPs shall cover all stakeholder groups (e.g., project affected persons: stakeholders living within site, along right-of-way, construction campsite) and their expectations (e.g., energy fund, local labor employment). The SEP shall include general guidance for communicating and managing communities' expectations.	Construction area and nearby communities	Throughout construction phase	Phalangngan Rungrueng Co., Ltd.

**TABLE 5.1-2**  
**ENVIRONMENTAL AND SOCIAL IMPACT PREVENTION AND CORRECTION MEASURES OF**  
**PHALANGNGAN RUNGRUEANG SOLAR POWER PLANT FOR CONSTRUCTION PHASE (CONT'D)**

<b>Environmental Parameters</b>	<b>Environmental Impact Prevention and Correction Measures</b>	<b>Location</b>	<b>Duration</b>	<b>Responsible Party</b>
6. Socio-economic and public participation (Cont'd)	8. Collaborate with community to establish a Corporate Social Responsibility (CSR) plan to initiate and support community activities to be implemented during construction phase, including: <ul style="list-style-type: none"> <li>• An environmental conservation plan;</li> <li>• A social, child, and youth development plan;</li> <li>• A health plan; and</li> <li>• A cultural and tradition plan</li> </ul>	Nearby communities	Throughout construction phase	Phalangngan Rungrueng Co., Ltd.
7. Gender-based violence and harassment (GBVH)	1. Establish policies on GBVH to safeguard workers and nearby community of the project.	Construction area, construction worker's camp, and nearby communities	Throughout construction phase	Phalangngan Rungrueng Co., Ltd.
	2. Ensure gender-sensitive policies are in place, promoting equal opportunities for employment, training, and advancement.	Construction area, and nearby communities	Throughout construction phase	Phalangngan Rungrueng Co., Ltd.
	3. Make a project-specific commitment to provide employment and supply chain opportunities for local women. For example, in service cleaning contracts, no gender specific within local content requirements to ensure the inclusion and participation of women in these opportunities.	Construction area, and nearby communities	Throughout construction phase	Phalangngan Rungrueng Co., Ltd.
	4. Establish Corporate Social Responsibility (CSR) activities to ensure that all genders can be involved.	Construction area, and nearby communities	Throughout construction phase	Phalangngan Rungrueng Co., Ltd.
	5. Ensure that all facilities (restrooms, changing rooms) are safe, accessible, and respectful of privacy for all genders.	Construction area and worker's camp	Throughout construction phase	Phalangngan Rungrueng Co., Ltd.

**TABLE 5.1-2**  
**ENVIRONMENTAL AND SOCIAL IMPACT PREVENTION AND CORRECTION MEASURES OF**  
**PHALANGGAN RUNGRUEANG SOLAR POWER PLANT FOR CONSTRUCTION PHASE (CONT'D)**

Environmental Parameters	Environmental Impact Prevention and Correction Measures	Location	Duration	Responsible Party
7. Gender-based violence and harassment (GBVH)	6. Conduct gender sensitivity training for all project work teams, managers, and contractors. This training aims to increase awareness of gender issues, promote inclusivity, and enhance understanding of the importance of gender equality in project implementation.	Construction area, worker's camp, and nearby communities	Throughout construction phase	Phalanggan Rungrueng Co., Ltd.
8. Public health and safety	1. Contractor shall prepare Construction Labor Management Plan (to cover labor related requirements for contractors, influx management and community impacts, labor camps conditions and management).	Construction workers' camp and nearby communities	Throughout construction phase	Phalanggan Rungrueng Co., Ltd.
	2. Establish measures on community health as follows: <ul style="list-style-type: none"> <li>– Require contractors to comply with the measures of the Ministry of Public Health and other laws related to strict epidemic control.</li> <li>– Supervise and control contractors to strictly adhere to agreements, including monitoring camps, residences, random drug testing, waste separation in the worker's camp, and closely controlling the behavior of construction workers to prevent nuisances in neighboring communities.</li> <li>– Inform the number of construction workers as information in the preparation of public health facilities in the area before starting work and in case of illness or accident.</li> <li>– Coordinate with local health agencies to provide personal hygiene education, information on communicable diseases, and personal care for construction workers of all levels.</li> <li>– Conduct training in regulations, health, and infectious disease prevention.</li> <li>– Establish a routine for keeping the area clean and hygienic, involving daily cleaning by the staff and regular check-ups by company personnel.</li> </ul>	Construction area and construction workers' camp	Throughout construction phase	Phalanggan Rungrueng Co., Ltd.

**TABLE 5.1-2**  
**ENVIRONMENTAL AND SOCIAL IMPACT PREVENTION AND CORRECTION MEASURES OF**  
**PHALANGNGAN RUNGRUEANG SOLAR POWER PLANT FOR CONSTRUCTION PHASE (CONT'D)**

Environmental Parameters	Environmental Impact Prevention and Correction Measures	Location	Duration	Responsible Party
8. Public health and safety (Cont'd)	3. Life and asset safety measures shall be established as follows: <ul style="list-style-type: none"> <li>– The Project shall provide strictly supervise the entrance and exit to the construction site.</li> <li>– The boundaries of the construction workers' camp and construction site shall be clearly demarcated.</li> <li>– Use strict security system in the construction workers' camp.</li> <li>– In the event that the construction workers' camp is close to a community, workers' behavior shall be closely supervised to prevent disturbance and annoyance.</li> <li>– A register of migrant labor and foreign labor shall be established.</li> </ul>	Construction area and construction workers' camp	Throughout construction phase	Phalangngan Rungrueng Co., Ltd.
	4. Contractor shall manage the workers' camp environment to have the following facilities. <ul style="list-style-type: none"> <li>– Clearly display signs indicating residential areas.</li> <li>– Equip sturdy and secure fences around the residential areas.</li> <li>– Ensure sufficient lighting along roads or general areas for safety in residential areas.</li> <li>– Provide adequate parking spaces for the number of residents.</li> <li>– Provide security systems and closed-circuit television.</li> </ul>	Construction workers' camp	Throughout construction phase	Phalangngan Rungrueng Co., Ltd.
	5. Provide clean and sufficient water for worker consumption.	Construction area and construction workers' camp	Throughout construction phase	Phalangngan Rungrueng Co., Ltd.
	6. Drinking water for workers must be clean. <ul style="list-style-type: none"> <li>– If bottled water are provided, the manufacturing company must meet the quality standards for drinking water as required by the law or international standards.</li> </ul>	Construction area and construction workers' camp	Throughout construction phase	Phalangngan Rungrueng Co., Ltd.

**TABLE 5.1-2**  
**ENVIRONMENTAL AND SOCIAL IMPACT PREVENTION AND CORRECTION MEASURES OF**  
**PHALANGNGAN RUNGRUEANG SOLAR POWER PLANT FOR CONSTRUCTION PHASE (CONT'D)**

Environmental Parameters	Environmental Impact Prevention and Correction Measures	Location	Duration	Responsible Party
8. Public health and safety (Cont'd)	– If water filtration systems are installed, the quality of the drinking water must meet the standards set by the Ministry of Public Health, and regular inspections must be conducted every three months.			
	7. Containers for storing drinking water must be tightly sealed and regular cleaning must be carried out consistently.	Construction area and construction workers' camp	Throughout construction phase	Phalangngan Rungrueng Co., Ltd.
9. Occupational health and safety	1. Occupational safety management shall be arranged in a systematical and efficient manner in conformity with the requirements of occupational safety, health and environment law relating to construction.	Construction area	Throughout construction phase	Phalangngan Rungrueng Co., Ltd.
	2. Warning signs indicating the perimeter of the project construction zones shall be installed in clearly visible and easily recognizable places.	Construction area	Throughout construction phase	Phalangngan Rungrueng Co., Ltd.
	3. The construction site shall be proportionally divided into construction zone, daytime rest zone, machinery and equipment storage zone, and unused material and equipment storage zone.	Construction area	Throughout construction phase	Phalangngan Rungrueng Co., Ltd.
	4. First aid kits including an ambulance or contact number of nearby medical facilities having an ambulance for emergency shall be provided. In addition, first aiders shall be routinely provided at the construction site and construction workers' camp, and ready for transporting an injured person to nearby hospitals at all times.	Construction area	Throughout construction phase	Phalangngan Rungrueng Co., Ltd.
	5. Ensure that personnel capable of providing first aid are stationed in the area at all times to facilitate the prompt transfer of injured individuals to nearby medical facilities.	Construction area	Throughout construction phase	Phalangngan Rungrueng Co., Ltd.
	6. Contractors are required to prepare Construction Health and Safety Plan before the commencement of construction.	Construction area	Throughout construction phase	Phalangngan Rungrueng Co., Ltd.

**TABLE 5.1-2**  
**ENVIRONMENTAL AND SOCIAL IMPACT PREVENTION AND CORRECTION MEASURES OF**  
**PHALANGNGAN RUNGRUEANG SOLAR POWER PLANT FOR CONSTRUCTION PHASE (CONT'D)**

Environmental Parameters	Environmental Impact Prevention and Correction Measures	Location	Duration	Responsible Party
10. Transportation	1. Contractor shall prepare traffic management plan before the construction begins.	Construction area and transportation route	Throughout construction phase	Phalangngan Rungrueng Co., Ltd.
	2. Warning signs or signals shall be put in place and clearly visible during daytime and nighttime at least 100 meters before reaching the construction site.	Construction area	Throughout construction phase	Phalangngan Rungrueng Co., Ltd.
	3. Drivers relating to all types of construction shall be trained and supervised to stringently comply with traffic rules.	Construction area	Throughout construction phase	Phalangngan Rungrueng Co., Ltd.
	4. If construction activities cause any damage to signboard, traffic light or road surface, repair shall be urgently conducted.	Construction area	Throughout construction phase	Phalangngan Rungrueng Co., Ltd.
11. Solid waste management	1. Waste bins must be categorized, such as organic waste, general waste, recyclable waste, and hazardous waste, and they must have tightly sealed lids and be sufficient in size for the amount of waste.	Construction area and construction workers' camp	Throughout construction phase	Phalangngan Rungrueng Co., Ltd.
	2. Designate a location for waste storage prior to disposal.	Construction area and construction workers' camp	Throughout construction phase	Phalangngan Rungrueng Co., Ltd.
	3. Workforce training in waste management, which includes handling, sorting, storing, and disposing of various sorts of waste.	Construction area and construction workers' camp	Throughout construction phase	Phalangngan Rungrueng Co., Ltd.
	4. Waste receptacles shall be sufficiently provided for waste generated by workers at various places in the construction site and worker camp and coordination shall be made with the relevant local agency for waste disposal.	Construction area and construction workers' camp	Throughout construction phase	Phalangngan Rungrueng Co., Ltd.
	5. In case the construction activities have hazardous waste having the characteristics and properties as prescribed in the Notification of Ministry of Industry on Disposal of Waste or Unusable Materials B. E. 2566 (2023), the agency permitted by the Department of Industrial Works shall collect hazardous waste for proper disposal. Operating	Construction area	Throughout construction phase	Phalangngan Rungrueng Co., Ltd.



**TABLE 5.1-2**  
**ENVIRONMENTAL AND SOCIAL IMPACT PREVENTION AND CORRECTION MEASURES OF**  
**PHALANGNGAN RUNGRUEANG SOLAR POWER PLANT FOR CONSTRUCTION PHASE (CONT'D)**

<b>Environmental Parameters</b>	<b>Environmental Impact Prevention and Correction Measures</b>	<b>Location</b>	<b>Duration</b>	<b>Responsible Party</b>
11. Solid waste management (Cont'd)	procedure for segregation of hazardous waste shall be established and training provided for relevant workers to inform them of the prohibition against waste dumping in drain ditches, drain pipes and water bodies near the construction site.			
12. Major hazard and emergency	1. Contractor shall prepare Emergency Preparedness and Response Plan before the beginning of the construction.	Construction area and construction workers' camp	Throughout construction phase	Phalangngan Rungrueng Co., Ltd.
	2. Conduct regular drills for fire evacuation and firefighting plans within 1 year of occupancy and annually thereafter following the initial drill.	Construction area and construction workers' camp	Throughout construction phase	Phalangngan Rungrueng Co., Ltd.
	3. Provide fire extinguishers in accordance with government regulations and standards for managing occupational health, safety, and environmental conditions related to fire prevention and control, as per the Occupational Safety, Health, and Environment Management in the Workplace to Prevent and Control Hazardous Incidents Act, B.E. 2555 (2012).	Construction area and construction workers' camp	Throughout construction phase	Phalangngan Rungrueng Co., Ltd.
	4. Implement an alarm system capable of signaling emergencies to cover the entire area.	Construction area and construction workers' camp	Throughout construction phase	Phalangngan Rungrueng Co., Ltd.
13. Land maintenance	1. Develop Site Maintenance to manage legacy cropping and vacating site, and avoidance of new encroached activities (such as grazing) and mechanism to handle possible future claims by former users or others.	Construction area	Throughout construction phase	Phalangngan Rungrueng Co., Ltd.

**TABLE 5.1-3**  
**ENVIRONMENTAL AND SOCIAL IMPACT PREVENTION AND CORRECTION MEASURES OF**  
**PHALANGGAN RUNGRUENG SOLAR POWER PLANT FOR OPERATION PHASE**

Environmental Parameters	Environmental Impact Prevention and Correction Measures	Location	Duration	Responsible Party
1. Water quality	<p>1. <b>Water Use</b></p> <p>In case groundwater is used, the agency's permit conditions shall be strictly adhered to, by specifying actual volume of water pumped in comparison with the permitted volume (Expressed in cubic meter per month).</p>	Project area	Throughout operation phase	Phalanggan Rungrueng Co., Ltd.
	<p>2. <b>Stormwater Drainage</b></p> <p>2.1 Stormwater discharge rate from the retention pond or the project area shall be controlled not to exceed the runoff rate in the area before the project development.</p> <p>2.2 Plant grass or ground cover to reduce soil erosion.</p>			
	<p>3. <b>Maintenance of Wastewater Treatment System</b></p> <p>Wastewater treatment system shall be maintained to have sufficient capacity for treatment of the project's total wastewater volume including sludge to be in compliance with the standard prior to being discharged to the outside of the project or reused within the project area.</p>			
2. Socio-economic and public participation	<p>1. Opportunities for project visits should be given to the communities so as to ease concerns;</p>	Project area	Throughout operation phase	Phalanggan Rungrueng Co., Ltd.
	<p>2. A complaint receiving plan shall be put in place, specifying channels for complaints, steps and duration of problem solving including responsible persons together with a chart clearly showing the procedure. In case remedial actions have not yet been completed, the complainant shall be notified of the progress every 7 days;</p>	Project area and nearby communities	Throughout operation phase	Phalanggan Rungrueng Co., Ltd.
	<p>3. A person shall be assigned to be responsible for the project's public relations and shall participate in public relations activities undertaken with communities including follow-up of complaints, disturbances and annoyances arising due to the project;</p>	Project area and nearby communities	Throughout operation phase	Phalanggan Rungrueng Co., Ltd.

TABLE 5.1-3

**ENVIRONMENTAL AND SOCIAL IMPACT PREVENTION AND CORRECTION MEASURES OF  
PHALANGNGAN RUNGRUENG SOLAR POWER PLANT FOR OPERATION PHASE (CONT'D)**

Environmental Parameters	Environmental Impact Prevention and Correction Measures	Location	Duration	Responsible Party
2. Socio-economic and public participation (Cont'd)	4. Information shall be disseminated and publicized regarding the project details and compliance with the Code of Practice so as to inform the local communities and the joint committee. Opportunities shall be offered for the communities to participate in the project monitoring throughout the project operation period;	Project area and nearby communities	Throughout operation phase	Phalangngan Rungrueng Co., Ltd.
	5. Community relation activities shall be supported and promotion of community activities shall be undertaken to build good relation with the local communities;	Nearby communities	Throughout operation phase	Phalangngan Rungrueng Co., Ltd.
	6. A joint committee shall be set up so that communities can participate in the project implementation and community and environmental development in joint cooperation with the project. The joint committee membership shall, at least, comprise representatives of people, local government agencies, local educational institutes or academics, and the project owner. The number of committee members from the people sector shall be, at least, more than half of the total number of the committee members. In establishing the aforesaid committee, the committee structure and composition shall be specified together with number of committee members, power and duties, term of office, type of meeting, frequency of meeting, etc. Moreover, the committee's work will be linked to the project management. The committee's power and duties include, for example, receipt of complaints and consideration of compliance with the project's measures, etc. In addition, the committee may carry on its duties in the operation phase.  The appointment of a joint committee shall be completed prior to commencing the project construction. If there is any constraint to the establishment of a joint committee in cooperation with communities and the committee cannot be set up according to the specified proportion, the project shall notify the OERC and set out measures to build good understanding and communicate the results of project implementation to the communities and the project's stakeholders in the surrounding area via various public relations media such as	Project area and nearby communities	Throughout operation phase	Phalangngan Rungrueng Co., Ltd.

TABLE 5.1-3

**ENVIRONMENTAL AND SOCIAL IMPACT PREVENTION AND CORRECTION MEASURES OF  
PHALANGGAN RUNGRUENG SOLAR POWER PLANT FOR OPERATION PHASE (CONT'D)**

Environmental Parameters	Environmental Impact Prevention and Correction Measures	Location	Duration	Responsible Party
2. Socio-economic and public participation (Cont'd)	documents, printed matter, personal media or information system, etc., and records of the project implementation throughout the project construction phase.			
	7. If it is proven that damage has resulted from the project operation, the appointed joint committee shall have power and duty to consider compensation for the damage.	Project area and nearby communities	Throughout operation phase	Phalanggan Rungrueng Co., Ltd.
	8. Collaborate with community to establish a Corporate Social Responsibility (CSR) plan to initiate and support community activities to be implemented during operation phase, including: <ul style="list-style-type: none"> <li>• An environmental conservation plan;</li> <li>• A social, child, and youth development plan;</li> <li>• A health plan; and</li> <li>• A cultural and tradition plan</li> </ul>	Nearby communities	Throughout operation phase	Phalanggan Rungrueng Co., Ltd.
3. Occupational health and safety	1. EHS division shall implement and maintain site ESMS.	Project area	Throughout operation phase	Phalanggan Rungrueng Co., Ltd.
	2. The work plan established for the project's risk areas shall be followed and a guideline shall be defined for risk prevention and mitigation in each area.	Project area	Throughout operation phase	Phalanggan Rungrueng Co., Ltd.
	3. The relevant laws, occupational health and safety requirements or other relevant and current labor laws shall be complied with.	Project area	Throughout operation phase	Phalanggan Rungrueng Co., Ltd.
	4. Training in occupational health and safety shall be adequately provided and suitable for the nature of work such as: <ul style="list-style-type: none"> <li>• Fire drills and proper use of firefighting equipment;</li> <li>• Rules and regulations on working in danger areas;</li> <li>• Inspection of workplace safety;</li> <li>• Training in use of personal protective equipment;</li> </ul>	Project area	Throughout operation phase	Phalanggan Rungrueng Co., Ltd.

TABLE 5.1-3

**ENVIRONMENTAL AND SOCIAL IMPACT PREVENTION AND CORRECTION MEASURES OF  
PHALANGNGAN RUNGRUENG SOLAR POWER PLANT FOR OPERATION PHASE (CONT'D)**

Environmental Parameters	Environmental Impact Prevention and Correction Measures	Location	Duration	Responsible Party
3. Occupational health and safety (Cont'd)	<ul style="list-style-type: none"> <li>• Prevention of danger from machinery, heat and electricity; and</li> <li>• Working at heights of 2 meters or higher</li> </ul>			
	5. Regular inspection of warning systems shall be conducted every year.	Project area	Throughout operation phase	Phalangngan Rungrueng Co., Ltd.
	6. Establish and implement project emergency action plan. Emergency action plan exercises shall be carried out within the project area. The plan may be divided into 3 levels based on the severity of emergency. There must be channels for coordination to request assistance from external agencies. The plan shall have operational procedures and responsible persons clearly designated as well as frequency of drills and exercises as prescribed by law.	Project area	Throughout operation phase	Phalangngan Rungrueng Co., Ltd.
	7. Regular inspection of the working condition shall be carried out for equipment, machinery and electrical system.	Project area	Throughout operation phase	Phalangngan Rungrueng Co., Ltd.
	8. The operation of electrical system in the plant shall be in compliance with technical principles or recognized standards; and	Project area	Throughout operation phase	Phalangngan Rungrueng Co., Ltd.
	9. Regular inspection and safety certification shall be carried out for electrical system in the plant every year in accordance with the criteria prescribed by law.	Project area	Throughout operation phase	Phalangngan Rungrueng Co., Ltd.
4. Solid waste management	1. Collection and transport of damaged or expired equipment for disposal shall be carried out in accordance with the Notification of the Ministry of Industry on Disposal of Waste or Unusable Materials B.E. 2566 (2023) or the latest law in force and shall comply with the following guidelines.	Project area	Throughout operation phase	Phalangngan Rungrueng Co., Ltd.

**TABLE 5.1-3**  
**ENVIRONMENTAL AND SOCIAL IMPACT PREVENTION AND CORRECTION MEASURES OF**  
**PHALANGNGAN RUNGRUENG SOLAR POWER PLANT FOR OPERATION PHASE (CONT'D)**

Environmental Parameters	Environmental Impact Prevention and Correction Measures	Location	Duration	Responsible Party
4. Solid waste management (Cont'd)	<ul style="list-style-type: none"> <li>In case of export of waste for management in other countries, the export shall be carried out in accordance with the law governing hazardous substances and international requirements. When the operation is completed, the ERC shall be informed within 30 days after the waste export for management in other countries.</li> </ul>	Store waste at the project area before arranging proper disposal		
	<ul style="list-style-type: none"> <li>In case of waste management in the country, hazardous waste shall be disposed in secure landfills or by incineration in a hazardous waste incinerator.</li> </ul>	Store waste at the project area before arranging proper disposal		
	2. Regular inspection of waste storage shall be carried out to prevent any impact which may arise from waste contamination or dispersion.	Project area	Throughout operation phase	Phalangngan Rungrueng Co., Ltd.
	3. Damaged PV panels shall be gathered in waste storage facility before the disposal. Their disposal method shall be in accordance with the Announcement of Ministry of Industry regarding the Management of Waste and Unused Materials, B.E. 2566 (2023).	Project area	Throughout operation phase	Phalangngan Rungrueng Co., Ltd.
5. Major hazard and emergency	1. The Project shall prepare Emergency Preparedness and Response Plan before the beginning of the operation phase.	Project area	Throughout operation phase	Phalangngan Rungrueng Co., Ltd.
	2. Conduct regular drills for fire evacuation and firefighting plans within 1 year of occupancy and annually thereafter following the initial drill.	Project area	Throughout operation phase	Phalangngan Rungrueng Co., Ltd.
	3. Provide fire extinguishers in accordance with government regulations and standards for managing occupational health, safety, and environmental conditions related to fire prevention and control, as per the Occupational Safety, Health, and Environment Management in the Workplace to Prevent and Control Hazardous Incidents Act, B.E. 2555 (2012).	Project area	Throughout operation phase	Phalangngan Rungrueng Co., Ltd.
	4. Implement an alarm system capable of signaling emergencies to cover the entire area.	Project area	Throughout operation phase	Phalangngan Rungrueng Co., Ltd.

**TABLE 5.1-3**  
**ENVIRONMENTAL AND SOCIAL IMPACT PREVENTION AND CORRECTION MEASURES OF**  
**PHALANGNGAN RUNGRUENG SOLAR POWER PLANT FOR OPERATION PHASE (CONT'D)**

Environmental Parameters	Environmental Impact Prevention and Correction Measures	Location	Duration	Responsible Party
6. Green area and aesthetics	1. The environmental impact prevention and correction measures shall be followed. Green areas shall be maintained and when dead plants are found, they shall be replaced with new plants to ensure the sustainability of green areas. Perennial trees shall be mainly considered and planted in the project's green areas as appropriate.	Project area	Throughout operation phase	Phalangngan Rungrueng Co., Ltd.
	2. Herbicide use in the Project area is prohibited.	Project area	Throughout operation phase	Phalangngan Rungrueng Co., Ltd.
7. Land access	1. Ensure that access to public road for local communities is not restricted for the landlocked area.	Project area	Throughout operation phase	Phalangngan Rungrueng Co., Ltd.

**TABLE 5.1-4**  
**ENVIRONMENTAL AND SOCIAL MONITORING MEASURES OF PHALANGNGAN RUNGRUENG SOLAR POWER PLANT**  
**FOR CONSTRUCTION PHASE**

Environment Parameters	Measurement Indices	Analysis/Measurement Method	Monitoring Station	Frequency	Responsible Party
1. Air quality	<ul style="list-style-type: none"> <li>- 24-hour average total suspended particulate (TSP)</li> <li>- 24-hour average particulate matters smaller than 10 microns (PM-10)</li> <li>- Wind direction and speed (at least 1 station)</li> </ul>	<ul style="list-style-type: none"> <li>- TSP and PM-10 by Gravimetric-High Volume or methods accepted by Pollution Control Department.</li> <li>- Wind direction and speed by using wind speed &amp; direction recording meter.</li> </ul>	3 monitoring stations, namely <ul style="list-style-type: none"> <li>- A1: The Project site</li> <li>- A2: Pa Nabun Chai Mongkhon Temple</li> <li>- A3: Khok Si Samran Temple</li> </ul>	<ul style="list-style-type: none"> <li>- Twice a year in 2 main wind directions throughout the construction phase. A 5-day consecutive measurement covering working days and holidays, as well as peak construction activities.</li> </ul>	Phalangngan Rungrueng Co., Ltd.
2. Noise level	<ul style="list-style-type: none"> <li>- 24-hour equivalent continuous sound level (<math>L_{eq\ 24\ hr}</math>)</li> <li>- Background noise level (<math>L_{90}</math>)</li> <li>- Day-night average sound level (<math>L_{dn}</math>)</li> <li>- Maximum noise level (<math>L_{max}</math>)</li> </ul>	<ul style="list-style-type: none"> <li>- International Organization for Standardization (ISO1996) or the methods specified by Pollution Control Department</li> </ul>	3 monitoring stations, namely <ul style="list-style-type: none"> <li>- N1: The Project site</li> <li>- N2: The house in the south of the project</li> <li>- N3: The house in the east of the project</li> </ul>	<ul style="list-style-type: none"> <li>- Twice a year throughout the construction phase. A 7-day consecutive measurement covering working days and holidays as well as peak construction activities.</li> </ul>	Phalangngan Rungrueng Co., Ltd.
3. Effluent quality	<ul style="list-style-type: none"> <li>- pH</li> <li>- BOD<sub>5</sub></li> <li>- Suspended Solid</li> <li>- Sulfide</li> <li>- Total Dissolved Solid</li> <li>- Settleable Solids</li> <li>- Oil &amp; Grease</li> <li>- TKN</li> <li>- Fecal Coliform Bacteria</li> </ul>	<ul style="list-style-type: none"> <li>- Measurement methods will be in compliance with the Notification of the Ministry of Industry regarding Industrial Effluent Standards B.E. 2560 (2017) and the Notification of Ministry of Natural Resources and Environment regarding Industrial Effluent Standards for Industrial Plants, Industrial Estates and Industrial Zones B.E. 2559 (2016)</li> </ul>	<ul style="list-style-type: none"> <li>- Retention pond at worker's camp</li> </ul>	<ul style="list-style-type: none"> <li>- If the contractor discharges treated waste or sewage outside into natural water sources or private area, the Project shall conduct water quality monitoring once a month</li> </ul>	Phalangngan Rungrueng Co., Ltd.



**TABLE 5.1-4  
ENVIRONMENTAL AND SOCIAL MONITORING MEASURES OF PHALANGNGAN RUNGRUENG SOLAR POWER PLANT  
FOR CONSTRUCTION PHASE (CONT'D)**

<b>Environment Parameters</b>	<b>Measurement Indices</b>	<b>Analysis/Measurement Method</b>	<b>Monitoring Station</b>	<b>Frequency</b>	<b>Responsible Party</b>
4. Socio-economic and public participation	- Complaints from the communities about the project with method and duration of remedial action	- Record	- Project area	- Prepare a summary of monthly data - Report the data every year	Phalangngan Rungrueng Co., Ltd.
	- Joint activities undertaken by the project together with the local communities	- Record	- Project area	- Prepare a summary of monthly data - Report the data every year	Phalangngan Rungrueng Co., Ltd.
	- The joint committee's performance	- Record	- Project area	- Report the data every year	Phalangngan Rungrueng Co., Ltd.
5. Occupational health and safety	- Accident statistics specifying causes and nature of accidents, health impact, number of injured or deceased workers including problem-solving methods and recommendations	- Record	- Project area	- Prepare a summary of monthly data - Report the data every year	Phalangngan Rungrueng Co., Ltd.

**TABLE 5.1-4  
ENVIRONMENTAL AND SOCIAL MONITORING MEASURES OF PHALANGNGAN RUNGRUENG SOLAR POWER PLANT  
FOR CONSTRUCTION PHASE (CONT'D)**

<b>Environment Parameters</b>	<b>Measurement Indices</b>	<b>Analysis/Measurement Method</b>	<b>Monitoring Station</b>	<b>Frequency</b>	<b>Responsible Party</b>
6. Transportation	<ul style="list-style-type: none"> <li>- Daily record the number and types of vehicles and time to enter the project construction area</li> <li>- Record the number of truck transporting material and equipment</li> <li>- Statistical record of accidents occurred from transportation including cause, location, time, and preventive measures for every accident</li> </ul>	- Record	- Project construction area and transportation route	- Everyday throughout the construction phase	Phalangngan Rungrueng Co., Ltd.
7. Solid waste management	- Type and quantity of waste and disposal method.	- Record	- Project area	<ul style="list-style-type: none"> <li>- Prepare a summary of monthly data</li> <li>- Report the data every year</li> </ul>	Phalangngan Rungrueng Co., Ltd.

**TABLE 5.1-5**  
**ENVIRONMENTAL AND SOCIAL MONITORING MEASURES OF PHALANGNGAN RUNGRUENG SOLAR POWER PLANT**  
**FOR OPERATION PHASE**

Environment Parameters	Measurement Indices	Analysis/Measurement Method	Monitoring Station	Frequency	Responsible Party
1. Water quality 1.1) Water use	<ul style="list-style-type: none"> <li>- The water volume used in the project for comparison with the volume permitted by the permitting agency</li> <li>- Problems and obstacles from the project's water use</li> </ul>	- Record	- Project area	- Every 6 months	Phalangngan Rungrueng Co., Ltd.
1.2) Effluent discharge	<ul style="list-style-type: none"> <li>- Water balance chart</li> <li>- The data on wastewater treatment system and effluent discharges</li> </ul>	- Record	- Project area	<ul style="list-style-type: none"> <li>- Prepare a summary of monthly data</li> <li>- Report the data every year</li> </ul>	Phalangngan Rungrueng Co., Ltd.
2. Socio-economic and public participation	- Complaints from the communities about the project with method and duration of remedial action	- Record and prepare a report	- Project area	<ul style="list-style-type: none"> <li>- Prepare a summary of monthly data</li> <li>- Report the data every year</li> </ul>	Phalangngan Rungrueng Co., Ltd.
	- Joint activities undertaken by the project together with the local communities	- Record and prepare a report	- Project area	<ul style="list-style-type: none"> <li>- Prepare a summary of monthly data</li> <li>- Report the data every year</li> </ul>	Phalangngan Rungrueng Co., Ltd.
	- The joint committee's performance	- Record and prepare a report	- Project area	- Once a year	Phalangngan Rungrueng Co., Ltd.

**TABLE 5.1-5**  
**ENVIRONMENTAL AND SOCIAL MONITORING MEASURES OF PHALANGNGAN RUNGRUENG SOLAR POWER PLANT**  
**FOR OPERATION PHASE (CONT'D)**

Environment Parameters	Measurement Indices	Analysis/Measurement Method	Monitoring Station	Frequency	Responsible Party
3. Occupational health and safety	- Accident statistics specifying causes and nature of accidents, health impact, number of injured or deceased workers as well as remedial actions and recommendations	- Record	- Project area	- Prepare a summary of monthly data - Report the data every year	Phalangngan Rungrueng Co., Ltd.
	- Inspection results of electrical system in the plant and safety certification for electrical system in the plant	- Record and prepare a report	- Project area	- Report the data every year	Phalangngan Rungrueng Co., Ltd.
	- Results of fire and emergency drills	- Record and prepare a report	- Project area	- Once a year or as requested by law	Phalangngan Rungrueng Co., Ltd.
	- Inspection results of warning systems and fire protection and suppression equipment	- Record and prepare a report	- Project area	- Report the data every year	Phalangngan Rungrueng Co., Ltd.
4. Solid waste management	- Waste type, volume and disposal method	- Record by using record form of the Department of Industrial Works (Form Sor Kor)	- Project area	- Report the data every year	Phalangngan Rungrueng Co., Ltd.

## 5.2 EMERGENCY PREPAREDNESS AND RESPONSE PLAN

Emergency Preparedness and Response Plan (ERP) is to be prepared by EPC Contractor for construction phase and submit to the project proponent for concurrence, while ERP for operation phase is to be prepared by Phalangngan Rungrueang Co., Ltd. ERP shall cover emergency incidents that may occur in the construction sites during the construction of the Project components and in the project area during operation phase. The emergency incidents could have adverse impacts on the environment, and on health and safety of construction workers, project staff, and nearby communities.

### 5.2.1 ERP for Construction Phase

During construction phase, ERP will mainly cover a construction accident that happens on a construction site and a fire incident occurring on a construction site and at worker camp. The ERPs for those incidents are as follow.

#### (1) Construction Incident

The contractor must provide the following welfare amenities in the construction area in compliance with the Ministry of Labour's regulations on the provision of welfare facilities in establishments, B.E. 2548 (2005):

- Medical supplies and basic first-aid equipment.
- A nursing room and a nurse on duty during work hours
- Vehicles ready to transport staff in the event of an emergency.

As a result, if an accident occurs at work, there will be equipment and medical supplies on hand, a technical nurse, as well as workers trained in first aid to address minor injuries. Vehicles are on standby to transfer patients who need to be referred for additional treatment.

#### (2) Fire Incident

A fire prevention and suppression plan that is to be prepared by EPC Contractor must be complied with the Ministerial Regulation on the Standard for Administration and Management of Occupational Safety, Health and Environment in relation to Fire Prevention and Control B.E. 2555 and the Ministerial Regulation of the Ministry of Labour on the prescribing of Standard for administration and management of occupational safety, health and environment and workplace environments about the fire prevention and prevention (No.2), B.E. 2561; and must be concurred by the project developer. According to the laws, the fire prevention and suppression plan must contain at least the following plans.

State	Details of plan
Before fire incident	Fire prevention campaign plan
	Training plan
	Inspection plan
During fire incident	Fire suppression plan
	Fire evacuation plan
	Relief plan (to be continued after fire incident)
After fire incident	Relief plan (continued from during fire incident state)
	Reform plan

## 5.2.2 ERP for Operation Phase

During the operation phase, emergency situations associated with the project will cover the fire incident. The environmental, health, and safety division shall be responsible for developing a site-specific ERP which shall be placed in the site's emergency response/procedures binder kept in the facility control room.

### 5.2.2.1 Fire Incident

#### (1) Risk Area

- Solar Panel
- Transformer
- Electrical equipment

#### (2) Responsibility

##### (2.1) EHS Division

- Determining the required level of fire prevention and necessary control.
- Tracking the training requirements.
- Organizing and training for all members of Emergency Response Team.
- Inspect all firefighting equipment and maintain as per manufacturer's recommendations.
- Develop the fire response plan.
- Develop the site-specific evacuation plan.

## **(2.2) Emergency Response Team**

- Immediately respond to a small fire preventing a major emergency.
- Perform both offensive and defensive activities with the use of protective equipment as per NFPA requirements.

## **(2.3) All Employees**

- Constantly alert for fires hazards.
- Eliminate fires hazards.
- Understanding the locations of fire extinguishers and alarm systems within the project.
- Participate in the evacuation drill at least annually.

## **(3) Fire Protection Rules**

- a) Know the location of all the fire extinguishers, fire hoses and other fire protection equipment in working area.
- b) Know how to use all the fire protection equipment in working area.
- c) Know the location of all fire exits in working area.
- d) Report all fired to the control room immediately.
- e) Obey “NO SMOKING” signs. Smoking permitted only in designated areas.
- f) Fire equipment is for fire use only and must not be disturbed or used for any other purpose.

## **(4) Fire Response Rules**

- a) In the event that a fire does start, to ensure prompt and proper operator actions, thereby minimizing the severity of the fire and extent of damage.
- b) A formal qualification program for plant operators, maintenance personnel shall be implemented to ensure proper fire prevention, firefighting and reporting techniques.
- c) Firefighting will not be done at the risk of injury to the employees involved. At any time a fire appears to be spreading and the situation can't be controlled, back out and wait for the fire department assistance.
- d) Inspection and maintenance of all firefighting equipment and protective clothing shall be performed monthly and the proper documentation maintained.

## **(5) Fire Response Plan/Fire Prevention Plans** shall set forth procedures, step by step, of the actions that each employee is to take in the event of a fire including;

- a) Immediate action upon the discovery of a fire
- b) Establish who, how and when the in-house and local emergency personnel should be contacted

- c) Method of notifying employees, main emergency response team, and response team members of the fire
- d) Method of determining mustering location and means of taking attendance for the main emergency response team, response team members, and all other employees
- e) Actions to be taken in the event of personnel injury
- f) Actions to declare the end of the state of emergency
- g) Follow-up actions

### 5.2.2.2 Evacuation

(1) The Environment, Health & Safety Division shall be responsible for developing site-specific evacuation plan addressing multiple evacuation routes throughout the site.

(2) All employees shall muster at pre-assigned locations and attendance will be taken by the Environment, Health and Safety Division, or if the Environment, Health and Safety Division Personnel is not present, the HR & Admin Division Personnel.

(3) Evacuation Routes shall be posted throughout the site.

(4) Planned evacuation drills shall be conducted at least once per year and documented. All persons in the plant must participate.

### 5.2.2.3 Emergency Plan Drill

Emergency plan drill is the preparatory drill for an emergency incident for the personnel and equipment. The drill follows the fire prevention plan of each unit. The drill for Emergency Level 1 will be organized at least once a year with an assessment of each drill to continuously improve the efficiency of the emergency plan.

## 5.3 MONITORING AND REPORTING

Apart from the general measures (as shown in **Table 5.1-1**) which set for ensuring the implementation of the proposed mitigation measures and monitoring program; and reporting. The Project will involve the representative of communities situated within 3-kilometer radius from the Project site, government agencies, and a qualified expert to participate in monitoring activities as Environmental Impact Monitoring Committee. The details of committee member, qualification of the members, terms and roles of the committee, and power and duties of the committee is addressed in **Table 5.1-2** under the economic, social and public participation aspect.



Besides, Phalangngan Rungrueng Co., Ltd. is a subsidiary of Gulf Energy Development PCL. (GED) which has established Environmental and Social Management System (ESMS) to apply to a project life cycled owned and managed by GED and its subsidiaries starting from feasibility study, project development to operation for the management of environmental, social, health and safety risk and opportunities.

Monitoring and reporting is a part of ESMS framework which requires the staff at appropriate level in the organization to monitor the environmental and social (ES) performance to measure continual improvement and ensure compliance with the measures by taking the following actions.

- **Site level**

- Conduct routine inspections to monitor the effectiveness of operating procedures being implemented and compliance
- Plan and perform ES monitoring program (or hire a third party to perform) regularly as required by the regulations such as air emissions, discharge, ambient noise, etc.).
- Report the performance against the group ES targets to the Corporate ES function at the frequency of agreed timeline.
- Conduct an investigation and deploy preventive and corrective actions when non-conformities arise from the inspection, monitoring and target achievements.

- **Corporate level**

- Review and analyse the group ES performance and make recommendations for continual improvement (including benchmarking and definition of group ES target).
- Report ES performance to external stakeholders as required by the obligations.
- Consider conducting a Group ES data verification program to ensure the completeness, accuracy and reliability of data so that ES performance is transparently disclosed.

The detail of GED's ESMS is presented in **Appendix 5A**.

## **5.4 MITIGATION MEASURES REGARDING TRANSMISSION LINE**

The project 115 kV TL is being constructed and will be operated and maintained by the PEA who owns the TL. The potential risks and impact from the installation and operation of these power lines are therefore managed by the PEA. *[This information has been removed as it falls within the exceptions to disclose specified in paragraph 17(2) of ADB's Access to Information Policy.]*

The Project's Grievance Redress Mechanism is open to all to raise concerns and grievances relating to the Project. Community members, including those along the TL route are aware of the project GRM. Where the Project receives complaints and grievances

related to the TL construction activities or the construction contractor, the Project will communicate these to PEA for evaluation and resolution. It is also noted that the PEA have their own GRM (as described in *Section 7.3*) through which communities can raise their issues and concerns relating to the TL to PEA directly. The PEA will be the designated authority to communicate with affected communities to resolve issues relating to TL.

The Project will ensure close coordination with PEA to gather relevant information relating to TL impacts, issues and mitigation measures implemented to the extent possible, which will be included in the Project's reports to lenders on any and all reported grievances.

## **CHAPTER 6**

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# **STAKEHOLDER ENGAGEMENT**

## CHAPTER 6 STAKEHOLDER ENGAGEMENT

### 6.1 INTRODUCTION

Stakeholder engagement is a crucial process whereby residents, government agencies and sensitive receptors in the study area are informed about Project-related information, provide feedback, express concerns of affected parties, and offer suggestions to minimize impacts. This stands as a key factor in an effective impact assessment process. Based on the information and approaches set out in this section of the IEE, a detailed Stakeholder Engagement Plan will be developed for the Project.

Phalangngan Rungrueang Co., Ltd. has a plan to develop Phalangngan Rungrueang Solar Power Plant Project, which incorporates ground-mounted PV technology. The Project recognizes that stakeholder engagement is an important process, through which people in the study area receive information about the Project, express concerns, and offer suggestions. The one-way and two-way communication, initiated from the early stage, will assist the Project owner in incorporating valuable information to refine and tailor the Project details according to community concerns.

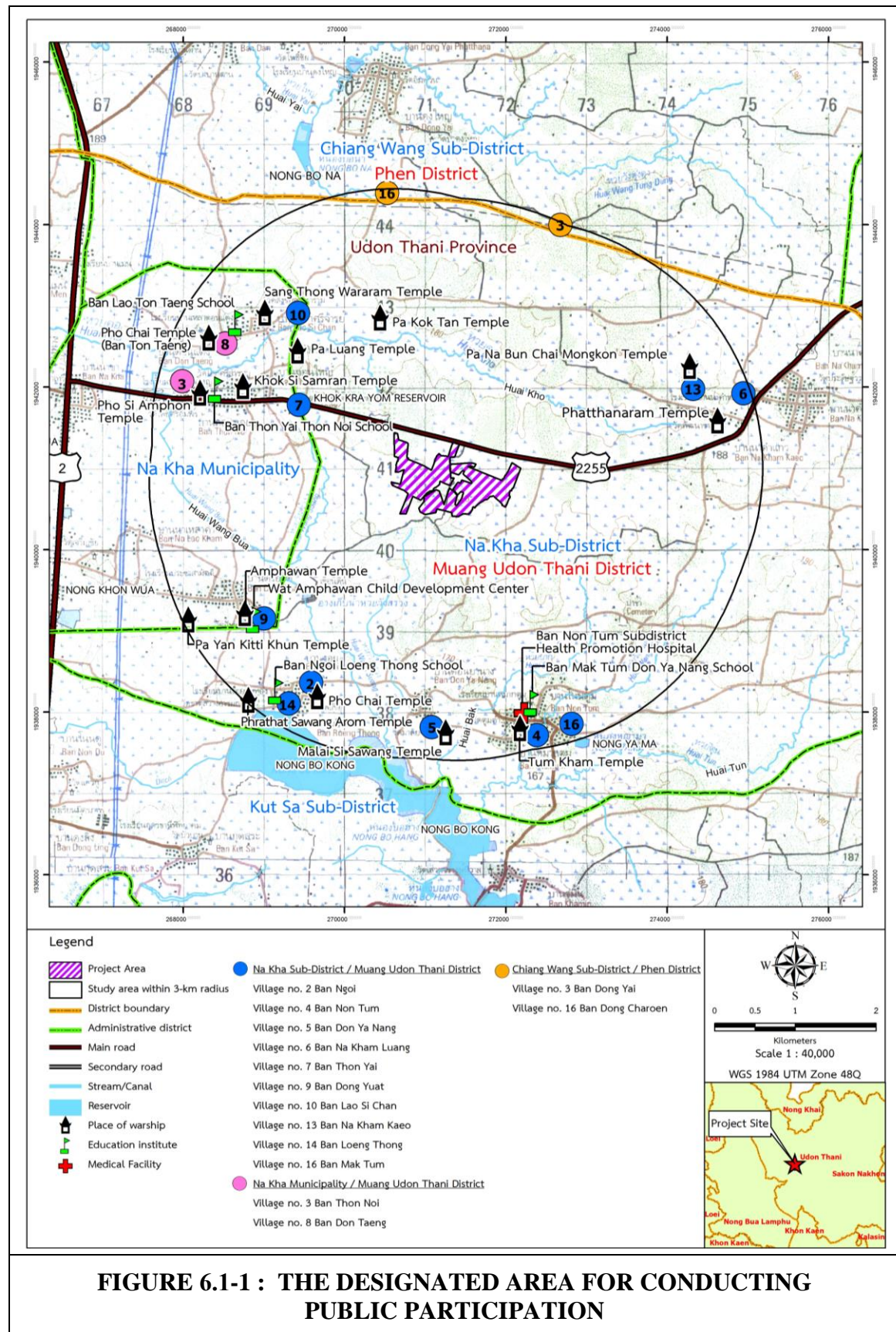
For a non-combustion power plant with an installed capacity of 10 megawatts or more, the targeted stakeholder engagement must encompass an area with a radius of at least 3 kilometers from the Project boundary. The designated area for conducting public participation for the Project is illustrated in **Figure 6.1-1**. Stakeholder engagement for the Project also includes the Transmission Line route in the ROW of existing public roads, where the Provincial Electricity Authority (PEA) will be responsible for construction and related impacts and communications.

### 6.2 STAKEHOLDER ANALYSIS, INFORMATION DISCLOSURE AND CONSULTATION

Stakeholder engagement is the key activity for this project to enable participation from the parties concerned, and in particular to enable effective impact prevention and mitigation. There are 3 steps to be conducted for stakeholder engagement namely stakeholder analysis, stakeholder information disclosure and consultation. A description of each step is elaborated in the following sections.

#### 6.2.1 Stakeholder Analysis

Analysis of stakeholder/community readiness was done as a desktop exercise prior to conducting the information gathering meetings as Project pre-engagement efforts. Next, the Project organized a meeting to gather opinions from the public and stakeholders who are affected or interested in the Project. This was focused on the relation to conduct of environmental studies and preparing a preliminary Project report. The purpose was to provide detailed Project information to relevant government agencies and community leaders in the vicinity areas within a 3-kilometer radius from the Project boundary. At this time, Transmission Line stakeholders were not yet directly involved. Stakeholder engagement activities to date are illustrated in **Figure 6.2-1**.



**FIGURE 6.1-1 : THE DESIGNATED AREA FOR CONDUCTING PUBLIC PARTICIPATION**

Implementation Procedure	Implementation Activity
<p>Provide detailed Project information, study results, environmental impact prevention and mitigation measures, and monitoring measures.</p>	<p>Channels for providing information to the public: 1) Directly engage in meetings/forums to promote the Project, solicit opinions, and receive suggestions from community leaders and relevant organizations. 2) Display Project information and an invitation to the public consultation forum on notice boards of government agencies and community centers.</p>
<p>Disseminate Project details to create understanding about the Project, within no less than 15 days.</p>	<p>3) Disseminate a preliminary CoP report at key locations, including: - Project's construction site - Energy Regulatory Commission Office: Regional Office - Provincial Industry Office - District offices and local administrative organization offices within a radius of at least 3-kilometer from the Project boundary - Sub-district administrative offices, community head's offices, and community halls within a radius of at least 3-kilometer from the Project boundary - Schools, religious institutions, community parks, and markets within a radius of at least 3-kilometer from the Project boundary 4) Send letters with documents and invitations to relevant organizations and community leaders. 5) Open pre-registration for interested participants of the public consultation forum.</p>
<p>Organize one opinion-gathering forum to explain Project details and gather opinions from the public and stakeholders who are affected.</p>	<p>Organize a public consultation forum to explain Project details and gather public opinions, and provide channels for receiving opinions, including: 1) During the forum proceedings 2) Comment forms (in case of inability to express opinions directly) 3) Post-meeting evaluation forms</p>
<p>Continuously receive additional comments for no less than 15 days after the opinion-gathering forum is concluded.</p>	<p>Social media, electronic media, internet, postal services, telephone, fax, electronic mail, local newspaper, community radio, and the information system network of the Office of Energy Regulatory Commission (OERC).</p>
<p>Compile and finalize the summary of opinion-gathering results within 30 days from the opinion-gathering forum.</p>	<p>Summary the details as follows: 1) Information about the participants providing opinions 2) Records of opinions from participants 3) Environmental impact prevention and mitigation measures of the Project</p>
<p>Continuously disseminate reports of summarizing opinion-gathering results for a period of no less than 15 days.</p>	<p>Announcement locations include: 1) Project's construction site 2) Energy Regulatory Commission Office, Regional Office 9 (Kanchanaburi) 3) Provincial Industry Office 4) District offices and local administrative organization offices within a radius of at least 3-kilometer from the Project boundary 5) Sub-district administrative offices, community head's offices, and community halls within a radius of at least 3-kilometer from the Project boundary 6) Schools, religious institutions, community parks, and markets within a radius of at least 3-kilometer from the Project boundary</p>
<p>Provide an opportunity for affected parties to express their comments or objections regarding the summary of opinion-gathering results within 30 days from the date of report dissemination.</p>	<p>Social media, electronic media, internet, postal services, telephone, fax, electronic mail, local newspaper, community radio, and the information system network of the Office of Energy Regulatory Commission (OERC).</p>
<p>Office of Energy Regulatory Commission (ERC)</p>	<p>Approach to the consideration process.</p>

**Remark :** Implementation procedure according to the Energy Regulatory Commission (ERC), regards listening to opinions and creating understanding with the public and stakeholders (B.E. 2565 (2022))

**FIGURE 6.2-1 : STAKEHOLDER CONSULTATION PROCESS**

The first stage in engaging stakeholders is to identify the key stakeholders who will be consulted and involved. Based on Safeguard Policy Statement of ADB, IFC Performance Standards, Equator Principles 4, and Public Participation guideline of ERC, the stakeholder categories were developed into the following broad stakeholder groups:

- **Affected Parties:** Local communities related communities' leaders within a 3-kilometer radius from the Project boundary, parties using or adjacent to the Transmission Line in the ROW of existing public roads, previous landowners and users, which may include all or some of the following:

- Community leaders and people in each of the project study communities;
- Women and vulnerable groups;
- Key community members, including community elders and spiritual leaders; and
- Key interest groups including religious leaders

- **Authorizing Agencies**

- **Relevant government agencies:** These are at different levels such as regional, provincial, district and local agencies, which may be involved in the project implementation or provide services to the people impacted by the Project.

- **Special or Environmentally Sensitive Areas**, which includes temples, hospitals and schools.

- **Mass Media**

- **General Interest Parties**, which may include non-government organizations, academics, or interested individuals, for example.

The specific stakeholders, their roles in the IEE and subsequent implementation process are presented in **Table 6.2-1**. This does not yet include the stakeholders specific to the Transmission Line area.

**TABLE 6.2-1**  
**ANALYSIS OF STAKEHOLDER’S ROLE IN IEE AND SUBSEQUENT**  
**PROJECT IMPLEMENTATION PROCESS**

Stakeholder Groups	Details	Role in the IEE and Subsequent Implementation Process
<p><b>1. Local communities</b></p>	<p><b>1.1 Na Kha Subdistrict Administrative Organization (SAO):</b> 10 villages</p> <ol style="list-style-type: none"> <li>1) Village no. 2 Ban Ngoi</li> <li>2) Village no. 4 Ban Non Tum</li> <li>3) Village no. 5 Ban Don Ya Nang</li> <li>4) Village no. 6 Ban Na Kham Luang</li> <li>5) Village no. 7 Ban Thon Yai</li> <li>6) Village no. 9 Ban Dong Yuat</li> <li>7) Village no. 10 Ban Lao Si Chan</li> <li>8) Village no. 13 Ban Na Kham Kaeo</li> <li>9) Village no. 14 Ban Loeng Thong</li> <li>10) Village no. 16 Ban Mak Tum</li> </ol>	<ul style="list-style-type: none"> <li>- To provide information on the following contexts: <ul style="list-style-type: none"> <li>• Village’s socio-economics</li> <li>• Impact arising from the project on the communities</li> </ul> </li> <li>- To participate the project public consultation activities.</li> </ul>
	<p><b>1.2 Na Kha Subdistrict Municipality:</b> 2 villages</p> <ol style="list-style-type: none"> <li>1) Village no. 3 Ban Thon Noi</li> <li>2) Village no. 8 Ban Don Taeng</li> </ol>	
	<p><b>1.3 Chiang Wang SAO:</b> 2 villages</p> <ol style="list-style-type: none"> <li>1) Village no. 3 Ban Dong Yai</li> <li>2) Village no. 16 Ban Dong Charoen</li> </ol>	
	<p><b>1.4 Subdistrict Woman Groups:</b> 2 groups</p> <ol style="list-style-type: none"> <li>1) Na Kha Subdistrict Women Group</li> <li>2) Chiang Wang Subdistrict Women Group</li> </ol>	
	<p><b>1.5 Religious Institutes:</b> 10 Temples</p> <ol style="list-style-type: none"> <li>1) Sang Thong Wararam Temple</li> <li>2) Pa Luang Temple</li> <li>3) Khok Si Samran Temple</li> <li>4) Pho Chai Temple (Ban Don Taeng)</li> <li>5) Pho Si Amphon Temple</li> <li>6) Amphawan Temple</li> <li>7) Pa Yan Kittikhun Temple (Pa Dong Yuat Temple)</li> <li>8) Pho Chai Temple</li> <li>9) That Sawang Arom Temple</li> <li>10) Malai Si Sawang Temple</li> <li>11) Tum Kham Temple</li> <li>12) Patthanaram Temple</li> <li>13) Pa Nabun Chai Mongkhon Temple</li> <li>14) Pa Kok Tan Temple</li> </ol>	



**TABLE 6.2-1  
ANALYSIS OF STAKEHOLDER’S ROLE IN IEE AND SUBSEQUENT  
PROJECT IMPLEMENTATION PROCESS (CONT’D)**

Stakeholder Groups	Details	Role in the IEE and Subsequent Implementation Process
<b>2. Government Agencies at Different Levels</b>	<b>2.1 Government Agencies at Regional Level</b> 1) Office of Energy Regulatory Commission (ERC), Regional Office 4 (Khon Kaen)	<ul style="list-style-type: none"> <li>- To consider and approve CoP Report / Grant Environmental permission for the project implementation</li> <li>- To provide information on regulation concerning the project development</li> <li>- To participate the project public consultation activities.</li> </ul>
	<b>2.2 Government Agencies at Provincial Level</b> 1) Udon Thani Provincial Industry Office	<ul style="list-style-type: none"> <li>- To consider and approve ESA Report / Grant Environmental permission for the project implementation</li> <li>- To provide information on regulation concerning the project development</li> <li>- To participate the project public consultation activities.</li> </ul>
	2) Udon Thani Provincial Natural Resources and Environment Office 3) Provincial Energy Office of Udon Thani 4) Udon Thani Provincial Public Relations Office 5) Udon Thani Public Works and Town Plan Office	<ul style="list-style-type: none"> <li>- To provide information on regulation concerning the project development</li> <li>- To engage in the project public consultation activities.</li> </ul>
	<b>2.3 Government Agencies at District Level</b> 1) Mueang Udon Thani District Office 2) Mueang Udon Thani District Public Health Office 3) Mueang Udon Thani Police Station 4) Mueang Udon Thani District Agriculture Office 5) Mueang Udon Thani District Livestock Office 6) Phen District Office 7) Phen District Public Health Office 8) Phen Police Station 9) Phen District Agriculture Office 10) Phen District Livestock Office	

**TABLE 6.2-1  
ANALYSIS OF STAKEHOLDER’S ROLE IN IEE AND SUBSEQUENT  
PROJECT IMPLEMENTATION PROCESS (CONT’D)**

Stakeholder Groups	Details	Role in the IEE and Subsequent Implementation Process
<b>2. Government Agencies at Different Levels (Cont’d)</b>	<b>2.4 Subdistrict/Local Administration Agencies</b> 1) Na Kha SAO 2) Na Kha Subdistrict Municipality 3) Chiang Wang SAO 4) Ban Non Tum Subdistrict Health Promotion Hospital 5) Ban Na Kha Subdistrict Health Promotion Hospital 6) Ban Dan Subdistrict Health Promotion Hospital	
<b>3. Private Sector</b>	<b>Business Establishment:</b> 3 companies 1) Guangken Rubber (Mekong River) Co., Ltd. 2) S-Con Concrete Co., Ltd. Udon Thani Branch 3) C Mix Concrete Co., Ltd.	- To provide information on impact arising from the project - To engage in the project public consultation activities.
<b>4. Educational Institutes and Independent Scholar</b>	<b>Educational Institutes:</b> 5 Institutes 1) Ban Lao Don Taeng School 2) Ban Thon Yai Thon Noi School 3) Ban Ngoi Loeng Thong School 4) Ban Mak Tum Don Ya Nang School 5) Wat Amphawan Child Development Center	- To engage in the project public consultation activities.
<b>5. General Public</b>	Interested Persons	- To engage in the project public consultation activities

Source : Fourtier Consultants Co., Ltd., 2023

## 6.2.2 Information Disclosure

### (1) Information Disclosure Techniques

The Project has several techniques to build relationships with stakeholders, gather information from stakeholders, consult with stakeholders, and disseminate project information to stakeholders. The main approaches consist of:

#### 1) One-way Communication

- Project brochure: Disclosure of the Project information to disseminate to stakeholders.

- Offline and Online Publishing: Disclosure of the Project information through various channels such as Visiting to send an invitation to attend a meeting, Announcements to display information in public places, Website and Facebook

page of the consultant company and Google Drive documents at the first step of consultation.

- In relation to land acquisition plan and process, Gulf's personnel also carried out direct consultation with individual landowners during B.E. 2564 (2021) - 2565 (2022).

## 2) Two-way Communication

- Publicize the project: Meeting with stakeholder to publicize the Project information through the community relations officers of the project.

- Pre-engagement: Disclosure of the Project information to a group of stakeholders, allow stakeholders to provide their views on targeted baseline information, build a relationship with communities, and record responses.

- Public meeting: Disclosure of the Project information to a large group of stakeholders, especially the communities including the vulnerable group, the occupation group, the village health volunteers, the women club, etc., and allow the group to provide their views and opinions, build a relationship with the communities, especially those affected, distribute non-technical information, and facilitate meetings with PowerPoint presentations and related documents.

- Opinion survey: The Project used an opinion survey form after the Public Meetings, available to any or all stakeholders to gather their opinions and concerns to develop the project. The results of this survey are presented in the sections below.

## (2) Stakeholder Consultation

Stakeholders Consultation activities have been arranged based on the guideline developed by the Energy Regulatory Commission (ERC), regards listening to opinions and creating understanding with the public and stakeholders, particularly when considering the issuance of a license to operate electricity generation (B.E. 2565 (2022)). The objective of the consultation activities is to listen and understand the opinions of the communities and stakeholders affected within the 3-kilometer radius from the Project area boundary is a process undertaken with the following steps;

1) Complying with the guidelines from Regulation of the Energy Regulatory Commission: Criteria for Preparing Code of Practice Report and Monitoring Report for the operation of electricity production, B.E. 2565 (2022). This includes summarizing Project details, action plans, and environmental impact prevention and mitigation measures as required by the Energy Regulatory Commission (ERC).

2) Notifying the schedule and location for receiving opinions to the Energy Regulatory Commission (ERC) and relevant parties at least 15 days prior to the opinion-receiving session.

3) Continuously disseminating Project information for a minimum of 15 days before commencing the public participation process. This information must be presented openly and accessible to the public and stakeholders as determined by the Energy Regulatory Commission (ERC).

4) Implementing a registration system to facilitate advanced registration for opinions by the public, stakeholders, and relevant agencies. This process should be convenient and can be conducted through online channels via QR Code as indicated in the meeting invitation documents.

5) Publicizing information to the public and stakeholders using suitable methods, such as social media, local newspaper, community radio, and the information system network of the Energy Regulatory Commission (ERC).

6) Conducting a forum to receive opinions with target groups including residents and affected parties, community leaders, relevant government agencies, educational institutions, and mass media (if available). This should encompass both those residing or working within the Project area and the 3-kilometer radius study area from the Project site. During these sessions, Project information should be presented, and the attendees should be given the opportunity to express opinions, concerns, and adequate suggestions.

7) Ensuring that there are ongoing and additional channels for opinion submission for at least 15 days through various mediums such as social media, electronic media, website, postal service, telephone, fax, electronic mail, local newspaper, community radio, and the information system network of the Energy Regulatory Commission (ERC).

8) Compiling a summary report of the opinions received and completing it within 30 days from the end of the opinion-receiving process.

9) Publicizing the summary report of opinions received by openly presenting it at a location accessible to the public and stakeholders as determined by the Energy Regulatory Commission (ERC). This should occur consistently for a duration of at least 15 days. Furthermore, it provides an opportunity for the public and stakeholders to present their opinions or suggestions regarding the report within 30 days from the day of the summary report is published.

## **6.3 RESULTS FROM STAKEHOLDER ENGAGEMENT**

### **6.3.1 Pre-engagement Process**

A pre-engagement meeting was conducted on April, B.E. 2566 (2023) by Fourtier Consultants Co., Ltd., which was in charge of preparing CoP report, to gather the information from the public and stakeholders regarding the preparation of an environmental report. This was initiated at the early stage of Project development with the aim of presenting preliminary Project details to gather feedback, concerns, and suggestions from stakeholders regarding the Project. From the pre-engagement activity, no concerns or complaints were raised regarding the land acquisition for the Project. Further details are elaborated below.

#### **6.3.1.1 Notifying the Schedule and Venue before Meeting**

The Project sent invitations to participate in the meeting, along with the Project brochure, to inform and disseminate detail of Project's information to the relevant stakeholders. In addition, the Project has displayed informational signboard and invitations to the meeting venues in public places and community areas. These actions were carried out between March 27-30, 2023, as communication channels for receiving feedback and pre-registration for participation were implemented, as shown in **Table 6.3-1** and **Figure 6.3-1**.

Project information was disclosed in the stakeholder engagement activities in Thai language including supporting maps. The project information disclosed in the activities cover following contents;

- Project background
- Project features such as location of site and project type
- Core project facilities.
- Project work plan

**TABLE 6.3-1  
ACTIVITIES AND MEDIA IN DISCLOSURE OF PROJECT INFORMATION**

Activities	Media	Date of activities
Delivery of the public consultation invitation letters	<ul style="list-style-type: none"> <li>• invitation letters</li> </ul>	Delivering the invitation letters was on March 27, 2023 for public consultation and meeting documents to stakeholders, including government agencies, educational institutions, religious institutions, community leaders and people in the study area to notify the meeting schedule and venue at least 15 days before the public consultation date.
Public relations and pre-registration	<ul style="list-style-type: none"> <li>• A billboard on public consultation</li> <li>• Meeting documents and report on the preliminary Code of practice</li> <li>• Preregistration forms</li> </ul>	Public relations and preregistration was during March 27-April 7, 2023. This introduces and explains the project details and an action plan, including measures to prevent and correct environmental impacts and measures to monitor environmental impacts. The schedule of the public consultation will be notified to the stakeholders at least 15 days before the date of the public consultation through various channels
Public consultation	<ul style="list-style-type: none"> <li>• Power Point of Project Presentation for public consultation</li> <li>• Bulletin board in the community and the government authority.</li> <li>• Infographic media</li> </ul>	<p>The public consultation were on the following date.</p> <ul style="list-style-type: none"> <li>• On April 8, 2023 from 09.00 a.m. to 12.00 p.m. at the meeting room of Na Kha SAO, Mueang Udon Thani District, Udon Thani Province</li> <li>• During May 30-31, 2023 via conferencing platform</li> </ul>
A billboard with public consultation summary of the public and stakeholders	<ul style="list-style-type: none"> <li>• A billboard on public consultation</li> </ul>	The billboards were posted at easily accessible and common locations.

Sample of billboard, documents for the public consultation meeting and pre-registration forms used already are shown in **Figure 6.3-1**



### 6.3.1.2 Pre-engagement Meeting

At the early stage of the Project, the public meeting was organized on April 8 and during May 30-31, 2023 with the participation of 79 people (**Table 6.3-2** and **Figure 6.3-2**). The purpose of the meeting is to disseminate to stakeholders related to the Project and to clarify the initial project information, the scope of work and the environmental study guidelines as well as the public participation plan. The participants can express their opinions and inquiries by expressing in the meeting session, or they can raise their opinions in the meeting evaluation form and submit to the Project after the meeting. The summary of public meeting, including the questions and responses is as follows and its details are addressed in **Appendix 6A**.

#### (1) Project Details

- Concerns were voiced about impacts on the areas near the project area, e.g. heat, electricity, etc.
- The stakeholders would like to know if the project has plan to expand the project in the future.
- The stakeholders inquired whether there was any research proving that the project's technology would not produce a temperature increase in the area.

#### (2) Environmental and Social Issues

- Concern were voiced about water flow obstructions due to land levelling.
- Concern about truck traffic which may worsen road damage and cause traffic congestion in some areas. There should be an online complaint system or group.
- Concern about the disposal of solar panels in the long term

#### (3) Occupational Health and Safety

- The stakeholders asked whether the project be affected, such as short circuits, or cause power outage in nearby areas during a thunderstorm or lightning.

#### (4) Socio-economics and Public Consultation

- Recommended to allocate a budget to support the community activities and traditional events at least once a year throughout the project period.
- Recommended that a community fund should be established for enhancing the project sustainability
- Recommended that during the construction, the project should have an office building for coordination or receiving complaints.
- Recommended that the project should keep the communities continuously informed of the project information

#### (5) Others

- Recommended to a process should be established in order to drive a rigorous and strict operation of the monitoring and complaint committee
- Recommended to job creation for communities.

**TABLE 6.3-2  
NUMBER OF PARTICIPANTS IN THE PUBLIC CONSULTATION**

Target Groups	Details	Number of Participants
<b>1. Local communities</b>	<b>1.1 Na Kha SAO</b>	
	1) Village no. 2 Ban Ngoi	4
	2) Village no. 4 Ban Non Tum	2
	3) Village no. 5 Ban Don Ya Nang	2
	4) Village no. 6 Ban Na Kham Luang	2
	5) Village no. 7 Ban Thon Yai	15
	6) Village no. 9 Ban Dong Yuat	4
	7) Village no. 10 Ban Lao Si Chan	3
	8) Village no. 13 Ban Na Kham Kaeo	2
	9) Village no. 14 Ban Loeng Thong	1
	10) Village no. 16 Ban Mak Tum	5
	<b>1.2 Na Kha Subdistrict Municipality</b>	
	1) Village no. 3 Ban Thon Noi	1
	2) Village no. 8 Ban Don Taeng	2
<b>1.3 Chiang Wang SAO</b>		
1) Village no. 3 Ban Dong Yai	-	
2) Village no. 16 Ban Dong Charoen	2	
<b>1.4 Subdistrict Woman Group</b>		
1) Na Kha Subdistrict Women Group	1	
2) Chiang Wang Subdistrict Women Group	1	
<b>2. Government Agencies at Different Levels</b>	<b>2.1 Government Agencies at Regional Level</b>	
	1) Office of Energy Regulatory Commission (OERC), Regional Office 4 (Khon Kaen)	-
	<b>2.2 Government Agencies at Provincial Level</b>	
	1) Udon Thani Provincial Industry Office	-
	2) Udon Thani Provincial Natural Resources and Environment Office	2
	3) Provincial Energy Office of Udon Thani	3
	4) Udon Thani Public Works and Town Plan Office	1
	<b>2.3 Government Agencies at District Level</b>	
	1) Mueang Udon Thani District Office	-
	2) Mueang Udon Thani District Agriculture Office	-
	3) Phen District Public Health Office	1
	4) Phen District Police Station	1



**TABLE 6.3-2  
NUMBER OF PARTICIPANTS IN THE PUBLIC CONSULTATION (CONT'D)**

Target Groups	Details	Number of Participants
<b>2. Government Agencies at Different Levels (Cont'd)</b>	<b>2.4 Local/Subdistrict Administration Agencies</b>	
	1) Na Kha SAO	7
	2) Na Kha Subdistrict Municipality	1
	3) Chiang Wang SAO	2
	4) Ban Non Tum Subdistrict Health Promotion Hospital	2
	5) Ban Na Kha Subdistrict Health Promotion Hospital	-
6) Ban Dan Subdistrict Health Promotion Hospital	-	
<b>3. Private Sector</b>	<b>Business Establishment</b> Guangken Rubber (Mekong River) Co., Ltd.	-
<b>4. Educational Institutes and Independent Scholar</b>	Natural Resources and Environmental Protection Volunteers (NEV) Network	-
	Child Development Center	1
<b>5. General Public</b>	People living outside the radius of 3 kilometers from the project boundary and government agencies outside the relevant administrative boundary	
	<b>5.1 Na Kha Subdistrict, Mueang Udon Thani District, Udon Thani Province</b>	
	(1) Village no. 1 Ban Na Kha	1
	(2) Village no. 11 Ban Dong Rai	1
	(3) Village no. 12 Ban Na Lao Kham	1
	(4) Village no. 15 Ban Na Kham Mun	5
	(5) Village no. 17 Ban Na Kham Luang	1
	<b>5.2 Chiang Wang Subdistrict, Phen District, Udon Thani Province</b>	
	(1) Village no. 11 Ban Sang Kham	1
	(2) Village no. 12 Ban Dong Yai Phatthana	-
<b>5.3 Interested Persons</b>	-	
<b>5.4 Ban Phue District Agriculture Office</b>	1	
<b>Total</b>		<b>79</b>

**Remarks :** Public consultation activities were held in accordance with the regulation of the Energy Regulatory Commission (ERC) regarding public consultation and promotion of public and stakeholder understanding for consideration and granting of licenses in energy industry operation, B.E. 2565 (2022).

**Source :** Fourtier Consultants Co., Ltd., 2023



**FIGURE 6.3-2 : ATMOSPHERE OF PUBLIC CONSULTATION**

### **6.3.1.3 Dissemination of Summary Report on Public Meeting Results**

After the completion of public consultation meeting, the project prepared a summary report of public and stakeholder consultation including explanations for disclosing the public consultation results including the results of continuous public consultation and making them available to all sectors. The project sent the summary report to the target groups of the public consultation and also posted the report at public places during May 1-3, 2023. The places where the summary report was publicized include:

- 1) Project area
- 2) Subdistrict and village headmen offices, and community halls
- 3) District offices, SAO
- 4) Relevant government agencies' office
- 5) Schools and religious places

### **6.3.2 Stakeholder Engagement Process**

#### **6.3.2.1 Document Preparation prior to Commencing Public Meeting**

The Project has followed Regulation of the Energy Regulatory Commission: Criteria for Preparing Code of Practice Report and Monitoring Report for the operation of electricity production, B.E. 2565 (2022), and Regulation of the Energy Regulatory Commission: Opinion Hearing and Understanding with the Public and Stakeholders for the issuance of a license of electricity production, B.E. 2565 (2022). The steps as summarized in **Table 6.3-3**

#### **6.3.2.2 Notifying the Schedule and Venue before Conducting Public Meeting**

The Project has initiated invitations to participate in the meeting, along with early distribution of preliminary CoP report, summary documents of Project details, and Project brochure to inform and disseminate detail of Project's information to the relevant stakeholders at least 15 days prior to the public meeting date. In addition, the Project has displayed an informational signboard and invitations to the meeting venues in public places and community areas. These actions were carried out between May 27-30, 2023, as communication channels for receiving feedback and pre-registration for participation were implemented, as shown in **Table 6.3-3**.

**TABLE 6.3-3  
PROCEDURES FOR IMPLEMENTATION ON PUBLIC MEETINGS**

Procedures and Methods of Operation	Period	Operation
1. Preliminary CoP report preparation, project details, and infographic media	3-12 May 2023	Prepare documents for the Office of the Energy Regulatory Commission Region 4 (Khon Kaen) to consider for use in considering the issuance of a license to operate electricity generation B.E. 2565, consisting of 1) Preliminary Code of practice Report, 2) Summary of project details, and 3) Infographic media
2. Submission of a list of documents that applicants must complete prior to the public hearing	12-18 May 2023	The project has received approval for the Preliminary CoP Report according to the ERC (Energy Regulatory Commission) letter No. 5526/0807 dated 22 May 2023 from the Office of the Energy Regulatory Commission Region 4 (Khon Kaen).
3. Delivery of invitation letter to participate in public hearing activities	27-30 May 2023	Distribute the invitation letter for the public hearing together with supporting documents to the stakeholder group, consisting of government agencies, educational institutions, religious places, community leaders, and people in the study area to notify interested groups of the meeting schedule and meeting place for such target groups at least 15 days in advance before the hearing date.
4. Public relations dissemination of project information and pre-registration forms for those interested in attending public hearings	31 May-14 June 2023	<p>To introduce and explain project details, operational plans, including measures to prevent and correct environmental impacts, and measures to monitor environmental impacts by notifying stakeholders of the public hearing schedule at least 15 days prior to the public hearing date through the following channels:</p> <ol style="list-style-type: none"> <li>1) Attaching a public hearing schedule (A3 size) with specified contents consisting of the project name, date, time, and venue of the meeting, along with a presentation of preliminary project details, operation area, project owner, construction plan, and the benefits of the project, including communication channels.</li> <li>2) Placement of meeting documents and reports on the basic code of conduct</li> <li>3) Prepare pre-registration forms, including paper registration forms and QR Codes for pre-registration, placed at places where project information can be easily accessed and seen, such as government agencies, the headman's office/village headman, infirmary, religious places, and educational institutions in the study area.</li> </ol> <p>For places to publicize and disseminate project information, they are displayed to be easily accessible and seen in the following locations:</p> <ul style="list-style-type: none"> <li>• The area where the project will be constructed.</li> <li>• Office of the Energy Regulatory Commission Region 4 Khon Kaen</li> <li>• Udon Thani Provincial Industrial Office</li> <li>• Udon Thani Provincial Energy Office</li> <li>• Udon Thani Provincial Natural Resources and Environment Office</li> <li>• Mueang Udon Thani District Office</li> <li>• Na Kha SAO</li> <li>• Na Kha Subdistrict Municipality</li> <li>• Chiang Wang SAO</li> </ul>

**TABLE 6.3-3  
PROCEDURES FOR IMPLEMENTATION ON PUBLIC MEETINGS.  
(CONT'D)**

Procedures and Methods of Operation	Period	Operation
<p>4. Public relations dissemination of project information and pre-registration forms for those interested in attending public hearings (Cont'd)</p>		<ul style="list-style-type: none"> <li>• Office of the Subdistrict Headman and Office of the Village Headman of Na Kha SAO, including Village no. 2, 4,,5, 6, 7, 9, 10, 13, 14, and 16</li> <li>• Office of the Subdistrict Headman and Office of the Community Headman of Na Kha Subdistrict Municipality, including Village no. 3 and 8</li> <li>• Office of the Subdistrict Headman and Office of Village Headman of Chiang Wang SAO, including Village no. 3 and 16.</li> <li>• Ban Lao Don Taeng School</li> <li>• Ban Thon Yai Thon Noi School</li> <li>• Ban Ngoi Loeng Thong School</li> <li>• Ban Mak Tum Don Ya Nang School</li> <li>• Wat Amphawan Child Development Center</li> <li>• Sang Thong Wararam Temple</li> <li>• Pa Luang Temple</li> <li>• Khok Si Samran Temple</li> <li>• Pho Chai Temple (Ban Don Taeng)</li> <li>• Pho Si Amphon Temple</li> <li>• Amphawan Temple</li> <li>• Pa Yan Kittikhun Temple (Pa Dong Yuat Temple)</li> <li>• Pho Chai Temple</li> <li>• That Sawang Arom Temple</li> <li>• Malai Si Sawang Temple</li> <li>• Tum Kham Temple</li> <li>• Patthanaram Temple</li> <li>• Pa Nabun Chai Mongkhon Temple</li> <li>• Pa Kok Tan Temple</li> </ul> <p>There are two ways to contact and inquire about the project as follows:</p> <p><b>Phalangngan Rungrueang Company Limited (Project Owner)</b> Project coordinator: Mr. Narin Thaongkaew Phone: 081-307-9776 Address: 87 M Thai Tower, All Seasons Place, 10th Floor, Wireless Road, Lumpini, Pathumwan, Bangkok 10330</p> <p><b>Fourtier Consultants Co., Ltd. (Environmental Consulting Company)</b> Project coordinator: Ms. Chanthip Yudi Phone: 082-435-5998 Address: 99/2 Village no. 8, Bang Mueang Subdistrict, Mueang Samut Prakan Fax: 0-2105-4609 Email: chanthip@4tier.co.th</p>

**TABLE 6.3-3  
PROCEDURES FOR IMPLEMENTATION ON PUBLIC MEETINGS.  
(CONT'D)**

Procedures and Methods of Operation	Period	Operation
5. Public meeting	15 June 2023	Conduct a public meeting on June 15, 2023 from 09.00 a.m. to 12.00 p.m. at the multipurpose building of Na Kha SAO.
6. Additional hearing for 15 days	16-30 June 2023	After the completion of the public hearing, the project has held a public hearing continuously for at least 15 days, starting from 16-30 June 2023, through the following channels: 1. Postal service business 2. Telephone 3. Email 4. Line application 5. Comment via Google Form (QR Code)
7. Preparation of a report summarizing the results of public hearings and stakeholders	5-7 July 2023	After 15 days of additional public hearings, the project has completed the preparation of a summary of the results of public hearings and stakeholders to publicize the results of public hearings of the project to target groups or stakeholders.
8. Closing of the announcement summarizing the results of public hearings and stakeholders	5-7 July 2023	The project proceeds to announce the summary of public hearing results and stakeholders by disseminating them in locations where target groups or stakeholder groups can be easily accessed and seen in places, as mentioned in "4. Public relations disseminating project information".
9. Dissemination of a report summarizing the results of public hearings and stakeholders	5-7 July 2023	The project disseminates a report summarizing the results of public hearings and stakeholders continuously for at least 15 days by disseminating them in places where the target group or stakeholder groups can be easily accessed and seen in the places, as mentioned in "4. Public relations disseminating project information".
10. Expressing opinions or objections to the hearing summary report	8 July to 7 August 2023	The project has allowed the public and stakeholders to express their opinions or objections to the report summarizing the results of public hearings and stakeholders for the study and preparation of the Code of Practice Report: CoP) Solar Development Plant Project of Solar Development Company within 30 days from the date of dissemination of the public hearing summary report, which is open to express opinions, contact the public hearing summary report from 8 July to 7 August 2023. For channels to express opinions or objections to the report through the following channels: 1. Postal service business 2. Telephone 3. Email 4. Line application 5. Comment via Google Form (QR Code) 6. Consultant's Facebook page

### 6.3.2.3 Public Meeting

The public meeting was conducted on June 15, 2023 from 09.00 a.m. to 12.00 p.m. at the multipurpose building of Na Kha SAO, Mueang Udon Thani, Udon Thani Province. A total of 284 people participated in the public consultation (excluding officials of project owners and environmental consulting firms and counting the number of attendees individually), consisting of representatives of people in the study area, community leaders, representatives of provincial government agencies, representatives of district government agencies, representatives of sub-district government agencies, infirmaries, educational institutions. The atmosphere of the public hearings went well. Details of the participants in the meeting are shown in **Table 6.3-4** and **Figure 6.3-3**. The invitation letter to attend the public meeting and its supporting meeting brochure are shown in **Appendix 6B** and **Appendix 6C**, and the powerpoint presentation for this meeting is shown in **Appendix 6D**.

**TABLE 6.3-4  
NUMBER OF PARTICIPANTS IN THE PUBLIC MEETING**

Target Groups	Details	Number of Participants
<b>1. Local communities</b>	<b>1.1 Na Kha SAO</b>	
	1) Village no. 2 Ban Ngoi	19
	2) Village no. 4 Ban Non Tum	10
	3) Village no. 5 Ban Don Ya Nang	15
	4) Village no. 6 Ban Na Kham Luang	10
	5) Village no. 7 Ban Thon Yai	22
	6) Village no. 9 Ban Dong Yuat	12
7) Village no. 10 Ban Lao Si Chan	12	
8) Village no. 13 Ban Na Kham Kaeo	11	
9) Village no. 14 Ban Loeng Thong	12	
10) Village no. 16 Ban Mak Tum	10	
<b>2. Government Agencies at Different Levels</b>	<b>1.2 Na Kha Subdistrict Municipality</b>	
	1) Village no. 3 Ban Thon Noi	13
	2) Village no. 8 Ban Don Taeng	8
	<b>1.3 Chiang Wang SAO</b>	
	1) Village no. 3 Ban Dong Yai	9
	2) Village no. 16 Ban Dong Charoen	10
	<b>1.4 Subdistrict Woman Group</b>	
1) Na Kha Subdistrict Women Group	2	
2) Chiang Wang Subdistrict Women Group	3	
<b>2. Government Agencies at Different Levels</b>	<b>2.1 Government Agencies at Regional Level</b>	
	1) Office of Energy Regulatory Commission (OERC), Regional Office 4 (Khon Kaen)	3
	<b>2.2 Government Agencies at Provincial Level</b>	
	1) Udon Thani Provincial Industry Office	2
	2) Udon Thani Provincial Natural Resources and Environment Office	3
3) Provincial Energy Office of Udon Thani	3	
4) Udon Thani Public Works and Town Plan Office	2	

**TABLE 6.3-4  
NUMBER OF PARTICIPANTS IN THE PUBLIC CONSULTATION (CONT'D)**

Target Groups	Details	Number of Participants
<b>2. Government Agencies at Different Levels (Cont'd)</b>	<b>2.3 Government Agencies at District Level</b>	
	1) Mueang Udon Thani District Office	1
	2) Mueang Udon Thani District Agriculture Office	1
	3) Phen District Public Health Office	1
	4) Phen District Police Station	-
	<b>2.4 Local/Subdistrict Administration Agencies</b>	
1) Na Kha SAO	40	
2) Na Kha Subdistrict Municipality	4	
3) Chiang Wang SAO	4	
4) Ban Non Tum Subdistrict Health Promotion Hospital	1	
5) Ban Na Kha Subdistrict Health Promotion Hospital	1	
6) Ban Dan Subdistrict Health Promotion Hospital	1	
<b>3. Private Sector</b>	<b>Business Establishment</b> Guangken Rubber (Mekong River) Co., Ltd.	2
<b>4. Educational Institutes and Independent Scholar</b>	Natural Resources and Environmental Protection Volunteers (NEV) Network	1
	Child Development Center	-
<b>5. General Public</b>	People living outside the radius of 3 kilometers from the project boundary and government agencies outside the relevant administrative boundary	
	<b>5.1 Na Kha Subdistrict, Mueang Udon Thani District, Udon Thani Province</b>	
	(1) Village no. 1 Ban Na Kha	7
	(2) Village no. 11 Ban Dong Rai	6
	(3) Village no. 12 Ban Na Lao Kham	4
	(4) Village no. 15 Ban Na Kham Mun	9
	(5) Village no. 17 Ban Na Kham Luang	6
<b>5.2 Chiang Wang Subdistrict, Phen District, Udon Thani Province</b>		
(1) Village no. 11 Ban Sang Kham	2	
(2) Village no. 12 Ban Dong Yai Phatthana	1	
<b>5.3 Interested Persons</b>		1
<b>5.4 Ban Phue District Agriculture Office</b>		-
<b>Total</b>		<b>284</b>

**Remarks :** Public consultation activities were held in accordance with the regulation of the Energy Regulatory Commission (ERC) regarding public consultation and promotion of public and stakeholder understanding for consideration and granting of licenses in energy industry operation, B.E. 2565 (2022).

**Source :** Fourtier Consultants Co., Ltd., 2023





**FIGURE 6.3-3 : ATMOSPHERE OF PUBLIC MEETING**

After presenting information about project details and impacts that may occur directly and indirectly, study results and draft measures of the Project, the consulting company provided the meeting participants with the opportunity to express their opinions by inquiries in the meeting through 2 platforms, including verbal comments in the meeting (Inquiries in the meeting) and opinion form in the meeting (the assessment form on comments from the public participation). Details are as follows:

### **(A) Discussion in the meeting**

The consulting company provided the meeting participants with the opportunity to express their opinions by inquiries in the meeting. The project owners and the consulting company responded to those questions. The inquiries, comments and suggestions from the meeting are summarized as follows and the details are attached in **Appendix 6E**.

#### **(1) Environmental and Social Issues**

- Concern about impact from the Project, such as air pollution and impact on pets, construction accident, effluent from solar panel cleaning, increase heat.
- Concern about the waste volume which may exceed the capacity of the waste disposal facility.
- Concern about impact from the electronic waste and hazardous waste generated by the project on the local people's health
- Concern about impact of the reflection of sunlight from solar panels on transportation.

#### **(2) Socio-economics and Public Consultation**

- PR activities of the project have to be proceeded to cover all target groups

#### **(3) Others**

- The stakeholders asked about construction workers' camp be located
- Concern on environmental impacts in the long term
- Recommended to take community leader to visit the power plant to gain the knowledge.
- The project should provide clear information on the care and support for communities as local people in the area are directly impacted by the project.
- The project should take part in education support, merit-making, and traditional events or other activities together with communities.

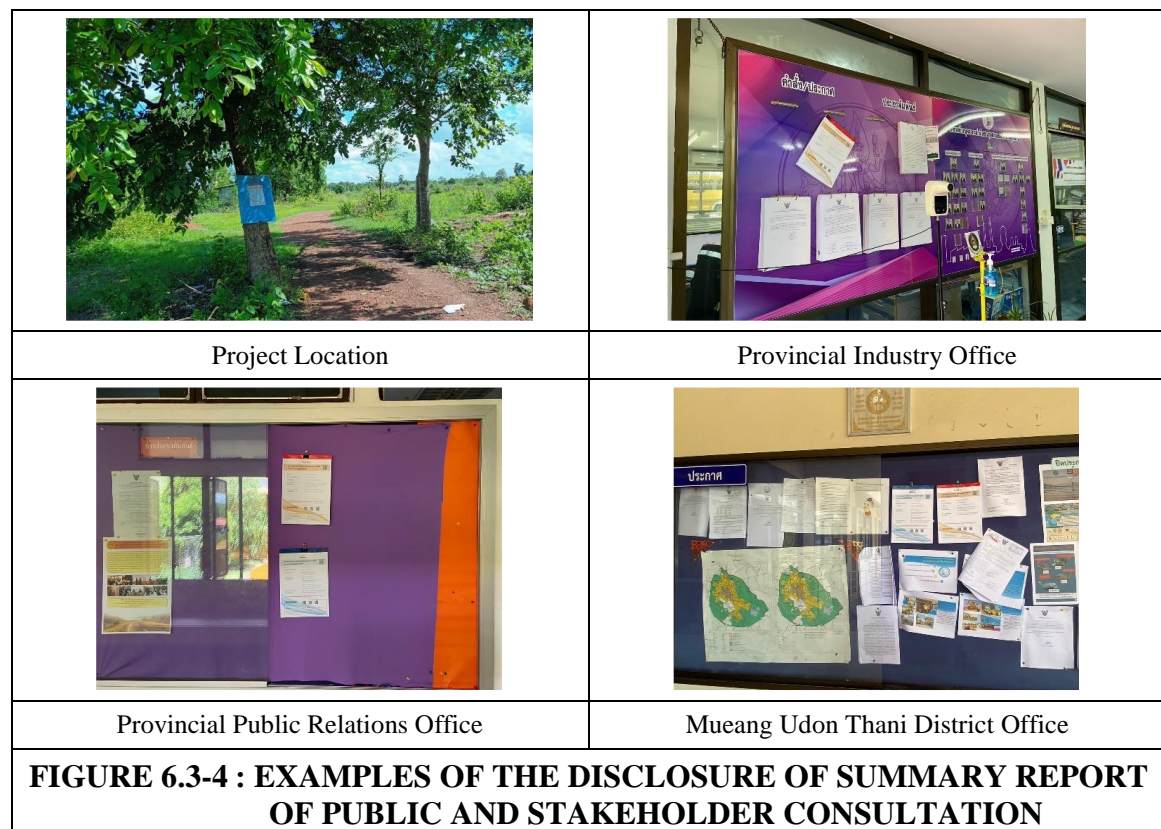
**(B) Opinion form**





After the public consultation meeting, the consulting company asked the attendees to express their opinions through the opinion form for the public participation and make an understanding with the public and stakeholders of the Phalangngan Rungrueang Solar Power Plant Project. A synthesis of the feedback is as attached in **Appendix 6E**.

**6.3.2.4 Dissemination of Summary Report on Public Meeting Results**

After the completion of public consultation meeting, the project prepared a summary report of public and stakeholder consultation including explanations for disclosing the public consultation results including the results of continuous public consultation and making them available to all sectors. The project sent the summary report to the target groups of the public consultation and also posted the report at public places during 5-7 July 2023 and published continuously for at least 15 days. Photo examples of the publicized announcements of the summary report are shown in **Figure 6.3-4**. The letter for submitting the summary of public meeting is shown in **Appendix 6F**. The places where the summary report was publicized include:

- 1) Project area
- 2) Subdistrict and village headmen offices, and community halls
- 3) District offices, SAO
- 4) Relevant government agencies’ office
- 5) Schools and religious places



	
<p>Na Kha Subdistrict Administrative Organization</p>	<p>Ban Ngoi Loeng Thong School Community Hall, Mu 7, Na Kha</p>
	
<p>Community Hall, Mu 7, Na Kha Subdistrict</p>	<p>Village Headman Office, Mu 3, Chiang Wang Subdistrict</p>
<p><b>FIGURE 6.3-4 : EXAMPLES OF THE DISCLOSURE OF SUMMARY REPORT OF PUBLIC AND STAKEHOLDER CONSULTATION (CONT'D)</b></p>	

## 6.4 CONSULTATION IN REGARD TO TRANSMISSION LINE

### 6.4.1 Description of Consultation

PEA is the government authority with the mandate to plan, construct and operate transmission lines (TL), which may traverse private or public land. In the case of this project, the TL will be in the Right of Way (ROW) on existing public roads, some of which are under the jurisdiction of the Department of Highways. Therefore, PEA seeks approval from the Department and represents the Project in all matters related to the TL, including leading all stakeholder engagement activities. While PEA has corporate stakeholder engagement plans (SEP), the Project also develops a project level SEP, to help ensure smoothly coordinated communication and management of stakeholder concerns, impacts and any potential grievances. The following sets out the TL-related stakeholder engagement to date.

The Project's Community Relations (CR) officers, who are in charge of stakeholder engagement, met with representatives of the local communities, namely, the chief executive of SAO, subdistrict headman, and village headman as shown in **Figure 6.4-1** and **Appendix 6G** and brochure for Transmission Line as shown in **Appendix 6H**, relying on their engagement plan to provide information about the Project's transmission line (TL) (route, construction plan, and responsible authority) that was not presented in the public consultation. Because PEA is the competent authority for TL construction, the Project's CR officers were not mandated to communicate TL information to local residents along the TL route. It is entirely the duty of PEA duty.



### 6.4.2 FURTHER CONSULTATION

There is a need to continue consultation activities further during the project implementation phase. For this purpose, the Project Stakeholder Engagement Plan will be developed, to ensure appropriate communication and engagement activities with the parties affected by the TL. Some of the key content of consultation related to the TL is to:

- (1) Inform the stakeholders about site clearance prior to civil works (in preconstruction phase).
- (2) Inform the stakeholders about tentative project schedule for project works.
- (3) Inform stakeholders about the Project Grievance Redress Mechanism and ensure contacts for Project and PEA CR officers are known.

If the Project receives complaints related to the contractor for the TL, the Project will coordinate with PEA to ensure resolution. As PEA and the Project have separate, but similar, Grievance Redress Mechanisms (GRMs), the Project will also ensure close coordination with PEA. The Project will record complaints and issues in grievance log.

## **CHAPTER 7**

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# **EXTERNAL COMMUNICATIONS AND GRIEVANCE MECHANISIM**

## CHAPTER 7 EXTERNAL COMMUNICATIONS AND GRIEVANCE MECHANISM

### 7.1 EXTERNAL COMMUNICATIONS

The process of external communication, which includes information disclosure and periodical visiting nearby communities to inquire and listen to opinions about environmental impacts from the project, was undertaken as part of the ESIA study. It was then suggested as a set of mitigation measures during a construction and operation phase in ESIA of Palangngan Rungrueang Solar Power Plant.

This external communication allows for trust to be built amongst the stakeholders through the sharing of information and also allow for more constructive participation in the other processes of consultation and resolution of grievances due to availability of accurate and timely information.

Following sections describe the information that will be disseminated throughout the project construction and operation, as well as the set of mitigation measures related to the external communication.

#### (a) Key Aspects being Covered in Disclosure

As part of the external communication, project information that will be shared with stakeholders from the beginning of the project through the project life cycle includes:

- The key project information;
- The key project impacts and corresponding mitigation measures and monitoring programs;
- The participation of the local stakeholders in the implementation and monitoring program and other mitigation measures;
- The project's progress; and
- The implementation of mitigation measures and monitoring programs.

#### (b) Process for External Communication

The process of external communication involves the provisioning of information in a timely and accessible manner to the various stakeholders and allowing feedback and participation at the same time. Copies of non-technical summaries document will be made available in the local language at suitable locations in the community.

The list of the mitigation measures related to the external communication is proposed as follows:

- **Construction Phase**
  - Information relating to the construction plan shall be publicized and disseminated by installing publicity boards in the project site or other appropriate

models in order to inform all the public and stakeholders at least 7 days prior to construction;

- The project staff shall periodically visit nearby communities throughout the construction phase to inquire and listen to opinions about environmental impacts from the project construction activities so as to determine a guideline for mitigating impacts which may arise;

- A coordination center shall be set up to receive recommendations and complaints about disturbances from the project construction;

- In case of complaints by people about impacts from the project construction activities, the project shall immediately investigate and take remedial action; and

- A joint committee shall be set up so that communities can participate in the project implementation and community and environmental development in joint cooperation with the project. The joint committee membership shall, at least, comprise representatives of people, local government agencies, local educational institutes or academics, and the project owner. The number of committee members from the people sector shall be, at least, more than half of the total number of the committee members. In establishing the aforesaid committee, the committee structure and composition shall be specified together with number of committee members, power and duties, term of office, type of meeting, frequency of meeting, etc. Moreover, the committee's work will be linked to the project management. The committee's power and duties include, for example, receipt of complaints and consideration of compliance with the project's measures, etc. In addition, the committee may carry on its duties in the operation phase.

The appointment of a joint committee shall be completed prior to commencing the project construction. If there is any constraint to the establishment of a joint committee in cooperation with communities and the committee cannot be set up according to the specified proportion, the project shall notify the OERC and set out measures to build good understanding and communicate the results of project implementation to the communities and the project's stakeholders in the surrounding area via various public relations media such as documents, printed matter, personal media or information system, etc., and records of the project implementation throughout the project construction phase.

- **Operation Phase**

- Opportunities for project visits should be given to the communities so as to ease concerns;

- A complaint receiving plan shall be put in place, specifying channels for complaints, steps and duration of problem solving including responsible persons together with a chart clearly showing the procedure. In case remedial actions have not yet been completed, the complainant shall be notified of the progress every 7 days;

- A person shall be assigned to be responsible for the project's public relations and shall participate in public relations activities undertaken with communities including follow-up of complaints, disturbances and annoyances arising due to the project;

- Information shall be disseminated and publicized regarding the project details and compliance with the Code of Practice so as to inform the local communities and the joint committee. Opportunities shall be offered for the communities to participate in the project monitoring throughout the project operation period;



- Community relation activities shall be supported and promotion of community activities shall be undertaken to build good relation with the local communities;

- A committee shall be jointly set up with communities so that communities can participate in the project implementation and community and environmental development in joint cooperation with the project. The joint committee membership shall, at least, comprise representatives of people, local government agencies, local educational institutes or academics, and the project owner. The number of committee members from the people sector shall be, at least, more than half of the total number of the committee members. In establishing the aforesaid committee, the committee structure and composition shall be specified together with number of committee members, power and duties, term of office, type of meeting, frequency of meeting, etc. Moreover, the committee's work will be linked to the project management. The committee's power and duties include, for example, receipt of complaints and consideration of compliance with the project's measures, etc. In the initial period of the operation phase, the aforesaid committee may be the same one as that of the construction phase.

If there is any constraint to the establishment a joint committee in cooperation with communities and the committee cannot be set up according to the specified proportion, the project shall notify the OERC and set out measures to build good understanding and communicate the results of project implementation to the communities and the project's stakeholders in the surrounding area via various public relations media such as documents, printed matter, personal media or information system, etc., and records of the project implementation throughout the operation phase; and

- If it is proven that damage has resulted from the project operation, the appointed joint committee shall have power and duty to consider compensation for the damage.

If the Project receives complaints related to the contractor for the TL, the Project will coordinate with PEA to ensure resolution. As PEA and the Project have separate, but similar, Grievance Redress Mechanisms (GRMs), the Project will also ensure close coordination with PEA to report to lenders on any and all reported grievances, the extent possible.

## **7.2 GRIEVANCE PROCEDURE**

### **7.2.1 Internal Grievance Redress Mechanism**

#### **(1) Employee**

If an employee wishes to raise a grievance regarding any abuse within the company, there are channels for lodging complaints as follows:

- 1) Email: ac@gulf.co.th or id@gulf.co.th or ia@gulf.co.th
- 2) Letter: To Chairman of the Audit Committee

M.Thai Tower 11<sup>th</sup> floor, All Seasons Place, Wireless Road,  
Lumpini, Pathumwan, Bangkok 10330

- 3) Report to the supervisor or internal audit department
- 4) Phone: 0-22080-4500

For anonymous complaints, the complainant should raise issues via a phone call. After receiving the issue, the following steps for resolution as shown in **Figure 7.2-1**.

In the event that an employee is subjected to disciplinary sanctions or is issued an unjust order of termination, employee possesses the right to file a grievance against the supervisory authority by submitting a written document within 7-day timeframe to the Human Resources department. Subsequently, the Human Resources department shall present the document to the supervisory authority for consideration of the grievance within 15-day period starting from the date of submission. In the event that the employee disagrees with the outcome of the evaluation, they are entitled to submit a second grievance within 7-day timeframe.

## **(2) Supplier and Contractor**

The company's grievance processes do not apply to suppliers. However, the corporation has a supplier code of conduct that states that suppliers must provide a grievance process for any incidents to be reported and investigated.

### **7.2.2 External Grievance Redress Mechanism**

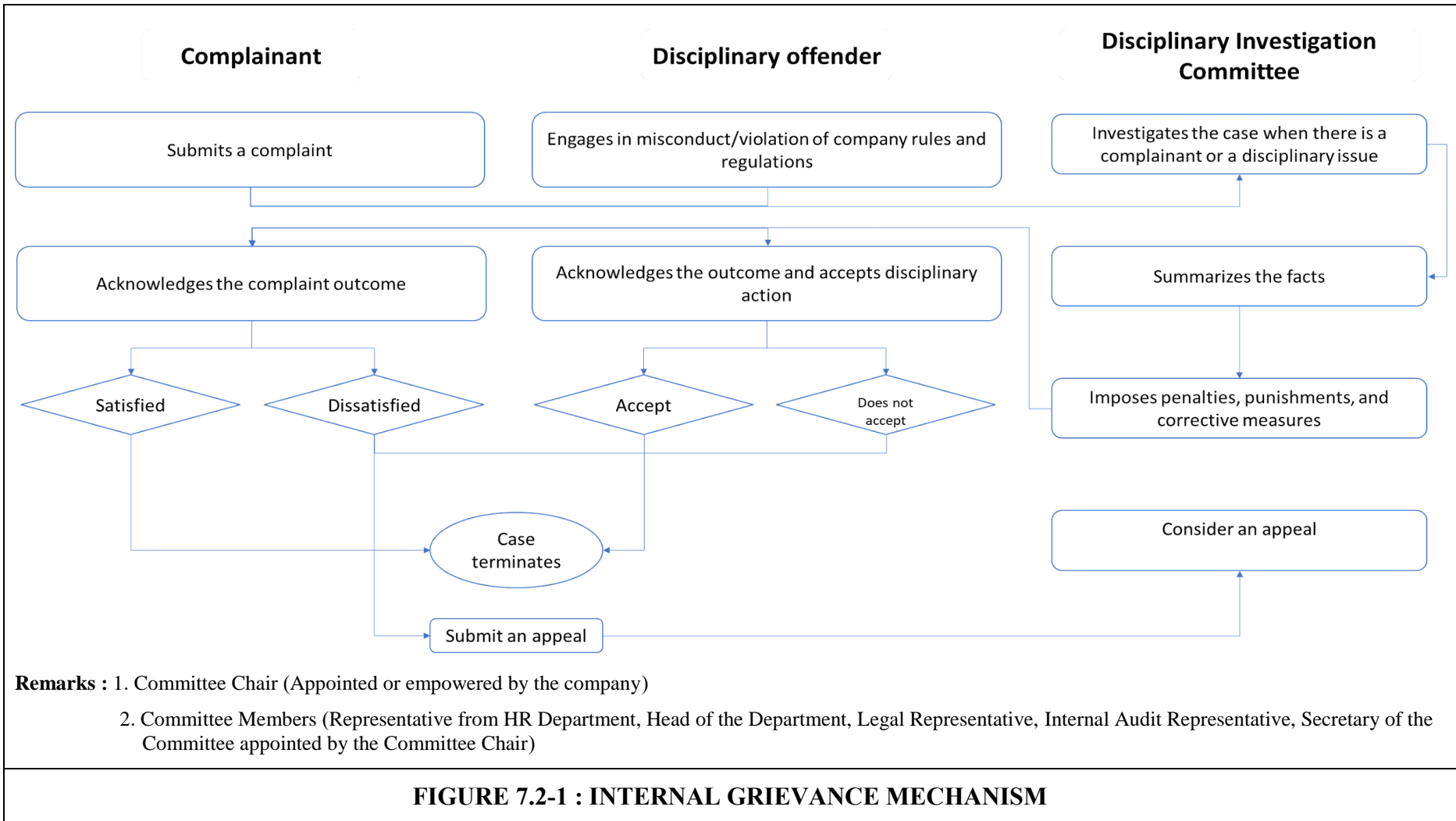
In order to effectively address such circumstances, the Project has established an initial grievance mechanism, which will be made available to relevant stakeholders. The Project is committed to enhancing and upholding a grievance mechanism that is characterized by transparency, gender inclusivity, cultural appropriateness, ease of access, and lack of financial burden for complainants.

#### **(1) Introduction**

Project development may incur impacts to surrounding communities of the Project area, from the construction phase through operation phase. In order to mitigate these impacts and alleviate concerns expressed by the neighboring communities proximate to the Project, grievance mechanism is to be provided. Consequently, mechanism for grievance redressal is established to rectify the potential consequences arising from Project development for both construction and operation phases. Additionally, receptivity is demonstrated towards recommendations and feedback from all pertinent stakeholders.

#### **(2) Objectives**

According a communication channel to receive complaints and address issues that may arise from Project development, the Project defines a clear operational mechanism to facilitate the reception of grievances. The mechanism aims to identify, rectify, mitigate, and monitor potential problems, ensuring the Project's harmonious coexistence within the community while minimizing adverse impacts. Additionally, the mechanism serves as an effective channel to receive suggestions that can benefit the Project's development.



**FIGURE 7.2-1 : INTERNAL GRIEVANCE MECHANISM**

### (3) Scope of Implementation

The implementation comprises of complaints receiving, managing grievances, and considering suggestions from complainants and proposers. This pertains to the surrounding communities, governmental entities, private organizations, and the general public, all of whom are affected by Project operation and dissatisfied with certain aspects of the Project's implementation.

### (4) Grievance Mechanism

The Project developer establishes the "Center for Receiving Complaints and Suggestions" and delegates responsibility for promoting the Project and listening to comments, recommendations, and complaints about the Project. People can send information or complaints by a variety of channels, including verbal communication, telephone, written form, line, letter, e-mail, or the project's officers. The project manager, who is appointed to oversee the project's development at each stage, will thereafter be in charge of managing the resolution of complaints. The grievance redress mechanism is shown in **Figure 7.2-2**.

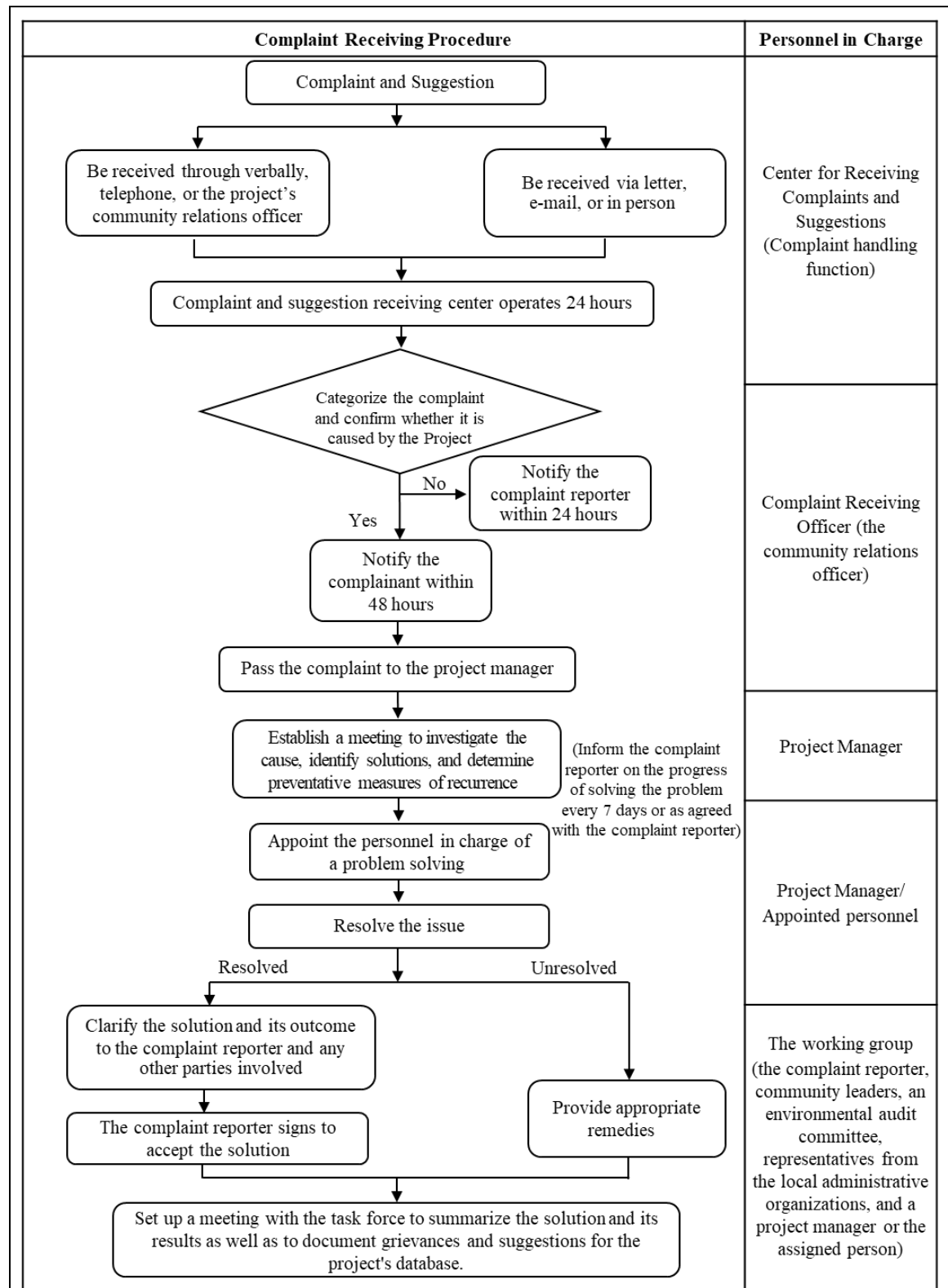
1) In case of reporting through verbal communication, telephone or community relations officers, an officer will be assigned to prepare and fill in the complaint form (**Figure 7.2-3**) and send the complaint to the person assigned by the company.

2) If the complaint is received via mail, email, or in person, an officer will be assigned to send the complaint to the person assigned by the company, along with the complaint form.

3) When a complainant files through various channels to the project, the responsible officer will receive and inspect the initial cause. The officer will categorize the nature of complaint and try to confirm if it is caused by the project. Main categorization of complaints include:

- Complaints about environmental impact
- Complaints about the damage or nuisance
- Complaints about health and safety incident
- Complaints about workforce or employee behavior
- Request for the support, donation, or information

4) If it is found that the problem may be caused by the project, the responsible officer will notify to the relevant section manager. Inform the complainant within 48 hours that they have received the complaint and have sent it to the project manager. If the Project receives complaints related to the contractor or the transmission line, the project will coordinate with the PEA to ensure resolution. As PEA and the Project have separate, but similar, GRMs, the Project will also ensure close coordination with PEA to report to lenders on any and all reported grievances, the extent possible.



Source : Palanggan Rungrueang Co., Ltd., 2023

**FIGURE 7.2-2 : PROPOSED EXTERNAL GRIEVANCE REDRESS PROCEDURE**

No.

- /

### Complaint and Suggestion Form

**Details**

Complaint  Suggestion  
 Complaint follow-up  Others.....

**Complaint Channel**

Self-notification  Verbal notification  
 Phone call  Via community relations officer  
 Email  Others (please specify).....

**Complaint and Suggestion Category**

Environmental impact  Damage and nuisance  
 Health and safety incident  Workforce or employee behavior  
 Request for the support, donation, or information  
 Others (please specify) .....

**Specific area in the Project**.....**Date** .....

Village name .....Subdistrict.....District.....

Province .....

**Name of a Complaint Reporter**

Name-Surname (Mr. / Mrs. / Miss) .....

Occupation.....

Address.....

Telephone ..... Mobile.....

**Complaint / Suggestion**

Details	Suggestion and Resolution

Signature .....

Complaint Reporter \*

(\* a complaint reporter signs the form during site investigation with the officer)

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**Source :** Palangngan Rungrueang Co., Ltd., 2023

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**FIGURE 7.2-3 : THE EXAMPLE OF COMPLAINT AND SUGGESTION FORM  
IN THE CONSTRUCTION PHASE AND THE OPERATION PHASE**

**For officer use**

Incident observed.....

**Initial cause (construction phase)**

- Non-compliance with environmental impact mitigation measures
- Non-compliance with rules, requirements, and contract by the contractor
- Delay in operation
- Impropriety or inaccuracy in the operation
- Unsatisfactory or noncompliance with the terms of completed task
- Others (please specify) .....

**Initial cause (operation phase)**

- Non-compliance with environmental impact mitigation measures
- Others (please specify) .....
- Others (please specify) .....

Complaint and suggestion category

- Health and safety
- Environment
- Others (please specify) .....

Signature .....

Complaint recipient

(...../...../.....)

Source : Palangnan Rungrueang Co., Ltd., 2023

**FIGURE 7.2-3 : THE EXAMPLE OF COMPLAINT AND SUGGESTION FORM  
IN THE CONSTRUCTION PHASE AND THE OPERATION PHASE (CONT'D)**

<b>Investigation Meeting and Corrective/Preventive Actions</b>	
<b>Cause</b> ..... .....	
<b>Corrective/Preventive Actions</b> ..... .....	
<i>(Note: Attach minute of meeting (if any))</i>	
<b>Comment / Instruction</b> ..... .....	
	Signature ..... Company Representative (...../...../.....)
<b>Resolution</b> ..... .....	
	Signature ..... Person responsible for resolution (...../...../.....)
<b>The complaint has been resolved.</b>	
Signature ..... The inspector acknowledged and recorded the complaint  (...../...../.....)	Signature ..... Complaint reporter (...../...../.....)
Signature ..... Company Representative (...../...../.....)	
<b>Source :</b> Palangngan Rungrueang Co., Ltd., 2023	
<b>FIGURE 7.2-3 : THE EXAMPLE OF COMPLAINT AND SUGGESTION FORM IN THE CONSTRUCTION PHASE AND THE OPERATION PHASE (CONT'D)</b>	



5) The project manager will arrange a meeting to identify the cause, determine a solution and prevention plan, and assign a person responsible for solving the problem. They must report progress on the problem-solving plan to the complaint reporter every 7 days or as agreed upon until the problem has been resolved.

6) When a complaint has been successfully resolved, the project will provide an explanation of how it was resolved and inform the complaint reporter and relevant parties. The complaint reporter must sign to acknowledge that they have received and accepted the project's resolution of the problem.

7) If the problem cannot be solved and it is proved that the problem was caused by project operation, a fair remedy must be provided to all stakeholders. The ad hoc working group comprised of representatives from 5 parties which are complainants, community leaders, environmental impact monitoring committees, representative from the Office of Energy Regulatory Commission Region 4 (Khon Kaen), and the project manager or the assigned person will be established.

8) Arrange the meeting of the working group to summarize the results and collect complaint and suggestions forms and solutions. These document will be kept as record to support the preparation of a monitoring report according to the CoP Monitor which must be submitted to the Office of the Energy Regulatory Commission (ERC) and report to the Environmental Impact Monitoring Committee in annual meeting or by notification letter.

#### **(5) Center for Receiving Complaints and Suggestions (Complaint handling function)**

Palangnan Rungrueang Solar Power Plant Project requires the establishment of a center for receiving complaints and suggestions, as follows:

- Local governing authorities (during construction phase)
- Community's office (during construction phase)
- Project office (during construction and operation phases).

### **7.3 COMPLAINTS CHANNELS IN REGARDING TO TRANSMISSION LINE**

Apart from the project's grievance mechanism that was discussed above, people can also raise their concern regarding to the transmission line (for both construction and operation phases) through the following channels of PEA;

- Website: <https://complaint.pea.co.th/addnew-stakeholders-complaint>
- Hotline: 1129
- Complaints via electricity billing officers or local electricity office

If the Project receives complaints related to the contractor for the TL, the Project will coordinate with PEA to ensure resolution. As PEA and the Project have separate, but similar, Grievance Redress Mechanisms (GRMs), the Project will also ensure close

coordination with PEA to report to lenders on any and all reported grievances, to the extent possible.

#### 7.4 GRIEVANCE MONITORING

The Project shall record complaints and issues from the community regarding the Project implementation, including the methods and timeframe for addressing complaints and issues. The Project shall provide monthly summary of grievances in a grievance log (Table 7.4-1).

**TABLE 7.4-1  
 EXAMPLE OF GRIEVANCE LOG**

Monthly Summary Record of Complaint Receipt				
Month/Year: _____		Project Name: _____		
Date of Complaint	Issues	Date of Correction	Result of Correction	Remark

## **APPENDIX**

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**APPENDIX 2A**

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**LAND TITLE DEEDS OF PHALANGNGAN  
RUNGRUEANG CO., LTD.**

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**APPENDIX 2B**

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**THE FEATURES OF PHOTO VOLTAIC MODULE**

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**APPENDIX 2C**

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**PV SOLAR STRUCTURE**



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## **APPENDIX 2D**

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# **TECHNICAL SPECIFICATION OF AN INVERTER**

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**APPENDIX 2E**

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**TRANSFORMER SPECIFICATION**

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**APPENDIX 2F**

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**SINGLE LINE DIAGRAMS**



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**APPENDIX 2G**

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**THE LAND USE INSPECTION LETTER**



ที่ มท ๐๗๑๑.๗/๑๕๙๒

สำนักผังประเทศและผังภาค  
กรมโยธาธิการและผังเมือง  
ถนนพระราม ๙ กทม. ๑๐๓๑๐

๑๓ ตุลาคม ๒๕๖๕

เรื่อง แจ้งผลการตรวจสอบการใช้ประโยชน์ที่ดินโครงการผลิตไฟฟ้าจากพลังงานแสงอาทิตย์ จังหวัดอุดรธานี

เรียน [This information has been removed as it falls within the exceptions to disclose specified in paragraph 17(2) of ADB's Access to Information Policy.] กรรมการบริษัท พลังงานรุ่งเรือง จำกัด

อ้างอิง หนังสือบริษัท พลังงานรุ่งเรือง จำกัด ที่ PRR O ๑๐๒๒/๐๐๒ ลงวันที่ ๓ ตุลาคม ๒๕๖๕

- สิ่งที่ส่งมาด้วย ๑. บริเวณที่ตั้งโครงการฯ ตำบลนาข่า อำเภอเมืองอุดรธานี จังหวัดอุดรธานี จำนวน ๑ ชุด  
๒. สำเนาข้อกำหนดการใช้ประโยชน์ที่ดินกฎกระทรวงให้ใช้บังคับผังเมืองรวม จังหวัดอุดรธานี พ.ศ. ๒๕๖๐ จำนวน ๑ ชุด

ตามหนังสือที่อ้างถึง บริษัท พลังงานรุ่งเรือง จำกัด ขอความอนุเคราะห์ตรวจสอบการใช้ประโยชน์ที่ดินโครงการผลิตไฟฟ้าจากพลังงานแสงอาทิตย์แบบติดตั้งบนพื้นดิน ในพื้นที่ตำบลนาข่า อำเภอเมืองอุดรธานี จังหวัดอุดรธานี เพื่อจำหน่ายไฟฟ้าให้กับภาครัฐ และสอดคล้องกับนโยบายของภาครัฐ ในการสนับสนุนการผลิตไฟฟ้าจากพลังงานหมุนเวียน สามารถดำเนินการได้โดยไม่ขัดต่อกฎหมายว่าด้วยการผังเมือง นั้น

สำนักผังประเทศและผังภาค ขอเรียนว่า ที่ตั้งโครงการผลิตไฟฟ้าจากแสงอาทิตย์แบบติดตั้งบนพื้นดิน ตำบลนาข่า อำเภอเมืองอุดรธานี จังหวัดอุดรธานี อยู่ในเขตผังเมืองรวมจังหวัดอุดรธานี ตามกฎกระทรวงให้ใช้บังคับผังเมืองรวมจังหวัดอุดรธานี พ.ศ. ๒๕๖๐ บริเวณหมายเลข ๓.๙ กำหนดการใช้ประโยชน์ที่ดินเป็นที่ดินประเภทชนบทและเกษตรกรรม (สีเขียว) ให้ใช้ประโยชน์ที่ดินเพื่อเกษตรกรรมหรือเกี่ยวข้องกับเกษตรกรรม การอยู่อาศัย สถาบันการศึกษา สถาบันศาสนา สถาบันราชการ การสาธารณสุขและสาธารณูปการ สำหรับการใช้ประโยชน์ที่ดินเพื่อกิจการอื่น ให้ดำเนินการหรือประกอบกิจการได้ในอาคารที่ไม่ใช่อาคารสูงหรืออาคารขนาดใหญ่ โดยมีข้อห้ามใช้ประโยชน์ที่ดินเพื่อกิจการตามที่กำหนดเป็นไปตามเงื่อนไขข้อกำหนดตามกฎกระทรวงฯ สำหรับบัญชีกำหนดประเภทหรือชนิดของโรงงานที่ห้ามประกอบกิจการทำกฎกระทรวงให้ใช้บังคับผังเมืองรวมจังหวัดอุดรธานี พ.ศ. ๒๕๖๐ ไม่ห้ามโรงงานลำดับที่ ๘๘ ดังนั้น โรงงานลำดับที่ ๘๘ (๑) โรงงานผลิตพลังงานไฟฟ้าจากพลังงานแสงอาทิตย์ ยกเว้นที่ติดตั้งบนหลังคา ดาดฟ้า หรือส่วนหนึ่งส่วนใดบนอาคารซึ่งบุคคลอาจเข้าอยู่หรือใช้สอยได้ โดยมีขนาดกำลังการผลิตติดตั้งสูงสุดรวมกันของแผงเซลล์แสงอาทิตย์ไม่เกิน ๑,๐๐๐ กิโลวัตต์ จึงสามารถดำเนินการได้ ทั้งนี้ การดำเนินการดังกล่าวจะต้องปฏิบัติให้เป็นไปตามกฎหมายอื่น ๆ ที่เกี่ยวข้องด้วย

จึงเรียนมาเพื่อทราบ

ขอแสดงความนับถือ

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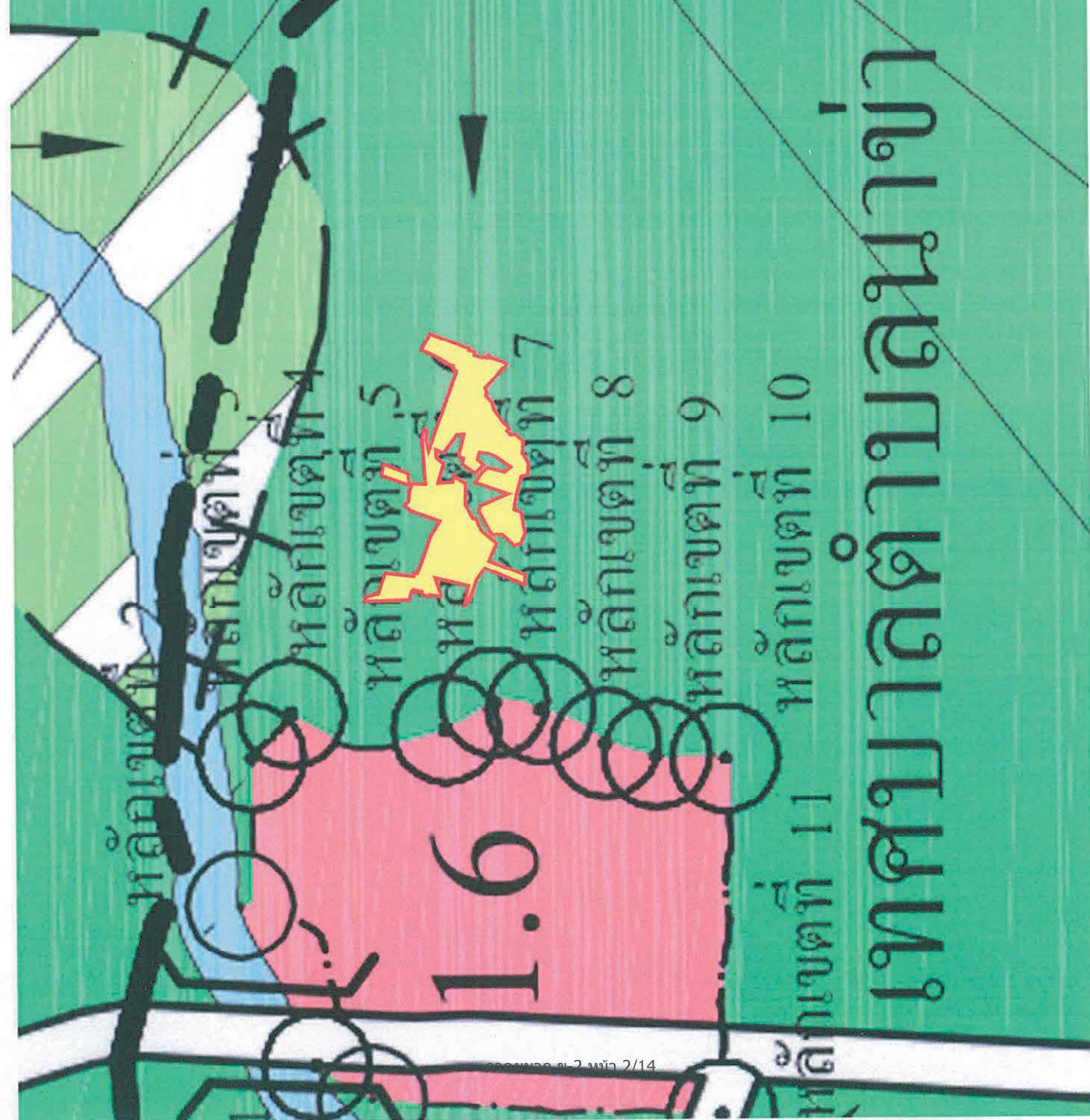
ผู้อำนวยการสำนักผังประเทศและผังภาค

กลุ่มงานผังจังหวัด ๓

โทร. ๐ ๒๒๐๑ ๘๓๑๔

โทรสาร ๐ ๒๖๔๓ ๑๗๑๗

อำเภอ









## กฎกระทรวง

ให้ใช้บังคับผังเมืองรวมจังหวัดอุดรธานี

พ.ศ. ๒๕๖๐

อาศัยอำนาจตามความในมาตรา ๕ แห่งพระราชบัญญัติการผังเมือง พ.ศ. ๒๕๑๘ และ มาตรา ๒๖ วรรคหนึ่ง แห่งพระราชบัญญัติการผังเมือง พ.ศ. ๒๕๑๘ ซึ่งแก้ไขเพิ่มเติมโดย พระราชบัญญัติการผังเมือง (ฉบับที่ ๔) พ.ศ. ๒๕๕๘ รัฐมนตรีว่าการกระทรวงมหาดไทยออกกฎกระทรวงไว้ ดังต่อไปนี้

ข้อ ๑ ให้ใช้บังคับผังเมืองรวม ในท้องที่จังหวัดอุดรธานี ภายในแนวเขตตามแผนที่ท้าย กฎกระทรวงนี้ เว้นแต่พื้นที่ที่อยู่ในแนวเขตดังต่อไปนี้ ให้ใช้ประโยชน์ตามวัตถุประสงค์ของที่ดินนั้น ๆ ตามที่มีกฎหมาย กฎ ระเบียบ ข้อบังคับ หรือประกาศที่เกี่ยวข้องกำหนดไว้ โดยไม่อยู่ในบังคับการใช้ ประโยชน์ที่ดินที่กำหนดในกฎกระทรวงนี้

- (๑) เขตพระราชฐาน
- (๒) พื้นที่ที่ได้ใช้หรือสงวนไว้เพื่อประโยชน์ในราชการทหาร
- (๓) เขตพัฒนาเศรษฐกิจพิเศษที่จัดตั้งขึ้นตามกฎหมาย
- (๔) ท้องที่มีมีการประกาศใช้บังคับกฎกระทรวงให้ใช้บังคับผังเมืองรวมเมืองหรือผังเมืองรวมชุมชน
- (๕) ที่ดินในเขตปฏิรูปที่ดิน เฉพาะที่ดินที่เป็นของรัฐหรือที่รัฐจัดซื้อหรือเวนคืนจากเจ้าของที่ดิน เพื่อใช้ประโยชน์ในการปฏิรูปที่ดิน

ข้อ ๒ การวางและจัดทำผังเมืองรวมตามกฎกระทรวงนี้ มีวัตถุประสงค์เพื่อใช้เป็น แนวทางในการพัฒนา และการดำรงรักษาเมืองและบริเวณที่เกี่ยวข้องหรือชนบท ในด้านการใช้ ประโยชน์ในทรัพย์สิน การคมนาคมและการขนส่ง การสาธารณูปโภค บริการสาธารณะ และ สภาพแวดล้อมในบริเวณแนวเขตตามข้อ ๑ ให้สอดคล้องกับการพัฒนาระบบเศรษฐกิจและสังคม ของประเทศตามแผนพัฒนาเศรษฐกิจและสังคมแห่งชาติ

ข้อ ๓ ผังเมืองรวมตามกฎหมายฉบับนี้ มีนโยบายและมาตรการเพื่อจัดระบบการใช้ประโยชน์ที่ดิน โครงข่ายคมนาคมขนส่งและบริการสาธารณะให้มีประสิทธิภาพ สามารถรองรับและสอดคล้องกับการขยายตัวของชุมชนในอนาคต รวมทั้งส่งเสริมและพัฒนาเศรษฐกิจ โดยมีสาระสำคัญดังต่อไปนี้

(๑) ส่งเสริมให้จังหวัดอุดรธานีเป็นเมืองนำอยู่ ศูนย์กลางการค้า การบริการ เพื่อให้สอดคล้องกับศักยภาพ วิทยาศาสตร์ และนโยบายการพัฒนาการใช้ทรัพยากรต่าง ๆ ให้มีประสิทธิภาพได้ประโยชน์สูงสุด โดยการพัฒนาแหล่งอุตสาหกรรม การค้า การท่องเที่ยว และสงวนพื้นที่ที่มีความอุดมสมบูรณ์และมีศักยภาพเหมาะสมทางเกษตร

(๒) ส่งเสริมให้จังหวัดอุดรธานีเป็นแหล่งท่องเที่ยวเชิงอนุรักษ์วัฒนธรรมเชิงมรดกโลกและเชิงนิเวศน์

(๓) ส่งเสริมและพัฒนาให้จังหวัดอุดรธานีมีการกำหนดพื้นที่ทางการเกษตรที่เหมาะสม รวมทั้งกำหนดศูนย์กลางการวิจัย การพัฒนา และถ่ายทอดเทคโนโลยีทางการเกษตรให้ครบวงจร

(๔) ส่งเสริมและพัฒนาให้จังหวัดอุดรธานีเป็นศูนย์กลางการขนส่งสินค้า นิคมอุตสาหกรรม การวิจัย และพัฒนาอุตสาหกรรม

(๕) ส่งเสริมให้จังหวัดอุดรธานีพัฒนาความเชื่อมโยงในทางการค้าชายแดนระหว่างอนุภาคและภูมิภาคอินโดจีน สามารถเชื่อมโยงด้านการค้าและการลงทุนได้อย่างเป็นระบบ

(๖) เพื่อให้เป็นแม่บททางการวางผังเมืองรวม ผังพัฒนาชุมชน และผังพัฒนาชนบท ตลอดจนเป็นแนวทางสำหรับการวางแผนพัฒนาเมือง และการดำเนินงานของส่วนราชการและภาคเอกชนที่เกี่ยวข้องในการพัฒนาจังหวัดอุดรธานี

(๗) อนุรักษ์พื้นที่เพื่อการรักษาสภาพแวดล้อมอย่างยั่งยืน

ข้อ ๔ การใช้ประโยชน์ที่ดินภายในเขตผังเมืองรวม ให้เป็นไปตามแผนผังกำหนดการใช้ประโยชน์ที่ดินตามที่ได้จำแนกประเภท และรายการประกอบแผนผังท้ายกฎหมายฉบับนี้

ข้อ ๕ การใช้ประโยชน์ที่ดินตามแผนผังกำหนดการใช้ประโยชน์ที่ดินตามที่ได้จำแนกประเภทท้ายกฎหมายฉบับนี้ ให้เป็นไปดังต่อไปนี้

(๑) ที่ดินในบริเวณหมายเลข ๑.๑ ถึงหมายเลข ๑.๒๗ ที่กำหนดไว้เป็นสีชมพู ให้เป็นที่ดินประเภทชุมชน

(๒) ที่ดินในบริเวณหมายเลข ๒.๑ และหมายเลข ๒.๒ ที่กำหนดไว้เป็นสีม่วง ให้เป็นที่ดินประเภทอุตสาหกรรมและคลังสินค้า

(๓) ที่ดินในบริเวณหมายเลข ๓.๑ ถึงหมายเลข ๓.๑๘ ที่กำหนดไว้เป็นสีเขียว ให้เป็นที่ดินประเภทชนบทและเกษตรกรรม

(๔) ที่ดินในบริเวณหมายเลข ๔.๑ ถึงหมายเลข ๔.๕ ที่กำหนดไว้เป็นสีขาวมีกรอบและเส้นทแยงสีเขียว ให้เป็นที่ดินประเภทอนุรักษ์ชนบทและเกษตรกรรม

(๕) ที่ดินในบริเวณหมายเลข ๕.๑ ถึงหมายเลข ๕.๒๒ ที่กำหนดไว้เป็นสีเขียวอ่อน มีเส้นทแยงสีขาว ให้เป็นที่ดินประเภทอนุรักษ์ป่าไม้

(๖) ที่ดินในบริเวณหมายเลข ๖.๑ ถึงหมายเลข ๖.๑๗ ที่กำหนดไว้เป็นสีฟ้า ให้เป็นที่ดินประเภทที่โล่งเพื่อการส่งเสริมคุณภาพสิ่งแวดล้อม

ข้อ ๖ ที่ดินประเภทชุมชน ให้ใช้ประโยชน์ที่ดินเพื่อการอยู่อาศัย พาณิชยกรรม เกษตรกรรมหรือเกี่ยวข้องกับเกษตรกรรม สถาบันการศึกษา สถาบันศาสนา สถาบันราชการ การสาธารณูปโภคและสาธารณูปการ สำหรับการให้ประโยชน์ที่ดินเพื่อกิจการอื่น ให้ดำเนินการหรือประกอบกิจการได้ในอาคารที่ไม่ใช่อาคารสูงหรืออาคารขนาดใหญ่

ที่ดินประเภทนี้ ห้ามใช้ประโยชน์ที่ดินเพื่อกิจการตามที่กำหนด ดังต่อไปนี้

(๑) โรงงานตามกฎหมายว่าด้วยโรงงานตามประเภท ชนิด และจำพวกท้ายกฎกระทรวงนี้

(๒) คลังน้ำมันและสถานที่เก็บรักษาน้ำมัน ลักษณะที่สาม ตามกฎหมายว่าด้วยการควบคุม น้ำมันเชื้อเพลิง เพื่อการจำหน่าย

(๓) คลังก๊าซปิโตรเลียมเหลว สถานที่บรรจุก๊าซปิโตรเลียมเหลวประเภทโรงบรรจุ สถานที่บรรจุก๊าซปิโตรเลียมเหลวประเภทห้องบรรจุ และสถานที่เก็บรักษาก๊าซปิโตรเลียมเหลวประเภทโรงเก็บ ตามกฎหมายว่าด้วยการควบคุมน้ำมันเชื้อเพลิง

(๔) เลี้ยงม้า โค กระบือ สุกร แพะ แกะ ห่าน เป็ด ไก่ ฝูง จระเข้ หรือสัตว์ป่า ตามกฎหมายว่าด้วยการสงวนและคุ้มครองสัตว์ป่า เพื่อการค้า

(๕) จัดสรรที่ดินเพื่อประกอบอุตสาหกรรม

(๖) กำจัดมูลฝอย เว้นแต่เป็นกิจการที่อยู่ภายใต้การควบคุมดูแลหรือได้รับอนุญาต ให้ดำเนินการจากองค์กรปกครองส่วนท้องถิ่น

ที่ดินประเภทนี้ในเขตป่าสงวนแห่งชาติ เขตรักษาพันธุ์สัตว์ป่า เขตห้ามล่าสัตว์ป่า และเขตอุทยานแห่งชาติ ให้ใช้ประโยชน์ที่ดินเพื่อการสงวนและคุ้มครองดูแลรักษาหรือบำรุงป่าไม้ สัตว์ป่า ต้นน้ำ ลำธาร และทรัพยากรธรรมชาติอื่น ๆ ตามมติคณะรัฐมนตรีและกฎหมายเกี่ยวกับการป่าไม้ การสงวนและคุ้มครองสัตว์ป่า และการส่งเสริมและรักษาคุณภาพสิ่งแวดล้อมแห่งชาติเท่านั้น

ข้อ ๗ ที่ดินประเภทอุตสาหกรรมและคลังสินค้า ให้ใช้ประโยชน์ที่ดินเพื่ออุตสาหกรรมหรือเกี่ยวข้องกับอุตสาหกรรม คลังสินค้า และการสาธารณูปโภคและสาธารณูปการ

ที่ดินประเภทนี้ ห้ามใช้ประโยชน์ที่ดินเพื่อกิจการตามที่กำหนด ดังต่อไปนี้

(๑) จัดสรรที่ดินเพื่อประกอบพาณิชยกรรม

(๒) จัดสรรที่ดินเพื่อการอยู่อาศัย

(๓) การประกอบพาณิชยกรรมประเภทอาคารขนาดใหญ่

(๔) สถานสงเคราะห์หรือรับเลี้ยงเด็ก

(๕) สถานสงเคราะห์หรือรับเลี้ยงคนชรา เว้นแต่เป็นส่วนหนึ่งของโครงการอุตสาหกรรม

ข้อ ๘ ที่ดินประเภทชนบทและเกษตรกรรม ให้ใช้ประโยชน์ที่ดินเพื่อเกษตรกรรมหรือเกี่ยวข้องกับเกษตรกรรม การอยู่อาศัย สถาบันการศึกษา สถาบันศาสนา สถาบันราชการ การสาธารณูปโภคและสาธารณูปการ สำหรับการให้ประโยชน์ที่ดินเพื่อกิจการอื่น ให้ดำเนินการหรือประกอบกิจการได้ในอาคารที่ไม่ใช่อาคารสูงหรืออาคารขนาดใหญ่

ที่ดินประเภทนี้ ห้ามใช้ประโยชน์ที่ดินเพื่อกิจการตามที่กำหนด ดังต่อไปนี้

(๑) โรงงานตามกฎหมายว่าด้วยโรงงานตามประเภท ชนิด และจำพวกท้ายกฎกระทรวงนี้

(๒) คลังน้ำมันและสถานที่เก็บรักษาน้ำมัน ลักษณะที่สาม ตามกฎหมายว่าด้วยการควบคุมน้ำมันเชื้อเพลิง เพื่อการจำหน่าย

(๓) คลังก๊าซปิโตรเลียมเหลว สถานที่บรรจุก๊าซปิโตรเลียมเหลวประเภทโรงบรรจุ สถานที่บรรจุก๊าซปิโตรเลียมเหลวประเภทห้องบรรจุ และสถานที่เก็บรักษาก๊าซปิโตรเลียมเหลวประเภทโรงเก็บ ตามกฎหมายว่าด้วยการควบคุมน้ำมันเชื้อเพลิง

(๔) จัดสรรที่ดินเพื่อประกอบอุตสาหกรรม

(๕) จัดสรรที่ดินเพื่อประกอบการพาณิชย์กรรม เว้นแต่ที่ดินในบริเวณหมายเลข ๓.๙ และหมายเลข ๓.๘ ดังต่อไปนี้

ด้านเหนือ จดเขตผังเมืองรวม ซึ่งเป็นเส้นแบ่งเขตการปกครองระหว่างจังหวัดอุดรธานี กับจังหวัดหนองคาย

ด้านตะวันออก จดทางหลวงแผ่นดินหมายเลข ๒ พากตะวันตก

ด้านใต้ จดทางหลวงแผ่นดินหมายเลข ๒๐๒๑ พากเหนือ

ด้านตะวันตก จดเขตป่าสงวนแห่งชาติ ป่าเขื่อนน้ำ

(๖) จัดสรรที่ดินเพื่อการอยู่อาศัย เว้นแต่ที่ดินในบริเวณหมายเลข ๓.๙ และหมายเลข ๓.๘ ดังต่อไปนี้

ด้านเหนือ จดเขตผังเมืองรวม ซึ่งเป็นเส้นแบ่งเขตการปกครองระหว่างจังหวัดอุดรธานี กับจังหวัดหนองคาย

ด้านตะวันออก จดทางหลวงแผ่นดินหมายเลข ๒ พากตะวันตก

ด้านใต้ จดทางหลวงแผ่นดินหมายเลข ๒๐๒๑ พากเหนือ

ด้านตะวันตก จดเขตป่าสงวนแห่งชาติ ป่าเขื่อนน้ำ

(๗) การประกอบพาณิชยกรรมประเภทอาคารขนาดใหญ่

(๘) การอยู่อาศัยประเภทอาคารชุด

ที่ดินประเภทนี้ในเขตป่าสงวนแห่งชาติ เขตรักษาพันธุ์สัตว์ป่า เขตห้ามล่าสัตว์ป่า และเขตอุทยานแห่งชาติ ให้ใช้ประโยชน์ที่ดินเพื่อการสงวนและคุ้มครองดูแลรักษาหรือบำรุงป่าไม้ สัตว์ป่า ต้นน้ำ ลำธาร และทรัพยากรธรรมชาติอื่น ๆ ตามมติคณะรัฐมนตรีและกฎหมายเกี่ยวกับการป่าไม้ การสงวนและคุ้มครองสัตว์ป่า และการส่งเสริมและรักษาคุณภาพสิ่งแวดล้อมแห่งชาติเท่านั้น

ข้อ ๙ ที่ดินประเภทอนุรักษ์ชนบทและเกษตรกรรม ให้ใช้ประโยชน์ที่ดินเพื่อเกษตรกรรม หรือเกี่ยวข้องกับเกษตรกรรม การสาธารณสุขโรคและสาธารณสุขการ และการอนุรักษ์และรักษา สภาพแวดล้อม สำหรับการให้ประโยชน์ที่ดินเพื่อกิจการอื่น ให้ดำเนินการหรือประกอบกิจการได้ในอาคารที่ไม่ใช่อาคารสูงหรืออาคารขนาดใหญ่

ที่ดินประเภทนี้ ห้ามใช้ประโยชน์ที่ดินเพื่อกิจการตามที่กำหนด ดังต่อไปนี้

(๑) โรงงานตามกฎหมายว่าด้วยโรงงานตามประเภท ชนิด และจำพวกท้ายกฎกระทรวงนี้

(๒) คลังน้ำมันและสถานที่เก็บรักษาน้ำมัน ลักษณะที่สาม ตามกฎหมายว่าด้วยการควบคุม น้ำมันเชื้อเพลิง เพื่อการจำหน่าย

(๓) คลังก๊าซปิโตรเลียมเหลว สถานที่บรรจุก๊าซปิโตรเลียมเหลวประเภทโรงบรรจุ สถานที่บรรจุก๊าซปิโตรเลียมเหลวประเภทห้องบรรจุ และสถานที่เก็บรักษาก๊าซปิโตรเลียมเหลวประเภทโรงเก็บ ตามกฎหมายว่าด้วยการควบคุมน้ำมันเชื้อเพลิง

(๔) โรงแรมตามกฎหมายว่าด้วยโรงแรม

(๕) จัดสรรที่ดินเพื่ออุตสาหกรรม

(๖) จัดสรรที่ดินเพื่อประกอบพาณิชยกรรม

(๗) จัดสรรที่ดินเพื่อการอยู่อาศัย

ข้อ ๑๐ ที่ดินประเภทอนุรักษ์ป่าไม้ ให้ใช้ประโยชน์ที่ดินเพื่อการสงวนและคุ้มครองดูแลรักษา หรือบำรุงป่าไม้ สัตว์ป่า ต้นน้ำ ลำธาร และทรัพยากรธรรมชาติอื่น ๆ ตามมติคณะรัฐมนตรีและกฎหมายเกี่ยวกับการป่าไม้ การสงวนและการคุ้มครองสัตว์ป่า และการส่งเสริมและรักษาคุณภาพสิ่งแวดล้อมแห่งชาติเท่านั้น

ที่ดินประเภทนี้ซึ่งเอกชนเป็นเจ้าของหรือผู้ครอบครองโดยชอบด้วยกฎหมาย ให้ใช้ประโยชน์ที่ดินเพื่อการอยู่อาศัย เกษตรกรรม การสาธารณสุขโรคและสาธารณสุขการ หรือสาธารณประโยชน์เท่านั้น และห้ามใช้ประโยชน์ที่ดินเพื่อกิจการตามที่กำหนด ดังต่อไปนี้

(๑) จัดสรรที่ดินเพื่อการอยู่อาศัย

(๒) การอยู่อาศัยประเภทอาคารสูงหรืออาคารขนาดใหญ่

(๓) การอยู่อาศัยประเภทอาคารชุด หอพัก หรืออาคารอยู่อาศัยรวม

ข้อ ๑๑ ที่ดินประเภทที่โล่งเพื่อการรักษาคุณภาพสิ่งแวดล้อม ให้ใช้ประโยชน์ที่ดินเพื่อการรักษาคุณภาพสิ่งแวดล้อมหรือเกี่ยวข้องกับการรักษาคุณภาพสิ่งแวดล้อม การประมง หรือสาธารณประโยชน์เท่านั้น

ข้อ ๑๒ ที่ดินในเขตโบราณสถาน ให้ใช้ประโยชน์ที่ดินตามกฎหมายว่าด้วยโบราณสถาน โบราณวัตถุ ศิลปวัตถุ และพิพิธภัณฑสถานแห่งชาติ

ข้อ ๑๓ ให้โรงงานที่ได้รับอนุญาตให้ประกอบกิจการอยู่ก่อนวันที่กฎกระทรวงนี้มีผลใช้บังคับ และยังประกอบกิจการอยู่ ขยายพื้นที่โรงงานได้เฉพาะในที่ดินแปลงเดียวกันหรือติดต่อกันหรือติดต่อกันกับแปลงที่ดินที่เป็นที่ตั้งของโรงงานเดิม ซึ่งเจ้าของโรงงานเดิมเป็นผู้ถือกรรมสิทธิ์หรือมีสิทธิครอบครองอยู่ก่อนวันที่กฎกระทรวงนี้มีผลใช้บังคับ หรือเป็นพื้นที่ในที่ดินที่เคยเป็นกรรมสิทธิ์หรือสิทธิครอบครองของเจ้าของโรงงานเดิมอยู่ก่อนวันที่กฎกระทรวงนี้มีผลใช้บังคับ ทั้งนี้ ไม่เกินหนึ่งเท่าของพื้นที่โรงงานที่ใช้ในการผลิตเดิม

ข้อ ๑๔ ให้ผู้มีอำนาจหน้าที่ในการควบคุมการก่อสร้างอาคารหรือการประกอบกิจการในเขตผังเมืองรวมปฏิบัติการให้เป็นไปตามกฎกระทรวงนี้

ให้ไว้ ณ วันที่ ๒๙ มีนาคม พ.ศ. ๒๕๖๐

พลเอก อนุพงษ์ เผ่าจินดา

รัฐมนตรีว่าการกระทรวงมหาดไทย

ประเภท ชนิด และจำพวกของโรงงานที่ห้ามประกอบกิจการ  
ท้ายกฎกระทรวงให้ใช้บังคับผังเมืองรวมจังหวัดอุดรธานี พ.ศ. ๒๕๖๐

- หมายเหตุ ๑. ลำดับที่ หมายถึง ลำดับที่ตามกฎหมายว่าด้วยโรงงาน  
๒. จำพวกที่ หมายถึง จำพวกที่ตามกฎหมายว่าด้วยโรงงาน

ที่ดินประเภทชุมชน			
ลำดับที่	ประเภทหรือชนิดของโรงงาน	จำพวกที่	หมายเหตุ
๗	(๑) โรงงานสกัดน้ำมันจากพืช หรือสัตว์ หรือไขมันจากสัตว์ ที่ใช้สารตัวทำละลายในการสกัด	๓	
	(๔) โรงงานทำน้ำมันจากพืช หรือสัตว์ หรือไขมันจากสัตว์ให้บริสุทธิ์ที่ใช้สารตัวทำละลายในการสกัด	๓	
๔๒	(๑) โรงงานทำเคมีภัณฑ์ สารเคมี หรือวัสดุเคมี ซึ่งมีไขปุย	๓	
	(๒) โรงงานเก็บรักษา ลำเลียง แยก คัดเลือก หรือแบ่งบรรจุเฉพาะเคมีภัณฑ์อันตราย ซึ่งมีไขปุย	๓	
๔๓	(๑) โรงงานทำปุ๋ย หรือสารป้องกันหรือกำจัดศัตรูพืชหรือสัตว์ (Pesticides)	๓	ยกเว้นจำพวกที่ ๓ เฉพาะปุ๋ยอินทรีย์ และปุ๋ยเคมีที่ไม่มีการใช้แอมโมเนียมไนเตรต (Ammonium Nitrate) หรือโปแตสเซียมคลอไรด์ (Potassium Chlorate) ให้ประกอบกิจการได้
	(๒) โรงงานเก็บรักษาหรือแบ่งบรรจุปุ๋ย หรือสารป้องกันหรือกำจัดศัตรูพืชหรือสัตว์ (Pesticides)	๓	
๔๔	โรงงานประกอบกิจการเกี่ยวกับการผลิตยางเรซินสังเคราะห์ ยางอีลาสโตเมอร์ พลาสติก หรือเส้นใยสังเคราะห์ซึ่งมีไขใยแก้ว	๓	
๔๕	(๑) โรงงานทำสี (Paints) สำหรับใช้ทา พื้น หรือเคลือบ	๓	ยกเว้นจำพวกที่ ๓ เฉพาะสีน้ำให้ประกอบกิจการได้
	(๒) โรงงานทำน้ำมันชักเงา น้ำมันผสมสี หรือน้ำยาล้างสี	๓	
	(๓) โรงงานทำเซลล์เล็ก แล็กเกอร์ หรือผลิตภัณฑ์สำหรับใช้ยาหรืออู๊ด	๓	

ลำดับที่	ประเภทหรือชนิดของโรงงาน	จำพวกที่	หมายเหตุ
๔๘	(๔) โรงงานทำไม้ขีดไฟ วัตถุระเบิด หรือดอกไม้เพลิง (๖) โรงงานทำหมึกหรือคาร์บอนดำ	๓ ๓	
๔๙	โรงงานกลั่นน้ำมันปิโตรเลียม	๓	
๕๐	(๔) โรงงานผสมผลิตภัณฑ์จากปิโตรเลียมเข้าด้วยกัน หรือการผสมผลิตภัณฑ์จากปิโตรเลียมกับวัสดุอื่น แต่ไม่รวมถึงการผสมผลิตภัณฑ์จากก๊าซธรรมชาติกับวัสดุอื่น	๓	ยกเว้นจำพวกที่ ๓ เฉพาะแอสฟัลต์ติกคอนกรีต ให้ประกอบกิจการได้
๘๙	โรงงานผลิตก๊าซ ซึ่งมีใช้ก๊าซธรรมชาติ และโรงงานส่งหรือจำหน่ายก๊าซ แต่ไม่รวมถึงโรงงานส่งหรือจำหน่ายก๊าซที่เป็นน้ำมันเชื้อเพลิงตามกฎหมายว่าด้วยการควบคุมน้ำมันเชื้อเพลิง	๓	
๙๑	(๒) โรงงานบรรจุก๊าซ แต่ไม่รวมถึงการบรรจุก๊าซที่เป็นน้ำมันเชื้อเพลิง ตามกฎหมายว่าด้วยการควบคุมน้ำมันเชื้อเพลิง	๓	
๙๒	โรงงานห้องเย็นที่ใช้แอมโมเนียเป็นสารทำความเย็น	๑ ๒ และ ๓	
๙๙	โรงงานผลิต ซ่อมแซม หรือดัดแปลง เครื่องกระสุน วัตถุระเบิด หรือสิ่งอื่นใดที่มีอำนาจในการประหาร ทำลาย หรือทำให้หมดสมรรถภาพ ในทำนองเดียวกับเครื่องกระสุนปืน หรือวัตถุระเบิด และรวมถึงสิ่งประกอบของสิ่งดังกล่าว	๓	
๑๐๑	โรงงานปรับปรุงคุณภาพของเสียรวม (Central Waste Treatment Plant)	๓	ยกเว้นจำพวกที่ ๓ เฉพาะโรงงานบำบัดน้ำเสียรวมของชุมชน ให้ประกอบกิจการได้
<b>ที่ดินประเภทชนบทและเกษตรกรรม</b>			
ลำดับที่	ประเภทหรือชนิดของโรงงาน	จำพวกที่	หมายเหตุ
๗	(๑) โรงงานสกัดน้ำมันจากพืช หรือสัตว์ หรือไขมันจากสัตว์ ที่ใช้สารตัวทำละลายในการสกัด (๔) โรงงานทำน้ำมันจากพืช หรือสัตว์ หรือไขมันจากสัตว์ให้บริสุทธิ์ ที่ใช้สารตัวทำละลายในการสกัด	๓ ๓	
๔๒	(๑) โรงงานทำเคมีภัณฑ์ สารเคมี หรือวัสดุเคมี ซึ่งมีไขปุย (๒) โรงงานเก็บรักษา ลำเลียง แยก คัดเลือก หรือแบ่งบรรจุเฉพาะเคมีภัณฑ์อันตราย ซึ่งมีไขปุย	๓ ๓	



ลำดับที่	ประเภทหรือชนิดของโรงงาน	จำพวกที่	หมายเหตุ
๔๓	(๑) โรงงานทำปุ๋ย หรือสารป้องกันหรือกำจัดศัตรูพืชหรือสัตว์ (Pesticides)  (๒) โรงงานเก็บรักษาหรือแบ่งบรรจุปุ๋ย หรือสารป้องกันหรือกำจัดศัตรูพืชหรือสัตว์ (Pesticides)	๓  ๓	ยกเว้นจำพวกที่ ๓ เฉพาะปุ๋ยอินทรีย์ และปุ๋ยเคมีที่ไม่มีการใช้แอมโมเนียมไนเตรต (Ammonium Nitrate) หรือโปแตสเซียมคลอไรด์ (Potassium Chlorate) ให้ประกอบกิจการได้  ยกเว้นจำพวกที่ ๓ เฉพาะปุ๋ยอินทรีย์ และปุ๋ยเคมีที่ไม่มีการใช้แอมโมเนียมไนเตรต (Ammonium Nitrate) หรือโปแตสเซียมคลอไรด์ (Potassium Chlorate) ให้ประกอบกิจการได้
๔๔	โรงงานประกอบกิจการเกี่ยวกับการผลิตยางเรซินสังเคราะห์ ยางอีลาสโตเมอร์ พลาสติก หรือเส้นใยสังเคราะห์ซึ่งมีโซไยแก้ว	๓	
๔๕	(๑) โรงงานทำสี (Paints) สำหรับใช้ทา พื้น หรือเคลือบ  (๒) โรงงานทำน้ำมันชักเงา น้ำมันผสมสี หรือน้ำยาล้างสี  (๓) โรงงานทำเซลล์เล็ก แล็กเกอร์ หรือผลิตภัณฑ์สำหรับใช้ยาหรืออุด	๓  ๓ ๓	ยกเว้นจำพวกที่ ๓ เฉพาะสีน้ำ ให้ประกอบกิจการได้
๔๘	(๔) โรงงานทำไม้ขีดไฟ วัตถุระเบิด หรือดอกไม้เพลิง  (๖) โรงงานทำหมึกหรือคาร์บอนดำ	๓ ๓	
๔๙	โรงงานกลั่นน้ำมันปิโตรเลียม	๓	
๕๐	(๔) โรงงานผสมผลิตภัณฑ์จากปิโตรเลียมเข้าด้วยกัน หรือการผสมผลิตภัณฑ์จากปิโตรเลียมกับวัสดุอื่น แต่ไม่รวมถึงการผสมผลิตภัณฑ์จากก๊าซธรรมชาติกับวัสดุอื่น	๓	ยกเว้นจำพวกที่ ๓ เฉพาะแอสฟัลต์ติกคอนกรีต ให้ประกอบกิจการได้
๘๙	โรงงานผลิตก๊าซ ซึ่งมีใช้ก๊าซธรรมชาติ และโรงงานส่งหรือจำหน่ายก๊าซ แต่ไม่รวมถึงโรงงานส่งหรือจำหน่ายก๊าซที่เป็นน้ำมันเชื้อเพลิงตามกฎหมายว่าด้วยการควบคุมน้ำมันเชื้อเพลิง	๓	
๙๑	(๒) โรงงานบรรจุก๊าซ แต่ไม่รวมถึงการบรรจุก๊าซที่เป็นน้ำมันเชื้อเพลิงตามกฎหมายว่าด้วยการควบคุมน้ำมันเชื้อเพลิง	๓	

ลำดับที่	ประเภทหรือชนิดของโรงงาน	จำพวกที่	หมายเหตุ
๙๒	โรงงานห้องเย็นที่ใช้แอมโมเนียเป็นสารทำความเย็น	๑ ๒ และ ๓	
๙๙	โรงงานผลิต ซ่อมแซม หรือดัดแปลง เครื่องกระสุน วัตถุระเบิด หรือสิ่งอื่นใดที่มีอำนาจในการประหาร ทำลาย หรือทำให้หมดสมรรถภาพ ในทำนองเดียวกับเครื่องกระสุนปืน หรือวัตถุระเบิด และรวมถึง สิ่งประกอบของสิ่งดังกล่าว	๓	
๑๐๑	โรงงานปรับปรุงคุณภาพของเสียรวม (Central Waste Treatment Plant)	๓	ยกเว้นจำพวกที่ ๓ เฉพาะ โรงงานบำบัดน้ำเสียรวม ของชุมชน ให้ประกอบ กิจการได้
<b>ที่ดินประเภทอนุรักษ์ชนบทและเกษตรกรรม</b>			
ลำดับที่	ประเภทหรือชนิดของโรงงาน	จำพวกที่	หมายเหตุ
๗	(๑) โรงงานสกัดน้ำมันจากพืช หรือสัตว์ หรือไขมันจากสัตว์ ที่ใช้สาร ตัวทำละลายในการสกัด	๓	
	(๔) โรงงานทำน้ำมันจากพืช หรือสัตว์ หรือไขมันจากสัตว์ให้บริสุทธิ์ ที่ใช้สารตัวทำละลายในการสกัด	๓	
๔๒	(๑) โรงงานทำเคมีภัณฑ์ สารเคมี หรือวัสดุเคมี ซึ่งมีไขปุ๋ย	๓	
	(๒) โรงงานเก็บรักษา ลำเลียง แยก คัดเลือก หรือแบ่งบรรจุเฉพาะเคมีภัณฑ์ อันตราย ซึ่งมีไขปุ๋ย	๓	
๔๓	(๑) โรงงานทำปุ๋ย หรือสารป้องกันหรือกำจัดศัตรูพืชหรือสัตว์ (Pesticides)	๓	ยกเว้นจำพวกที่ ๓ เฉพาะ ปุ๋ยอินทรีย์ และปุ๋ยเคมีที่ไม่มี การใช้แอมโมเนียมไนเตรต (Ammonium Nitrate) หรือโปแตสเซียมคลอเรต (Potassium Chlorate) ให้ประกอบกิจการได้
	(๒) โรงงานเก็บรักษาหรือแบ่งบรรจุปุ๋ย หรือสารป้องกันหรือกำจัดศัตรูพืช หรือสัตว์ (Pesticides)	๓	ยกเว้นจำพวกที่ ๓ เฉพาะ ปุ๋ยอินทรีย์ และปุ๋ยเคมีที่ไม่มี การใช้แอมโมเนียมไนเตรต (Ammonium Nitrate) หรือโปแตสเซียมคลอเรต (Potassium Chlorate) ให้ประกอบกิจการได้

ลำดับที่	ประเภทหรือชนิดของโรงงาน	จำพวกที่	หมายเหตุ
๔๔	โรงงานประกอบกิจการเกี่ยวกับการผลิตยางเรซินสังเคราะห์ ยางอีลาสโตเมอร์ พลาสติก หรือเส้นใยสังเคราะห์ซึ่งมีใยแก้ว	๓	
๔๕	(๑) โรงงานทำสี (Paints) สำหรับใช้ทา พื้น หรือเคลือบ (๒) โรงงานทำน้ำมันชักเงา น้ำมันผสมสี หรือน้ำยาล้างสี (๓) โรงงานทำเซลล์เล็ก แล็กเกอร์ หรือผลิตภัณฑ์สำหรับใช้ยาหรืออุด	๓ ๓ ๓	ยกเว้นจำพวกที่ ๓ เฉพาะสีน้ำ ให้ประกอบกิจการได้
๔๘	(๔) โรงงานทำไม้ขีดไฟ วัตถุระเบิด หรือดอกไม้เพลิง (๖) โรงงานทำหมึกหรือคาร์บอนดำ	๓ ๓	
๔๙	โรงงานกลั่นน้ำมันปิโตรเลียม	๓	
๕๐	(๔) โรงงานผสมผลิตภัณฑ์จากปิโตรเลียมเข้าด้วยกัน หรือการผสมผลิตภัณฑ์จากปิโตรเลียมกับวัสดุอื่น แต่ไม่รวมถึงการผสมผลิตภัณฑ์จากก๊าซธรรมชาติกับวัสดุอื่น	๓	ยกเว้นจำพวกที่ ๓ เฉพาะ แอสฟัลต์ติกคอนกรีต ให้ประกอบกิจการได้
๘๙	โรงงานผลิตก๊าซ ซึ่งมีใช้ก๊าซธรรมชาติ และโรงงานส่งหรือจำหน่ายก๊าซ แต่ไม่รวมถึงโรงงานส่งหรือจำหน่ายก๊าซที่เป็นน้ำมันเชื้อเพลิงตามกฎหมายว่าด้วยการควบคุมน้ำมันเชื้อเพลิง	๓	
๙๑	(๒) โรงงานบรรจุก๊าซ แต่ไม่รวมถึงการบรรจุก๊าซที่เป็นน้ำมันเชื้อเพลิง ตามกฎหมายว่าด้วยการควบคุมน้ำมันเชื้อเพลิง	๓	
๙๒	โรงงานห้องเย็นที่ใช้แอมโมเนียเป็นสารทำความเย็น	๑ ๒ และ ๓	
๙๙	โรงงานผลิต ซ่อมแซม หรือดัดแปลง เครื่องกระสุน วัตถุระเบิด หรือสิ่งอื่นใดที่มีอำนาจในการประหาร ทำลาย หรือทำให้หมดสมรรถภาพ ในทำนองเดียวกับเครื่องกระสุนปืน หรือวัตถุระเบิด และรวมถึงสิ่งประกอบของสิ่งดังกล่าว	๓	
๑๐๑	โรงงานปรับคุณภาพของเสียรวม (Central Waste Treatment Plant)	๓	

**APPENDIX 2H**

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**THE CONFIRMATION LETTER ISSUED BY  
PROVINCIAL WATER AUTHORITY, UDON THANI  
BRANCH FOR SUPPLY WATER TO THE PROJECT**



ที่ มท ๕๕๒๒๐-๑๑/ ๗๕๗๗

การประปาส่วนภูมิภาคสาขาอุดรธานี  
๔๔๔ ม.๑๑ ถ.ศุภกิจจรรยา ต.หมากแข้ง  
อำเภอเมือง จังหวัดอุดรธานี ๔๑๐๐๐

๗ กรกฎาคม ๒๕๖๖

เรื่อง ยืนยันความสามารถในการจ่ายน้ำประปาให้กับโครงการ

เรียน กรรมการผู้จัดการ บริษัท พลังงานรุ่งเรือง จำกัด

อ้างถึง หนังสือบริษัทฯ ที่ PRR O ๐๕๒๓/๐๐๓ ลงวันที่ ๒๕ พฤษภาคม ๒๕๖๖

สิ่งที่ส่งมาด้วย ผังแนวท่อบริเวณที่ตั้งโครงการ จำนวน ๑ แผ่น

ตามหนังสือที่อ้างถึง ท่านมีความประสงค์ให้การประปาส่วนภูมิภาค สาขาอุดรธานี รับรองการให้บริการน้ำประปา เพื่อรองรับโครงการ โรงไฟฟ้าพลังงานแสงอาทิตย์แบบติดตั้งบนพื้นดิน ที่ตั้ง ทางหลวงหมายเลข ๒๒๕๕ สายนาข่า-สุ่มเส้า ตำบลนาข่า อำเภอเมืองอุดรธานี จังหวัดอุดรธานี

การประปาส่วนภูมิภาค สาขาอุดรธานี ได้ตรวจสอบพิกัดที่ตั้ง โครงการโรงไฟฟ้าพลังงานรุ่งเรือง แล้ว พบว่าอยู่ในพื้นที่ให้บริการน้ำประปาของการประปาส่วนภูมิภาค สาขาอุดรธานี จึงขอรับรองว่าสามารถให้บริการน้ำประปาให้กับโครงการของท่านได้อย่างเพียงพอ และหวังเป็นอย่างยิ่งว่าจะได้รับใช้ท่านเมื่อโครงการฯ แล้วเสร็จ

จึงเรียนมาเพื่อทราบ

ขอแสดงความนับถือ

*[This information has been removed as it falls within the exceptions to disclose specified in paragraph 17(2) of ADB's Access to Information Policy.]*

รักษาการแทน ผู้จัดการ กปภ.สาขาอุดรธานี

งานบริการและควบคุมน้ำสูญเสีย

โทร. ๐๔๒-๒๔๗-๘๗๔

## แผนผังแสดงแนวท่อ / ผังบริเวณรับรองพื้นที่จ่ายน้ำ

โครงการ      โรงไฟฟ้าพลังงานรุ่งเรือง

เจ้าของโครงการ บริษัท พลังงานรุ่งเรือง จำกัด

87 อาคารเอ็มไทย ทาวเวอร์ ออลซีซั่นเพลส ชั้น 10 ถ.วิฑู แขวงลุมพินี เขตปทุมวัน กรุงเทพมหานคร



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นายช่างโยธา 6

ท.น.งานบริการและควบคุมน้ำสูญเสีย 2

ผ.ช.ผู้จัดการการประปาส่วนภูมิภาค สาขาอุดรธานี

ป.อุดรธานี  
เลขรับที่ 1410  
วันที่ 29 ม.ค. 66  
เวลา 14.20 น.

25 พฤษภาคม 2566

เรื่อง ขอบความอนุเคราะห์รับรองและยืนยันศักยภาพในการจัดหาน้ำใช้

เรียน ผู้จัดการการประปาส่วนภูมิภาค สาขาอุดรธานี

เอกสารแนบ พิกัดที่ตั้งโครงการโรงไฟฟ้าพลังงานรุ่งเรือง

เนื่องด้วยบริษัท พลังงานรุ่งเรือง จำกัด ("บริษัท") มีแผนพัฒนาโครงการโรงไฟฟ้าพลังงานรุ่งเรือง ("โครงการฯ") ซึ่งเป็นโครงการโรงไฟฟ้าพลังงานแสงอาทิตย์แบบติดตั้งบนพื้นดิน ตั้งอยู่ในตำบลนาข่า อำเภอเมืองอุดรธานี จังหวัดอุดรธานี โดยบริษัทฯ มีความประสงค์จะขอใช้น้ำจากการประปาส่วนภูมิภาค สาขาอุดรธานี ในการดำเนินการโครงการฯ

ปัจจุบัน โครงการฯ อยู่ระหว่างการศึกษาและจัดทำรายงานประมวลหลักการปฏิบัติ (CoP) ตามระเบียบคณะกรรมการกำกับกิจการพลังงาน ว่าด้วยหลักเกณฑ์การจัดทำรายงานประมวลหลักการปฏิบัติและรายงานผลการปฏิบัติตามประมวลหลักการปฏิบัติ สำหรับการประกอบกิจการผลิตไฟฟ้า พ.ศ. 2565 โดยจากการออกแบบพบว่า ในระยะก่อสร้างและระยะดำเนินการ โครงการฯ มีความจำเป็นต้องใช้น้ำสูงสุดประมาณ 2,820 ลูกบาศก์เมตรต่อเดือน และมีแผนเริ่มใช้น้ำเบื้องต้น ตั้งแต่เดือน มกราคม พ.ศ. 2567 เป็นต้นไป ด้วยวิธีการขนส่งทางรถบรรทุก

ในการนี้ บริษัทฯ จึงใคร่ขอความอนุเคราะห์ทางหน่วยงานของท่านพิจารณาออกหนังสือรับรองและยืนยันศักยภาพในการจัดหาน้ำใช้ให้กับทางโครงการฯ ตามรายละเอียดข้างต้น เพื่อนำมาใช้ในการประกอบการจัดทำรายงานประมวลหลักการปฏิบัติ (CoP) ให้มีความครบถ้วนสมบูรณ์ต่อไป

จึงเรียนมาเพื่อโปรดพิจารณา

ขอแสดงความนับถือ

[This information has been removed as it falls within the exceptions to disclose specified in paragraph 17(2) of ADB's Access to Information Policy.]

กรรมการ

ผู้ประสานงาน

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[This information has been removed as it falls within the exceptions to disclose specified in paragraph 17(2) of ADB's Access to Information Policy.]

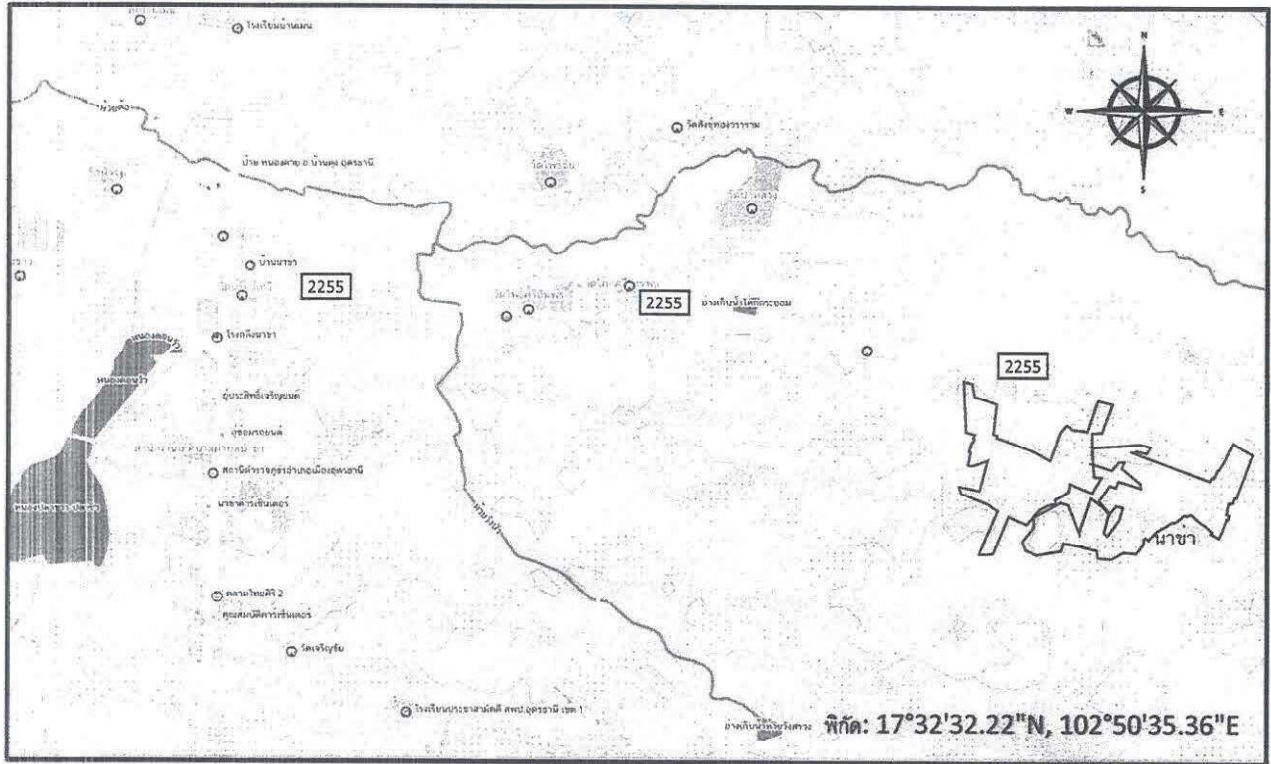
- วิทยมน เพื่อ
- หน่วยงานอำนาจการ
- หน่วยงานจัดเก็บ
- หน่วยงานลูกค้า
- หน่วยงานบริการ
- หน่วยงานผลิต

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ผู้ช่วยผู้จัดการ กปภ.สาขาอุดรธานี  
รักษาการแทน ผู้จัดการ กปภ.สาขาอุดรธานี

29 พ.ค. 2566

พิกัดที่ตั้งโครงการโรงไฟฟ้าพลังงานรุ่งเรือง  
ตำบลนาซ่า อำเภอมืองอุดรธานี จังหวัดอุดรธานี



□ ขอบเขตที่ดินโครงการโรงไฟฟ้าพลังงานรุ่งเรือง



**APPENDIX 2I**

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**RETENTION POND CALCULATION**

CODE OF PRACTICE (COP)

SOLAR PLANT

## PHALANGGAN RUNGUEANG PROJECT

*[This information has been removed as it falls within the exceptions to disclose specified in paragraph 17(2) of ADB's Access to Information Policy.]*

*[This information has been removed as it falls within the exceptions to disclose specified in paragraph 17(2) of ADB's Access to Information Policy.]*

PREPARED FOR

**พลังงานรุ่งเรือง**  
PHALANGGAN RUNGUEANG

Client Name: Phalanggan Rungrueang Co., Ltd.

11 JULY 2023

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## การออกแบบบ่อน้ำฝน

- ออกแบบให้มีบ่อน้ำฝนได้อย่างน้อย 3 ชั่วโมง และควบคุมอัตราการระบายน้ำออกจากพื้นที่โครงการไม่ให้เพิ่มขึ้นมากกว่าก่อนมีโครงการ โดยต้องแสดงรายการคำนวณปริมาณน้ำฝนที่ตก ในพื้นที่โครงการและอัตราการระบายน้ำฝนก่อนและหลังพัฒนาโครงการ ตำแหน่งและความจุของบ่อน้ำฝน ช่วงเวลาและอัตราการระบายน้ำฝนออกจากพื้นที่โครงการ

## รายการคำนวณการคำนวณปริมาตรบ่อน้ำฝน

รายละเอียดโครงการ

ชื่อโครงการ : SO-UDT4 สถานที่ : จ.อุตรธานี-4

การใช้งาน : บ่อน้ำฝนภายในโครงการ

### **CRITERIA**

พื้นที่ของโครงการที่พิจารณาออกแบบ = 729,095.20 ตร.ม.

ก่อนมีโครงการ

สภาพพื้นที่เป็นพื้นที่ว่างเปล่ามีหญ้าปกคลุมดิน โดยรอบเป็นพื้นที่โล่งทำการเกษตร

### **DESIGN**

คำนวณการไหลนองของน้ำฝน

Q = CIA

โดยที่

Q = อัตราการไหลนองของน้ำฝน, ลบ.ม./ชม (m<sup>3</sup>/hr)

C = สัมประสิทธิ์การไหลนองโดยเฉลี่ย

I = ความเข้มของฝน, ม./ชม. (m/hr)

A = พื้นที่รับน้ำ, ตร.ม. (m<sup>2</sup>)

*[This information has been removed as it falls within the exceptions to disclose specified in paragraph 17(2) of ADB's Access to Information Policy.]*

**Undeveloped Area** พื้นที่ก่อนการพัฒนา

Q = CIA

โดยที่

C= 0.30

I= 0.150 mm/3hr

A= 729,095.20 m<sup>2</sup>

Q= 0.30 X 0.150 m/3hr X 729,095.20 m<sup>2</sup>

Qbefore = 32,809.28 m<sup>3</sup>/3hr

**Developed Area** พื้นที่มีการพัฒนา

**อาคารที่ 4 (SO-UDT4)**

Solar Plant

**Development Area**

	W m	L m	Area m <sup>2</sup>
Main Power Transformer & Substation		55	33 1,815.00 m <sup>2</sup>
Admin		8	15 120.00 m <sup>2</sup>
Total			<b>1,935.00 m<sup>2</sup></b>

**Rainfall**

Rainfall Amount	205 mm	@25year return period
3 hrs rainfall intensity (I)	150 mm/hr	@25year return period
1 hrs rainfall intensity (I)	92 mm/hr	@25year return period

Frequency Analysis of Maximum Rainfall for Each Period at A.Nam Phong C.Khon Keen  
(1971-1989)

Time (hr)	Rainfall Amount (mm)								
	2 yr	5 yr	10 yr	25 yr	50 yr	100 yr	200 yr	500 yr	1000 yr
0.25	25.5	31.1	34.7	39.3	42.8	46.2	49.6	54.0	57.4
0.5	36.5	45.8	52.0	59.8	65.5	71.3	77.0	84.5	90.2
0.75	43.4	57.2	66.4	78.0	86.6	95.1	103.6	114.8	123.3
1	47.2	65.1	77.0	92.0	103.2	114.2	125.2	139.8	150.8
2	56.1	84.3	103.0	126.7	144.2	161.6	179.0	201.8	219.1
3	60.8	95.3	118.1	147.0	168.3	189.6	210.7	238.6	259.7
6	72.4	108.1	131.8	161.7	183.9	205.9	227.8	256.7	278.6
12	82.2	121.9	148.1	181.3	206.0	230.4	254.8	287.0	311.3
24	85.5	125.9	152.7	186.5	211.5	236.4	261.2	293.9	318.6

*[This information has been removed as it falls within the exceptions to disclose specified in paragraph 17(2) of ADB's Access to Information Policy.]*

อ้างอิงจาก “ความสัมพันธ์ระหว่างความเข้มฝน - ช่วงเวลา - ความถี่ฝน และเปอร์เซ็นต์การแผ่กระจายของปริมาณฝนสูงสุดในช่วงเวลา 24 ชั่วโมง ภาคตะวันออกเฉียงเหนือ, กรมชลประทาน, กระทรวงเกษตรและสหกรณ์”

**Developed Area** พื้นที่มีการพัฒนา

โดยที่แบ่งเป็นพื้นที่พัฒนาใหม่

Q = CIA

โดยที่

C= 0.90

I= 0.150 m/3hr @25Y 3 hrs

A= **1,935.00** m<sup>2</sup>

Q=0.90 x (0.1500 m/3hr) x (1,935.00 m<sup>2</sup>)

Qd1= **261.23** m<sup>3</sup>/hr Used **400.00** m<sup>3</sup>/hr

และแบ่งเป็นพื้นที่ส่วนที่ไม่ได้พัฒนาที่เหลือ

Q = CIA

โดยที่

c= 0.30

I= 0.150 m/3hr

A= **727,160.20** m<sup>2</sup>

Q=0.30 x (0.1500 m/3hr) x (727,160.20 m<sup>2</sup>)

Qd2 = **32,722.21** m<sup>3</sup>/3hr

Qafter = Qd2 + Qd1

Qafter = **32,722.21 + 400.00** m<sup>3</sup>/3hr

Qafter = **33,122.21** m<sup>3</sup>/3hr

Qafter - Qbefore= 33,122.21 - 32,809.28 m<sup>3</sup>/3hr

Qremain = **312.92** m<sup>3</sup>/3hr

Used **500.00** m<sup>3</sup>/3hr SO site

ดังนั้น ปริมาตรบ่อหน่วงน้ำ Retention Pond = **500** ลบ.ม. (m<sup>3</sup>)

*[This information has been removed as it falls within the exceptions to disclose specified in paragraph 17(2) of ADB's Access to Information Policy.]*

*[This information has been removed as it falls within the exceptions to disclose specified in paragraph 17(2) of ADB's Access to Information Policy.]*

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**APPENDIX 3A**

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**ASSESSMENT OF EXISTING SOIL EROSION**



**การประเมินการชะล้างพังทลายของดิน**  
**โครงการโรงไฟฟ้าพลังงานรุ่งเรือง**  
**ตั้งอยู่ที่ตำบลนาข่า อำเภอเมืองอุดรธานี จังหวัดอุดรธานี**

**1. บทนำ**

ตามที่บริษัท พลังงานรุ่งเรือง จำกัด จะพัฒนาโครงการโรงไฟฟ้าพลังงานรุ่งเรือง ซึ่งเป็นโครงการโรงไฟฟ้าพลังงานแสงอาทิตย์แบบติดตั้งบนพื้นดิน บนพื้นที่ประมาณ 456 ไร่ ในตำบลนาข่า อำเภอเมืองอุดรธานี จังหวัดอุดรธานี ซึ่งสภาพปัจจุบันของพื้นที่โครงการเป็นพื้นที่รกร้างรอการใช้ประโยชน์ อย่างไรก็ตามเพื่อเป็นข้อมูลพื้นฐานก่อนมีโครงการ บริษัทที่ปรึกษาจึงได้ทำการประเมินการชะล้างพังทลายของดินเพื่อให้ทราบถึงสภาพและความรุนแรงของการชะล้างพังทลายของดินบริเวณพื้นที่โครงการ โดยการประเมินการชะล้างพังทลายของดินจะใช้วิธีการเดียวกับที่กรมพัฒนาที่ดินได้นำมาใช้ในการศึกษาและใช้ประโยชน์ในประเทศไทย ได้แก่การประเมินการชะล้างพังทลายของดิน โดยใช้สมการการสูญเสียดินสากล (Universal Soil Loss Equation : USLE) ที่พัฒนาโดย Wischmeier และ Smith ในปี พ.ศ. 2521 ซึ่งการประเมินการชะล้างพังทลายของดิน โดยสมการ USLE นิยมใช้กันอย่างกว้างขวางในด้านการวางแผนอนุรักษ์ดิน โดยรูปแบบของสมการมีดังนี้

$$A = RKLSCP$$

โดยที่ A = ค่าการสูญเสียดินต่อหน่วยของพื้นที่ (ตัน/เฮกตาร์/ปี)

R = ค่าปัจจัยน้ำฝนและการไหลบ่า (Rainfall and run off erosivity Index : R-factor)

K = ค่าปัจจัยความคงทนต่อการชะล้างพังทลายของดิน (Soil erodibility factor : K-factor)

L = ค่าปัจจัยความยาวของความลาดเท (Slope length factor)

S = ค่าปัจจัยความชันของความลาดเท (Slope steepness factor)

C = ค่าปัจจัยการจัดการพืช (Crop management factor)

P = ค่าปัจจัยการปฏิบัติการป้องกันและการชะล้างพังทลาย (Conservation practice)

ทั้งนี้ การประเมินการชะล้างพังทลายของดิน บริษัทที่ปรึกษาจะทำการประเมินตามแนวทาง “การชะล้างพังทลายของดินในประเทศไทย” ของกรมพัฒนาที่ดิน (พ.ศ. 2543) ที่กรมพัฒนาที่ดินได้นำมาใช้ในการศึกษาการชะล้างพังทลายของดินในประเทศไทย

การหาค่าปัจจัยต่าง ๆ ที่ใช้ในประเมินการชะล้างพังทลายของดินตามสมการ USLE มีดังนี้

### 1) การหาค่าปัจจัยน้ำฝนและการไหลบ่า (Rainfall and run off erosivity Index : R-factor)

ค่าปัจจัยน้ำฝนและการไหลบ่า (R-factor) เป็นค่าความสัมพันธ์ของพลังงานจลน์ของเม็ดฝนที่ตกกระทบผิวหน้าดินกับปริมาณความหนาแน่นของฝน (Rainfall Intensity) ในช่วงระยะเวลาหนึ่ง ซึ่งสำหรับประเทศไทย มนูและคณะ (1984) ได้สร้างสมการเพื่อใช้ประเมินค่า R-Factor ที่เหมาะสมกับปริมาณฝนของประเทศไทย ดังนี้

$$R = 0.4669 X - 12.1415$$

โดยที่ R = ค่าปัจจัยการชะล้างพังทลายของฝน (ตัน/เฮกแตร์/ปี)

X = ค่าปริมาณฝนเฉลี่ยรายปี (มิลลิเมตร/ปี)

ทั้งนี้ ปริมาณฝนบริเวณพื้นที่โครงการ จะอ้างอิงจากสถานีอุตุนิยมวิทยอุดรธานี ซึ่งเป็นสถานีอุตุนิยมวิทยาที่อยู่ใกล้พื้นที่โครงการมากที่สุด ซึ่งจากการรวบรวมข้อมูลปริมาณฝนในคาบ 30 ปี (2535-2564) มีปริมาณฝนเฉลี่ยเท่ากับ 1,444.3 มิลลิเมตร/ปี

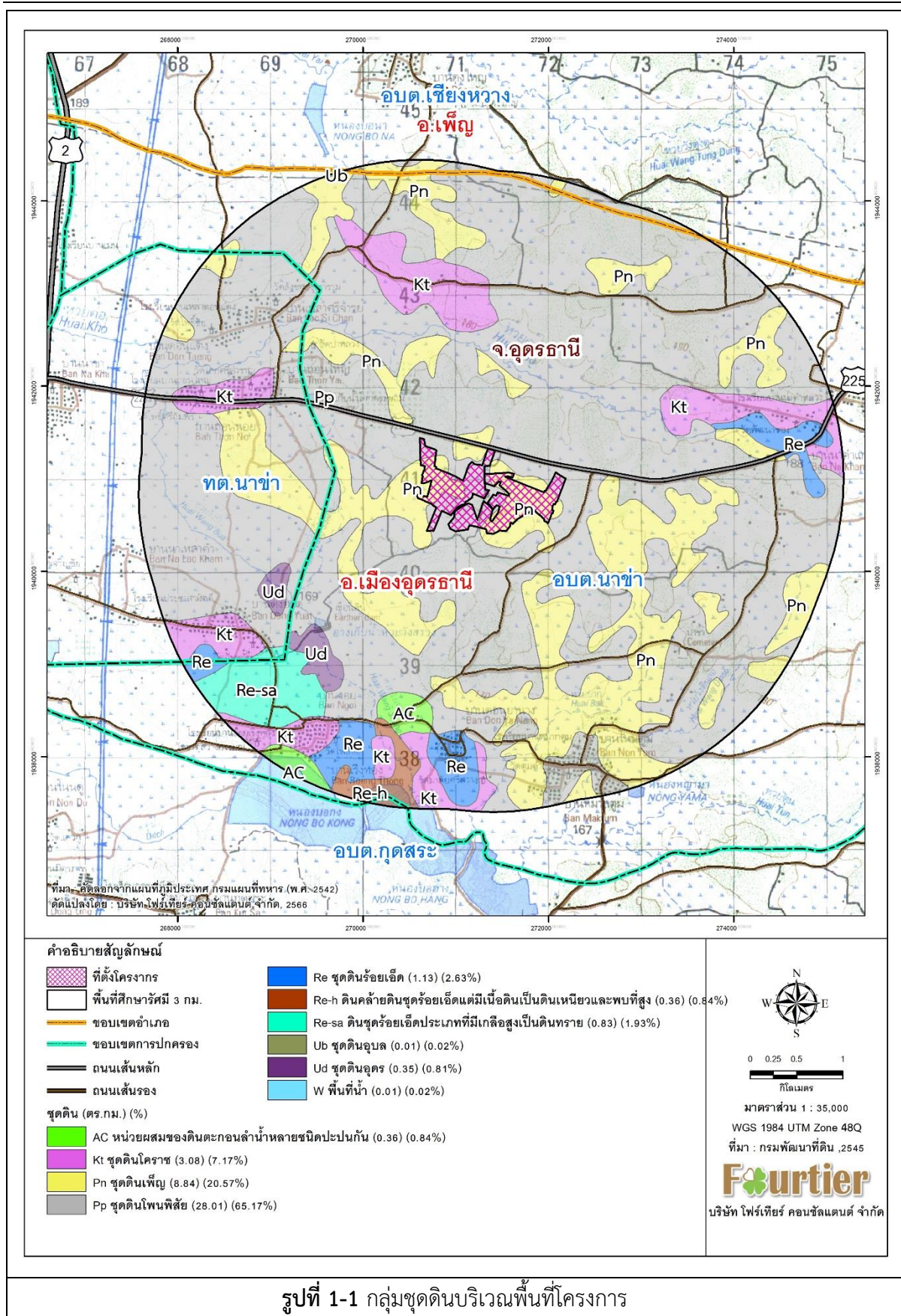
เมื่อแทนค่าในสมการ จะได้ค่า R-factor =  $(0.4669 \times 1,444.3) - 12.1415 = 662.20$

ดังนั้น ค่าปัจจัยการชะล้างพังทลายของฝนบริเวณพื้นที่โครงการเท่ากับ 662.20 ตัน/เฮกแตร์/ปี

### 2) ค่าปัจจัยความคงทนของดิน (Soil erodibility factor)

ค่าปัจจัยความคงทนของดิน (K-factor) เป็นค่าเฉพาะของดินแต่ละชนิด ซึ่งกรมพัฒนาที่ดิน (2526) ได้ศึกษาการประเมินค่าปัจจัย K-factor ของดินในประเทศไทย โดยอาศัยข้อมูลสมบัติ 5 ประการของตัวแทนชุดดิน (Soil Series) ที่มีการเก็บตัวอย่างดินมาวิเคราะห์หาคุณสมบัติในห้องปฏิบัติการ ผลจากการศึกษาครอบคลุมกลุ่มชุดดินและจำแนกตามภูมิภาคของประเทศไทย (ตารางที่ 1-1)

เมื่อพิจารณาข้อมูลดินบริเวณพื้นที่โครงการ พบว่าจะเป็นดินชุดเพ็ญ (Pn) (กลุ่มชุดดินที่ 25) และดินชุดโพนพิสัย (Pp) (กลุ่มชุดดินที่ 49) (รูปที่ 1-1) ซึ่งเมื่อพิจารณาจากค่าปัจจัย K-factor ของกรมพัฒนาที่ดิน กลุ่มดินดินที่ 25 (ดินชุดเพ็ญ) จะมีค่าปัจจัย K-factor เท่ากับ 0.26 และกลุ่มชุดดินที่ 49 (ดินชุดโพนพิสัย) ค่าปัจจัย K-factor เท่ากับ 0.24 ดังนั้น ในการเลือกใช้ค่าปัจจัย K-factor จะเลือกใช้ค่า 0.26 ซึ่งเป็นค่าสูงสุด ซึ่งแต่ละชุดดินบริเวณพื้นที่โครงการมีรายละเอียดดังนี้



รูปที่ 1-1 กลุ่มชุดดินบริเวณพื้นที่โครงการ

### (1) กลุ่มชุดดินเพ็ญ (Pn)

ชุดดินเพ็ญ เกิดจากตะกอนชะมาทับถมบนหินตะกอนเนื้อละเอียดพบในส่วนต่ำของพื้นผิวของการเคลี่ยผิวแผ่นดิน มีสภาพพื้นที่ราบเรียบถึงค่อนข้างราบเรียบ ความลาดชันร้อยละ 0-2 การระบายเลว การไหลบ่าของน้ำบนผิวดินช้า การซึมผ่านได้ของน้ำปานกลางในดินบนและช้าในดินล่าง มีลักษณะและสมบัติดินเป็นดินตื้นถึงชั้นลูกรัง ดินบนเป็นดินร่วนปนทราย สีน้ำตาลหรือสีน้ำตาลปนเทา มีจุดประสีน้ำตาลแก่ สีน้ำตาลปนเหลือง และ/หรือ สีแดงปนเหลือง ส่วนดินล่างภายใน 50 เซนติเมตร มักเป็นดินร่วนเหนียวปนทรายปนกรวดมากในดินล่างตอนบนและเป็นดินเหนียวในดินล่าง ปริมาณลูกรังจะลดลงตามความลึก สีของดินล่างตอนบนจะเป็นสีน้ำตาลอ่อน ดินล่างเป็นสีเทาและพบจุดประสีน้ำตาลแดงปนเหลืองและแดงตลอดหน้าตัดดิน ศิลาแลงอ่อนมีปริมาณ 5-50% โดยปริมาตร ภายใน 150 เซนติเมตร จากผิวดิน ปฏิกริยาดินเป็นกรดจัดถึงเป็นกรดเล็กน้อย (pH 5.5-6.5) ในดินบนและเป็นกรดจัดมาก (pH 4.5-5.0) ในดินล่าง ข้อจำกัดในการใช้ประโยชน์เป็นดินตื้น มีความอุดมสมบูรณ์ต่ำ ในการใช้ประโยชน์ ทำนา ควรใส่ปุ๋ยคอก ปุ๋ยหมักและปุ๋ยเคมี เพื่อเพิ่มความอุดมสมบูรณ์ของดิน ควรจัดหาแหล่งน้ำให้เพียงพอสำหรับการเพาะปลูก

### (2) กลุ่มชุดดินโพนพิสัย (Pp)

ชุดดินโพนพิสัย เกิดจากตะกอนชะมาทับถมบนหินตะกอนเนื้อละเอียด มีสภาพพื้นที่ราบเรียบถึงลูกคลื่นลอนลาดเล็กน้อย ความลาดชันร้อยละ 1-5 การระบายน้ำดีปานกลาง การไหลบ่าของน้ำบนผิวดินปานกลางถึงเร็ว การซึมผ่านได้ของน้ำปานกลางในดินบนและช้าในดินล่าง มีลักษณะและสมบัติดินเป็นดินตื้นถึงชั้นกรวดลูกรัง ดินบนเป็นดินร่วนปนทรายหรือดินร่วน สีน้ำตาลปนเทาเข้ม ดินล่างตอนบน เป็นดินร่วนเหนียวปนทรายถัดไปเป็นดินร่วนเหนียวปนทรายปนกรวดหรือดินเหนียวปนกรวดมาก มีสีน้ำตาลหรือน้ำตาลแก่ ส่วนดินล่างภายใน 50-100 เซนติเมตร เป็นดินร่วนเหนียวปนกรวดมากหรือดินเหนียวปนกรวดมากถัดไปจะเป็นชั้นดินเหนียวตลอด มีสีเทาปนน้ำตาลอ่อนหรือสีเทาอ่อน มีจุดประสีแดงของศิลาแลงอ่อนและน้ำตาลแก่หรือน้ำตาลปนเหลือง ปฏิกริยาดินเป็นกรดจัดมากถึงเป็นกรดเล็กน้อย (pH 5.0-6.5) ในดินบนและเป็นกรดจัดมากถึงเป็นกรดจัด (pH 4.5-5.5) ในดินล่าง ข้อจำกัดในการใช้ประโยชน์เป็นดินตื้นถึงชั้นกรวดลูกรัง เนื้อดินบนค่อนข้างเป็นทราย การใช้ประโยชน์ กรณีที่ใช้ปลูกพืชไร่ ควรเลือกพืชที่มีรากสั้น เช่น ข้าวโพด ข้าวฟ่าง ถั่วเขียว และอื่นๆ ส่วนกรณีที่ปลูกไม้ผลหรือไม้ยืนต้น ควรนำหน้าดินหรือดินจากที่อื่นมาผสมกับปุ๋ยอินทรีย์ใส่ลงในหลุมปลูก เมื่อผสมแล้วนำกลับลงไปเป็นหลุมก่อนที่จะปลูกไม้ผลหรือไม้ยืนต้น

โดยสรุปแล้วดินบริเวณพื้นที่โครงการส่วนใหญ่จะเป็นดินที่การระบายน้ำดีปานกลาง การไหลบ่าของน้ำบนผิวดินปานกลาง การซึมผ่านได้ของน้ำปานกลาง มีลักษณะและสมบัติดินเป็นดินลึก ดินบนเป็นดินทรายปนดินร่วนหรือดินร่วนปนทรายเสี่ยงต่อการขาดแคลนน้ำสำหรับพืชในฤดูเพาะปลูกและเสี่ยงต่อการชะล้างพังทลาย

### 3) ค่าปัจจัยความยาวของความลาดเท (Slope length factor) และค่าปัจจัยความชันของความลาดเท (Slope steepness factor)

สภาพพื้นที่มีบทบาทสำคัญต่อการชะล้างพังทลายของดินใน 2 ทาง คือ ความยาวของความลาดเท (Slope length) และความชัน (Slope Gradient) โดยสมการคำนวณค่าปัจจัยความยาวของความลาดเท (L-factor) ได้แก่

$$L = (\lambda / 22.13)^m$$

โดยที่ L = ค่าปัจจัยความยาวของความลาดเท

$\lambda$  = เป็นระยะทางตามแนวราบนับตั้งแต่จุดเริ่มมีน้ำไหลเอ่อผิวดิน (Overland Flow) ถึงจุดที่มีความลาดชันเปลี่ยนแปลงลดลงจนเกิดการทับถมของตะกอน หรือจุดที่มีการรวมตัวของน้ำไหลบ่า

m = ตัวเลขยกกำลังซึ่งผันแปรตามความลาดชัน

เมื่อพิจารณาข้อมูลดินบริเวณพื้นที่โครงการ เป็นดินชุดเพ็ญ (Pn) และดินชุดโพนพิสัย (Pp) สภาพพื้นที่โดยส่วนใหญ่จะราบเรียบถึงค่อนข้างราบเรียบ มีความลาดชันร้อยละ 0-2 ส่วนที่เหลือจะเป็นลูกคลื่นลอนลาดเล็กน้อย มีความลาดชันร้อยละ 1-5 ซึ่งจากผลการคำนวณค่าปัจจัย LS-factor ของกลุ่มชุดดิน ของกรมพัฒนาที่ดิน (ตารางที่ 1-2) สรุปได้ว่า บริเวณพื้นที่โครงการมีค่า LS-factor เท่ากับ 0.323

### 4) ค่าปัจจัยการจัดการพืช (Crop management factor)

ค่าปัจจัยการจัดการพืช (C-factor) เป็นดัชนีที่ได้จากอัตราส่วนของปริมาณการสูญเสียดินจากแปลงทดลองที่มีการปลูกพืชและการจัดการพืชชนิดใดชนิดหนึ่งกับปริมาณการสูญเสียดินที่ถูกชะล้าง ซึ่งจากผลการประเมินค่า C-factor (ตารางที่ 1-3) และเมื่อพิจารณาจากสภาพพื้นที่โครงการในปัจจุบันที่เป็นพื้นที่รกร้างรอการไถประโยชน์ สรุปได้ว่า บริเวณพื้นที่โครงการมีค่า C-factor เท่ากับ 0.8

### 5) ค่าปัจจัยการปฏิบัติการป้องกันและการชะล้างพังทลาย (Conservation practice factor)

ค่าปัจจัยการปฏิบัติการป้องกันและการชะล้างพังทลาย (P-factor) เป็นปัจจัยแสดงสมรรถนะในการควบคุมการชะล้างพังทลายของดินที่ได้จากอัตราส่วนของปริมาณการสูญเสียดินที่ได้จากแปลงทดลองที่มีการใช้วิธีการอนุรักษ์ประเภทใดประเภทหนึ่งกับปริมาณการสูญเสียดินจากแปลงทดลองที่ไถพรวนดินขึ้นลงตามความลาดชันในสภาพการณ์อย่างอื่นที่เหมือนกัน ทั้งนี้ การปฏิบัติป้องกันการชะล้างพังทลายของดิน ได้แบ่งออกเป็น 4 มาตรการที่สำคัญ ได้แก่

- การทำการเกษตรตามแนวระดับ (Contouring) ซึ่งรวมถึงวิธีการไถพรวนและการปลูกพืช

- ควบคุมแนวการปลูกพืชและปรับพื้นที่เป็นคันดินเป็นการทำแนวระดับที่แน่นอนและปรับพื้นที่ลาดชันให้สม่ำเสมอและมีแนวการเบนน้ำออกจากพื้นที่ โดยคันและคูระบายน้ำไม่ให้งออยู่ในพื้นที่และยังรวมถึงการใช้เศษวัสดุของพืชในปริมาณสูงไว้ในพื้นที่เป็นแถวตามแนวระดับ

- การปลูกพืชสลับตามแนวระดับ (Contouring Strip Cropping) เป็นการปลูกพืชสลับเป็นแนวโดยมีความกว้างของแต่ละแถวเท่า ๆ กันและพืชที่ปลูกสลับจะครอบคลุมพื้นที่ต่อเนื่องตลอดทั้งปี

- การทำขั้นบันได (Terracing)

เมื่อพิจารณาจากสภาพพื้นที่โครงการในปัจจุบันที่เป็นพื้นที่รกร้างรอการใช้ประโยชน์ ไม่มีการป้องกันการชะล้างพังทลายของดิน สรุปได้ว่า บริเวณพื้นที่โครงการมีค่า P-factor เท่ากับ 1

#### 6) การประเมินการชะล้างพังทลายของดินบริเวณพื้นที่โครงการ

จากผลการหาค่าปัจจัยต่าง ๆ ที่ใช้ในประเมินการชะล้างพังทลายของดินตามสมการ USLE ข้างต้น เมื่อแทนค่าปัจจัยต่าง ๆ ในสมการ USLE ดังนี้

$$\begin{aligned} A &= RKLSCP \\ &= 662.20 \times 0.26 \times 0.323 \times 0.8 \times 1 \\ &= 44.49 \text{ ตัน/เฮกเตอร์/ปี} \quad \text{หรือ} = 7.12 \text{ ตัน/ไร่/ปี} \end{aligned}$$

สรุปได้ว่า บริเวณพื้นที่โครงการในปัจจุบันที่เป็นพื้นที่รกร้างรอการใช้ประโยชน์ มีอัตราการชะล้างพังทลายของดินประมาณ 7.12 ตัน/ไร่/ปี และเมื่อนำเปรียบเทียบกับการจัดชั้นระดับความรุนแรงของการชะล้างพังทลายของดินในประเทศไทย (ตารางที่ 1-4) พบว่า อัตราการสูญเสียดินบริเวณพื้นที่โครงการมีความรุนแรงของการชะล้างพังทลายในระดับปานกลาง (Moderate)

เมื่อพัฒนาโครงการแล้วเสร็จ พื้นที่โดยส่วนใหญ่ร้อยละ 62 ของพื้นที่โครงการจะเป็นพื้นที่ติดตั้งแผงเซลล์แสงอาทิตย์บนพื้นดิน ซึ่งเมื่อฝนตกลงมาเม็ดฝนจะไม่กระทบต่อพื้นดินโดยตรง ทำให้ค่าปัจจัย R-factor ซึ่งเป็นค่าความสัมพันธ์ของพลังงานจลน์ของเม็ดฝนที่ตกกระทบผิวดินกับปริมาณความหนาแน่นของฝน (Rainfall Intensity) ลดลงจะทำให้ดินบริเวณพื้นที่โครงการถูกชะล้างพังทลายลดลง ส่วนพื้นที่อื่น ๆ ที่เหลือโดยส่วนใหญ่จะมีหญ้าปกคลุมผิวดินซึ่งจะช่วยลดการชะล้างพังทลายลงด้วยเช่นกัน ดังนั้น ในระยะดำเนินการปัญหาการชะล้างพังทลายของดินบริเวณพื้นที่โครงการจะลดลงจากที่เป็นอยู่ในปัจจุบัน

**ตารางที่ 1-1** ค่า K ของกลุ่มชุดดินจำแนกตามภูมิภาคของประเทศไทย

กลุ่มชุดดิน	ภูมิภาค				
	ใต้	เหนือ	ตอ. เฝียงเหนือ	ตะวันออก	กลาง/ตะวันออก
1-5	0.14	0.18	0.15	0.14	0.18
6-7	0.31	0.27	0.36	0.35	0.29
8	0.14	0.18	0.15	0.14	0.18
9	0.21	0.27	0.21	0.14	0.29
10-14	0.14	0.18	0.15	0.14	0.18
15	0.31	0.27	0.36	0.35	0.29
16	0.34	0.34	0.34	0.44	0.47
17-20	0.30	0.30	0.26	0.34	0.26
21	0.34	0.35	0.35	0.33	0.43
22	0.04	0.06	0.05	0.08	0.07
23	0.04	0.06	0.16	0.05	0.07
24	0.04	0.06	0.05	0.08	0.07
25	0.30	0.30	0.26	0.34	0.26
26	0.33	0.30	0.18	0.25	0.29
27	0.22	0.18	0.18	0.27	0.18
28	0.11	0.15	0.13	0.12	0.14
29-31	0.29	0.24	0.25	0.30	0.28
32	0.33	0.30	0.26	0.30	0.36
33	0.40	0.49	0.37	0.44	0.56
34	0.20	0.19	0.26	0.19	0.21
35-40	0.20	0.27	0.24	0.19	0.34
41	0.04	0.05	0.04	0.07	0.08
42	0.04	0.05	0.14	0.05	0.04
43	0.04	0.05	0.04	0.05	0.04
44	0.07	0.05	0.04	0.05	0.08
45	0.33	0.30	0.18	0.30	0.30
46	0.29	0.24	0.25	0.30	0.28
47	0.33	0.33	0.29	0.30	0.33
48-49	0.20	0.27	0.24	0.34	0.34
50	0.20	0.19	0.26	0.19	0.23

ที่มา : การชะล้างพังทลายของดินในประเทศไทย ของกรมพัฒนาที่ดิน, 2543

**ตารางที่ 1-2** ค่าปัจจัยรวม LS-Factor ของชั้นความลาดชันตามแผนที่กลุ่มชุดดิน

ชั้นความลาดชันตามแผนที่กลุ่มชุดดิน	เปอร์เซ็นต์ความชัน (ค่า s)	ความยาวของความลาดเท (ค่า $\lambda$ เป็นเมตร)	ค่าปัจจัยรวม LS-Factor
A	1.2	150	0.226
B	2.0	150	0.323
C	5.0	100	0.567
D	12.0	50	1.927
E	20.0	50	2.753
F (กลุ่มดิน 62)	35.0	50	4.571

ที่มา : การชะล้างพังทลายของดินในประเทศไทย ของกรมพัฒนาที่ดิน, 2543

**ตารางที่ 1-3** การกำหนดค่า C-factor และ P-factor สำหรับหน่วยแผนที่การใช้ประโยชน์ที่ดิน 1:50,000

ชนิดพืช	ค่า C	ค่า P
นาร้าง	0.100	0.100
นาข้าว นาดำ นาหว่าน นาน้ำฝน	0.280	0.100
เกษตรผสมผสาน/ไร่นา	0.225	1.000
ข้าวสาลี ข้าวบาเลย์ ข้าวไรน์	0.280	1.000
พืชไร่ พืชผสม พืชไร่อื่น ๆ	0.340	1.000
สับประรด ว่านหางจระเข้ ป่านศรนารายณ์	0.380	1.000
ถั่วดำ ถั่วแดง งา ผัก	0.386	1.000
ถั่วเขียว	0.390	1.000
อ้อย	0.400	1.000
ถั่วลิสง	0.406	1.000
ถั่วเหลือง	0.421	1.000
ฝ้าย ไร่ร้าง	0.500	1.000
ข้าวโพด	0.502	1.000
มันสำปะหลัง ปอแก้ว ปอกระเจา ปอสา ปอป่าน พืชเส้นใย	0.600	1.000
มันฝรั่ง มันแกว มันเทศ แตงโม ชิง กะหล่ำปลี มะเขือเทศ พริก	0.600	1.000
กัญชา กระจับปี่	0.600	1.000
ข้าวฟ่าง ลูกเดือย	0.650	1.000
ข้าวไร่ ยาสูบ ทานตะวัน	0.700	1.000
ละหุ่ง	0.790	1.000
สัก สะเดา กระจับปี่ ประดู่ ช้อ	0.088	1.000
ไม้ยืนต้น ไม้ยืนต้นผสม ยางพารา ยูคาลิปตัส สนประดิพัทธ์	0.150	1.000
ปาล์มน้ำมัน	0.300	1.000
ไม้ชายเลน	0.000	0.000
ระกำ สละ	0.020	1.000



**ตารางที่ 1-3 (ต่อ) การกำหนดค่า C-factor และ P-factor สำหรับหน่วยแผนที่การใช้ประโยชน์ที่ดิน 1:50,000**

ชนิดพืช	ค่า C	ค่า P
จามจุรี ก้ามปู	0.088	1.000
ชา ฝั่ ไม้ผล ไม้ผลผสม สวนผลไม้ ทุเรียน เงาะ ลิ้นจี่ มะม่วง	0.150	1.000
กล้วย มะขาม ลำไย ขนุน กระท้อน ชมพู่ มังคุด ลางสาด ลองกอง	0.150	1.000
ละมุด	0.150	1.000
สตรอเบอรี่ แรสบอรี่	0.270	1.000
กาแฟ ุ่น ตินเป็ด ส้ม พุทรา น้อยหน่า ฝรั่ง มะนาว	0.300	1.000
ไม้ผลเมืองหนาว	0.300	1.000
ไม้ดอก	0.386	1.000
หมาก มะพร้าว มะม่วงหิมพานต์ ตาล	0.400	1.000
หม่อน เปล้า มะละกอ พืชสวน พืชสวนผสม พืชผัก ่อุ่น พริกไทย	0.600	1.000
เสาวรส มะกอก	0.600	1.000
ไร่ร้าง	0.020	1.000
ไร่หมุนเวียน ข้าวไร่(หมุนเวียน) ข้าวโพด(หมุนเวียน)	0.250	1.000
ถั่วต่างๆ(หมุนเวียน) งา(หมุนเวียน) มันต่างๆ(หมุนเวียน)	0.250	1.000
พืชผัก(หมุนเวียน) ผัก(หมุนเวียน)	0.250	1.000
พื้นที่เตรียมปลูกไร่หมุนเวียน ึ่งร้างไร่หมุนเวียน	0.250	1.000
พื้นที่ที่ร้างจากการทำไร่หมุนเวียน ไร่เลื่อนลอยที่ยังใช้ประโยชน์	0.250	1.000
ทุ่งหญ้าเลี้ยงสัตว์ ทุ่งหญ้าเลี้ยงสัตว์และโรงเรือนเลี้ยงสัตว์	0.100	1.000
โรงเรือนเลี้ยงสัตว์ผสม โรงเรือนเลี้ยงโค กระบือ สัตว์ปีก สุกร	0.000	0.000
คอกม้า	0.000	0.000
พืชน้ำ พืชน้ำผสม กก บัว กระจับ แห้ว ผักบุงน้ำ ผักกระเฉด	0.000	0.000
สถานที่เพาะเลี้ยงสัตว์น้ำร้าง สถานที่เพาะเลี้ยงสัตว์น้ำผสม	0.000	0.000
สถานที่เพาะเลี้ยงปลา กุ้ง ปู หอย สัตว์น้ำอื่น ๆ ฟาร์มจระเข้	0.000	0.000
ป่าบึงน้ำจืดหรือป่าพรุ ป่าชายเลน	0.000	0.000
ป่าดิบชื้น ป่าดงดิบ ป่าไม่ผลัดใบอื่น ๆ	0.001	1.000
ป่าดิบเขา	0.003	1.000
ป่าดิบแล้ง ป่านสนเขา	0.019	1.000
พื้นที่ป่าไม้ ป่าเบญจพรรณ ป่าแดงหรือป่าเต็งรัง ป่าแพะ ป่าผลัดใบ	0.020	1.000
ป่าไม่ผลัดใบเสื่อมโทรม ป่าดิบชื้นถูกทำลาย	0.040	1.000
ป่าละเมาะ	0.048	1.000
ป่าไผ่	0.150	1.000
ป่าผลัดใบเสื่อมโทรม ป่าไม้เสื่อมโทรม	0.250	1.000
ป่าชายหาด	0.450	1.000
สวนป่าไม้ชายเลน	0.000	0.000
สวนป่าสน สวนป่ายาง สวนป่ายูคาลิปตัส สวนป่าสัก สวนป่าสะเดา	0.088	1.000

**ตารางที่ 1-3 (ต่อ) การกำหนดค่า C-factor และ P-factor สำหรับหน่วยแผนที่การใช้ประโยชน์ที่ดิน 1:50,000**

ชนิดพืช	ค่า C	ค่า P
สวนป่าสนประดิพัทธ์ สวนป่ากระถิน สวนป่าประดู่ สวนป่าซ้อ	0.088	1.000
สวนป่าเลี่ยน สวนป่านางพญาเสือโคร่ง สวนมะยมป่า สวนแอปเปิลป่า	0.088	1.000
สวนป่าเหียง สวนป่าสีเสียด สวนไม้กระยาเลย	0.088	1.000
สวนป่า สวนป่าผสม สวนป่าอื่น ๆ วนเกษตร	0.088	1.000
นาร้างเขตชลประทาน	0.100	0.100
นาดีเขตชลประทาน นาหว่านเขตชลประทาน	0.280	0.100
ไม้ผลผสมเขตชลประทาน	0.100	1.000
กล้วยเขตชลประทาน	0.150	1.000
อ้อยเขตชลประทาน	0.400	1.000
มันสำปะหลังเขตชลประทาน	0.600	1.000
พื้นที่ลุ่ม พื้นที่ลุ่มน้ำขัง พื้นที่ลุ่มชื้นแฉะ	0.000	0.000
ทุ่งหญ้า ทุ่งหญ้าธรรมชาติ ทุ่งหญ้าปรับปรุงแล้ว สนามกอล์ฟ	0.015	1.000
ไผ่	0.020	1.000
ทุ่งหญ้าสลัดไม้ละเมาะ	0.032	1.000
ทุ่งหญ้าสลัดไม้พุ่ม หรือไม้พุ่ม ทุ่งหญ้าสลัดไม้เตี้ย ไม้พุ่มและไม้ละเมาะ	0.048	1.000
บ่อขุดเก่า บ่อลูกรัง บ่อทราย บ่อดิน พื้นที่เปิดเตล็ดอื่น ๆ	0.000	0.000
หาดทราย ที่หินโผล่ พื้นที่ทราย	0.800	1.000
เหมืองแร่	0.800	1.000
พื้นที่ซึ่งไม่สามารถใช้ประโยชน์ได้, พื้นที่อื่น ๆ ซึ่งไม่ได้ใช้ประโยชน์	0.800	1.000
พื้นที่ซึ่งไม่ได้ทำประโยชน์ ที่ดินจัดสรร พื้นที่ดินถม พื้นที่อื่น ๆ	0.800	1.000
ที่ทิ้งขยะ	0.000	0.000
นาเกลือ	0.000	0.100
โครงการที่ดินจัดสรร	0.000	0.000
ตัวเมืองและย่านการค้า หมู่บ้าน สถานที่ราชการและสถาบันต่างๆ	0.000	0.000
หมู่บ้านบนพื้นที่ราบ หมู่บ้านชาวเขาบนพื้นที่สูง พื้นที่อยู่อาศัยอื่น ๆ	0.000	0.000
สถานีคมนาคม สนามบิน สถานีรถไฟ สถานีขนส่ง ท่าเรือ	0.000	0.000
ย่านอุตสาหกรรม นิคมอุตสาหกรรม โรงงานอุตสาหกรรม ศูนย์อพยพ	0.000	0.000
สุสาน สถานที่พักผ่อนหย่อนใจ	0.000	0.000
พื้นที่น้ำ แม่น้ำลำคลอง แหล่งน้ำธรรมชาติ แหล่งน้ำที่สร้างขึ้น	0.000	0.000
ทะเลสาบ บึง อ่างเก็บน้ำ บ่อน้ำในไร่นา	0.000	0.000

ที่มา : การชะล้างพังทลายของดินในประเทศไทย ของกรมพัฒนาที่ดิน, 2543

**ตารางที่ 1-4** อัตราการชะล้างพังทลายของดินในประเทศไทย

ชั้นความรุนแรงของการชะล้างพังทลาย	อัตราการสูญเสียดิน (ตัน/ไร่/ปี)
1 : น้อยมาก (very slight)	0-2
2 : น้อย (slight)	2-5
3 : ปานกลาง (moderate)	5-15
4 : รุนแรง (severe)	15-20
5 : รุนแรงมาก (very severe)	มากกว่า 20

ที่มา : การชะล้างพังทลายของดินในประเทศไทย ของกรมพัฒนาที่ดิน, 2543

**APPENDIX 3B**

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**THE RESULTS OF AMBIENT AIR QUALITY, WIND  
SPEED, AND WIND DIRECTION MEASUREMENT**



# Analysis / Test Report

TESTING  
No.0009

**Client :** Fournier Consultants Co., Ltd.  
99/2 Moo 8, Tambon Bang Mueang, Amphoe Mueang Samut Prakan, Samut Prakan  
Thailand 10270  
**P/O :** Q2318493(R1)  
**Project Name :** โครงการโรงไฟฟ้าพลังงานรุ่งเรือง (UDT4) บริษัท พลังงานรุ่งเรือง จำกัด  
**Project Location :** ในพื้นที่ตำบลนาขา อำเภอเมืองอุดรธานี จังหวัดอุดรธานี

**Lot ID: 2363941**

Date Received : Jun 12, 2023  
Date Reported : Jun 16, 2023  
Report Number : 2670348-1

Page 1 of 10

<b>Sample Number</b>	2363941-1
<b>Sampled Date</b>	Jun 06, 2023
<b>Sample Description</b>	Air Quality
<b>Location</b>	วัดป่านาบุญชัยมงคล (A1) (GPS 48Q 274351, 1942269)
<b>Date Analysis Commenced</b>	Jun 12, 2023
<b>Condition of Sample</b>	Drawn into one glass filter paper (8x10 inch) placed in plastic bag and one quartz filter paper (8x10 inch) placed in plastic bag
<b>Barometric Pressure</b>	736 mmHg
<b>Atmospheric Temperature</b>	31.0 °C

Analyte	Sampled Date/time	Unit	LOD	LOQ (LOR)	Result	Guideline Limit	Method	Guideline	Testing Location
<b>Air Testing</b>									
Particulate matter as PM 10	06/06/23 - 07/06/23	mg/m3	-	0.005	0.017	0.12	US EPA 40 CFR Part 50, Appendix J	NEB No.24 Bangkok	
Total Suspended Particulate	06/06/23 - 07/06/23	mg/m3	-	0.005	0.022	0.33	US EPA 40 CFR Part 50, Appendix B	NEB No.24 Bangkok	

**Guideline :**

NEB No.24 : Notification of the National Environmental Board. No.24, 2004 (B.E.2547) dated September 22, 2004

**Sampled By :** Adisak Phomphai

**Remark :**

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# Analysis / Test Report

TESTING  
No.0009

**Client :** Fourtier Consultants Co., Ltd.  
99/2 Moo 8, Tambon Bang Mueang, Amphoe Mueang Samut Prakan, Samut Prakan  
Thailand 10270  
**P/O :** Q2318493(R1)  
**Project Name :** โครงการโรงไฟฟ้าพลังงานรุ่งเรือง (UDT4) บริษัท พลังงานรุ่งเรือง จำกัด  
**Project Location :** ในพื้นที่ตำบลนาขา อำเภอเมืองอุดรธานี จังหวัดอุดรธานี

**Lot ID: 2363941**  
Date Received : Jun 12, 2023  
Date Reported : Jun 16, 2023  
Report Number : 2670348-1

<b>Sample Number</b>	2363941-2
<b>Sampled Date</b>	Jun 07, 2023
<b>Sample Description</b>	Air Quality
<b>Location</b>	วัดป่านาบุญชัยมงคล (A1) (GPS 48Q 274351, 1942269)
<b>Date Analysis Commenced</b>	Jun 12, 2023
<b>Condition of Sample</b>	Drawn into one glass filter paper (8x10 inch) placed in plastic bag and one quartz filter paper (8x10 inch) placed in plastic bag
<b>Barometric Pressure</b>	736 mmHg
<b>Atmospheric Temperature</b>	31.0 °C

Analyte	Sampled Date/time	Unit	LOD	LOQ (LOR)	Result	Guideline Limit	Method	Guideline	Testing Location
<b>Air Testing</b>									
Particulate matter as PM 10	07/06/23 - 08/06/23	mg/m3	-	0.005	0.011	0.12	US EPA 40 CFR Part 50, Appendix J	NEB No.24 Bangkok	
Total Suspended Particulate	07/06/23 - 08/06/23	mg/m3	-	0.005	0.011	0.33	US EPA 40 CFR Part 50, Appendix B	NEB No.24 Bangkok	

**Guideline :**  
NEB No.24 : Notification of the National Environmental Board. No.24, 2004 (B.E.2547) dated September 22, 2004  
**Sampled By :** Adisak Phomphai

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No.0009

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99/2 Moo 8, Tambon Bang Mueang, Amphoe Mueang Samut Prakan, Samut Prakan  
Thailand 10270  
**P/O :** Q2318493(R1)  
**Project Name :** โครงการโรงไฟฟ้าพลังงานรุ่งเรือง (UDT4) บริษัท พลังงานรุ่งเรือง จำกัด  
**Project Location :** ในพื้นที่ตำบลนาขา อำเภอเมืองอุดรธานี จังหวัดอุดรธานี

**Lot ID: 2363941**  
Date Received : Jun 12, 2023  
Date Reported : Jun 16, 2023  
Report Number : 2670348-1

<b>Sample Number</b>	2363941-3
<b>Sampled Date</b>	Jun 08, 2023
<b>Sample Description</b>	Air Quality
<b>Location</b>	วัดป่านาบุญชัยมงคล (A1) (GPS 48Q 274351, 1942269)
<b>Date Analysis Commenced</b>	Jun 12, 2023
<b>Condition of Sample</b>	Drawn into one glass filter paper (8x10 inch) placed in plastic bag and one quartz filter paper (8x10 inch) placed in plastic bag
<b>Barometric Pressure</b>	736 mmHg
<b>Atmospheric Temperature</b>	31.0 °C

Analyte	Sampled Date/time	Unit	LOD	LOQ (LOR)	Result	Guideline Limit	Method	Guideline	Testing Location
<b>Air Testing</b>									
Particulate matter as PM 10	08/06/23 - 09/06/23	mg/m3	-	0.005	0.009	0.12	US EPA 40 CFR Part 50, Appendix J	NEB No.24 Bangkok	
Total Suspended Particulate	08/06/23 - 09/06/23	mg/m3	-	0.005	0.027	0.33	US EPA 40 CFR Part 50, Appendix B	NEB No.24 Bangkok	

**Guideline :**  
NEB No.24 : Notification of the National Environmental Board. No.24, 2004 (B.E.2547) dated September 22, 2004  
**Sampled By :** Adisak Phomphai

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# Analysis / Test Report

TESTING  
No.0009

**Client :** Fournier Consultants Co., Ltd.  
99/2 Moo 8, Tambon Bang Mueang, Amphoe Mueang Samut Prakan, Samut Prakan  
Thailand 10270  
**P/O :** Q2318493(R1)  
**Project Name :** โครงการโรงไฟฟ้าพลังงานรุ่งเรือง (UDT4) บริษัท พลังงานรุ่งเรือง จำกัด  
**Project Location :** ในพื้นที่ตำบลนาขา อำเภอเมืองอุดรธานี จังหวัดอุดรธานี

**Lot ID: 2363941**

Date Received : Jun 12, 2023  
Date Reported : Jun 16, 2023  
Report Number : 2670348-1

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<b>Sample Number</b>	2363941-4
<b>Sampled Date</b>	Jun 09, 2023
<b>Sample Description</b>	Air Quality
<b>Location</b>	วัดป่านาบุญชัยมงคล (A1) (GPS 48Q 274351, 1942269)
<b>Date Analysis Commenced</b>	Jun 12, 2023
<b>Condition of Sample</b>	Drawn into one glass filter paper (8x10 inch) placed in plastic bag and one quartz filter paper (8x10 inch) placed in plastic bag
<b>Barometric Pressure</b>	736 mmHg
<b>Atmospheric Temperature</b>	31.0 °C

Analyte	Sampled Date/time	Unit	LOD	LOQ (LOR)	Result	Guideline Limit	Method	Guideline	Testing Location
<b>Air Testing</b>									
Particulate matter as PM 10	09/06/23 - 10/06/23	mg/m3	-	0.005	0.018	0.12	US EPA 40 CFR Part 50, Appendix J	NEB No.24 Bangkok	
Total Suspended Particulate	09/06/23 - 10/06/23	mg/m3	-	0.005	0.044	0.33	US EPA 40 CFR Part 50, Appendix B	NEB No.24 Bangkok	

**Guideline :**

NEB No.24 : Notification of the National Environmental Board. No.24, 2004 (B.E.2547) dated September 22, 2004

**Sampled By :** Adisak Phomphai

**Remark :**

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# Analysis / Test Report

TESTING  
No.0009

**Client :** Fournier Consultants Co., Ltd.  
99/2 Moo 8, Tambon Bang Mueang, Amphoe Mueang Samut Prakan, Samut Prakan  
Thailand 10270  
**P/O :** Q2318493(R1)  
**Project Name :** โครงการโรงไฟฟ้าพลังงานรุ่งเรือง (UDT4) บริษัท พลังงานรุ่งเรือง จำกัด  
**Project Location :** ในพื้นที่ตำบลนาขา อำเภอเมืองอุดรธานี จังหวัดอุดรธานี

**Lot ID: 2363941**  
Date Received : Jun 12, 2023  
Date Reported : Jun 16, 2023  
Report Number : 2670348-1

<b>Sample Number</b>	2363941-5
<b>Sampled Date</b>	Jun 10, 2023
<b>Sample Description</b>	Air Quality
<b>Location</b>	วัดป่านาบุญชัยมงคล (A1) (GPS 48Q 274351, 1942269)
<b>Date Analysis Commenced</b>	Jun 12, 2023
<b>Condition of Sample</b>	Drawn into one glass filter paper (8x10 inch) placed in plastic bag and one quartz filter paper (8x10 inch) placed in plastic bag
<b>Barometric Pressure</b>	736 mmHg
<b>Atmospheric Temperature</b>	31.0 °C

Analyte	Sampled Date/time	Unit	LOD	LOQ (LOR)	Result	Guideline Limit	Method	Guideline	Testing Location
<b>Air Testing</b>									
Particulate matter as PM 10	10/06/23 - 11/06/23	mg/m3	-	0.005	0.014	0.12	US EPA 40 CFR Part 50, Appendix J	NEB No.24 Bangkok	
Total Suspended Particulate	10/06/23 - 11/06/23	mg/m3	-	0.005	0.031	0.33	US EPA 40 CFR Part 50, Appendix B	NEB No.24 Bangkok	

**Guideline :**  
NEB No.24 : Notification of the National Environmental Board. No.24, 2004 (B.E.2547) dated September 22, 2004  
**Sampled By :** Adisak Phomphai

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# Analysis / Test Report

TESTING  
No.0009

**Client :** Fournier Consultants Co., Ltd.  
99/2 Moo 8, Tambon Bang Mueang, Amphoe Mueang Samut Prakan, Samut Prakan  
Thailand 10270  
**P/O :** Q2318493(R1)  
**Project Name :** โครงการโรงไฟฟ้าพลังงานรุ่งเรือง (UDT4) บริษัท พลังงานรุ่งเรือง จำกัด  
**Project Location :** ในพื้นที่ตำบลนาขา อำเภอเมืองอุดรธานี จังหวัดอุดรธานี

**Lot ID: 2363941**

Date Received : Jun 12, 2023  
Date Reported : Jun 16, 2023  
Report Number : 2670348-1

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<b>Sample Number</b>	2363941-6
<b>Sampled Date</b>	Jun 06, 2023
<b>Sample Description</b>	Air Quality
<b>Location</b>	วัดโคกศรีสำราญ (A2) (GPS 48Q 268723, 1941996)
<b>Date Analysis Commenced</b>	Jun 12, 2023
<b>Condition of Sample</b>	Drawn into one glass filter paper (8x10 inch) placed in plastic bag and one quartz filter paper (8x10 inch) placed in plastic bag
<b>Barometric Pressure</b>	736 mmHg
<b>Atmospheric Temperature</b>	31.0 °C

Analyte	Sampled Date/time	Unit	LOD	LOQ (LOR)	Result	Guideline Limit	Method	Guideline	Testing Location
<b>Air Testing</b>									
Particulate matter as PM 10	06/06/23 - 07/06/23	mg/m3	-	0.005	0.015	0.12	US EPA 40 CFR Part 50, Appendix J	NEB No.24 Bangkok	
Total Suspended Particulate	06/06/23 - 07/06/23	mg/m3	-	0.005	0.029	0.33	US EPA 40 CFR Part 50, Appendix B	NEB No.24 Bangkok	

**Guideline :**

NEB No.24 : Notification of the National Environmental Board. No.24, 2004 (B.E.2547) dated September 22, 2004

**Sampled By :** Adisak Phomphai

Remark :

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# Analysis / Test Report

TESTING  
No.0009

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99/2 Moo 8, Tambon Bang Mueang, Amphoe Mueang Samut Prakan, Samut Prakan  
Thailand 10270  
**P/O :** Q2318493(R1)  
**Project Name :** โครงการโรงไฟฟ้าพลังงานรุ่งเรือง (UDT4) บริษัท พลังงานรุ่งเรือง จำกัด  
**Project Location :** ในพื้นที่ตำบลนาขา อำเภอเมืองอุดรธานี จังหวัดอุดรธานี

**Lot ID: 2363941**  
Date Received : Jun 12, 2023  
Date Reported : Jun 16, 2023  
Report Number : 2670348-1

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<b>Sample Number</b>	2363941-7
<b>Sampled Date</b>	Jun 07, 2023
<b>Sample Description</b>	Air Quality
<b>Location</b>	วัดโคกศรีสาทร (A2) (GPS 48Q 268723, 1941996)
<b>Date Analysis Commenced</b>	Jun 12, 2023
<b>Condition of Sample</b>	Drawn into one glass filter paper (8x10 inch) placed in plastic bag and one quartz filter paper (8x10 inch) placed in plastic bag
<b>Barometric Pressure</b>	736 mmHg
<b>Atmospheric Temperature</b>	32.0 °C

Analyte	Sampled Date/time	Unit	LOD	LOQ (LOR)	Result	Guideline Limit	Method	Guideline	Testing Location
<b>Air Testing</b>									
Particulate matter as PM 10	07/06/23 - 08/06/23	mg/m3	-	0.005	0.016	0.12	US EPA 40 CFR Part 50, Appendix J	NEB No.24 Bangkok	
Total Suspended Particulate	07/06/23 - 08/06/23	mg/m3	-	0.005	0.016	0.33	US EPA 40 CFR Part 50, Appendix B	NEB No.24 Bangkok	

**Guideline :**  
NEB No.24 : Notification of the National Environmental Board. No.24, 2004 (B.E.2547) dated September 22, 2004  
**Sampled By :** Adisak Phomphai

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No.0009

**Client :** Fournier Consultants Co., Ltd.  
99/2 Moo 8, Tambon Bang Mueang, Amphoe Mueang Samut Prakan, Samut Prakan  
Thailand 10270  
**P/O :** Q2318493(R1)  
**Project Name :** โครงการโรงไฟฟ้าพลังงานรุ่งเรือง (UDT4) บริษัท พลังงานรุ่งเรือง จำกัด  
**Project Location :** ในพื้นที่ตำบลนาขา อำเภอเมืองอุดรธานี จังหวัดอุดรธานี

**Lot ID: 2363941**  
Date Received : Jun 12, 2023  
Date Reported : Jun 16, 2023  
Report Number : 2670348-1

<b>Sample Number</b>	2363941-8
<b>Sampled Date</b>	Jun 08, 2023
<b>Sample Description</b>	Air Quality
<b>Location</b>	วัดโคกศรีสำราญ (A2) (GPS 48Q 268723, 1941996)
<b>Date Analysis Commenced</b>	Jun 12, 2023
<b>Condition of Sample</b>	Drawn into one glass filter paper (8x10 inch) placed in plastic bag and one quartz filter paper (8x10 inch) placed in plastic bag
<b>Barometric Pressure</b>	736 mmHg
<b>Atmospheric Temperature</b>	31.0 °C

Analyte	Sampled Date/time	Unit	LOD	LOQ (LOR)	Result	Guideline Limit	Method	Guideline	Testing Location
<b>Air Testing</b>									
Particulate matter as PM 10	08/06/23 - 09/06/23	mg/m3	-	0.005	0.019	0.12	US EPA 40 CFR Part 50, Appendix J	NEB No.24 Bangkok	
Total Suspended Particulate	08/06/23 - 09/06/23	mg/m3	-	0.005	0.035	0.33	US EPA 40 CFR Part 50, Appendix B	NEB No.24 Bangkok	

**Guideline :**  
NEB No.24 : Notification of the National Environmental Board. No.24, 2004 (B.E.2547) dated September 22, 2004  
**Sampled By :** Adisak Phomphai

- Remark :
- LOD : Limit of Detection
  - "<" : Lower than LOQ (Limit of Quantitation) / LOR (Limit of Reporting)
  - Analyte(s) marked \* is/are not included in scope of Accreditation ISO/IEC 17025.
  - The laboratory has been accepted as an accredited laboratory complying with the ISO/IEC 17025.

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Scientist (4)



# Analysis / Test Report

TESTING  
No.0009

**Client :** Fourtier Consultants Co., Ltd.  
99/2 Moo 8, Tambon Bang Mueang, Amphoe Mueang Samut Prakan, Samut Prakan  
Thailand 10270  
**P/O :** Q2318493(R1)  
**Project Name :** โครงการโรงไฟฟ้าพลังงานรุ่งเรือง (UDT4) บริษัท พลังงานรุ่งเรือง จำกัด  
**Project Location :** ในพื้นที่ตำบลนาขา อำเภอเมืองอุดรธานี จังหวัดอุดรธานี

**Lot ID: 2363941**  
Date Received : Jun 12, 2023  
Date Reported : Jun 16, 2023  
Report Number : 2670348-1

<b>Sample Number</b>	2363941-9
<b>Sampled Date</b>	Jun 09, 2023
<b>Sample Description</b>	Air Quality
<b>Location</b>	วัดโคกศรีสำราญ (A2) (GPS 48Q 268723, 1941996)
<b>Date Analysis Commenced</b>	Jun 12, 2023
<b>Condition of Sample</b>	Drawn into one glass filter paper (8x10 inch) placed in plastic bag and one quartz filter paper (8x10 inch) placed in plastic bag
<b>Barometric Pressure</b>	736 mmHg
<b>Atmospheric Temperature</b>	31.0 °C

Analyte	Sampled Date/time	Unit	LOD	LOQ (LOR)	Result	Guideline Limit	Method	Guideline	Testing Location
<b>Air Testing</b>									
Particulate matter as PM 10	09/06/23 - 10/06/23	mg/m3	-	0.005	0.024	0.12	US EPA 40 CFR Part 50, Appendix J	NEB No.24 Bangkok	
Total Suspended Particulate	09/06/23 - 10/06/23	mg/m3	-	0.005	0.032	0.33	US EPA 40 CFR Part 50, Appendix B	NEB No.24 Bangkok	

**Guideline :**  
NEB No.24 : Notification of the National Environmental Board. No.24, 2004 (B.E.2547) dated September 22, 2004  
**Sampled By :** Adisak Phomphai

- Remark :
- LOD : Limit of Detection
  - "<" : Lower than LOQ (Limit of Quantitation) / LOR (Limit of Reporting)
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Scientist (4)



# Analysis / Test Report

TESTING  
No.0009

**Client :** Fournier Consultants Co., Ltd.  
99/2 Moo 8, Tambon Bang Mueang, Amphoe Mueang Samut Prakan, Samut Prakan  
Thailand 10270  
**P/O :** Q2318493(R1)  
**Project Name :** โครงการโรงไฟฟ้าพลังงานรุ่งเรือง (UDT4) บริษัท พลังงานรุ่งเรือง จำกัด  
**Project Location :** ในพื้นที่ตำบลนาขา อำเภอเมืองอุดรธานี จังหวัดอุดรธานี

**Lot ID: 2363941**  
Date Received : Jun 12, 2023  
Date Reported : Jun 16, 2023  
Report Number : 2670348-1

<b>Sample Number</b>	2363941-10
<b>Sampled Date</b>	Jun 10, 2023
<b>Sample Description</b>	Air Quality
<b>Location</b>	วัดโคกศรีสำราญ (A2) (GPS 48Q 268723, 1941996)
<b>Date Analysis Commenced</b>	Jun 12, 2023
<b>Condition of Sample</b>	Drawn into one glass filter paper (8x10 inch) placed in plastic bag and one quartz filter paper (8x10 inch) placed in plastic bag
<b>Barometric Pressure</b>	736 mmHg
<b>Atmospheric Temperature</b>	30.0 °C

Analyte	Sampled Date/time	Unit	LOD	LOQ (LOR)	Result	Guideline Limit	Method	Guideline	Testing Location
<b>Air Testing</b>									
Particulate matter as PM 10	10/06/23 - 11/06/23	mg/m3	-	0.005	0.020	0.12	US EPA 40 CFR Part 50, Appendix J	NEB No.24 Bangkok	
Total Suspended Particulate	10/06/23 - 11/06/23	mg/m3	-	0.005	0.036	0.33	US EPA 40 CFR Part 50, Appendix B	NEB No.24 Bangkok	

**Guideline :**  
NEB No.24 : Notification of the National Environmental Board. No.24, 2004 (B.E.2547) dated September 22, 2004  
**Sampled By :** Adisak Phomphai

- Remark :
- LOD : Limit of Detection
  - "<" : Lower than LOQ (Limit of Quantitation) / LOR (Limit of Reporting)
  - Analyte(s) marked \* is/are not included in scope of Accreditation ISO/IEC 17025.
  - The laboratory has been accepted as an accredited laboratory complying with the ISO/IEC 17025.

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Scientist (4)



# Analysis / Test Report

**Client** : Fournier Consultants Co., Ltd.  
99/2 Moo 8, Tambon Bang Mueang, Amphoe Mueang Samut Prakan,  
Samut Prakan Thailand 10270

**Lot ID** : 2363944  
Date Received : Jun 12, 2023  
Date Reported : Jun 15, 2023  
Report Number : 2670350-1

**P/O** : Q2318493(R1)

**Project Name** : โครงการโรงไฟฟ้าพลังงานรุ่งเรือง (UDT4) บริษัท พลังงานรุ่งเรือง จำกัด

**Project Location** : ในพื้นที่ตามลนาขา อำเภอเมืองอุตรธานี จังหวัดอุตรธานี

Page 1 of 2

**Sample Number** : 2363944-1 to 5  
**Parameter** : Wind Speed / Wind Direction  
**Location** : วัดป่านานัญชัยมงคล (A1) (GPS 48Q 274351, 1942269)  
**Sampling Date** : Jun 06 - Jun 11, 2023  
**Sampling by** : Adisak Phomphai

Time	Jun 06 - Jun 07, 2023			Jun 07 - Jun 08, 2023			Jun 08 - Jun 09, 2023			Jun 09 - Jun 10, 2023			Jun 10 - Jun 11, 2023			-			-		
	WS (m/s)	WD (deg)		WS (m/s)	WD (deg)		WS (m/s)	WD (deg)		WS (m/s)	WD (deg)		WS (m/s)	WD (deg)		-	-	-	-	-	-
02:00 PM - 03:00 PM	0.7	0.0	N	2.4	284.0	WNW	0.9	242.0	WSW	1.7	285.0	WNW	1.2	52.0	NE	-	-	-	-	-	-
03:00 PM - 04:00 PM	0.9	148.0	SSE	0.8	157.0	SSE	0.2	-	-	1.2	209.0	SSW	1.5	305.0	NW	-	-	-	-	-	-
04:00 PM - 05:00 PM	0.7	217.0	SW	0.3	139.0	SE	0.8	242.0	WSW	0.8	221.0	SW	0.4	61.0	ENE	-	-	-	-	-	-
05:00 PM - 06:00 PM	0.7	200.0	SSW	0.2	-	-	1.4	182.0	S	0.8	225.0	SW	0.2	-	-	-	-	-	-	-	-
06:00 PM - 07:00 PM	0.6	171.0	S	0.3	167.0	SSE	0.1	-	-	0.1	-	-	0.2	-	-	-	-	-	-	-	-
07:00 PM - 08:00 PM	0.1	-	-	0.5	167.0	SSE	0.1	-	-	0.2	-	-	0.1	-	-	-	-	-	-	-	-
08:00 PM - 09:00 PM	0.2	-	-	2.1	257.0	WSW	0.2	-	-	0.1	-	-	0.1	-	-	-	-	-	-	-	-
09:00 PM - 10:00 PM	0.1	-	-	0.4	192.0	SSW	0.1	-	-	0.1	-	-	0.1	-	-	-	-	-	-	-	-
10:00 PM - 11:00 PM	0.1	-	-	0.5	209.0	SSW	0.1	-	-	0.2	-	-	0.2	-	-	-	-	-	-	-	-
11:00 PM - 12:00 AM	0.2	-	-	0.2	-	-	0.1	-	-	0.2	-	-	0.1	-	-	-	-	-	-	-	-
12:00 AM - 01:00 AM	1.0	116.0	ESE	0.3	205.0	SSW	0.2	-	-	0.4	222.0	SW	0.1	-	-	-	-	-	-	-	-
01:00 AM - 02:00 AM	0.3	191.0	S	0.6	174.0	S	0.4	137.0	SE	0.1	-	-	0.3	197.0	SSW	-	-	-	-	-	-
02:00 AM - 03:00 AM	0.2	-	-	0.5	166.0	SSE	0.2	-	-	0.1	-	-	0.1	-	-	-	-	-	-	-	-
03:00 AM - 04:00 AM	0.2	-	-	0.2	-	-	0.1	-	-	0.5	42.0	NE	0.1	-	-	-	-	-	-	-	-
04:00 AM - 05:00 AM	0.3	109.0	ESE	0.1	-	-	0.1	-	-	0.2	-	-	0.2	-	-	-	-	-	-	-	-
05:00 AM - 06:00 AM	0.1	-	-	0.2	-	-	0.2	-	-	0.2	-	-	0.4	146.0	SE	-	-	-	-	-	-
06:00 AM - 07:00 AM	0.1	-	-	0.1	-	-	0.1	-	-	0.1	-	-	0.1	-	-	-	-	-	-	-	-
07:00 AM - 08:00 AM	0.4	131.0	SE	0.3	202.0	SSW	0.3	198.0	SSW	0.2	-	-	0.6	134.0	SE	-	-	-	-	-	-
08:00 AM - 09:00 AM	1.0	129.0	SE	0.3	158.0	SSE	0.2	-	-	1.0	173.0	S	0.2	-	-	-	-	-	-	-	-
09:00 AM - 10:00 AM	0.5	168.0	SSE	1.2	149.0	SSE	0.8	137.0	SE	0.9	221.0	SW	0.7	113.0	ESE	-	-	-	-	-	-
10:00 AM - 11:00 AM	1.6	148.0	SSE	0.3	10.0	N	0.4	287.0	WNW	1.3	142.0	SE	0.1	-	-	-	-	-	-	-	-
11:00 AM - 12:00 PM	0.3	140.0	SE	1.1	110.0	ESE	0.1	-	-	1.7	239.0	WSW	0.7	211.0	SSW	-	-	-	-	-	-
12:00 PM - 01:00 PM	0.5	205.0	SSW	0.9	342.0	NNW	1.5	309.0	NW	2.1	335.0	NNW	0.5	172.0	S	-	-	-	-	-	-
01:00 PM - 02:00 PM	0.6	75.0	ENE	0.5	129.0	SE	2.3	300.0	WNW	1.1	325.0	NW	0.4	182.0	S	-	-	-	-	-	-

Reference Method : Cup Anemometer & Anodized Aluminium Vane Method

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Assistant General Manager



# Analysis / Test Report

**Client** : Fournier Consultants Co., Ltd.  
 99/2 Moo 8, Tambon Bang Mueang, Amphoe Mueang Samut Prakan,  
 Samut Prakan Thailand 10270

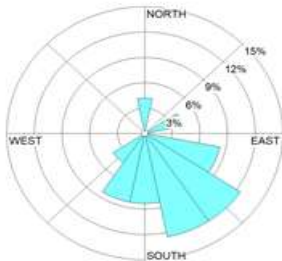
**Lot ID** : 2363944  
 Date Received : Jun 12, 2023  
 Date Reported : Jun 15, 2023  
 Report Number : 2670350-1

**P/O** : Q2318493(R1)

**Project Name** : โครงการโรงไฟฟ้าพลังงานรุ่งเรือง (UDT4) บริษัท พลังงานรุ่งเรือง จำกัด

**Project Location** : ในพื้นที่ตำบลนาขา อำเภอมืองอุดรธานี จังหวัดอุดรธานี

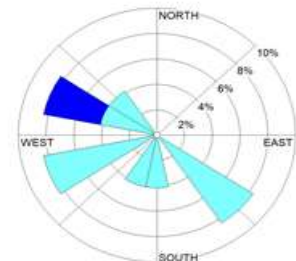
## Wind Rose



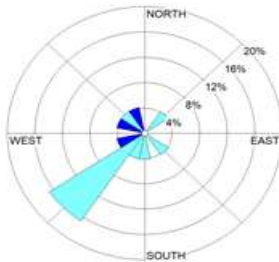
Date : Jun 06-07, 2023



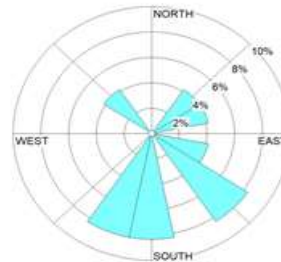
Date : Jun 07-08, 2023



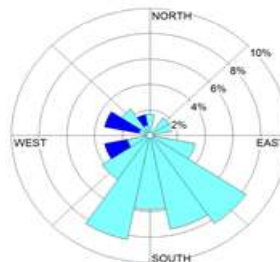
Date : Jun 08-09, 2023



Date : Jun 09-10, 2023



Date : Jun 10-11, 2023



Date : Jun 06-11, 2023

WS(m/s)	%
≥ 10.0	0.00
8.0-10.0	0.00
5.5-8.0	0.00
3.3-5.5	0.00
1.7-3.3	5.00
0.3-1.7	48.33
Calms	46.67

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Assistant General Manager





# Analysis / Test Report

**Client** : Fournier Consultants Co., Ltd.  
99/2 Moo 8, Tambon Bang Mueang, Amphoe Mueang Samut Prakan,  
Samut Prakan Thailand 10270

**Lot ID** : 2363944  
Date Received : Jun 12, 2023  
Date Reported : Jun 15, 2023  
Report Number : 2670350-1

**P/O** : Q2318493(R1)

**Project Name** : โครงการโรงไฟฟ้าพลังงานรุ่งเรือง (UDT4) บริษัท พลังงานรุ่งเรือง จำกัด

**Project Location** : ในพื้นที่ตามลนาขา อำเภอเมืองอุตรธานี จังหวัดอุตรธานี

Page 1 of 2

**Sample Number** : 2363944-6 to 10  
**Parameter** : Wind Speed / Wind Direction  
**Location** : วัดโคกศรีสำราญ (A2) (GPS 48Q 268723, 1941996)  
**Sampling Date** : Jun 06 - Jun 11, 2023  
**Sampling by** : Adisak Phomphai

Time	Jun 06 - Jun 07, 2023			Jun 07 - Jun 08, 2023			Jun 08 - Jun 09, 2023			Jun 09 - Jun 10, 2023			Jun 10 - Jun 11, 2023			-		-	
	WS (m/s)	WD (deg)		WS (m/s)	WD (deg)		WS (m/s)	WD (deg)		WS (m/s)	WD (deg)		WS (m/s)	WD (deg)		-	-	-	-
01:00 PM - 02:00 PM	2.3	53.0	NE	3.3	63.0	ENE	1.6	67.0	ENE	1.3	0.0	N	1.7	199.0	SSW	-	-	-	-
02:00 PM - 03:00 PM	0.6	156.0	SSE	4.9	169.0	S	1.7	105.0	ESE	4.7	74.0	ENE	6.2	80.0	E	-	-	-	-
03:00 PM - 04:00 PM	4.0	163.0	SSE	1.0	168.0	SSE	1.6	153.0	SSE	4.6	76.0	ENE	2.0	231.0	SW	-	-	-	-
04:00 PM - 05:00 PM	3.4	150.0	SSE	0.7	192.0	SSW	2.4	174.0	S	1.0	79.0	E	0.2	-	-	-	-	-	-
05:00 PM - 06:00 PM	2.4	159.0	SSE	0.2	-	-	3.4	153.0	SSE	0.6	116.0	ESE	0.5	210.0	SSW	-	-	-	-
06:00 PM - 07:00 PM	2.5	162.0	SSE	0.1	-	-	0.7	76.0	ENE	0.5	108.0	ESE	0.2	-	-	-	-	-	-
07:00 PM - 08:00 PM	0.9	154.0	SSE	5.3	64.0	ENE	0.3	175.0	S	2.5	152.0	SSE	0.3	107.0	ESE	-	-	-	-
08:00 PM - 09:00 PM	1.3	162.0	SSE	1.0	1.0	N	0.1	-	-	1.6	155.0	SSE	0.5	151.0	SSE	-	-	-	-
09:00 PM - 10:00 PM	1.1	156.0	SSE	0.7	121.0	ESE	0.4	142.0	SE	1.3	139.0	SE	0.1	-	-	-	-	-	-
10:00 PM - 11:00 PM	0.9	151.0	SSE	1.1	156.0	SSE	0.1	-	-	0.5	153.0	SSE	0.1	-	-	-	-	-	-
11:00 PM - 12:00 AM	0.8	156.0	SSE	0.1	-	-	1.8	116.0	ESE	0.2	-	-	0.2	-	-	-	-	-	-
12:00 AM - 01:00 AM	0.1	-	-	0.2	-	-	0.1	-	-	0.1	-	-	0.4	153.0	SSE	-	-	-	-
01:00 AM - 02:00 AM	0.2	-	-	0.1	-	-	0.2	-	-	0.1	-	-	0.1	-	-	-	-	-	-
02:00 AM - 03:00 AM	0.4	162.0	SSE	0.5	154.0	SSE	0.1	-	-	0.2	-	-	0.1	-	-	-	-	-	-
03:00 AM - 04:00 AM	0.1	-	-	0.3	128.0	SE	0.3	91.0	E	0.4	188.0	S	0.1	-	-	-	-	-	-
04:00 AM - 05:00 AM	0.3	186.0	S	0.1	-	-	0.2	-	-	0.1	-	-	0.3	189.0	S	-	-	-	-
05:00 AM - 06:00 AM	0.1	-	-	0.2	-	-	0.1	-	-	0.2	-	-	0.4	147.0	SSE	-	-	-	-
06:00 AM - 07:00 AM	0.2	-	-	0.1	-	-	0.1	-	-	0.1	-	-	0.6	158.0	SSE	-	-	-	-
07:00 AM - 08:00 AM	0.1	-	-	3.8	144.0	SE	1.7	154.0	SSE	0.3	168.0	SSE	2.9	149.0	SSE	-	-	-	-
08:00 AM - 09:00 AM	0.2	-	-	0.4	199.0	SSW	1.4	79.0	E	4.2	81.0	E	1.5	169.0	S	-	-	-	-
09:00 AM - 10:00 AM	0.3	195.0	SSW	1.4	227.0	SW	1.0	81.0	E	2.8	128.0	SE	1.6	1.0	N	-	-	-	-
10:00 AM - 11:00 AM	2.5	90.0	E	1.4	7.0	N	1.3	68.0	ENE	2.1	134.0	SE	2.6	106.0	ESE	-	-	-	-
11:00 AM - 12:00 PM	5.0	185.0	S	0.5	91.0	E	2.2	79.0	E	8.0	65.0	ENE	2.2	121.0	ESE	-	-	-	-
12:00 PM - 01:00 PM	2.0	148.0	SSE	1.4	193.0	SSW	0.6	93.0	E	1.0	9.0	N	1.1	127.0	SE	-	-	-	-

Reference Method : Cup Anemometer & Anodized Aluminium Vane Method

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Assistant General Manager



# Analysis / Test Report

**Client** : Fournier Consultants Co., Ltd.  
 99/2 Moo 8, Tambon Bang Mueang, Amphoe Mueang Samut Prakan,  
 Samut Prakan Thailand 10270

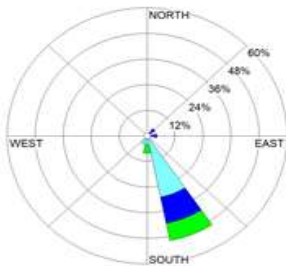
**Lot ID** : 2363944  
 Date Received : Jun 12, 2023  
 Date Reported : Jun 15, 2023  
 Report Number : 2670350-1

**P/O** : Q2318493(R1)

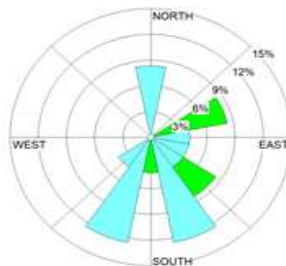
**Project Name** : โครงการโรงไฟฟ้าพลังงานรุ่งเรือง (UDT4) บริษัท พลังงานรุ่งเรือง จำกัด

**Project Location** : ในพื้นที่ตำบลนาขา อำเภอมืองอุดรธานี จังหวัดอุดรธานี

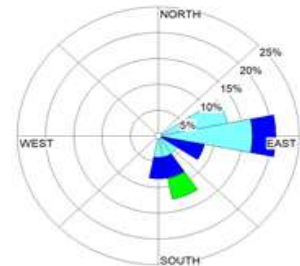
## Wind Rose



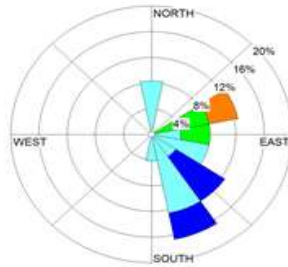
Date : Jun 06-07, 2023



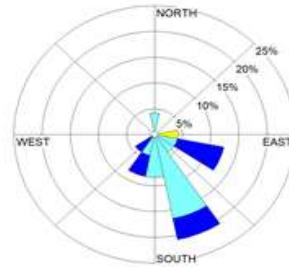
Date : Jun 07-08, 2023



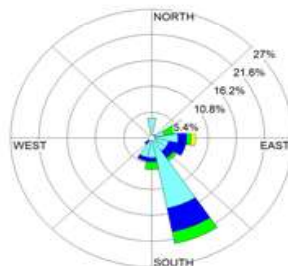
Date : Jun 08-09, 2023



Date : Jun 09-10, 2023



Date : Jun 10-11, 2023



Date : Jun 06-11, 2023

WS(m/s)	%
≥ 10.0	0.00
8.0-10.0	0.83
5.5-8.0	0.83
3.3-5.5	9.17
1.7-3.3	15.00
0.3-1.7	42.50
Calms	31.67

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Assistant General Manager

**APPENDIX 3C**

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**THE RESULTS OF NOISE LEVEL MEASUREMENT**



# Analysis / Test Report

**Client :** Fournier Consultants Co., Ltd.  
 99/2 Moo 8, Tambon Bang Mueang, Amphoe Mueang Samut Prakan, Samut Prakan Thailand 10271  
**P/O :** Q2318493(R1)  
**Project Name :** โครงการโรงไฟฟ้าพลังงานรุ่งเรือง (UDT4) บริษัท พลังงานรุ่งเรือง จำกัด  
**Project Location :** ในพื้นที่ตามลนาขา อำเภอเมืองอุตรธานี จังหวัดอุตรธานี

**Lot ID: 2363918**

Date Received : Jun 12, 2023

Date Reported : Jun 16, 2023

Report Number: 2687117-1

**Sample Number** 2363918-1  
**Parameter** Noise (Leq 24 hrs.)  
**Location** บ้านพักอาศัยด้านทิศใต้ (N1) (GPS 48Q 271171, 1940332)  
**Measurement Date** Jun 06 - Jun 07, 2023  
**Measurement by** [This information has been removed as it falls within the exceptions to disclose specified in paragraph 17(2) of ADB's Access to Information Policy.]  
**Sound Level meter** Serial No. 222542

Time	Leq (dB(A))	Lmax (dB(A))	L90 (dB(A))
08:00 AM - 09:00 AM	46.2	56.6	42.8
09:00 AM - 10:00 AM	48.2	63.1	44.4
10:00 AM - 11:00 AM	47.0	62.4	42.7
11:00 AM - 12:00 PM	43.1	67.4	37.6
12:00 PM - 01:00 PM	43.4	64.3	38.2
01:00 PM - 02:00 PM	42.3	70.7	36.2
02:00 PM - 03:00 PM	43.4	60.3	35.0
03:00 PM - 04:00 PM	44.3	64.6	34.9
04:00 PM - 05:00 PM	43.5	65.3	34.2
05:00 PM - 06:00 PM	45.6	61.2	34.8
06:00 PM - 07:00 PM	49.1	62.8	42.7
07:00 PM - 08:00 PM	54.9	68.2	53.2
08:00 PM - 09:00 PM	52.6	64.9	50.0
09:00 PM - 10:00 PM	51.2	70.9	46.3
10:00 PM - 11:00 PM	52.8	69.6	47.0
11:00 PM - 12:00 AM	48.0	68.9	42.4
12:00 AM - 01:00 AM	44.6	66.8	40.3
01:00 AM - 02:00 AM	42.5	57.5	39.6
02:00 AM - 03:00 AM	39.0	52.8	37.1
03:00 AM - 04:00 AM	40.6	57.0	37.2
04:00 AM - 05:00 AM	42.4	57.9	38.2
05:00 AM - 06:00 AM	46.7	60.0	42.8
06:00 AM - 07:00 AM	45.2	61.4	40.9
07:00 AM - 08:00 AM	45.5	64.0	40.1

Leq Average 24 hrs. (dB(A)) 47.9  
 Lmax (dB(A)) 70.9  
 L90 (dB(A)) 40.1  
 Ldn (dB(A)) 53.4  
 Standard (dB(A)) 70 115

Reference Method : ISO1996-1 and 1996-2

- Standard : 1. ประกาศคณะกรรมการสิ่งแวดล้อมแห่งชาติ ฉบับที่ 15 (พ.ศ. 2540) เรื่องกำหนดมาตรฐานระดับเสียงโดยทั่วไป  
 2. ประกาศกระทรวงอุตสาหกรรม เรื่องกำหนดค่าระดับเสียงการรบกวน และระดับเสียงที่เกิดจากการประกอบกิจการโรงงาน พ.ศ. 2548

**Technical Management**

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**Approved by**

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# Analysis / Test Report

**Client :** Fournier Consultants Co., Ltd.  
 99/2 Moo 8, Tambon Bang Mueang, Amphoe Mueang Samut Prakan, Samut Prakan Thailand 10271  
**P/O :** Q2318493(R1)  
**Project Name :** โครงการโรงไฟฟ้าพลังงานรุ่งเรือง (UDT4) บริษัท พลังงานรุ่งเรือง จำกัด  
**Project Location :** ในพื้นที่ตามลนาขา อำเภอเมืองอุตรธานี จังหวัดอุตรธานี

**Lot ID: 2363918**

Date Received : Jun 12, 2023

Date Reported : Jun 16, 2023

Report Number: 2687118-1

Page 1 of 1

**Sample Number** 2363918-2  
**Parameter** Noise (Leq 24 hrs.)  
**Location** บ้านพักอาศัยด้านทิศใต้ (N1) (GPS 48Q 271171, 1940332)  
**Measurement Date** Jun 07 - Jun 08, 2023  
**Measurement by** [This information has been removed as it falls within the exceptions to disclose specified in paragraph 17(2) of ADB's Access to Information Policy.]  
**Sound Level meter** Serial No. 222542

Time	Leq (dB(A))	Lmax (dB(A))	L90 (dB(A))
08:00 AM - 09:00 AM	44.4	63.3	40.2
09:00 AM - 10:00 AM	47.5	61.7	45.1
10:00 AM - 11:00 AM	61.9	70.5	53.8
11:00 AM - 12:00 PM	45.7	68.1	41.1
12:00 PM - 01:00 PM	42.7	55.0	36.1
01:00 PM - 02:00 PM	44.4	71.7	33.5
02:00 PM - 03:00 PM	57.2	91.5	40.9
03:00 PM - 04:00 PM	42.5	60.4	38.3
04:00 PM - 05:00 PM	43.2	59.8	37.5
05:00 PM - 06:00 PM	41.2	66.2	34.7
06:00 PM - 07:00 PM	42.9	58.1	39.4
07:00 PM - 08:00 PM	51.2	68.1	48.7
08:00 PM - 09:00 PM	44.5	60.6	39.0
09:00 PM - 10:00 PM	42.3	59.7	37.9
10:00 PM - 11:00 PM	41.5	59.6	37.8
11:00 PM - 12:00 AM	42.5	57.2	38.2
12:00 AM - 01:00 AM	40.8	56.0	38.1
01:00 AM - 02:00 AM	39.3	55.3	36.7
02:00 AM - 03:00 AM	39.4	55.7	35.9
03:00 AM - 04:00 AM	40.3	56.0	36.3
04:00 AM - 05:00 AM	41.2	56.2	37.2
05:00 AM - 06:00 AM	47.5	58.3	43.9
06:00 AM - 07:00 AM	47.9	64.6	42.1
07:00 AM - 08:00 AM	45.9	63.3	41.1

Leq Average 24 hrs. (dB(A)) 50.6  
 Lmax (dB(A)) 91.5  
 L90 (dB(A)) 38.2  
 Ldn (dB(A)) 52.8  
 Standard (dB(A)) 70 115

Reference Method : ISO1996-1 and 1996-2

- Standard : 1. ประกาศคณะกรรมการสิ่งแวดล้อมแห่งชาติ ฉบับที่ 15 (พ.ศ. 2540) เรื่องกำหนดมาตรฐานระดับเสียงโดยทั่วไป  
 2. ประกาศกระทรวงอุตสาหกรรม เรื่องกำหนดค่าระดับเสียงการรบกวน และระดับเสียงที่เกิดจากการประกอบกิจการโรงงาน พ.ศ. 2548

**Technical Management**

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**Approved by**

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# Analysis / Test Report

**Client :** Fournier Consultants Co., Ltd.  
 99/2 Moo 8, Tambon Bang Mueang, Amphoe Mueang Samut Prakan, Samut Prakan Thailand 10271  
**P/O :** Q2318493(R1)  
**Project Name :** โครงการโรงไฟฟ้าพลังงานรุ่งเรือง (UDT4) บริษัท พลังงานรุ่งเรือง จำกัด  
**Project Location :** ในพื้นที่ตามลนาขา อำเภอเมืองอุตรธานี จังหวัดอุตรธานี

**Lot ID: 2363918**

Date Received : Jun 12, 2023

Date Reported : Jun 16, 2023

Report Number: 2687119-1

**Sample Number** 2363918-3  
**Parameter** Noise (Leq 24 hrs.)  
**Location** บ้านพักอาศัยด้านทิศใต้ (N1) (GPS 48Q 271171, 1940332)  
**Measurement Date** Jun 08 - Jun 09, 2023  
**Measurement by** [This information has been removed as it falls within the exceptions to disclose specified in paragraph 17(2) of ADB's Access to Information Policy.]  
**Sound Level meter** Serial No. 222542

Time	Leq (dB(A))	Lmax (dB(A))	L90 (dB(A))
08:00 AM - 09:00 AM	49.0	71.7	43.5
09:00 AM - 10:00 AM	48.3	67.3	43.9
10:00 AM - 11:00 AM	47.4	55.9	43.6
11:00 AM - 12:00 PM	45.9	62.7	40.2
12:00 PM - 01:00 PM	43.4	55.2	35.4
01:00 PM - 02:00 PM	43.1	56.4	35.0
02:00 PM - 03:00 PM	44.4	66.6	38.0
03:00 PM - 04:00 PM	43.1	65.7	35.9
04:00 PM - 05:00 PM	44.9	70.9	37.0
05:00 PM - 06:00 PM	41.4	67.0	34.5
06:00 PM - 07:00 PM	43.5	62.8	38.9
07:00 PM - 08:00 PM	54.8	60.7	53.9
08:00 PM - 09:00 PM	47.8	59.8	45.4
09:00 PM - 10:00 PM	45.1	56.0	43.6
10:00 PM - 11:00 PM	44.8	53.7	43.0
11:00 PM - 12:00 AM	43.5	51.6	41.3
12:00 AM - 01:00 AM	44.9	51.1	43.3
01:00 AM - 02:00 AM	43.9	53.9	41.2
02:00 AM - 03:00 AM	38.6	54.9	36.2
03:00 AM - 04:00 AM	39.9	56.8	36.1
04:00 AM - 05:00 AM	42.2	56.5	37.6
05:00 AM - 06:00 AM	46.5	62.4	42.0
06:00 AM - 07:00 AM	46.9	63.4	41.3
07:00 AM - 08:00 AM	47.4	58.1	43.3

Leq Average 24 hrs. (dB(A)) 46.5  
 Lmax (dB(A)) 71.7  
 L90 (dB(A)) 41.2  
 Ldn (dB(A)) 51.2  
 Standard (dB(A)) 70 115

Reference Method : ISO1996-1 and 1996-2

- Standard : 1. ประกาศคณะกรรมการสิ่งแวดล้อมแห่งชาติ ฉบับที่ 15 (พ.ศ. 2540) เรื่องกำหนดมาตรฐานระดับเสียงโดยทั่วไป  
 2. ประกาศกระทรวงอุตสาหกรรม เรื่องกำหนดค่าระดับเสียงการรบกวน และระดับเสียงที่เกิดจากการประกอบกิจการโรงงาน พ.ศ. 2548

### Technical Management

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### Approved by

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# Analysis / Test Report

**Client :** Fournier Consultants Co., Ltd.  
 99/2 Moo 8, Tambon Bang Mueang, Amphoe Mueang Samut Prakan, Samut Prakan Thailand 10270  
**P/O :** Q2318493(R1)  
**Project Name :** โครงการโรงไฟฟ้าพลังงานรุ่งเรือง (UDT4) บริษัท พลังงานรุ่งเรือง จำกัด  
**Project Location :** ในพื้นที่ตามลนาขา อำเภอเมืองอุตรธานี จังหวัดอุตรธานี

**Lot ID: 2363918**

Date Received : Jun 12, 2023

Date Reported : Jun 16, 2023

Report Number: 2687120-1

**Sample Number** 2363918-4  
**Parameter** Noise (Leq 24 hrs.)  
**Location** บ้านพักอาศัยด้านทิศใต้ (N1) (GPS 48Q 271171, 1940332)  
**Measurement Date** Jun 09 - Jun 10, 2023  
**Measurement by** [This information has been removed as it falls within the exceptions to disclose specified in paragraph 17(2) of ADB's Access to Information Policy.]  
**Sound Level meter** Serial No. 222542

Time	Leq (dB(A))	Lmax (dB(A))	L90 (dB(A))
08:00 AM - 09:00 AM	49.4	61.3	46.8
09:00 AM - 10:00 AM	49.3	60.8	46.5
10:00 AM - 11:00 AM	46.2	57.8	42.0
11:00 AM - 12:00 PM	45.5	64.2	37.1
12:00 PM - 01:00 PM	43.3	55.6	36.1
01:00 PM - 02:00 PM	44.6	66.7	37.3
02:00 PM - 03:00 PM	44.2	67.0	35.3
03:00 PM - 04:00 PM	45.6	63.1	34.6
04:00 PM - 05:00 PM	43.1	58.5	33.1
05:00 PM - 06:00 PM	42.2	59.7	37.5
06:00 PM - 07:00 PM	45.6	62.0	43.4
07:00 PM - 08:00 PM	55.7	59.7	55.1
08:00 PM - 09:00 PM	50.1	64.1	47.1
09:00 PM - 10:00 PM	49.2	57.2	43.9
10:00 PM - 11:00 PM	48.6	55.8	43.2
11:00 PM - 12:00 AM	40.8	61.3	39.5
12:00 AM - 01:00 AM	39.8	51.2	38.2
01:00 AM - 02:00 AM	41.6	50.8	38.4
02:00 AM - 03:00 AM	39.4	57.4	36.7
03:00 AM - 04:00 AM	38.8	55.3	35.5
04:00 AM - 05:00 AM	40.1	57.2	36.1
05:00 AM - 06:00 AM	46.5	58.0	42.6
06:00 AM - 07:00 AM	46.0	63.2	40.6
07:00 AM - 08:00 AM	50.4	84.6	44.4

Leq Average 24 hrs. (dB(A)) 47.4  
 Lmax (dB(A)) 84.6  
 L90 (dB(A)) 38.4  
 Ldn (dB(A)) 51.4  
 Standard (dB(A)) 70 115

Reference Method : ISO1996-1 and 1996-2

- Standard : 1. ประกาศคณะกรรมการสิ่งแวดล้อมแห่งชาติ ฉบับที่ 15 (พ.ศ. 2540) เรื่องกำหนดมาตรฐานระดับเสียงโดยทั่วไป  
 2. ประกาศกระทรวงอุตสาหกรรม เรื่องกำหนดค่าระดับเสียงการรบกวน และระดับเสียงที่เกิดจากการประกอบกิจการโรงงาน พ.ศ. 2548

**Technical Management**

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**Approved by**

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# Analysis / Test Report

**Client :** Fournier Consultants Co., Ltd.  
 99/2 Moo 8, Tambon Bang Mueang, Amphoe Mueang Samut Prakan, Samut Prakan Thailand 10270  
**P/O :** Q2318493(R1)  
**Project Name :** โครงการโรงไฟฟ้าพลังงานรุ่งเรือง (UDT4) บริษัท พลังงานรุ่งเรือง จำกัด  
**Project Location :** ในพื้นที่ตามลนาขา อำเภอเมืองอุตรธานี จังหวัดอุตรธานี

**Lot ID: 2363918**

Date Received : Jun 12, 2023

Date Reported : Jun 16, 2023

Report Number: 2687121-1

**Sample Number** 2363918-5  
**Parameter** Noise (Leq 24 hrs.)  
**Location** บ้านพักอาศัยด้านทิศใต้ (N1) (GPS 48Q 271171, 1940332)  
**Measurement Date** Jun 10 - Jun 11, 2023  
**Measurement by** [This information has been removed as it falls within the exceptions to disclose specified in paragraph 17(2) of ADB's Access to Information Policy]  
**Sound Level meter** Serial No. 222542

Time	Leq (dB(A))	Lmax (dB(A))	L90 (dB(A))
08:00 AM - 09:00 AM	47.4	64.3	45.0
09:00 AM - 10:00 AM	47.7	57.5	45.4
10:00 AM - 11:00 AM	46.3	60.3	40.1
11:00 AM - 12:00 PM	46.1	72.4	36.8
12:00 PM - 01:00 PM	45.1	67.0	38.6
01:00 PM - 02:00 PM	44.4	72.9	35.9
02:00 PM - 03:00 PM	48.2	73.4	42.9
03:00 PM - 04:00 PM	48.2	69.4	43.9
04:00 PM - 05:00 PM	43.5	60.3	38.7
05:00 PM - 06:00 PM	47.7	61.7	45.4
06:00 PM - 07:00 PM	47.5	59.0	44.3
07:00 PM - 08:00 PM	53.0	63.3	51.8
08:00 PM - 09:00 PM	46.6	59.7	42.7
09:00 PM - 10:00 PM	44.9	64.1	40.3
10:00 PM - 11:00 PM	42.4	65.3	36.3
11:00 PM - 12:00 AM	37.9	58.4	34.9
12:00 AM - 01:00 AM	43.8	67.8	37.7
01:00 AM - 02:00 AM	38.5	52.1	36.3
02:00 AM - 03:00 AM	37.7	54.5	35.3
03:00 AM - 04:00 AM	37.6	58.6	34.6
04:00 AM - 05:00 AM	40.2	60.6	35.1
05:00 AM - 06:00 AM	47.6	64.6	40.7
06:00 AM - 07:00 AM	45.3	65.0	38.4
07:00 AM - 08:00 AM	45.5	64.7	38.8

Leq Average 24 hrs. (dB(A)) 46.2  
 Lmax (dB(A)) 73.4  
 L90 (dB(A)) 38.7  
 Ldn (dB(A)) 50.2  
 Standard (dB(A)) 70 115

Reference Method : ISO1996-1 and 1996-2

- Standard : 1. ประกาศคณะกรรมการสิ่งแวดล้อมแห่งชาติ ฉบับที่ 15 (พ.ศ. 2540) เรื่องกำหนดมาตรฐานระดับเสียงโดยทั่วไป  
 2. ประกาศกระทรวงอุตสาหกรรม เรื่องกำหนดค่าระดับเสียงการรบกวน และระดับเสียงที่เกิดจากการประกอบกิจการโรงงาน พ.ศ. 2548

**Technical Management**

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**Approved by**

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# Analysis / Test Report

**Client :** Fournier Consultants Co., Ltd.  
 99/2 Moo 8, Tambon Bang Mueang, Amphoe Mueang Samut Prakan, Samut Prakan Thailand 10271  
**P/O :** Q2318493(R1)  
**Project Name :** โครงการโรงไฟฟ้าพลังงานรุ่งเรือง (UDT4) บริษัท พลังงานรุ่งเรือง จำกัด  
**Project Location :** ในพื้นที่ตามลนาขา อำเภอเมืองอุตรธานี จังหวัดอุตรธานี

**Lot ID: 2363918**

Date Received : Jun 12, 2023

Date Reported : Jun 16, 2023

Report Number: 2687122-1

**Sample Number** 2363918-6  
**Parameter** Noise (Leq 24 hrs.)  
**Location** บ้านพักอาศัยด้านทิศตะวันออก (N2) (GPS 48Q 272171, 1940934)  
**Measurement Date** Jun 06 - Jun 07, 2023  
**Measurement by** [This information has been removed as it falls within the exceptions to disclose specified in paragraph 17(2) of ADB's Access to Information Policy.]  
**Sound Level meter** Serial No. 900075

Time	Leq (dB(A))	Lmax (dB(A))	L90 (dB(A))
08:00 AM - 09:00 AM	54.6	73.2	50.1
09:00 AM - 10:00 AM	43.8	64.6	37.3
10:00 AM - 11:00 AM	45.9	65.6	40.4
11:00 AM - 12:00 PM	51.8	70.5	38.9
12:00 PM - 01:00 PM	45.5	66.9	37.4
01:00 PM - 02:00 PM	44.6	68.5	36.4
02:00 PM - 03:00 PM	43.6	60.7	35.5
03:00 PM - 04:00 PM	42.5	70.4	34.6
04:00 PM - 05:00 PM	41.9	62.5	35.7
05:00 PM - 06:00 PM	44.8	67.5	36.2
06:00 PM - 07:00 PM	57.8	78.2	56.4
07:00 PM - 08:00 PM	63.5	65.6	63.0
08:00 PM - 09:00 PM	61.0	65.3	56.8
09:00 PM - 10:00 PM	59.4	65.0	52.8
10:00 PM - 11:00 PM	54.4	64.5	50.3
11:00 PM - 12:00 AM	54.0	59.5	52.3
12:00 AM - 01:00 AM	51.6	61.8	49.8
01:00 AM - 02:00 AM	54.7	62.1	52.6
02:00 AM - 03:00 AM	55.6	62.2	54.2
03:00 AM - 04:00 AM	57.9	65.5	56.0
04:00 AM - 05:00 AM	58.6	66.1	55.8
05:00 AM - 06:00 AM	57.0	68.6	52.0
06:00 AM - 07:00 AM	53.1	66.0	45.2
07:00 AM - 08:00 AM	52.5	73.8	43.1

Leq Average 24 hrs. (dB(A)) 55.8  
 Lmax (dB(A)) 78.2  
 L90 (dB(A)) 49.8  
 Ldn (dB(A)) 62.2  
 Standard (dB(A)) 70 115

Reference Method : ISO1996-1 and 1996-2

- Standard : 1. ประกาศคณะกรรมการสิ่งแวดล้อมแห่งชาติ ฉบับที่ 15 (พ.ศ. 2540) เรื่องกำหนดมาตรฐานระดับเสียงโดยทั่วไป  
 2. ประกาศกระทรวงอุตสาหกรรม เรื่องกำหนดค่าระดับเสียงการรบกวน และระดับเสียงที่เกิดจากการประกอบกิจการโรงงาน พ.ศ. 2548

**Technical Management**

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**Approved by**

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# Analysis / Test Report

**Client :** Fourtier Consultants Co., Ltd.  
 99/2 Moo 8, Tambon Bang Mueang, Amphoe Mueang Samut Prakan, Samut Prakan Thailand 10271  
**P/O :** Q2318493(R1)  
**Project Name :** โครงการโรงไฟฟ้าพลังงานรุ่งเรือง (UDT4) บริษัท พลังงานรุ่งเรือง จำกัด  
**Project Location :** ในพื้นที่ตามลนาขา อำเภอเมืองอุตรธานี จังหวัดอุตรธานี

**Lot ID: 2363918**

Date Received : Jun 12, 2023

Date Reported : Jun 16, 2023

Report Number: 2687123-1

**Sample Number** 2363918-7  
**Parameter** Noise (Leq 24 hrs.)  
**Location** บ้านพักอาศัยด้านทิศตะวันออก (N2) (GPS 48Q 272171, 1940934)  
**Measurement Date** Jun 07 - Jun 08, 2023  
**Measurement by** [This information has been removed as it falls within the exceptions to disclose specified in paragraph 17(2) of ADB's Access to Information Policy.]  
**Sound Level meter** Serial No. 900075

Time	Leq (dB(A))	Lmax (dB(A))	L90 (dB(A))
08:00 AM - 09:00 AM	46.0	69.0	40.3
09:00 AM - 10:00 AM	44.6	65.2	40.5
10:00 AM - 11:00 AM	46.1	70.4	41.4
11:00 AM - 12:00 PM	43.7	62.0	37.9
12:00 PM - 01:00 PM	42.6	60.2	34.4
01:00 PM - 02:00 PM	50.5	89.2	36.9
02:00 PM - 03:00 PM	63.7	97.4	42.7
03:00 PM - 04:00 PM	46.6	67.6	39.4
04:00 PM - 05:00 PM	49.1	73.2	37.9
05:00 PM - 06:00 PM	45.6	68.3	38.3
06:00 PM - 07:00 PM	57.1	71.1	56.0
07:00 PM - 08:00 PM	62.5	70.6	61.6
08:00 PM - 09:00 PM	53.0	67.2	50.2
09:00 PM - 10:00 PM	52.3	65.2	48.9
10:00 PM - 11:00 PM	49.3	67.0	47.1
11:00 PM - 12:00 AM	52.3	60.9	50.7
12:00 AM - 01:00 AM	55.9	61.9	54.0
01:00 AM - 02:00 AM	55.5	60.2	53.4
02:00 AM - 03:00 AM	55.7	61.1	53.9
03:00 AM - 04:00 AM	56.2	61.8	53.4
04:00 AM - 05:00 AM	55.9	64.7	52.7
05:00 AM - 06:00 AM	56.6	67.5	53.4
06:00 AM - 07:00 AM	50.5	66.4	45.9
07:00 AM - 08:00 AM	45.7	67.0	39.3

Leq Average 24 hrs. (dB(A)) 55.3  
 Lmax (dB(A)) 97.4  
 L90 (dB(A)) 45.9  
 Ldn (dB(A)) 61.4  
 Standard (dB(A)) 70 115

Reference Method : ISO1996-1 and 1996-2

- Standard : 1. ประกาศคณะกรรมการสิ่งแวดล้อมแห่งชาติ ฉบับที่ 15 (พ.ศ. 2540) เรื่องกำหนดมาตรฐานระดับเสียงโดยทั่วไป  
 2. ประกาศกระทรวงอุตสาหกรรม เรื่องกำหนดค่าระดับเสียงการรบกวน และระดับเสียงที่เกิดจากการประกอบกิจการโรงงาน พ.ศ. 2548

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# Analysis / Test Report

**Client :** Fournier Consultants Co., Ltd.  
 99/2 Moo 8, Tambon Bang Mueang, Amphoe Mueang Samut Prakan, Samut Prakan Thailand 10271  
**P/O :** Q2318493(R1)  
**Project Name :** โครงการโรงไฟฟ้าพลังงานรุ่งเรือง (UDT4) บริษัท พลังงานรุ่งเรือง จำกัด  
**Project Location :** ในพื้นที่ตามลนาขา อำเภอเมืองอุตรธานี จังหวัดอุตรธานี

**Lot ID: 2363918**

Date Received : Jun 12, 2023

Date Reported : Jun 16, 2023

Report Number: 2687124-1

**Sample Number** 2363918-8  
**Parameter** Noise (Leq 24 hrs.)  
**Location** บ้านพักอาศัยด้านทิศตะวันออก (N2) (GPS 48Q 272171, 1940934)  
**Measurement Date** Jun 08 - Jun 09, 2023  
**Measurement by** [This information has been removed as it falls within the exceptions to disclose specified in paragraph 17(2) of ADB's Access to Information Policy.]  
**Sound Level meter** Serial No. 900075

Time	Leq (dB(A))	Lmax (dB(A))	L90 (dB(A))
08:00 AM - 09:00 AM	46.7	70.7	39.5
09:00 AM - 10:00 AM	45.1	65.6	41.2
10:00 AM - 11:00 AM	45.5	60.9	38.8
11:00 AM - 12:00 PM	44.2	62.4	37.0
12:00 PM - 01:00 PM	43.9	63.3	34.3
01:00 PM - 02:00 PM	41.3	62.8	34.5
02:00 PM - 03:00 PM	51.9	67.2	48.2
03:00 PM - 04:00 PM	43.9	66.1	37.4
04:00 PM - 05:00 PM	47.6	75.1	41.9
05:00 PM - 06:00 PM	52.1	62.6	47.2
06:00 PM - 07:00 PM	62.9	68.2	61.3
07:00 PM - 08:00 PM	66.8	69.8	66.0
08:00 PM - 09:00 PM	63.3	68.8	58.9
09:00 PM - 10:00 PM	64.3	69.7	59.1
10:00 PM - 11:00 PM	65.9	68.5	59.6
11:00 PM - 12:00 AM	64.8	68.2	57.7
12:00 AM - 01:00 AM	65.2	69.2	58.4
01:00 AM - 02:00 AM	62.2	68.5	55.4
02:00 AM - 03:00 AM	55.6	61.4	53.4
03:00 AM - 04:00 AM	61.6	68.9	58.9
04:00 AM - 05:00 AM	60.4	68.8	58.0
05:00 AM - 06:00 AM	59.3	68.3	56.3
06:00 AM - 07:00 AM	47.2	71.4	42.7
07:00 AM - 08:00 AM	46.7	68.1	41.8

Leq Average 24 hrs. (dB(A)) 60.7  
 Lmax (dB(A)) 75.1  
 L90 (dB(A)) 48.2  
 Ldn (dB(A)) 68.5  
 Standard (dB(A)) 70 115

Reference Method : ISO1996-1 and 1996-2

- Standard : 1. ประกาศคณะกรรมการสิ่งแวดล้อมแห่งชาติ ฉบับที่ 15 (พ.ศ. 2540) เรื่องกำหนดมาตรฐานระดับเสียงโดยทั่วไป  
 2. ประกาศกระทรวงอุตสาหกรรม เรื่องกำหนดค่าระดับเสียงการรบกวน และระดับเสียงที่เกิดจากการประกอบกิจการโรงงาน พ.ศ. 2548

**Technical Management**

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**Approved by**

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# Analysis / Test Report

**Client :** Fournier Consultants Co., Ltd.  
 99/2 Moo 8, Tambon Bang Mueang, Amphoe Mueang Samut Prakan, Samut Prakan Thailand 10271  
**P/O :** Q2318493(R1)  
**Project Name :** โครงการโรงไฟฟ้าพลังงานรุ่งเรือง (UDT4) บริษัท พลังงานรุ่งเรือง จำกัด  
**Project Location :** ในพื้นที่ตำบลนาข่า อำเภอเมืองอุตรธานี จังหวัดอุตรธานี

**Lot ID: 2363918**

Date Received : Jun 12, 2023

Date Reported : Jun 16, 2023

Report Number: 2687125-1

**Sample Number** 2363918-9  
**Parameter** Noise (Leq 24 hrs.)  
**Location** บ้านพักอาศัยด้านทิศตะวันออก (N2) (GPS 48Q 272171, 1940934)  
**Measurement Date** Jun 09 - Jun 10, 2023  
**Measurement by** [This information has been removed as it falls within the exceptions to disclose specified in paragraph 17(2) of ADB's Access to Information Policy.]  
**Sound Level meter** Serial No. 900075

Time	Leq (dB(A))	Lmax (dB(A))	L90 (dB(A))
08:00 AM - 09:00 AM	47.2	68.2	42.9
09:00 AM - 10:00 AM	45.5	65.8	41.3
10:00 AM - 11:00 AM	43.5	60.3	39.0
11:00 AM - 12:00 PM	44.7	66.9	38.2
12:00 PM - 01:00 PM	43.7	60.9	37.1
01:00 PM - 02:00 PM	44.7	62.5	38.6
02:00 PM - 03:00 PM	44.5	69.2	37.5
03:00 PM - 04:00 PM	44.4	64.5	38.3
04:00 PM - 05:00 PM	44.6	62.6	38.5
05:00 PM - 06:00 PM	44.8	68.5	39.0
06:00 PM - 07:00 PM	58.3	69.2	55.6
07:00 PM - 08:00 PM	64.0	73.4	61.4
08:00 PM - 09:00 PM	67.9	73.6	66.2
09:00 PM - 10:00 PM	68.5	73.6	66.4
10:00 PM - 11:00 PM	61.5	71.1	59.1
11:00 PM - 12:00 AM	60.3	65.5	58.1
12:00 AM - 01:00 AM	62.3	67.5	57.9
01:00 AM - 02:00 AM	56.7	64.7	54.4
02:00 AM - 03:00 AM	60.3	69.2	57.2
03:00 AM - 04:00 AM	64.4	69.7	61.9
04:00 AM - 05:00 AM	65.3	70.8	62.6
05:00 AM - 06:00 AM	60.7	70.8	57.4
06:00 AM - 07:00 AM	48.5	67.5	45.2
07:00 AM - 08:00 AM	46.7	67.8	41.6

Leq Average 24 hrs. (dB(A)) 61.0  
 Lmax (dB(A)) 73.6  
 L90 (dB(A)) 45.2  
 Ldn (dB(A)) 67.9  
 Standard (dB(A)) 70 115

Reference Method : ISO1996-1 and 1996-2

- Standard : 1. ประกาศคณะกรรมการสิ่งแวดล้อมแห่งชาติ ฉบับที่ 15 (พ.ศ. 2540) เรื่องกำหนดมาตรฐานระดับเสียงโดยทั่วไป  
 2. ประกาศกระทรวงอุตสาหกรรม เรื่องกำหนดค่าระดับเสียงการรบกวน และระดับเสียงที่เกิดจากการประกอบกิจการโรงงาน พ.ศ. 2548

**Technical Management**

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**Approved by**

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# Analysis / Test Report

**Client :** Fournier Consultants Co., Ltd.  
 99/2 Moo 8, Tambon Bang Mueang, Amphoe Mueang Samut Prakan, Samut Prakan Thailand 10271  
**P/O :** Q2318493(R1)  
**Project Name :** โครงการโรงไฟฟ้าพลังงานรุ่งเรือง (UDT4) บริษัท พลังงานรุ่งเรือง จำกัด  
**Project Location :** ในพื้นที่ตามลนาขา อำเภอเมืองอุตรธานี จังหวัดอุตรธานี

**Lot ID: 2363918**

Date Received : Jun 12, 2023

Date Reported : Jun 16, 2023

Report Number: 2687126-1

**Sample Number** 2363918-10  
**Parameter** Noise (Leq 24 hrs.)  
**Location** บ้านพักอาศัยด้านทิศตะวันออก (N2) (GPS 48Q 272171, 1940934)  
**Measurement Date** Jun 10 - Jun 11, 2023  
**Measurement by** [This information has been removed as it falls within the exceptions to disclose specified in paragraph 17(2) of ADB's Access to Information Policy.]  
**Sound Level meter** Serial No. 900075

Time	Leq (dB(A))	Lmax (dB(A))	L90 (dB(A))
08:00 AM - 09:00 AM	44.5	62.3	39.0
09:00 AM - 10:00 AM	45.3	66.9	39.4
10:00 AM - 11:00 AM	45.1	66.3	37.6
11:00 AM - 12:00 PM	45.5	67.8	39.5
12:00 PM - 01:00 PM	45.2	61.8	41.3
01:00 PM - 02:00 PM	45.0	73.9	38.9
02:00 PM - 03:00 PM	49.3	73.9	43.2
03:00 PM - 04:00 PM	49.8	73.9	45.0
04:00 PM - 05:00 PM	48.8	74.0	42.4
05:00 PM - 06:00 PM	56.0	72.5	53.1
06:00 PM - 07:00 PM	58.6	69.6	55.9
07:00 PM - 08:00 PM	60.8	66.8	60.4
08:00 PM - 09:00 PM	64.2	68.3	61.6
09:00 PM - 10:00 PM	60.0	68.2	57.6
10:00 PM - 11:00 PM	59.5	68.3	51.3
11:00 PM - 12:00 AM	66.5	70.2	63.7
12:00 AM - 01:00 AM	66.4	70.0	63.3
01:00 AM - 02:00 AM	66.3	70.0	64.0
02:00 AM - 03:00 AM	66.1	71.8	63.4
03:00 AM - 04:00 AM	59.5	71.2	55.8
04:00 AM - 05:00 AM	63.8	69.2	60.7
05:00 AM - 06:00 AM	57.9	67.7	54.6
06:00 AM - 07:00 AM	48.6	66.3	43.9
07:00 AM - 08:00 AM	46.0	65.2	41.5

Leq Average 24 hrs. (dB(A)) 60.7  
 Lmax (dB(A)) 74.0  
 L90 (dB(A)) 51.3  
 Ldn (dB(A)) 69.8  
 Standard (dB(A)) 70 115

Reference Method : ISO1996-1 and 1996-2

Standard : 1. ประกาศคณะกรรมการสิ่งแวดล้อมแห่งชาติ ฉบับที่ 15 (พ.ศ. 2540) เรื่องกำหนดมาตรฐานระดับเสียงโดยทั่วไป  
 2. ประกาศกระทรวงอุตสาหกรรม เรื่องกำหนดค่าระดับเสียงการรบกวน และระดับเสียงที่เกิดจากการประกอบกิจการโรงงาน พ.ศ. 2548

**Technical Management**

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**Approved by**

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**APPENDIX 3D**

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**THE RESULTS OF SURFACE WATER QUALITY  
ANALYSIS**



## Analysis / Test Report

TESTING

No.0009

Lot ID: 2361443

Date Received : Jun 13, 2023

Date Reported : Jun 19, 2023

Report Number : 2665070-1

Client : Fourtier Consultants Co., Ltd.

99/2 Moo 8, Tambon Bang Mueang, Amphoe Mueang Samut Prakan, Samut Prakan  
Thailand 10270

P/O : Q2318493(R1)

Project Name : โครงการโรงไฟฟ้าพลังงานรุ่งเรือง (UDT4) บริษัท พลังงานรุ่งเรือง จำกัด

Project Location : ในพื้นที่ตามลนาขา อำเภอเมืองอุดรธานี จังหวัดอุดรธานี

Page 1 of 6

Sample Number	2361443-1
Sampled Date	Jun 12, 2023 10:10 AM
Sample Description	Surface water
Location	ทางน้ำสาธารณะด้านทิศใต้ของโครงการ (SW1) (GPS 48Q 270900, 1940338)
Date Analysis Commenced	Jun 13, 2023
Condition of Sample	Contained in two BOD bottles and four plastic bottles, sample containers comply to pretreatment - preservation standards (APHA, USEPA)

Analyte	Unit	LOD	LOQ (LOR)	Result	Guideline / Specification	Method	Testing Location
<b>Microbiological Testing</b>							
Fecal Coliform	MPN/100mL	-	-	13.0	No Standard	Standard Methods for the Examination of Water and Wastewater. APHA, AWWA & WEF, 23rd ed., 2017, part 9221 B, E	Bangkok
Total Coliform	MPN/100mL	-	-	240.0	No Standard	Standard Methods for the Examination of Water and Wastewater. APHA, AWWA & WEF, 23rd ed., 2017, part 9221 B	Bangkok
<b>Water Testing</b>							
BOD (5 days at 20 degree C) *	mg/L	-	2.0	4.0	≤4	Standard Methods for the Examination of Water and Wastewater. APHA, AWWA & WEF, 23rd ed., 2017, part 5210 B, 4500 - O (C)	Bangkok
COD *	mg/L	-	25	34	No Standard	Standard Methods for the Examination of Water and Wastewater. APHA, AWWA & WEF, 23rd ed., 2017, part 5220 D	Bangkok
Dissolved Oxygen *	mg/L	-	0.1	5.3	≥2	Standard Methods for the Examination of Water and Wastewater. APHA, AWWA & WEF, 23rd ed., 2017, part 4500-O (C)	Bangkok
Flow rate *	m3/hr	-	-	No Report	No Standard	Flow meter	Bangkok
pH at 25 degree C		-	-	6.9	5.0-9.0	In-house method : STM 04-003 based on Standard Methods for the Examination of Water and Wastewater. APHA, AWWA & WEF, 23rd ed., 2017, part 4500 - H (B)	Bangkok
Temperature *	Degree C	-	-	28.6	n'	Standard Methods for the Examination of Water and Wastewater. APHA, AWWA & WEF, 23rd ed., 2017, part 2550 B	Bangkok
Total Dissolved solids Dried at 180 degree C *	mg/L	-	5	16	No Standard	Standard Methods for the Examination of Water and Wastewater. APHA, AWWA & WEF, 23rd ed., 2017, part 2540 C	Bangkok

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## Analysis / Test Report

TESTING

No.0009

Lot ID: 2361443

Date Received : Jun 13, 2023

Date Reported : Jun 19, 2023

Report Number : 2665070-1

Client : Fournier Consultants Co., Ltd.

99/2 Moo 8, Tambon Bang Mueang, Amphoe Mueang Samut Prakan, Samut Prakan  
Thailand 10270

P/O : Q2318493(R1)

Project Name : โครงการโรงไฟฟ้าพลังงานรุ่งเรือง (UDT4) บริษัท พลังงานรุ่งเรือง จำกัด

Project Location : ในพื้นที่ตำบลนาขา อำเภอเมืองอุดรธานี จังหวัดอุดรธานี

Page 2 of 6

Sample Number	2361443-1
Sampled Date	Jun 12, 2023 10:10 AM
Sample Description	Surface water
Location	ทางน้ำสาธารณะด้านทิศใต้ของโครงการ (SW1) (GPS 48Q 270900, 1940338)
Date Analysis Commenced	Jun 13, 2023
Condition of Sample	Contained in two BOD bottles and four plastic bottles, sample containers comply to pretreatment - preservation standards (APHA, USEPA)

Analyte	Unit	LOD	LOQ (LOR)	Result	Guideline / Specification	Method	Testing Location
<b>Water Testing</b>							
Total Suspended Solids Dried at 103-105 degree C *	mg/L	-	5	21	No Standard	Standard Methods for the Examination of Water and Wastewater. APHA, AWWA & WEF, 23rd ed., 2017, part 2540 D	Bangkok
Width *	m	-	-	9.60	No Standard	Laser Distance Meter	Bangkok

**Guideline** : Notification of the National Environmental Board, No. 8, B.E.2537 issued under the Enhancement and Conservation of National Environmental Quality Act. B.E.2535, published in the Royal Government Gazette, Vol. 111, Part 16, Dated February 24, B.E. 2537 (Class 4)

n': Change from Natural condition not more than 3 degree C

**Sampling By** : Adisak Phomphai

Remark :

- LOD : Limit of Detection
- "<" : Lower than LOQ (Limit of Quantitation) / LOR (Limit of Reporting)
- Analyte(s) marked \* is/are not included in scope of Accreditation ISO/IEC 17025.
- The laboratory has been accepted as an accredited laboratory complying with the ISO/IEC 17025.

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## Analysis / Test Report

TESTING

No.0009

Lot ID: 2361443

Date Received : Jun 13, 2023

Date Reported : Jun 19, 2023

Report Number : 2665070-1

Client : Fourtier Consultants Co., Ltd.

99/2 Moo 8, Tambon Bang Mueang, Amphoe Mueang Samut Prakan, Samut Prakan  
Thailand 10270

P/O : Q2318493(R1)

Project Name : โครงการโรงไฟฟ้าพลังงานรุ่งเรือง (UDT4) บริษัท พลังงานรุ่งเรือง จำกัด

Project Location : ในพื้นที่ตามลนาขา อำเภอเมืองอุดรธานี จังหวัดอุดรธานี

Page 3 of 6

Sample Number	2361443-2
Sampled Date	Jun 12, 2023 10:40 AM
Sample Description	Surface water
Location	ทางน้ำสาธารณะด้านทิศใต้ของโครงการ 1 กิโลเมตร (SW2) (GPS 48Q 2706300, 1939575)
Date Analysis Commenced	Jun 13, 2023
Condition of Sample	Contained in two BOD bottles and four plastic bottles, sample containers comply to pretreatment - preservation standards (APHA, USEPA)

Analyte	Unit	LOD	LOQ (LOR)	Result	Guideline / Specification	Method	Testing Location
<b>Microbiological Testing</b>							
Fecal Coliform	MPN/100mL	-	-	130.0	No Standard	Standard Methods for the Examination of Water and Wastewater. APHA, AWWA & WEF, 23rd ed., 2017, part 9221 B, E	Bangkok
Total Coliform	MPN/100mL	-	-	790.0	No Standard	Standard Methods for the Examination of Water and Wastewater. APHA, AWWA & WEF, 23rd ed., 2017, part 9221 B	Bangkok
<b>Water Testing</b>							
BOD (5 days at 20 degree C) *	mg/L	-	2.0	16.0	≤4	Standard Methods for the Examination of Water and Wastewater. APHA, AWWA & WEF, 23rd ed., 2017, part 5210 B, 4500 - O (C)	Bangkok
COD *	mg/L	-	25	97	No Standard	Standard Methods for the Examination of Water and Wastewater. APHA, AWWA & WEF, 23rd ed., 2017, part 5220 D	Bangkok
Dissolved Oxygen *	mg/L	-	0.1	3.4	≥2	Standard Methods for the Examination of Water and Wastewater. APHA, AWWA & WEF, 23rd ed., 2017, part 4500-O (C)	Bangkok
Flow rate *	m3/hr	-	-	No Report	No Standard	Flow meter	Bangkok
pH at 25 degree C		-	-	6.8	5.0-9.0	In-house method : STM 04-003 based on Standard Methods for the Examination of Water and Wastewater. APHA, AWWA & WEF, 23rd ed., 2017, part 4500 - H (B)	Bangkok
Temperature *	Degree C	-	-	29.1	n'	Standard Methods for the Examination of Water and Wastewater. APHA, AWWA & WEF, 23rd ed., 2017, part 2550 B	Bangkok
Total Dissolved solids Dried at 180 degree C *	mg/L	-	5	488	No Standard	Standard Methods for the Examination of Water and Wastewater. APHA, AWWA & WEF, 23rd ed., 2017, part 2540 C	Bangkok

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## Analysis / Test Report

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Lot ID: 2361443

Date Received : Jun 13, 2023

Date Reported : Jun 19, 2023

Report Number : 2665070-1

Client : Fournier Consultants Co., Ltd.

99/2 Moo 8, Tambon Bang Mueang, Amphoe Mueang Samut Prakan, Samut Prakan  
Thailand 10270

P/O : Q2318493(R1)

Project Name : โครงการโรงไฟฟ้าพลังงานรุ่งเรือง (UDT4) บริษัท พลังงานรุ่งเรือง จำกัด

Project Location : ในพื้นที่ตำบลนาขา อำเภอเมืองอุดรธานี จังหวัดอุดรธานี

Page 4 of 6

Sample Number	2361443-2
Sampled Date	Jun 12, 2023 10:40 AM
Sample Description	Surface water
Location	ทางน้ำสาธารณะด้านทิศใต้ของโครงการ 1 กิโลเมตร (SW2) (GPS 48Q 2706300, 1939575)
Date Analysis Commenced	Jun 13, 2023
Condition of Sample	Contained in two BOD bottles and four plastic bottles, sample containers comply to pretreatment - preservation standards (APHA, USEPA)

Analyte	Unit	LOD	LOQ (LOR)	Result	Guideline / Specification	Method	Testing Location
<b>Water Testing</b>							
Total Suspended Solids Dried at 103-105 degree C *	mg/L	-	5	60	No Standard	Standard Methods for the Examination of Water and Wastewater. APHA, AWWA & WEF, 23rd ed., 2017, part 2540 D	Bangkok
Width *	m	-	-	6.00	No Standard	Laser Distance Meter	Bangkok

**Guideline** : Notification of the National Environmental Board, No. 8, B.E.2537 issued under the Enhancement and Conservation of National Environmental Quality Act. B.E.2535, published in the Royal Government Gazette, Vol. 111, Part 16, Dated February 24, B.E. 2537 (Class 4)

n': Change from Natural condition not more than 3 degree C

**Sampling By** : Adisak Phomphai

Remark :

- LOD : Limit of Detection
- "<" : Lower than LOQ (Limit of Quantitation) / LOR (Limit of Reporting)
- Analyte(s) marked \* is/are not included in scope of Accreditation ISO/IEC 17025.
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## Analysis / Test Report

TESTING

No.0009

Lot ID: 2361443

Date Received : Jun 13, 2023

Date Reported : Jun 19, 2023

Report Number : 2665070-1

Client : Fourtier Consultants Co., Ltd.

99/2 Moo 8, Tambon Bang Mueang, Amphoe Mueang Samut Prakan, Samut Prakan  
Thailand 10270

P/O : Q2318493(R1)

Project Name : โครงการโรงไฟฟ้าพลังงานรุ่งเรือง (UDT4) บริษัท พลังงานรุ่งเรือง จำกัด

Project Location : ในพื้นที่ตามลนาขา อำเภอเมืองอุดรธานี จังหวัดอุดรธานี

Page 5 of 6

Sample Number	2361443-3
Sampled Date	Jun 12, 2023 10:50 AM
Sample Description	Surface water
Location	ทางน้ำสาธารณะด้านทิศใต้ของโครงการ 2 กิโลเมตร (SW3) (GPS 48Q 270602, 1938621)
Date Analysis Commenced	Jun 13, 2023
Condition of Sample	Contained in two BOD bottles and four plastic bottles, sample containers comply to pretreatment - preservation standards (APHA, USEPA)

Analyte	Unit	LOD	LOQ (LOR)	Result	Guideline / Specification	Method	Testing Location
<b>Microbiological Testing</b>							
Fecal Coliform	MPN/100mL	-	-	13.0	No Standard	Standard Methods for the Examination of Water and Wastewater. APHA, AWWA & WEF, 23rd ed., 2017, part 9221 B, E	Bangkok
Total Coliform	MPN/100mL	-	-	240.0	No Standard	Standard Methods for the Examination of Water and Wastewater. APHA, AWWA & WEF, 23rd ed., 2017, part 9221 B	Bangkok
<b>Water Testing</b>							
BOD (5 days at 20 degree C) *	mg/L	-	2.0	6.9	≤4	Standard Methods for the Examination of Water and Wastewater. APHA, AWWA & WEF, 23rd ed., 2017, part 5210 B, 4500 - O (C)	Bangkok
COD *	mg/L	-	25	67	No Standard	Standard Methods for the Examination of Water and Wastewater. APHA, AWWA & WEF, 23rd ed., 2017, part 5220 D	Bangkok
Dissolved Oxygen *	mg/L	-	0.1	3.2	≥2	Standard Methods for the Examination of Water and Wastewater. APHA, AWWA & WEF, 23rd ed., 2017, part 4500-O (C)	Bangkok
Flow rate *	m3/hr	-	-	No Report	No Standard	Flow meter	Bangkok
pH at 25 degree C		-	-	7.4	5.0-9.0	In-house method : STM 04-003 based on Standard Methods for the Examination of Water and Wastewater. APHA, AWWA & WEF, 23rd ed., 2017, part 4500 - H (B)	Bangkok
Temperature *	Degree C	-	-	31.1	n'	Standard Methods for the Examination of Water and Wastewater. APHA, AWWA & WEF, 23rd ed., 2017, part 2550 B	Bangkok
Total Dissolved solids Dried at 180 degree C *	mg/L	-	5	884	No Standard	Standard Methods for the Examination of Water and Wastewater. APHA, AWWA & WEF, 23rd ed., 2017, part 2540 C	Bangkok

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## Analysis / Test Report

TESTING  
No.0009

**Client :** Fourtier Consultants Co., Ltd.  
99/2 Moo 8, Tambon Bang Mueang, Amphoe Mueang Samut Prakan, Samut Prakan  
Thailand 10270

**P/O :** Q2318493(R1)

**Project Name :** โครงการโรงไฟฟ้าพลังงานรุ่งเรือง (UDT4) บริษัท พลังงานรุ่งเรือง จำกัด

**Project Location :** ในพื้นที่ตำบลนาข่า อำเภอเมืองอุดรธานี จังหวัดอุดรธานี

**Lot ID: 2361443**

Date Received : Jun 13, 2023

Date Reported : Jun 19, 2023

Report Number : 2665070-1

Page 6 of 6

<b>Sample Number</b>	2361443-3
<b>Sampled Date</b>	Jun 12, 2023 10:50 AM
<b>Sample Description</b>	Surface water
<b>Location</b>	ทางน้ำสาธารณะด้านทิศใต้ของโครงการ 2 กิโลเมตร (SW3) (GPS 48Q 270602, 1938621)
<b>Date Analysis Commenced</b>	Jun 13, 2023
<b>Condition of Sample</b>	Contained in two BOD bottles and four plastic bottles, sample containers comply to pretreatment - preservation standards (APHA, USEPA)

Analyte	Unit	LOD	LOQ (LOR)	Result	Guideline / Specification	Method	Testing Location
<b>Water Testing</b>							
Total Suspended Solids Dried at 103-105 degree C *	mg/L	-	5	43	No Standard	Standard Methods for the Examination of Water and Wastewater. APHA, AWWA & WEF, 23rd ed., 2017, part 2540 D	Bangkok
Width *	m	-	-	10.00	No Standard	Laser Distance Meter	Bangkok

**Guideline :** Notification of the National Environmental Board, No. 8, B.E.2537 issued under the Enhancement and Conservation of National Environmental Quality Act. B.E.2535, published in the Royal Government Gazette, Vol. 111, Part 16, Dated February 24, B.E. 2537 (Class 4)

n': Change from Natural condition not more than 3 degree C

**Sampling By :** Adisak Phomphai

Remark :

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**APPENDIX 4A**

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**HUMAN RIGHTS RISK AND IMPACT ASSESSMENT  
PROCESS**

## HUMAN RIGHTS RISK AND IMPACT ASSESSMENT PROCESS

The process of HRIA included scoping, baseline data collection and assessment as follows:

### (1) Scoping of Impact and Risks

The first step of HRIA is to scope the potential impact and risk from following sources:

- Human right issues and related data from Code of Practice (CoP) report.
- Human rights risks reference from relevant organization such as Guidance Note on Implementation of Human Rights Assessments under the Equator Principles, Guide to Human Rights Impact Assessment and Management (HRIAM), Guiding Principles on Business and Human Right.
- Human rights risks that have already occurred and those likely to occur throughout the entire value chain. This includes direct project activities by the project and indirect activities by suppliers or contractors; both of which may cause complicity in human rights violation.

These potential human rights issues are then grouped by topics with potential negative impact/risk and effectors as presented in **Table 1**.

### (2) Baseline Data Collection

Baseline data collection is an important step to collect human right risks issues, from participants of human right risks assessment process, who have direct association with those risks issue as initially scoped in **Table 1**.

The Baseline data collection were collected through public consultation with project stakeholders. The result of the public consultation was analyzed and assessed as presented in **Table 2**.

**TABLE 1**  
**SCOPING OF RELEVANT HUMAN RIGHTS ISSUES FROM PROJECT**  
**IMPLEMENTATION ACTIVITIES**

<b>Relevant Human Rights Issues</b>	<b>Potential Negative Impact/Risk</b>	<b>Effectors</b>
<b>Labour rights</b>		
Occupational health and safety	<ul style="list-style-type: none"> <li>Risk that workers will face occupational accident during the project construction and operation phase.</li> </ul>	<ul style="list-style-type: none"> <li>Project Developer</li> <li>Contractors</li> </ul>
Discrimination	<ul style="list-style-type: none"> <li>Risk that workers may be treated unfairly (either through recruitment, hiring, management, compensation, career progression/ opportunities, or termination practices) due to certain attributes such as on the basis of their disability, religion, health, ethnicity, gender, sexual orientation, gender, age, indigenous origin, migrant worker status, etc. (as such, it intersects with other rights e.g. right to health).</li> </ul>	<ul style="list-style-type: none"> <li>Project Developer</li> <li>Contractors</li> </ul>
Wages (pay equity, standard of life)	<ul style="list-style-type: none"> <li>Using staff that are paid extremely low wages with no or very limited entitlements to sick pay or leave.</li> </ul>	<ul style="list-style-type: none"> <li>Project Developer</li> <li>Contractors</li> </ul>
Working Hours	<ul style="list-style-type: none"> <li>Mandating unreasonable working hours for employees that are inconsistent with ILO standards, which generally indicate that employees should not be required to work more than 48 hours per week, or ten hours a day, and should have one day off per week.</li> </ul>	<ul style="list-style-type: none"> <li>Project Developer</li> <li>Contractors</li> </ul>
<b>Community rights</b>		
Community Safety & Standard of Living	<ul style="list-style-type: none"> <li>Risk that project transportation incurs road accident;</li> <li>Impact of pollution that is affected by project construction, such as noise and vibration, and waste;</li> <li>Impacts on public utility services which is affected by labour migration into the area</li> </ul>	<ul style="list-style-type: none"> <li>Project Developer</li> </ul>

**TABLE 2**  
**HUMAN RIGHTS RISKS IN THE PROJECT IMPLEMENTATION ACTIVITIES**

Project activity	Respective rights	Description of human rights risks	Receptor	
			Employees	Local community
<b>Labour rights</b>				
Employment of staff and workers (full time and part time)	Occupational health and safety	<ul style="list-style-type: none"> <li>Risk that workers will face occupational accident during the project construction and operation period.</li> </ul>	✓	
	Discrimination	<ul style="list-style-type: none"> <li>Risk that workers may be treated unfairly (either through recruitment, hiring, management, compensation, career progression/ opportunities, or termination practices) due to certain attributes such as on the basis of their disability, religion, health, ethnicity, gender, sexual orientation, gender, age, indigenous origin, migrant worker status, etc. (as such, it intersects with other rights e. g. right to health services).</li> </ul>	✓	
	Working Hours	<ul style="list-style-type: none"> <li>Mandating unreasonable working hours for employees that are inconsistent with ILO standards, which generally indicate that employees should not be required to work more than 48 hours per week, or ten hours a day, and should have one day off per seven days.</li> </ul>	✓	
<b>Community Right</b>				
Construction of the project	Community Safety & Standard of Living	<ul style="list-style-type: none"> <li>Risk that project transportation incurs road accident;</li> <li>Impact of pollution that is affected by the project construction, such as noise and vibration, and waste;</li> <li>The conflict between migrant workers and the local people;</li> <li>Utilization of public infrastructures affected by migrant workers are inadequate to the local people.</li> <li>Infestation of disease carriers</li> </ul>		✓
Operation of the project	Community Safety & Standard of Living	<ul style="list-style-type: none"> <li>Risk that project transportation incurs road accident;</li> <li>Contamination to the environment</li> <li>Infestation of disease carriers</li> </ul>		✓



### **(3) Assessment**

#### **(a) Human Right Risks Assessment Criteria**

According to the UN Guiding Principles, Human right assessment considers 2 key parameters i.e. severity of Risk and Likelihood of Occurrence. Consideration on Severity of the identified human rights risks consider the impacts through the 3 factors of which are most severe (based on scale, scope, and remediability). These two dimensions (severity and likelihood), human rights risk assessment criteria is developed to identify level of risks from 1-4 as presented in **Table 3**.

#### **(b) Assessment of Level of Human Right Risk**

Considering the severity and likelihood of occurrence of each implement activity and plot in the Human Right risk assessment matrix as show in **Figure 1** the level of Human Rights Risk can be obtained in the level of low, medium high or critical with definition of Impact/Risk describe in **Table 4**.

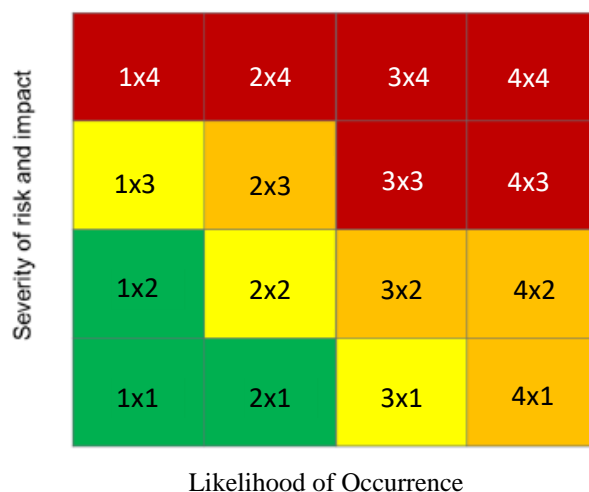
#### **(c) Assessment for Type of Human Rights Risk**

For Human Rights Risks and Impact Assessment, there are two types of risk to consider:

- Inherent risk, which is the level of risk inherent, or natural, to the situation. It is based on the nature of the context when no mitigation measures are in place.
- Residual risk, which is the level of risk with all the measures and controls are in place.

**TABLE 3  
HUMAN RIGHTS RISKS ASSESSMENT CRITERIA**

<b>Criteria for Severity</b>				
	<b>Low (1)</b>	<b>Medium (2)</b>	<b>High (3)</b>	<b>Critical (4)</b>
<b>Scale</b>	Minor impact to health and safety: first aid case	Slight impact to health and safety: minor injury or illness (no loss time)	Moderate impact to health and safety: serious injury that needs rehabilitation (loss time injury)	Significant impact to health and safety: physical disability or fatality
<b>Scope</b>	No negative impact to stakeholder	Impact to some stakeholders in particular stakeholder group	Impact to most stakeholders in particular stakeholder group	Impact to all stakeholders group (such as local communities, affected community members, and vulnerable)
<b>Remediability</b>	Take less than a year (<1 year) to restore the impact	Take 1-3 years to restore the impact	Take 3-5 years to restore the impact	Impossible to restore or will take longer than 5 years (>5 years) to restore the impact
<b>Criteria for Likelihood</b>				
	<b>Rare (1)</b>	<b>Unlikely (2)</b>	<b>Possible (3)</b>	<b>Likely (4)</b>
	Incident has occurred within the industry, but it is very improbable that the incident will occur in the company's area of operations (<1%)	Incident rarely occurs within the area of operations, but it is possible (1-10%)	Incident occasionally occurs within the area of operations occasionally (10-25%)	Incident occurs within the area of operations several times per year (>25%)



**FIGURE 1 : THE HUMAN RIGHTS RISK AND IMPACT ASSESSMENT MATRIX**

**TABLE 4  
DESCRIPTION OF THE LEVEL OF HUMAN RIGHTS RISK/IMPACT**

Level of Risk Impact	Type of Impact
Extreme <span style="color: red;">■</span>	<ul style="list-style-type: none"> <li>Human rights impact covers a wide scope of area or population, extending beyond the area of operations.</li> <li>The project cannot control or mitigate human rights impacts to remediate the affected victims and restore them to their original condition.</li> <li>The impact/ incident related to human rights requires the support of an independent, trusted third party to mediate the issue.</li> </ul>
High <span style="color: orange;">■</span>	<ul style="list-style-type: none"> <li>The project is complicit in assisting or supporting an activity that resulted in human rights violation (legal complicity).</li> <li>The human rights impact was caused by the activities of the project or the activities in the project's supply chain, and created impacts on stakeholders in the area of operations.</li> <li>The project has a human rights conflict with a vulnerable group.</li> </ul>
Medium <span style="color: yellow;">■</span>	<ul style="list-style-type: none"> <li>The project benefited from activities conducted by external parties that resulted in human rights violation (non-legal complicity).</li> <li>The project cannot respond to the human rights concerns of internal or external stakeholders.</li> </ul>
Low <span style="color: green;">■</span>	<ul style="list-style-type: none"> <li>Potential human rights impacts and concerns raised by internal or external stakeholders are resolved, with prevention measures put in place. The project's grievance mechanisms are effective.</li> </ul>

**APPENDIX 5A**

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**ENVIRONMENTAL AND SOCIAL MANAGEMENT  
MANUAL OF GULF ENERGY DEVELOPMENT  
PUBLIC COMPANY LIMITED**



## ES Policy

GED aspires to become a trusted company that innovates to develop premier energy across boundaries. GED is committed to conducting business operations towards a sustainable long-term growth taking into account of economic, environmental and social risks and opportunities. The ESMS Framework provides foundation for our approach in everything we do across the Group and in line with international standards.

Key attributes of the Policy are:

1. Implement and maintain the ESMS in order to continuously improve and escalate ES performance throughout the organization;
2. Comply with environmental, social, health and safety related laws, applicable environmental and social safeguard requirements, customers' requirements, and other regulations as a minimum criterion;
3. Conduct business with responsibilities towards environment and society by reducing our footprint along the value chains in which operate whilst balancing the interests of a diverse range of stakeholders to assure sustainable business growth;
4. Embed and foster good ES culture and behaviour throughout the organization with emphasis on participation from management and employees at all levels;
5. Manage, cooperate and improve ES performance with key contractors, suppliers and business partners; and
6. Regularly review our ES performance and publicly report our progress.

This policy shall be communicated and made available to all of Company staff. The policy shall be reviewed on every three (3) years and modified to incorporate changes as arising from change and progress of the Company business.

*[This information has been removed as it falls within the exceptions to disclose specified in paragraph 17(2) of ADB's Access to Information Policy.]*

President

**Date:** December 25, 2017

**Rev:**0

# GULF ENERGY DEVELOPMENT PUBLIC COMPANY

## Environmental and Social Management System Manual



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# **GED Environmental and Social Management System Manual**

**Area of Applicability:** Gulf Group Plant Facilities

**Responsible Center:** Environment, Health and Safety

**Revision:** 0

**Effective Date:** December 26, 2017

**Approved By:**

*[This information has been removed as it falls within the exceptions to disclose specified in paragraph 17(2) of ADB's Access to Information Policy.]*

**Senior Executive Vice President and  
Chief Operating Officer**

# 1 Introduction

## 1.1 Purpose

The Manual describes the application of GED Environmental and Social (ES) Management System (ESMS) to a project cycle owned and managed by GED Energy Development (GED) starting from Feasibility Study, Project Development to Operation.

The ESMS also incorporates elements from, or are aligned with, other international policies, standards and management practices to which GED has committed, such as Asian Development Bank's Safe Guard Policy Statement 2009, ISO 14001: 2015, Global Reporting Initiative (GRI) and International Standards ISO 26000: 2010.

The purpose of ESMS is to establish the system requirements and tools required for the management of environmental, social, health and safety risks and opportunities throughout the project cycle. Further, the ESMS describe corporate level ES Policy and its management and demarcate roles and responsibilities at each stage of project cycle.

Implementation of ESMS is the responsibility of everyone in GED in order to accomplish the set objectives. Moreover, each operating site is responsible for developing their own plan, procedures and programs plans specific and applicable to the nature of the business.

## 1.2 Scope of Application

All GED businesses, their managed sites and functional locations must implement, or demonstrate conformance to the requirements of this ESMS.

The ESMS applies to:

- (a) feasibility studies;
- (b) implementation;
- (c) operation;
- (d) decommissioning<sup>1</sup>
- (e) goods provided to GED; and
- (f) services delivered/ performed by contractors undertaken on GED sites or under GED management.

Newly acquired businesses or sites must conform to GED's ESMS by performing a gap analysis and by developing and starting to implement an action plan to close the gaps within three (3) years or upon the reasonable timeline agreed with the target company.

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<sup>1</sup> The ES requirements for decommissioning phase will be included in the next update of this ESMS Manual as the decommissioning of the operating site is not expected in the next 10 years.

GED aspires to become a trusted company that innovates to develop premier energy across boundaries. GED is committed to conducting business operations towards a sustainable long-term growth taking into account of economic, environmental and social risks and opportunities. The ESMS Framework provides foundation for our approach in everything we do across the Group and in line with international standards.

Key attributes of the Policy are:

1. Implement and maintain the ESMS in order to continuously improve and escalate ES performance throughout the organization;
2. Comply with environmental, social, health and safety related laws, applicable environmental and social safeguard requirements, customers' requirements, and other regulations as a minimum criterion;
3. Conduct business with responsibilities towards environment and society by reducing our footprint along the value chains in which operate whilst balancing the interests of a diverse range of stakeholders to assure sustainable business growth;
4. Embed and foster good ES culture and behaviour throughout the organization with emphasis on participation from management and employees at all levels;
5. Manage, cooperate and improve ES performance with key contractors, suppliers and business partners; and
6. Regularly review our ES performance and publicly report our progress.

This policy shall be communicated and made available to all of Company staff. The policy shall be reviewed on every three (3) years and modified to incorporate changes as arising from change and progress of the Company business.

### 3 ESMS Framework, Structure and Responsibilities

In achieving GED Sustainable Development Policy, GED is required to apply its ESMS throughout a project lifecycle of the business.

The project lifecycle of GED are from feasibility study, project development (implementation) to operation. This ESMS framework in the document is split into three (3) types:

- Feasibility Study and Implementation
- Merger & Acquisition
- Operation

The ESMS frameworks for these three types are described as follows.

#### 3.1 ESMS Framework for Feasibility and Implementation

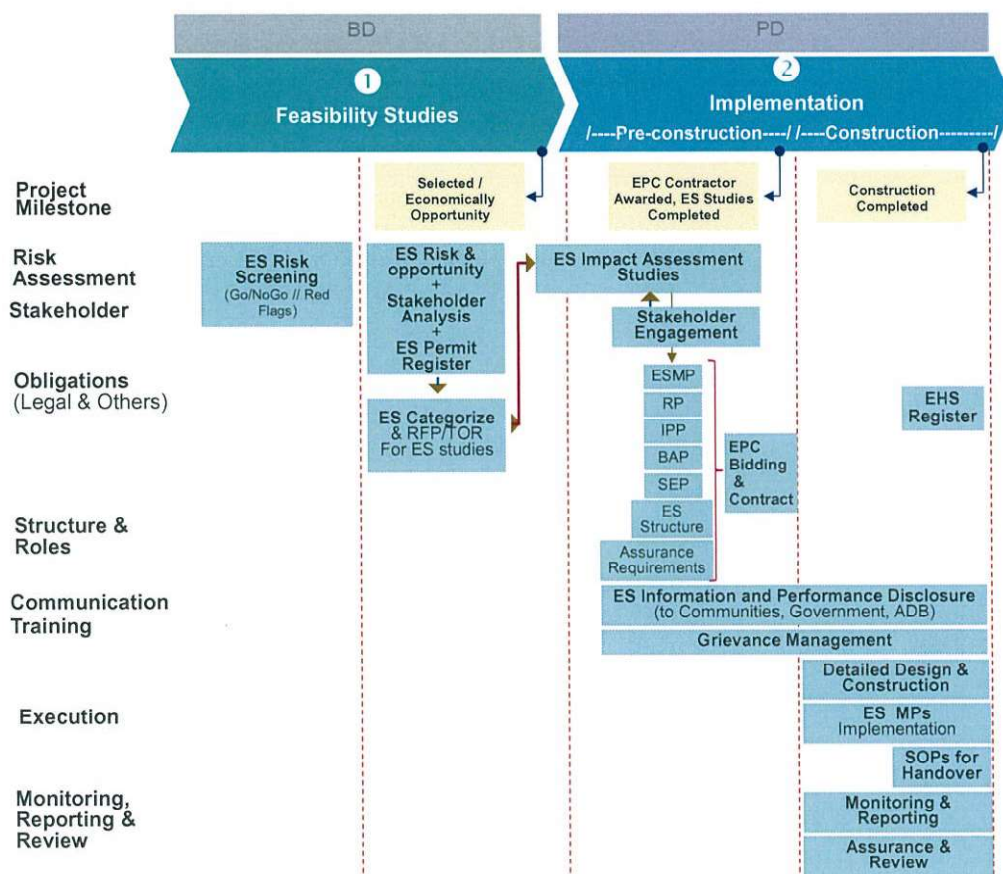
A feasibility study is where new opportunities are initiated and is subject to screening and evaluated prior to entering the implementation phase.

The implementation is where an economically feasible opportunity is furthered developed through (a) pre-construction [scoping, conceptual design, planning, tendering and awarding to Engineering, Procurement and Construction (EPC) Contractor]; and (b) construction [detailed design, mobilization, construction, commissioning and evaluation].

The ESMS framework for the feasibility and implementation can be demonstrated in *Figure 1* overleaf.

Figure 1

ESMS Framework for Feasibility and Implementation



Milestones or ES indicators related to this phase are summarized as follows.

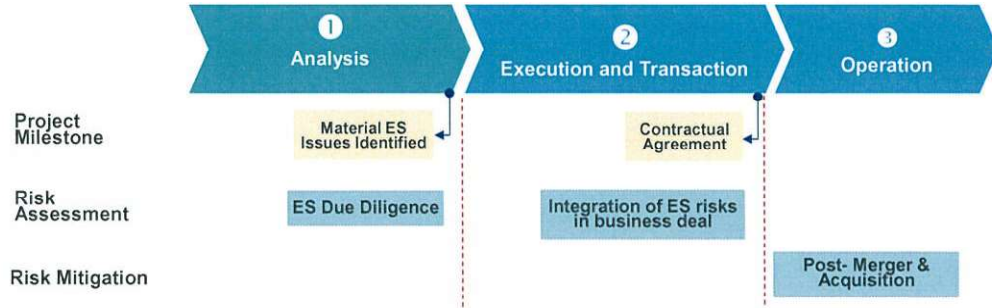
- ES Indicators for the Feasibility Study
  - Key ES risks and opportunities influence to business decision identified
  - Key stakeholders' views and interests considered in the scoping of ES impact assessment study
- ES Indicators for the Pre-construction
  - ES licenses/ permits and their timelines incorporated into an overall project master plan
  - Required ES Studies e.g. EIA/IEE/ESIA approved against the overall project master plan
  - Number of formal/written complaints unaddressed
  - Number of complaints impacting the project schedule
- ES Indicators for the Construction
  - Review of detailed design as per project ES specifications completed
  - ES Management Plans integrated into EPC contractor's Management Plan
  - ES performance of EPC contractors during construction activities
  - Number of formal/written complaints unaddressed
  - Percentage of corrective actions for ES issues closed
  - Number of complaints impacting the project schedule

### 3.2 ESMS Framework for Merger & Acquisition

Mergers and Acquisition (M&A) is another type of investment beyond the project development where due diligence is required. This is another way GED grows the business operations and services.

The ESMS framework for the M&A is described in *Figure 2* as follows.

**Figure 2 ESMS Framework for Mergers & Acquisition**



Milestones or ES indicators related to the M&A are summarized as follows.

- Material ES issues are identified and incorporated in business deals/negotiations.
- ES liabilities to address material ES issues are taken into account in a contractual arrangement.
- Action plan to address material ES issues are implemented and tracked after the mergers and acquisition.

### 3.3 ESMS Framework for Operation

An operational phase is when the project starts a commercial run/ plant operation and maintenance activities. The ESMS framework for the operational phase is demonstrated in *Figure 3* as follows.

**Figure 3 ESMS Framework for the Operation**



ES Elements for Operation comprises 16 topics as follows:

1. Management Leadership and Commitment;
2. Risk and Opportunities;
3. Change Management;
4. Compliance;
5. Goal and Improvement Plan;
6. Stakeholder Engagement;
7. Awareness and Competency;
8. Contractor and Suppliers;
9. Operational Control & Maintenance;
10. Emergency Preparedness and Response;
11. Communication;
12. Incident Management;
13. Monitoring and Reporting;
14. Audit;
15. Handling of Non-Conformities; and
16. Management Review.

Milestones or ES indicators related to the operational phase are

- ES risks mitigated and reduced to an acceptable level throughout the operation.
- Compliance with environmental, social, health and safety related obligations.
- ES performance improvement made during the operation.

### **3.4 Roles and Responsibilities**

Each phase of the project requires different project management roles and responsibilities, as business and commercial conditions including levels of authorisation vary throughout the project lifecycle.

Thus, the roles and responsibilities of ESMS shall be appropriately designed and tailor-made to fit with each project phase through the lifecycle to address ES risks and opportunities.

Below are the key roles and responsibilities at various phases of relevant functions/ groups within GED.

#### **3.4.1 Business Development Group (BD)**

- Feasibility Study
  - Be accountable for a feasibility study for new opportunities
  - Conducts ES risk screening to identify potential ES red-flag issues to inform business decision for new project development
  - In case of M&A, ensure that environmental and social due diligence is conducted for the selected opportunities to inform material ES issues for business deals/ negotiations

### 3.4.2 Community Relation Department (CR)

- Feasibility Study
  - Conduct a stakeholder identification to inform scope of studies for relevant ES impact assessment
  - Support Business Development Group (BD) for information regarding social-related risks that could arise from the identified opportunities
- Pre-construction
  - Develop stakeholder engagement plan and provide the results to EIA/IEE/ESIA study
  - Implement stakeholder engagement activities as planned
- Construction
  - Drive the implementation of Indigenous People Plan (IPP), Resettlement Plan (RP) and Stakeholder Engagement Plan (SEP) as planned
  - Report the implementation progress of IPP, IR and SEP and results to relevant stakeholders

### 3.4.3 EIA Department (EIA)

- Feasibility Study
  - Identify ES permits and licenses required for the opportunity to be further developed e.g. IEE/ ESA, EIA, ESIA and related permits
  - Determine environmental issues associated to the project to further inform the scope of ES studies
- Pre-construction
  - Facilitate and ensure that IEE/ ESA/ EIA/ ESIA study is completed and approved before the construction
  - Report implementation progress and results of ES studies to relevant stakeholders
- Construction
  - Support and guide the implementation of ES Management Plans to PD where needed

### 3.4.4 Engineering Group

- Feasibility Study
  - Perform technology studies to be applied for the project
  - Identify relevant permit required for the selected technology with support from BD and Legal Department
- Pre-construction
  - Incorporate requirements regarding engineering requirements and requirements associated ES issues (e.g. environmental pollution abatement equipment, ES specification as per regulations, etc.) into TOR for EPC Contactor Bidding
  - Work with PD to select EPC Contractor using ES selection criteria
- Construction
  - Provide support in engineering design to Project Implementation Team
  - Provide support in review and approval to ensure the design and construction are in compliance with project specifications including performance guarantee



### 3.4.5 Project Development Group (PD)

- Pre-construction
  - Develop TOR for the required ES studies e.g. EIA/IEE/ESIA study and engages qualified third parties to conduct detailed studies
  - Incorporate results from ES studies (e.g. EIA) from each relevant department into TOR for EPC Contractor Bidding
  - Work with Engineering Department to select EPC Contractor using the ES selection criteria
  - Develop contract with the awarded EPC Contractor and incorporate ES management requirements into the contract
  - Monitor for all contracts and required permits/licenses are finalized and important studies are completed
  - Handover the project requirements and information to Project Implementation Team to be ready for construction
  - Work with Engineering Group to develop contract with the awarded EPC Contractor and incorporate ES management requirements into the contract
- Construction
  - Oversight EPC contractor for ES management for detailed design and construction
  - Monitor and review EPC contractor's ES management implementation and performance
  - Report the ES performance to relevant stakeholders

### 3.4.6 Asset Management Group (AM)

- Pre-construction
  - Prepare relevant ESMS procedures/ documents/ plan to be ready for operation team
  - Deploy GED's ESMS and related procedures, and plan to Operation team for standardization
- Operation
  - Support the operating site to conform to GED ESMS within one (1) year
  - Assure effective implementation and maintenance of ESMS
  - Consolidate, analyse the ES performance from each operating site and report to GED executive management
  - Provide supports for the ESMS implementation for each operating site as required

### 3.4.7 Operating Site

- Operation
  - Adopt GED ESMS Policy and requirements and implement for continuously improvement and minimize ES impacts
  - Report performance of ESMS implementation to Asset Management Department

## 4 ESMS Elements for Feasibility Study and Implementation

### 4.1 Feasibility Study

#### 4.1.1 Risk Screening

##### Intent

- Determine 'Go/No Go' or 'Red Flag' risks that call for attention at early stage
- Confirm compliance with the fund's policy and Exclusion List.

##### Requirements

- Identify critical ES risks and liabilities specific to project type, locations based on publicly available information using ES Feasibility Study Checklist as a tool for assessment
  - ES issues to be reviewed for ES risks comprise, but not limited to, the followings:
    - Land availability and proximity to supporting infrastructures;
    - Environmentally sensitive areas including biodiversity;
    - Community receptiveness and concerns;
    - Involuntary resettlement of people;
    - Water risk/ water scarcity;
    - Utility availability and capacity;
    - Transmission line locations and distance; and
    - Environmental concerns such as emission limits.
  - No-Go conditions:
    - Environmental and social conditions which prompt an early decision in potential investment review not to proceed further (e.g. critical habitats, illegal business, area legally protected)
  - Red Flag conditions:
    - Environmental and social conditions which require further attention in the review process to identify potential management and mitigation measures relating to these conditions.
- Review compliance against ADB's PIAL (Prohibited Investment Activities List) *Annex 2*.
- Develop actions to address Red Flag by considering alternative(s) or gaining more specific project info for further assessment/ re-assessment in Feasibility Stage
- Integrate risk screening as part of the project feasibility study/ decision-making process

##### Documents

- ES Risk Matrix

## 4.1.2 Stakeholder Identification

### Intent

- Identify stakeholders and consider their opinions and interests as inputs to investment analysis

### Requirements

- Identify stakeholders that can have a direct influence in the project development in terms of permitting and acceptance of the project
  - who have ability to impact to and interests in the project and their concerns (i.e. to go forward with the project or vice versa)
  - who are directly affected by the project, whether from the use of land at the project site or effects of the environment changed, or even the socio-economic effects throughout the supply chain
- Develop engagement plan to address stakeholder associated with 'Red Flag' issues
- Integrate stakeholder analysis results/ stakeholder map as part of the project feasibility study/ decision-making process

### Documents

- Stakeholder Analysis and Engagement Procedure

## 4.1.3 ES Obligations and Permits

### Intent

- Identify what ES studies and permits being required, e.g. IEE, ESA, EIA, ESIA
- Determine resources required as inputs to investment analysis and project schedule

### Requirements

- Identify relevant environmental and social permits required by reviewing against:
  - Relevant host country laws
  - ADB's 2009 Safeguard Policy Statement (SPS);
  - Ratified international agreements on environmental, health and safety, land acquisition and involuntary resettlement, indigenous peoples, human resource and labour practices, gender and other social matters, which are in full effect at the time of authorization;
  - IFC General Environmental and Social (ES) Guidelines (2007); and
  - IFC ES sector-specific guidelines, including Thermal Power and others as applicable
- Review related local regulations of the host country to identify whether an ES permits (e.g. EIA/ ESIA report) is compulsory required.
- Integrate list of ES studies and permits/ licenses together with time and schedule identification as part of the project feasibility study/ overall project master plan.

### Documents

- Standard list of ES studies, permits and licenses

#### 4.1.4 Project Categorization (A, B, C)

##### Intent

- Determine project categorization

##### Requirements

- Assess scope of project against ADB's Categorization (Environment, Involuntary Resettlement, Indigenous People)
- Advise project categorization and ES screening to ADB
- Identify safeguard requirements as input into the project feasibility study/ decision-making process
- Develop scope of ES study based on identified ES inputs (risk, stakeholder, project category, permit and license) from feasibility assessment to develop an appropriate Terms of Reference for required ES study
- Integrate scope of ES studies (e.g. EIA, ESIA) in the Terms of Reference

**Figure 1** *ABD's Environment and Social Safeguards Categorization Definition*

Category	Environment	Involuntary Resettlement	Indigenous Peoples
<b>A – Significant</b>	Subprojects that anticipate significant adverse environmental impacts that are irreversible, diverse, or unprecedented. These impacts may affect an area larger than the sites or facilities subject to physical works.	Subprojects where 200 or more persons will experience major impacts, which are defined as (i) being physically displaced from housing, or (ii) losing 10% or more of their productive assets (income generating).	Subprojects that are expected to significantly affect the dignity, human rights, livelihood systems, or culture of Indigenous Peoples or affects the territories or natural or cultural resources that Indigenous Peoples own, use, occupy, or claim as an ancestral domain or asset.
<b>B – Less Significant</b>	Subprojects with potential adverse impacts that are site-specific, few if any of them are irreversible, and in most cases mitigation measures can be more readily designed than Category A subprojects.	Subprojects with involuntary resettlement impacts that are not deemed significant.	Subprojects that are likely to have limited impacts on Indigenous Peoples.
<b>C – Minimal or impact</b>	Subprojects that have minimal or no adverse environmental impacts	Subprojects with no involuntary resettlement impacts.	Subprojects that are not expected to have impacts on Indigenous Peoples.

## 4.2 Implementation (Pre-construction and Construction)

### Pre-construction

#### 4.2.1 ES Impact Assessment Study & Management Plan (EMP) Development

##### Intent

- Assess environmental and social impacts and risks, and determine mitigation measures and monitoring requirements to mitigate the impacts and risks.

##### Requirements

- Engage a qualified independent ES expert to undertake ES studies (e.g. IEE, ESA, EIA, ESIA) in compliance with relevant standards and in consultation with stakeholders, including affected people and local community stakeholders.
- Submit ES studies information to ADB for disclosure and periodically monitoring report along the implementation as required.
- Provide all necessary supports and assign delegates to accomplish any activities required to accomplish the ES studies.
- Participate or assign delegates to disseminate the project information to the public in all stakeholder engagement activities.
- Keep the original final ES studies and their-related mandatory reports, e.g. Monitoring report, and Compliance Audit report.
- In case of any deviations of project information and/ or EMP in the ES study report, communicate, and take these issues to consult with consent agencies whether such deviation may pose significantly adverse impacts to sensitive receptors.

##### Documents

- ES studies (e.g. IEE, ESA, EIA, ESIA)
- Related reports to ES studies (e.g. monitoring reports, compliance audit reports)

##### References

- ADB's Safeguard Requirements (SR1)
- ADB's SPS, 2009 – Safeguard Requirements (SR2) on Involuntary Resettlement
- ADB's Public Communication Policy

#### 4.2.2 Biodiversity Action Plan (BAP) Development

##### Intent

- Assess impacts to biodiversity and develop mitigation plan aiming at a net positive impact on biodiversity
- Avoid impacts on critical habitats and high value species
  - Commit not to explore/mine/drill in World Heritage areas and IUCN Category I-IV protected areas
  - Ensure that its activities will not lead to the extinction of IUCN listed endangered species

### **Requirements**

- Assess the need for a Biodiversity Action Plan (BAP) based on identified ES inputs (risks, stakeholders, project category, permit and license) from the feasibility stage:
  - Are there legal, regulatory, planning, permitting or third party requirements for biodiversity?
  - Are there significant observed or predicted biodiversity impacts i.e. project is located in natural habitats or potential presence of high value species?
  - Are there business benefits and a business case for biodiversity?
- Engage a qualified party to conduct the baseline survey of biodiversity and prepare the BAP. The study of BAP preparation can be part of the EIA study
- Develop BAP outlining
  - priorities for conservation by identifying species, habitats and ecosystems and ecosystem services that need special management, taking into account international, national and local priorities within existing national and local biodiversity action plans and relation priorities.
  - conservation plan by identifying the objectives of the BAP; measures to avoid, minimize, or mitigate potentially adverse impacts and risks; propose compensatory measures to achieve no net loss or a net gain of the affected biodiversity
  - Prioritized actions to achieve the objectives and targets set which progress can be monitored
- Submit BAP to ADB (could be as a part of EIA study) for disclosure and periodically monitoring report along the implementation.

### **Documents**

- Biodiversity Action Plan (BAP)

### **References**

- UN Convention on Biological Diversity - <http://www.cbd.int>
- Convention on International Trade in Endangered Species of Wild Fauna and Flora - <http://www.cites.org/>
- UNESCO World Heritage Centre - <http://whc.unesco.org/>
- International Union for Conservation of Nature - <http://www.iucn.org/>
- Guideline for biodiversity studies from Thailand's Fine Arts Department and Thailand's Royal Forest Department

## **4.2.3 Resettlement Plan (RP) Development**

### **Intent**

- Avoid involuntary resettlement wherever possible
- Provide adequate and appropriate compensation including replacement land and structures, or cash
- Enhance, or as minimum least restore, the livelihoods of all displaced persons in real terms relative to pre-project levels.

### **Requirements**

- Assess the project impacts causing involuntary resettlement (physically and economically) based on identified ES inputs (risks, stakeholders, project category, permit and license) from the feasibility stage

- Conduct meaningful consultations with affected persons, their host communities, and civil society to understand the need of disadvantaged or vulnerable groups
- Develop Project Resettlement Plan (RP), to ensure that livelihoods and standards of living of displaced persons are improved, or at least restored to pre-project (physical and/or economic) levels. At minimum RP should include
  - Minimizing the acquisition of land resulting in physical or economic displacement
  - Disclosure of displacement eligibility and entitlements as early as possible in project planning
  - Fair determination of compensation for land acquisition and other assets
  - Development of Resettlement Action Plans for physical displacement
  - Development of Livelihood Restoration Plans for economic displacement
  - Physical and economic displacement grievance redress mechanisms
  - Periodic audit and assessment of Resettlement Action Plans and/or Livelihood Restoration Plans
- Submit of RP to ADB (could be as part of EIA study) for disclosure and periodically monitoring report along the implementation.

#### **Documents**

- Resettlement Plan (RP)

#### **References**

- IFC Performance Standard 5: Land Acquisition and Involuntary Resettlement
- ADB's SPS, 2009 – Safeguard Requirements (SR2) on Involuntary Resettlement

### **4.2.4**

#### **Indigenous People Plan (IPP) Development**

##### **Intent**

- Avoid negative impacts to Indigenous People
- Develop mitigation measures to minimize negative impacts to Indigenous People

##### **Requirements**

- Assess the need for Social Impact Assessment (SIA) based on identified ES inputs (risks, stakeholders, project category, permit and license) from the feasibility stage and the scale to the potential effects on Indigenous Peoples
- Develop Indigenous Peoples Plan (IPP) outlining the measures to
  - Identifying affected Indigenous People
  - Understanding the local context for engaging with Indigenous People
  - Principles of good engagement of Indigenous People
  - Free Prior and Informed Consent
  - Cultural preservation
  - Grievance redress mechanisms
  - Audit and assessment of relocation/ resettlement
- Submit IPP to ADB (could be as part of EIA study) for disclosure and periodically monitoring report along the implementation.

##### **Document**

- Indigenous People Plan (IPP)

##### **References**

- ADB's SPS SR 3 on Indigenous Peoples

- IFC Performance Standard 7: Indigenous Peoples
- ICMM Indigenous Peoples and Mining Good Practice Guide 2016
- ILO Convention 169 on Indigenous and Tribal Peoples 1989
- United Nations Declaration on the Rights of Indigenous Peoples 2007

#### 4.2.5 Stakeholder Engagement Plan (SEP) Development

##### Intent

- Maintain the alignment of stakeholders' expectations with the project's objectives.

##### Requirements

- Identify and analyse stakeholders who have ability to impact and have interests in ES matters and performance of the project development, such as local agencies, community leaders, customers and local NGOs.
- Develop a stakeholder engagement plan, taking into account of the results of stakeholder analysis including priorities given to those stakeholders.
- Assign responsible parties/ engagement team (e.g. CR) to implement the stakeholder engagement plan. The selection of the team takes into consideration of subject knowledge, experience, and the style/ approach of engagement.
- Tracks the progress of the implementation of the stakeholder engagement program. Upon any deviation from the plan, corrective actions and/ or changes will be implemented as necessary to ensure the engagement objective is being met.
- Participate or assign delegates to disseminate the project information to the public in all stakeholder engagement activities.
- Review and update the stakeholder analysis and engagement plan annually/ during the project development.

##### Documents

- Stakeholder Analysis and Engagement Procedure
- Stakeholder Analysis and Mapping Format
- Stakeholder Engagement Program Format

#### 4.2.6 Grievance Redress Management

##### Intent

- Provide channel to receive grievances including feedbacks and complaints.
- To be able to handle grievances in an appropriate and timely manner.

##### Requirements

- Develop a systematic process to receive, record, investigate, respond to ES related concerns or complaints from internal and external stakeholders.
- Provide local communication channels that stakeholders can raise their grievances or complaints such as through staff, security officers or contractors
- Train frontline staff to be familiar with grievance mechanism to ensure the system is active properly.
- Document the issues in the grievance system when receiving grievances.
- Escalate grievances to the Corporate ES Function to provide assistance and management support as necessary.



- Provide internal communication and report evaluation results to the management.

**Document:**

- Grievance Handling Procedure ENV-P-004

#### 4.2.7 EPC Bidding and Contracting

**Intent**

- Set out ES expectations for EPC tender or Terms of Reference (TOR)
- Establish ES organization structure with clear accountabilities in executing the project detailed design and construction

**Requirements**

- Identify and integrate ES requirements in the TOR for EPC contractors bidding. The ES requirements to be requested from EPC contractor shall comprise, but not limited to, the following requirements;
  - National, local regulation including relevant international ES regulation that any particular project is obliged to
  - ES Management Plans where GED would like EPC contractor to be responsible e.g. EMP, IPP, RP, BAP and SEP, etc.
  - ES organization for the project construction. The organization should include all required ES personnel per applicable requirements and at least ES Management Representative.
  - Monitoring of ES Management Plans implementation, inspection and audit
- Evaluate EPC Contractors bidding document considering the ability to manage ES requirements as part of the supplier/ contractor selection. Example of ES criteria for EPC contractor review are;
  - EPC's ability to implement the ES requirements defined in the TOR;
  - Information relating to the EPC's ES history, non-conformances and performance reviews where available;
- Integrate ES requirements into Contract clauses for the selected EPC. Contract Documents should contain:
  - ES requirements defined in the TOR;
  - Measurement, monitoring and reporting of ES Management Plans implementation, progress and performance;
  - Any special conditions relating to the work and ES provisions such as
    - Environmental standards for supplier's processes, products or services
    - Fundamental human rights (e.g. forced or child labour, freedom of association) (ILO conventions)
    - Labour influx management plan
    - Emergency preparedness and response management plan including community
    - Traffic management
    - Grievance redress mechanisms
    - Working conditions (e.g. working hours, lay-off practices, remuneration)
    - Occupational health and safety
    - Business ethics (e.g. corruption, anti-competitive practices)
    - Management System for environmental and social matters

- Environmental performance data available (e.g. waste generation, water consumption, electricity consumption)
- Social, including safety performance data available (e.g. incidents, injuries rate, near-miss, worker conditions)
- Guidance regarding sub-contracting (i.e. requiring to replicate own standards down the supply chain)

#### **Documents**

- Standard ES Provisions in EPC Terms of Reference
- Standard ES Provisions in EPC Contract

### **4.2.8 ES Information and Performance Disclosure**

#### **Intent**

- Inform project information to relevant stakeholders for transparency and obtain timely input

#### **Requirements**

- Develop communication and reporting plan to internal and external stakeholders throughout the construction phase
  - List of reporting required e.g. progress report, implementation & monitoring report, etc.
  - Stakeholders who GED reported to
  - Frequency/timeline
- Report ES program, progress, performance and compliance status communicated to relevant stakeholders (e.g. ADB, government, communities) at appropriate channels and frequency

#### **Document**

- Communication and Reporting Plan

## **Construction**

### **4.2.9 Project Detailed Design and Construction**

#### **Intent**

- Ensure the project has been appropriately developed to address ES issues

#### **Requirements**

- Execute the detailed design as per Project's Basis of Design and ES specifications
- Implement Change Management Process in case of changes in design
- Review and approve the detailed designs and drawings to conform with Project ES specifications
- Provide ES induction to the selected EPC contractor prior to start construction activities to communicate GED's minimum ES requirements
- Develop ES measures and requirements as rules for EPC contractor to follow during construction activities <contractors must have the followings>
  - Implementation of ES measures and requirements such as recommendations from required ES study e.g. EIA/ IEE, ESMP for construction activities
  - Construction management plan for contractor and subcontractor
  - Occupational health and safety management plan

- Contractor management and oversight plan
- Labour influx management plan
- Waste management plan
- Emergency preparedness and responsible management including community plan
- Traffic management plan
- Grievance redress mechanisms
- Emergency prepare
- Execute the construction activities as planned
- Assess the change, its impacts and cost incorporated to the investment project modification as well as identifies mitigation actions. Factors which trigger change include
  - Change in design and layout
  - Change in construction activities
- Develop updated project progress and other important information as per GED request. In case such project undergoes the delay, cost overrun, scope change, or any other significant issues which PD considers as severe, more information shall be reported to GED accordingly

**Documents**

- EPC's ES Management Plan
- ES Daily Report Work Instruction
- Change Management Procedure

**4.2.10 Implementation of ES Management Plans**

**Intent**

- Execute the ES Management Plans to minimize the identified impacts and comply with the ES obligations and commitments

**Requirements**

- Execute ES Management Plans and other relevant plans such as EMP, BAP, RP, IPP for construction activities by GED
- Execute ES Management Plans (including labor and human rights issues) for construction activities by EPC Contractor
- Execute Corporate Chance-Find Procedure in case of cultural heritage found during construction

**Documents**

- Corporate Chance-Find Procedure

**4.2.11 Monitoring & Reporting of ES Management Plans**

**Intent**

- Ensure all ES Management Plans implemented completely and effectively

**Requirements**

- Develop systematic processes and tools to daily monitor ES performance (GED and EPC) to ensure compliance with ES Management Plans and other relevant plans such as EMP, BAP, RP, IPP

- Conduct routine inspection and audit of construction activities in accordance to the systematic process developed
- Engage competent 3rd party to conduct the compliance review against requirements prescribed in required ES study e.g. IEE/ EIA/ ESIA management and monitoring plans and other regulations
- Identify and execute routine reporting requirements to related parties (e.g. ADB, government, etc.) regarding compliance status, progress of ES Management Plans implementation.

#### **Documents**

- ES Daily Report Work Instruction (PD)

### **4.2.12 Assurance and Continual Improvement**

#### **Intent**

- Validate the implementation of ES Management Plans
- Inform performance of ES Management to Management
- Evaluate the quality of project management

#### **Requirements**

- Engage the qualified and experienced external experts to conduct the audit to verify the information of ES management and monitoring implementation and performances compliance issues at least on quarterly basis
- Develop corrective action plan for any non-compliance issues identified from the audit and update the progress toward the closure
- Execute management review of ES management and performances on a six monthly basis
- Provide supports needs from management to address key ES issues from ES Management Plans implementations
- Submit reporting to regulator and ADB as required
- Assess, address issues and identify lesson learnt from the past project management process
  - What worked and what didn't?
  - What and how can we do better?
  - What are the key success factors and what are the constraints?

#### **Documents**

- Lesson Learnt Report
- Environmental and social audit report template
- Scope for an Annual ES Safeguards Monitoring Report to ADB

### **4.2.13 Standard Procedures for Handover**

#### **Intent**

- Prepare handover packages to be readily available for implementation during operation
- Ensure the project is effectively transferred to operation phase with standard of quality

### **Requirements**

- Identify and develop procedures for ESMS to be used during plant operation (taking into consideration equipment and process design/manufacture recommendations, applicable standard requirements and good industry practices)
- Communicate and provide training to operation team to ensure continuation of project ES knowledge
- Engage contractors and suppliers to ensure technology and experience transfer from licensors to operation team

### **Documents**

- ES Operation Preparation Plan
- Completion & Handover Form
- Acceptance Certificate
- Completion Report

## **4.2.14 Operational ES Compliance**

### **Intent**

- Establish ES Compliance register to enable the compliance management for operation stage

### **Requirements**

- Identify ES related regulatory requirements and other requirements (a register of ES requirements) applicable to the operational phase by reviewing against:
  - ES provisions stipulated from permits and licenses obtained;
  - Relevant host country laws;
  - ADB's 2009 Safeguard Policy Statement (SPS);
  - Ratified international agreements on environmental, health and safety, land acquisition and involuntary resettlement, indigenous peoples, human resource and labour practices, gender and other social matters, which are in full effect at the time of authorization;
  - IFC General Environmental and Social (ES) Guidelines (2007);
  - IFC ES sector-specific guidelines, including Thermal Power and others as applicable.
- Assess if there are any discrepancies or potential non-compliance with respect to the hand over from the project construction to plant operations.
- Address such discrepancies and also inform the Operation Team to be prepared.

### **Documents**

- Register of ES Requirements Template

## 5 ESMS Elements for Merger & Acquisition

### 5.1.1 Due Diligence

#### Intent

- Assess the ES risks and opportunities of the proposed investment in order to make an informed decision.

#### Requirements

- Execute a desktop review to collect and review ES documentation, including publicly available information and documents requested from the target company.
- Assess whether there are potential 'red-flag' ES risks or opportunities which may impact on the Target's investment, its growth assumptions, or its forecasted cash flows. A potential 'red-flag' ES risks in the context of this Assessment will include any and/or all of the following criteria:
  - Potential significant impact on valuation or reputation;
  - May be an issue which should be factored into the SPA (share/ sale and purchase agreement) negotiations;
  - May need to be referenced against other Due Diligence work streams (e.g. insurance, financials, etc.); and
  - Issues to factor into post-Due Diligence phase
- Define the scope of ES Due Diligence based on specific subproject requirements to ensure that relevant assessments are covered
- Conduct ES Due Diligence (including site visit) of the target project by the competent persons or engage a qualified independent ES expert/consultant.
- Assess target site's capacity to address risks and capitalise on opportunities.
- Consider ES issues into business deal for further ES action plan development.

#### Documents:

- Scope for Environmental and Social Due Diligence Assessment Template
- Outline of an Environmental and Social Due Diligence Report

### 5.1.2 Integration of ES Issues into Business Deals

#### Intent

- Factor ES issues into cost of deal to ensure the plan to eliminate/ minimize ES liabilities budgeted and implemented.

#### Requirements

- Develop ES Action Plan addressing ES issues identified from ES Due Diligence
- Integrate ES Action Plans into cost of deal
- Integrate ES Action Plans to be implemented operation phase into Transaction/Integration Plan

#### Documents

- ES Action Plan

### 5.1.3

#### Post-Merger & Acquisition

##### Intent

- Ensure that the acquired target is effectively and efficiently synergized for ES management system

##### Requirements

- Implement ES Action Plan as per Transaction/ Integration plan (such as 90 days plan, 120 days plan).
- Report the implementation of ES Action Plan to the Corporate EHS Function on a monthly basis.
- Adopt GED ES Policy and ESMS requirements to ensure compliance, risks controls and continuously improvement in ES performance within three years or upon reasonable timeline after the mergers and acquisition.
- Conduct look-back session to obtain lesson learnt for ES improvements and knowledge sharing regarding ES related matter during the mergers and acquisition.

##### Documents

- ES Integration Plan after M&A
- Progress of ES Action Plan

## 6 ESMS Elements for Operation

### 6.1 Planning

#### 6.1.1 Management Leadership and Commitment

##### Intent

- To demonstrate visible leadership from the senior management in driving ES Management System (ESMS) and culture within the organization.
- To continually provide all necessary supports towards excellence in ES management and performance.

##### Requirements

###### Corporate Level

1. Review and update ES policy at least every a year or where appropriate based on changed circumstances. The ES policy shall be appropriate to nature, scale, significant ES risks and opportunities and be compatible with the strategic direction and the context of the organization.
2. Communicate the ES policy to all corporate functions, sites and also to interested parties including contractors and suppliers.

###### Site Level

1. Communicate the ES policy to all employees, suppliers and contractors through existing programs and channels including orientations, bulletins and other campaigns.
2. Allocate necessary resources including man-power and budget to implement, maintain and improve the site ESMS and ES performance. This allocation should be part of annual budget setting.
3. Appoint an ES management representative to facilitate and help drive the implementation of the site ESMS.
4. Integrate ES matters such as performance reporting, incidents and lessons learned/ sharing as part of the agenda in formal routine discussion amongst management.
5. Act as a role model by consistently participating in and contributing in ES initiatives, campaigns and activities to continually demonstrate visible leadership in ES performance and culture.
6. Recognize, reinforce and reward on ES initiatives, desired behaviors and achievement of expected performance to create motivation for implementation of ES programs.
7. Ensure that employees realize their right and responsibility to stop work or refuse to work whenever they consider unsafe.

##### Document

- Corporate Environmental and Social Policy



## 6.1.2

### Risks and Opportunities

#### Intent

- To identify, assess and manage ES risks and opportunities associated with the operations, products and services/ throughout the value chain.

#### Requirements

##### Site Level

1. Identify and document ES aspects associated with all existing assets, equipment, activities, products and services across the value chain, including potential implications to the environment, employees, contractors, suppliers, and other relevant stakeholders including communities. ES aspects and impacts from the environmental studies (e.g. ESIA, EIA, IEE) shall be taken into account when identifying ES aspects.
2. Assess and prioritize ES risks and opportunities associated with the ES aspects so that mitigation plans/ measures can be arranged to reduce the risks down to an acceptable level, whereas ES opportunities can be captured. Opportunities may include those related to eco-efficiency, environmental enhancement and corporate social responsibility/ enterprise.
3. ES risk and opportunities assessment shall be carried out by competent individuals/ group with support from subject matter experts as appropriate.
4. Review and update the ES risk assessment at least annually and on an as-needed basis to reflect changes in organization, assets, activities, products and services.
5. Develop and implement mitigation measures such as documented procedures and/ or plans for managing ES risks and opportunity management [Refer to *Element – Operational Control and Maintenance*].
6. Inform employees and relevant suppliers and contractors to be aware of ES risks and mitigation measures/ plans

#### Document

- Identification of hazards and risks assessment (ENV-P-003)

### 6.1.3

## Change Management

### Intent

- To assess and properly manage ES risks associated with changes throughout the whole process from prior-to change and to post-change. Changes include materials, products, equipment, machinery and operating procedures.

### Requirements

#### Site Level

1. Define the scope of change potentially causes ES implications, required to implement change management process, covering the change of raw materials, operations, activities, equipment and machines both temporary and permanent changes occurring at the site.
2. Conduct ES risk assessment of proposed changes shall be assessed, considering potential implications for ES performance, and risk reduction measures shall be defined by competent staff and approved by authorized person prior to change.
3. Conduct ES risk assessment of propose changes prior to change by competent personnel according to nature of change together with a working team comprising personnel related to change. The assessment shall take into account of potential impacts and compliance with regulatory requirements, customers' requirements and other applicable requirements as well as impacts to ES performance.
4. Define appropriate mitigation measures/ plans for ES risks associated with change. The measures/ plans shall cover actions towards compliance including regulatory permits.
5. Monitor change implementation progress including ES risk mitigation measures/ plans to ensure completion within the defined timeline.
6. Develop or update relevant information resulting from the change such as operating procedures, as-built drawings, ES risk register and other related documents, to reflect the change.
7. Provide necessary communication and training to those personnel affected by the change including employees and external stakeholders, as relevant.
8. If the scope of change is defined as new project development, such change shall be managed in accordance with *ESMS for Phase I Feasibility Study and Implementation*.

### Document

- Change Management Procedure

## 6.1.4

### Compliance

#### Intent

- To continually comply with ES regulatory requirements, customers' requirements, and other applicable requirements that are applicable or being adopted.

#### Requirements

##### Corporate Level

1. Monitor emerging regulatory issues and trends (including participation in external panels that formulate ES public policies and regulations, lending agreements, etc.) that may affect the business and operations.
2. Conduct an overall ES compliance evaluation program for all operating sites to assure compliance and mitigate liability at least every three years (or having a third-party to conduct the assessment).
3. Report an overall compliance status and critical findings from the ES compliance evaluation program to the senior management to ensure necessary resources and efforts are made to assure compliance.

##### Site Level

1. Develop a register of ES requirements including regulatory requirements, customers' requirements and other applicable requirements (including lenders' agreements/ requirements) being adopted to cover the requirements during the operation [If a register has been developed during the hand-over of the project to the operation, the action here is to update the register].
2. Define, communicate and implement actions to achieve compliance by integrating into the day-to-day jobs and tasks as much as practicable.
3. Review and update ES requirements (register of ES requirements) at least every quarter or upon changes of requirements. In case of new or changed requirements, compliance evaluation shall be conducted and necessary efforts are to be made to address such changes. Also the changes shall be made to the register of ES requirements.
4. Conduct a compliance evaluation at least once a year. Non-compliance or potential non-compliance issues identified from the evaluation shall be corrected and prevented [Refer to *Element – Non-compliance Handling*].
5. Identify and consolidate ES standards and guidelines of the industry or best practices from other industries for further communicating, developing and implementing the practices as appropriate to the organization.

#### Documents

- Environmental, Health and Safety Laws and Regulations (ENV-P-002)

## 6.1.5

### Goals and Improvement Plan

#### Intent

- To ensure that ES objectives, performance indicators, targets and improvement plan are established and implemented to drive continual performance improvement.

#### Requirements

##### Corporate Level

1. Review and analyse the group ES performance (i.e. ES performance indicators) annually to understand the status and identify areas for improvement.
2. Define corporate-level ES objectives and targets which require consistency in improving group ES performance. Considerations shall be given to the ES policy, business direction and strategy, significant risks and opportunities, group ES past performance and views of interested parties including lender's requirements.
3. Deploy corporate-level ES objectives and targets to all sites including provision of necessary supports such as training, tools, etc.

##### Site Level

1. Define site-level ES objectives and targets as part of the business planning process, taking into account of ES policy, business contexts, significant risks and opportunities, performance improvement and views of interested parties. The site-level ES objectives and targets shall at least include corporate-level ES objectives and targets. The targets set shall be specific to the objectives, measurable, and practical with clear timeframe. The target shall demonstrate commitment on reduction of impacts to environment and stakeholders, reduction of resource use, minimization of potential hazards, and continual improvement.
2. Define performance indicators including leading indicators and lagging indicator together with those targets.
3. Establish ES improvement plan that specifies actions, responsible person, timeline and budget. Those defined actions should be integrated into the existing processes/ platforms to ensure the target achievement.
4. Report the performance resulting from the improvement plan detailing effectiveness analysis and recommendations where the programs tend not to be achieved, to the site senior management as well as to the Corporate ES Function at the frequency of agreed timeline.

#### Document

-

**Intent**

- To identify and prioritize stakeholders/ interested parties relevant to the business and organization based on their interests and the level of influence on the company with respect to ES matters.
- To develop and implement suitable engagement programs so that mutual respect, understanding, transparency, trust and relationship can be built and maintained between the company and relevant stakeholders.

**Requirements**Corporate-Level

1. Identify and analyse external stakeholders who have ability to impact and have interests in ES matters and performance of the company, such as government agencies, other policy makers, industry associations, customers, lenders and country-level/ international NGOs.
2. Develop corporate-level stakeholder engagement program and its approach, taking into account of the results of stakeholder analysis including priorities given to those stakeholders.
3. Assign responsible parties/ engagement team to implement the stakeholder engagement program. The selection of the team takes into consideration of subject knowledge, experience, and the style/ approach of engagement.
4. Tracks the progress of the implementation of the stakeholder engagement program. Upon any deviation from the plan, corrective actions and/ or changes will be implemented as necessary to ensure the engagement objective is being met.
5. Review and update a corporate-level stakeholder analysis and engagement program annually.

Site Level

1. Identify and analyse site-specific internal and external stakeholders who have ability to impact and have interests in ES matters and performance of the site, such as local agencies, community leaders, customers and local NGOs.
2. Develop site-level stakeholder engagement program and its approach, taking into account of the results of stakeholder analysis including priorities given to those stakeholders.
3. Assign responsible parties/ engagement team to implement the stakeholder engagement program. The selection of the team takes into consideration of subject knowledge, experience, and the style/ approach of engagement.
4. Tracks the progress of the implementation of the stakeholder engagement program. Upon any deviation from the plan, corrective actions and/ or changes will be implemented as necessary to ensure the engagement objective is being met.
5. Review and update the site-level stakeholder analysis and engagement program annually. In order to evaluate the success of the engagement program and/ or gain perceptions from certain group of stakeholders, attitude surveys may be considered.

**Documents**

- Stakeholder Analysis and Engagement Procedure
- Stakeholder Analysis and Mapping Format
- Stakeholder Engagement Program Format

## 6.2 Implementation (Do)

### 6.2.1 Awareness and Competency

#### Intent

- To ensure that the employees and the contractors have knowledge, understanding and skills in performing their job according to the legal requirements and ESMS.
- To motivate the employees and the contractors to become aware of the benefit of ESMS.

#### Requirements

##### Site Level

1. Define ES competencies, qualifications and performance expectations for key positions (i.e. certified ES personnel, managers, supervisors) in the job profile/ description.
2. Incorporate ES qualifications, competencies and performance expectations in the hiring and promotion process.
3. Ensure ES competency and knowledge of each position prior to commencement of tasks associated with significant ES risks.
4. Develop ES training matrix for each job title of employees and contractors based on associated risks specific to the job including the key positions and those that have significant implication to ESMS and performance.
5. Develop and implement training programs covering topics specific to the risks of jobs associated with significant ES risks and according to regulatory requirements in order to enhance competency of employees and contractors to the defined level.
6. Conduct pre-training and post-training evaluations as necessary and maintain documented training records.
7. Conduct a post-training follow-up for key positions (e.g. job observation) to ensure the trainee performs the job in accordance with the operating procedures. Re-training shall be required as necessary to ensure the employees are able to perform their job as per expectation.
8. Promote ES initiatives/ campaigns to motivate and raise awareness of employees and contractors on the ES policy, significant ES risks, and their contributions to the effectiveness of ESMS, as well as the implications of not conforming with the ESMS requirements.
9. Define channels for employees at all levels and contractors to contribute in providing feedbacks or recommendation for improving ES initiatives/ campaigns.

#### Relevant Document

- EH&S Training Awareness and Competence (EHS-P-016)

## 6.2.2

### Contractors and Suppliers

#### Intent

- To manage ES risks associated with goods and services provided by contractors and suppliers to minimize any adverse ES consequences.

#### Requirements

##### Corporate Level & Site Level

1. Define the ES criteria for screening contractors and suppliers, taking into account of the ES past performance, in order to include contractors and suppliers into the company vendor list.
2. Prioritize contractors and suppliers based on ES risks arisen from use of products and services provided by contractors and suppliers, volume of products and services, and level of influence that the company has control over such contractors and suppliers.
3. Define ES Management criteria specific to the ES risks associated with products and services as part of the bidding and selection criteria for key contractors and procurement of product and critical equipment and materials from key suppliers.
4. Specify ES conditions, e.g. requirements, rules, regulations, standards specific to ES risks arisen from products or services, as well as consequences from not following such conditions into purchase order, contract, agreement or contract's attachment for key contractors and suppliers.
5. Perform onsite regular monitoring and inspection including evaluation after the service completion or prior to contract renewal by contract owner or user to ensure compliance with ES conditions stated in the contract document or agreement.
6. Conduct ES assessment at the premises of key contractors and suppliers especially those customers' requirements and issues of interest of the community and public.
7. Track the ES performance of those contractors and suppliers routinely. Corrective actions, as the result of routine internal audit within the company and at the premise of contractor and supplier, shall be in place.
8. Support the development and improvement of ES management system of the key contractors and suppliers having significant ES impacts to the company, especially to serve customer's requirements and interests of the community and public.

#### Document

- Green Procurement (ENV-P-005)

## 6.2.3

### Operational Control & Maintenance

#### Intent

- To manage ES risks associated with the activities related to business operations and comply with the relevant applicable requirements through operational control and maintenance programs.

#### Requirements

##### Site Level

1. Develop operating procedures and maintenance programs to properly manage ES risks and compliance associated with operational activities (identified from *Element - Risks and Opportunities* and from the *related ES Management Plans* during the operations developed during the Project Development Stage). The operating procedures and maintenance programs shall address ES risks arising from normal, abnormal and emergency situations.
2. Educate relevant personnel on the defined operating procedures and maintenance programs through training, including on-the-job training, coaching and/ or communication program where appropriate.
3. Monitor the effectiveness of implementation of the defined operating procedures and maintenance programs through inspections and audits as part of the site ESMS.
4. Maintain the documented operating procedures, their relevant documents and tools as per the company document control procedure.
5. Review and continually update the operating procedures, maintenance programs, relevant documents and tools at least every two years and also upon changes.

#### Documents

- Environmental and Social Management Plan (ESMP) during the Operation
- Resettlement Plan (RP) if relevant
- Indigenous People Plan (IPP) if relevant
- Biodiversity Action Plan (BAP) if relevant
- Laboratory Safety (EHS-P-003)
- Powered Industrial Trucks (EHS-P-004)
- Plant Security (EHS-P-005)
- General First Aid (EHS-P-006)
- Health and Medical Program (EHS-P-007)
- Bloodborne Pathogen (EHS-P-008)
- Hearing Conservation (EHS-P-009)
- Respiratory Protection (EHS-P-010)
- Physical Heat Exposure (EHS-P-011)
- General Safety Practice (EHS-P-012)
- Safety Committee (EHS-P-014)
- Personal Protective Equipment (EHS-P-017)
- Hazardous Work Permit (EHS-P-018)
- Lock out-Tag out (EHS-P-019)
- General Electrical Safety (EHS-P-020)
- Sling, Rigging and Crane (EHS-P-021)
- Ladder and Scaffolding (EHS-P-022)



- Walking Surface, Stairs and Floor (EHS-P-023)
- Confined Space Entry (EHS-P-024)
- Portable Tools, Machines and Machinery Guarding (EHS-P-025)
- Cutting Welding and Brazing (EHS-P-026)
- Safety Sign and Color Coding (EHS-P-027)
- General Fire Safety (EHS-P-029)
- Fire Protection Plan (EHS-P-030)
- Fire System Impairment (EHS-P-031)
- Fire Extinguisher (EHS-P-032)
- Fire Pump, Sprinklers, Fixed and Detection System (EHS-P-033)
- Combustible and Flammable Liquid (EHS-P-034)
- Stand Pipes and House System (EHS-P-035)
- Compressed Gas (EHS-P-036)
- Waste Management (ENV-P-006)
- Relevant equipment/ machinery maintenance programs

#### 6.2.4 Emergency Preparedness and Response

##### Intent

- To identify reasonably foreseeable emergencies and appropriate response measures are planned together with proper response equipment to minimize or mitigate any adverse impacts to the environment, personnel and relevant external parties.

##### Requirements

###### Site Level

1. Identify potential emergency and crisis situations and their impacts related to site activities as well as those associated with neighbouring activities.
2. Establish an emergency preparedness and response plan and related procedures to mitigate ES and associated business impacts. The response plan shall specify roles and responsibilities of relevant personnel; effective procedures for communication to employees and external stakeholders; and simulation of scenarios for periodic drill exercise.
3. Assign personnel/ response team and periodically train and enhance skills of personnel related to emergency response.
4. Provide adequate response equipment and routinely inspect the equipment to be ready for use at all times.
5. Implement and maintain a crisis communication plan to inform relevant internal and external stakeholders (including nearby communities) in the event of emergencies.
6. Plan and conduct drills of emergency response and crisis communication plans at least annually and with involvement from external emergency agencies, as appropriate.
7. Lessons learned from actual emergencies and emergency drill shall be documented, used to review and amend existing plan, and shared amongst other sites as appropriate.
8. Report emergency events to corporate ES department upon occurrence.

## Documents

- Spill Prevention and Control Plan (EHS-P-001)
- Emergency Preparedness (EHS-P-037)

## 6.2.5

## Communication

### Intent

- To provide effective and transparent communication to internal and external stakeholders to encourage participation and contribution in ES performance improvement and ensure that concerns/ grievances are counted and responded in a timely manner.

### Requirements

#### Corporate Level

1. Communicate corporate ES requirements and the requirements the group are obliged to the sites when appropriate.
2. Conduct an ES forum annually to enhance sharing, networking and enhancing the group ESMS. The forum may cover the topics such as overall group ES performance, best practices, lessons learned, other knowledge sharing, and deployment of group/ medium-term ES targets.
3. Disclose ES information related to ESMS to external interested stakeholders such as lenders, agencies and shareholders. This could be by means of annual reporting, sustainability reporting, etc.

#### Site Level

1. Establish a process/ plan for ES communication to internal and external stakeholders in accordance with their relevance and interest. The process shall include what to communicate, channels/ means, frequency and target audience. The topics may cover the followings:
  - a. ES policy;
  - b. Objectives, targets, performance indicators, improvement plans;
  - c. Applicable ES requirements;
  - d. Key contents of operating procedures and rules;
  - e. ES performance against targets and monitoring results; and
  - f. Incidents and emergency drills with lessons learned.
2. Exchange and share of ES information, knowledge and good practices within the site through the effective means of communications.
3. Establish a process to motivate employees, contractors and suppliers to involve in providing opinions and suggestions for continually improving ES management and performance.
4. Deploy a process for recording, handling and responding internal and external ES related grievances to ensure that responses are made in addressing such grievances in a timely manner.
5. Define criteria and method of evaluation that reflect internal and external communication performance in order to achieve the communication objectives.

### Documents

- Hazardous Communication (EHS-P-002)
- General Safety Meeting (EHS-P-012)
- Receipt of Complaint (ENV-P-004)

## 6.2.6 Incident Management

### Intent

- To timely report and investigate ES incidents as well as to mitigate impacts from the incidents
- To share lessons learned across the sites to prevent recurrence and to improve ES performance.

### Requirements

#### Corporate Level

1. Develop and deploy a *Corporate Incident Reporting and Investigation Procedure* to ensure consistency amongst all sites that cover:
  - a. Types of incidents. The incidents shall cover those that could impact the environment, personnel and other stakeholders outside the company;
  - b. Reporting requirements (what incidents to be reported to whom);
  - c. Level of investigation required;
  - d. Requirements for the level of investigation (i.e. root cause analysis method, investigation team, facilitator/ leader, time for report completion); and
  - e. Guidance for performing the root cause analysis/ investigation.
2. Shares lessons learned from incidents, especially for serious cases, to relevant functions and all sites through briefings, notices, meeting or other effective communications.
3. Review and analyze the group ES incidents and make recommendations for reducing the group incidents and for continual improvement.

#### Site Level

1. Report all incidents (e.g. accidental releases, spills, permit violation, injuries, fires, property damage, etc.) in accordance with *Corporate Incident Reporting and Investigation Procedure*. Where required, serious incident shall be reported to the Corporate ES Function.
2. Sets up the investigation team according to level of investigation required as per *Corporate Incident Reporting and Investigation Procedure*.
3. Conduct incident investigations to identify root causes and contributing factors to determine where improvements in the systems and practices are required. Incident investigation shall be performed by a designated team with combination of competent and experienced individuals including external subject matter expert, where required, for serious incident. Appropriate technique for investigation shall be deployed.
4. Develop and implement corrective and preventive actions within due date to reduce the likelihood of a recurrence.
5. Follows up the progress and tracks the completion of corrective and preventive actions through closure, and report the progress of completion of corrective and preventive action to the site senior management.

6. Communicate and share knowledge and lessons learned from the incidents throughout the site to avoid recurrence.

#### **Document**

- Accident and Incident Investigation (EHS-P-015)

## **6.3 Checking**

### **6.3.1 Monitoring and Reporting**

#### **Intent**

- To monitor ES performance periodically to measure continual improvement and ensure compliance with obligations.

#### **Requirements**

##### Corporate Level

1. Hire a third party to conduct ES monitoring as required by the environmental studies, such as ESIA, EIA and IEE.
2. Review and analyse the group ES performance and make recommendations for continual improvement (including benchmarking and the definition of group ES target).
3. Report ES performance to external stakeholders as required by the obligations. This may include (but are not limited to)
  - a. Incident reporting to Government Agencies
  - b. Progress reporting of Resettlement Action Plan (RAP), Indigenous People Plan (IPP) and Biodiversity Action Plan (BAP) to Lenders such as Asian Development Bank
4. Consider conducting a Group ES data verification program to ensure the completeness, accuracy and reliability of data so that ES performance is transparently disclosed.

##### Site Level

1. Conduct routine inspections to monitor the effectiveness of operating procedures being implemented and compliance.
2. Plan and perform ES monitoring program (or hire a third party to perform) regularly as required by the regulations such as air emissions, discharge, ambient noise, etc.).
3. Track the performance indicators and progress against ES targets and report the performance to the site senior management on a monthly basis in meetings.
4. Report the performance against the group ES targets to the Corporate ES Function at the frequency of agreed timeline.
5. Conduct an investigation and deploy preventive and corrective actions when non-conformities arise from the inspection, monitoring and target achievements.

#### **Document**

- Monitoring Corrective Action for Nonconformity with Standard of Environmental Monitoring Result (ENV-P-001)

## 6.3.2

### Audit

#### Intent

- To evaluate the effectiveness of ESMS periodically to drive continual improvement.
- To ensure that the top management acknowledges the ESMS performance and supports the continual improvement.

#### Requirements

##### Corporate Level

1. Develop a corporate audit plan that cover the whole organization and sites to assess the effectiveness of the group ESMS.
2. Conduct a corporate audit at least once every 3 years or more frequent depending upon the group performance.
3. Report the group ESMS audit results to the top management of the company to seek views and support for continual improvement.

##### Site Level

1. Develop an annual internal audit plan that cover all elements of the site ESMS.
2. Conduct a refresh training of internal auditors at least every two years on the auditing skills and ESMS requirements and objective evidences against the ESMS.
3. Conduct an internal audit to assess the effectiveness of the site ESMS implementation. The internal audit shall be conducted by competent team.
4. Report the internal audit results to the site senior management in the management review to seek views and recommendations for continual improvement.

#### Documents

- Audit Procedure

## 6.4 Improvement (Act)

### 6.4.1 Handling of Non-conformities

#### Intent

- To manage ES non-conformities properly through implementation of preventive and corrective actions to avoid recurrence, so that the ESMS is effectively maintained.

#### Requirements

##### Site Level

1. Define scope of ES non-conformities to include those arisen from, but not limited to, internal inspections and audits, corporate audits, external audits, inspections by governmental authorities, customer audit, and any other deviation from normal work that could lead ES incident.
2. Initiate and report non-conformities to relevant functions to immediately mitigate impacts and also to the site ES department for initiating a root cause analysis.
3. Conduct a root cause analysis of non-conformity by competent and trained personnel. Corrective and preventive actions shall be initiated based on the identified root causes in order to rectify and avoid repetition.
4. Track the progress of preventive and corrective actions shall be systematically monitored to ensure completion within the timeline.
5. Evaluate the completion of corrective and preventive actions through closure (in which the effectiveness of actions are achieved in a way that such risks/ findings are mitigated and prevented).
6. Shares lessons learned from non-conformities within the site and also to the corporate ES department so that lessons learned can be shared amongst all sites to avoid reoccurrence.

#### Relevant Documents

- Procedure Handling of Non-conformities

**Intent**

- To review an overall ESMS by the top management to ensure the ESMS is achieving the desired outcomes and promoting a continual improvement in ES performance.

**Requirements**Corporate Level

1. Organize and conduct at least once a year the group ESMS review at corporate level, chaired by top management of the company. The agenda may include:
  - a. Changes in business contexts including internal and external factors associated with threats and opportunities that have implications to the direction and contexts of ESMS;
  - b. Overall ES compliance status and audit results;
  - c. Overall complaints/grievances and status;
  - d. Achievement of the group ES objectives and targets;
  - e. Review of ES budgets required;
  - f. Follow-up of actions proposed in the previous management review; and
  - g. Recommendations for future ESMS implementation.
2. Assign responsibilities to execute the recommendations and/ or proposed actions made from the management review so that they are deployed to all relevant functions and sites.
3. Document the management review minutes, and tracks the progress of the actions defined from the management review.
4. Considers an overall validation of the ESMS every five years by a competent party to reflect suitability and adequacy of the ESMS.

Site Level

1. Organize and plan the agenda for the site management review which will be conducted at least once a year. The management review on the adequacy and effectiveness of ESMS, programs and performance.  
The agenda or areas of interest must, at minimum, cover the following topics:
  - Changes in site contexts including external factors associated with threats and opportunities that have implications to the direction and contexts of the site ESMS
  - Results of compliance evaluations
  - Achievement of ES objectives, targets and specific action plans
  - Adequacy of resources
  - ES complaints/grievances and status
  - Results of audits and follow-up of corrective/ preventive actions
  - Follow-up of actions proposed in the previous management review
  - ES initiatives and campaigns
  - Support required to promote awareness and improve ESMS performance (including human and financial resources)
2. Assign responsibilities to execute the recommendations and/ or proposed actions made from the management review.
3. Document the management review minutes, and tracks the progress of the actions defined from the management review.

Relevant Documents

- Management review minutes

## 7.1 Abbreviation and Glossary

### Abbreviations

ADB	Asian Development Bank
AM	Asset Management Group
BAP	Biodiversity Action Plan
BD	Business Development Group
CR	Community Relation Department
EHS	Environmental, Health and Safety
EIA	Environmental Impact Assessment
EMP	Environmental Management Plan
EPC	Engineering, Procurement and Construction
ES	Environmental and Social
ESA	Environmental Safety Assessment
ESIA	Environmental and Social Impact Assessment
ESMP	Environmental and Social Management Plan
ESMS	Environmental and Social Management System
GAD	Gender and Development
GED	Gulf Energy Development Public Company
GRI	Global Reporting Initiative
ICMM	International Council on Mining and Metals
IEE	Initial Environmental Examination
IFC	International Finance Corporation
ILO	International Labour Organization
IPP	Indigenous People Plan
IR	Involuntary Resettlement
ISO	International Organization for Standardization
IUCN	International Union for Conservation of Nature
M&A	Mergers and Acquisition
NGOs	Non-Governmental Organizations
ONEP	Office of Natural Resources and Environmental Policy and Planning
OHSMS	Occupational Health and Safety Management Systems
PD	Project Development Group
PIAL	Prohibited Investment Activities List
RAP	Resettlement Action Plan
RFP	Request for Proposal
RP	Resettlement Plan
SEP	Stakeholder Engagement Plan
SIA	Social Impact Assessment
SOP	Standard Operating Procedure
SPS	ADB's 2009 Safeguard Policy Statement
SR	ADB's Safeguard Requirements
TOR	Terms of Reference



## Glossary

Biodiversity		The variability among living organisms from all sources including, inter alia, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part; this includes diversity within species, between species and of ecosystems.
Chance Procedure	Find	A project-specific procedure that outlines what will happen if previously unknown physical resources are encountered during project construction or operation. The procedure includes record-keeping and expert verification procedures, chain of custody instructions for movable finds, and clear criteria for potential temporary work stoppages that could be required for rapid disposition of issues related to the finds.
Critical Habitat		A subset of both natural and modified habitat that deserves particular attention. Critical habitat includes areas with high biodiversity value, including habitat required for the survival of critically endangered or endangered species; areas having special significance for endemic or restricted-range species; sites that are critical for the survival of migratory species; areas supporting globally significant concentrations or numbers of individuals of congregator species; areas with unique assemblages of species or that are associated with key evolutionary processes or provide key ecosystem services; and areas having biodiversity of significant social, economic, or cultural importance to local communities.
Displaced Persons		In the context of involuntary resettlement, displaced persons are those who are physically displaced (relocation, loss of residential land, or loss of shelter) and/or economically displaced (loss of land, assets, access to assets, income sources, or means of livelihoods) as a result of (i) involuntary acquisition of land, or (ii) involuntary restrictions on land use or on access to legally designated parks and protected areas.
Economic Displacement		Loss of land, assets, access to assets, income sources, or means of livelihoods as a result of (i) involuntary acquisition of land, or (ii) involuntary restrictions on land use or on access to legally designated parks and protected areas.
Environmental and Social Assessment		A generic term used to describe a process of environmental and social analysis and planning to address the environmental and social impacts and risks associated with a project. The assessment may take the form of an EIA, IEE, ESIA, ESA, environmental audit, or Matrix of Environmental Impacts.
Environmental and Social Management Plan (ESMP)		A plan that guides the implementation of environmental and social management and mitigation measures. It contains the following key elements: mitigation measures, implementation and monitoring program, cost estimates, resource requirements, budget, and institutional arrangements.
Environmental and Social Monitoring Plan		A plan that details environmental and social monitoring and reporting requirements, including parameters to be measured, methods, sampling locations, frequency of measurements, detection limits, and definition of thresholds that will signal the need for corrective actions; typically a part of an ESMP.
External Experts		Experts not involved in day-to-day project implementation or supervision.

Free Prior and Informed Consent	<p><i>Free</i> implies that there is no coercion, intimidation or manipulation.</p> <p><i>Prior</i> implies that consent is to be sought sufficiently in advance of any authorization or commencement of activities and respect is shown to time requirements of indigenous consultation/consensus processes.</p> <p><i>Informed</i> implies that information is provided that covers a range of aspects, including the nature, size, pace, reversibility and scope of any proposed project or activity; the purpose of the project as well as its duration; locality and areas affected; a preliminary assessment of the likely economic, social, cultural and environmental impact, including potential risks; personnel likely to be involved in the execution of the project; and procedures the project may entail. This process may include the option of withholding consent. Consultation and participation are crucial components of a consent process.</p>
Indigenous People	<p>Broadly defined as a distinct social and cultural group possessing the following characteristics in varying degrees: self-identification as members of a distinct indigenous cultural group and recognition of this identity by others; collective attachment to geographically distinct habitats or ancestral territories in the Project area and to the natural resources in these habitats and territories; customary cultural, economic, social or political institutions that are separate from those of the dominant society or culture; and/or an indigenous language often different from the official language of the country or region.</p>
Involuntary Resettlement	<p>Refers both to physical displacement and economic displacement as a result of Project related land acquisition. Resettlement is considered involuntary when affected individuals or communities do not have the right to refuse land acquisition that result in displacement.</p>
Mismanagement of stakeholder engagement	<p>A situation where stakeholder engagement is organized or controlled inadequately and ineffectively</p>
Meaningful Consultations	<p>A process that (i) begins early in the project preparation stage and is carried out on an ongoing basis throughout the project cycle; (ii) provides timely disclosure of relevant and adequate information that is understandable and readily accessible to affected people; (iii) is undertaken in an atmosphere free of intimidation or coercion; (iv) is gender inclusive and responsive, and tailored to the needs of disadvantaged and vulnerable groups; and (v) enables the incorporation of all relevant views of affected people and other stakeholders into decision making, such as project design, mitigation measures, the sharing of development benefits and opportunities, and implementation issues.</p>
Natural Habitat	<p>Movable or immovable objects, sites, structures, groups of structures, and natural features and landscapes that have archaeological, paleontological, historical, architectural, religious, aesthetic, or other cultural significance. Physical cultural resources may be located in urban or rural settings and may be above or below ground or underwater. Their cultural interest may be at the local, provincial, national, or international level</p>
Physical Displacement	<p>Relocation, loss of residential land, or loss of shelter as a result of (i) involuntary acquisition of land, or (ii) involuntary restrictions on land use or on access to legally designated parks and protected areas.</p>
Significant Conversion or	<p>(i) the elimination or severe diminution of the integrity of a habitat caused by a major, long-term change in land or water use; or (ii) the</p>

Degradation	modification of a habitat that substantially reduces the habitat's ability to maintain viable populations of its native species.
Subproject	A subproject is defined as a set of separately executed activities. Separate financial and economic analyses would typically be carried out at appraisal for each subproject, together with overall financial and economic analyses

## 7.2

## Correspondence to ADB's Safeguard Policy and ISO

GED's ESMS Framework	ADB's Safeguard Policy	ISO 14001	ISO26000
2. Policy	ADB SPS, V. Safeguard Policy Statement, 43	5.2 Environmental Policy	-
4. ESMS Elements for Feasibility Study and Implementation			
4.1 Feasibility Study			
4.1.1 Risk Screening	ADB SPS. V. Safeguarding Policy Statement, 49 - 52, p.24 ADB SPS. V. Safeguarding Policy Statement, 66, p.29	-	6.3.4 Human rights risk situations
4.1.2 Stakeholder Identification	ADB SPS. V. Safeguarding Policy Statement, 54, p.25	-	3.3.3 The role of stakeholders in social responsibility 4.5 Respect to stakeholder interests
4.1.3 ES Obligations and Permits	ADB SPS. V. Safeguarding Policy Statement, 58, p.26	-	6.5.1.1 Organizations and the environment
4.1.4 Project Categorization (A, B, C)	ADB SPS. V. Safeguarding Policy Statement, 50, 57, p.24	-	-
4.2 Implementation			
Pre-construction			
4.2.1 ES Impact Assessment Study & Management Plan (EMP) Development	ADB SPS. V. Safeguarding Policy Statement, 13-16,p.25 ADB SPS. Safeguarding: Environment, 4-9, p.35-36 ADB SPS. Safeguarding: Environment, 12-18, p.37-38	-	5.2.1 Impacts, interests and expectations 6.6.7 Fair operating practices issue: Respect for property rights
4.2.2 Biodiversity Action Plan (BAP) Development	ADB SPS. Safeguard Requirement 1: Environment, 8, p.34-38	-	6.5.6 Environmental issue 4: Protection of the environment, biodiversity and restoration of natural habitats
4.2.3 Resettlement Plan (RP) Development	ADB SPS. Safeguard Requirements 2: Involuntary Resettlement, 7-33, p. 50-55	-	7.3.2 Determining relevance and significance of core subjects and issues to an organization
4.2.4 Indigenous People Plan (IPP) Development	ADB SPS. Safeguard Requirements 3: Indigenous Peoples, 10-37, p. 61-66	-	6.3.7 Human rights issue 5: Discrimination and vulnerable groups
4.2.5 Stakeholder Engagement Plan (SEP) Development	ADB SPS. Safeguard Requirements 1: Environment, Outline of an Environmental Impact Assessment Report, G. Information Disclosure, Consultation, and Participation, p.47 ADB SPS. Safeguard Requirements 2: Involuntary Resettlement, 28, p. 54 ADB SPS. Safeguard Requirements 2: Involuntary Settlement, Outline of a Resettlement Plan, E. Information Disclosure, Consultation, and Participation, p.51-52 ADB SPS. Safeguard Requirements 3: Indigenous Peoples, 10-12, p.61-62 ADB SPS. Safeguard Requirements 3: Indigenous Peoples, Outline of an Indigenous Peoples Plan, D. Information	-	5.3.3 Stakeholder engagement

GED's ESMS Framework	ADB's Safeguard Policy	ISO 14001	ISO26000
	Disclosure, Consultation, and Participation, p.64		
4.2.6 Grievance Redress Management	ADB SPS. Safeguard Requirements 1: Environment, 20, p.38 ADB SPS. Safeguard Requirements 2: Involuntary Resettlement, 29, p.54 ADB SPS. Safeguard Requirements 3: Indigenous Peoples, 22, p.63	-	6.3.6 Resolving grievances
4.2.7 EPC Bidding	ADB SPS. V. Safeguarding Policy Statement, 73, p.31	-	-
4.2.8 ES Organizational Structure	ADB SPS. V. Safeguarding Policy Statement, 66, p.29	-	6.2.1 Overview of organizational governance 6.2.2 Principles and consideration 6.2.3 Decision-making processes and structures
4.2.9 ES Information and Performance Disclosure	ADB SPS. Safeguard Requirements 1: Environment, Outline of an Environmental Impact Assessment Report, G. Information Disclosure, Consultation, and Participation, p.47 ADB SPS. Safeguard Requirements 2: Involuntary Settlement, Outline of a Resettlement Plan, E. Information Disclosure, Consultation, and Participation, p.51-52 ADB SPS. Safeguard Requirements 3: Indigenous Peoples, Outline of an Indigenous Peoples Plan, D. Information Disclosure, Consultation, and Participation, p.64	-	6.5.3 Environmental issue 1: Prevention of pollution
Construction			
4.2.10 Project Detailed Design and Construction	ADB SPS. Safeguard Requirements 1: Environment, 12-16, p.37-38 ADB SPS. Safeguard Requirements 2: Involuntary Settlement, 18-24, p.52-53	-	-
4.2.11 Implementation of ES Management Plans	ADB SPS. Safeguard Requirements 1: Environment, 21-22, p.39 ADB SPS. Safeguard Requirements 1: Environment, Outline of an Environmental Impact Assessment Report, I. Environmental Management Plan, p.47 ADB SPS. Safeguard Requirements 2: Involuntary Settlement, 30, p.55 ADB SPS. Safeguard Requirements 2: Involuntary Settlement, Outline of a Resettlement Plan, M. Implementation schedule – N.	-	6.8.9 Community Involvement and development issue 7: Social investment

GED's ESMS Framework	ADB's Safeguard Policy	ISO 14001	ISO26000
	Monitoring and Reporting, p.58-59 ADB SPS. Safeguard Requirements 3: Indigenous Peoples, 16-19, p.62-63 ADB SPS. Safeguard Requirements 3: Indigenous Peoples, Outline of an Indigenous Peoples Plan, I. Monitoring, Reporting and Evaluation, p.69		
4.2.12 Standard Procedures for Handover	ADB SPS. Safeguard Requirements 1: Environment, 12-16, p.37 ADB SPS. Safeguard Requirements 2: Involuntary Settlement, 17-24, p.52-53 ADB SPS. Safeguard Requirements 3: Indigenous Peoples, 13-19, p.62-63	-	-
4.2.13 Operational ES Compliance	ADB SPS. Safeguard Requirements 1: Environment, 1, p.35 ADB SPS. Safeguard Requirements 2: Involuntary Settlement, 2, p.49 ADB SPS. Safeguard Requirements 3: Indigenous Peoples, 2, p.60	-	4.6 Respect for the rule of law
4.2.14 Monitoring & Reporting of ES Management Plans	ADB SPS. Safeguard Requirements 2: Involuntary Settlement, 21, p.39 ADB SPS. Safeguard Requirements 2: Involuntary Settlement, 30, p.55 ADB SPS. Safeguard Requirements 3: Indigenous Peoples, 23, p.63	-	7.7.2 Monitoring activities on social responsibility 7.7.3 Review an organization's progress and performance on social responsibility 7.7.4 Enhancing the reliability of data and information collection and management
4.2.15 Assurance and Continual Improvement	ADB SPS. Safeguard Requirements 2: Involuntary Settlement, 21, p.39 ADB SPS. Safeguard Requirements 2: Involuntary Settlement, 30-31, p.55 ADB SPS. Safeguard Requirements 3: Indigenous Peoples, 23-24, p.63	-	7.7.5 Improving performance
5 ESMS Elements for Merger & Acquisition			
5.1.1 Due Diligence	ADB SPS. V. Safeguarding Policy Statement, 43, p.19 ADB SPS. V. Safeguarding Policy Statement, 56, p.26	-	7.3.1 Due diligence
5.1.2 Integration of ES Issues into Business Deals	ADB SPS. V. Safeguarding Policy Statement, 44, p.19	-	-
5.1.3 Post-Merger & Acquisition	ADB SPS. V. Safeguarding Policy Statement, 44, p.19	-	-
6 ESMS Elements for Operation			
6.1 Management Leadership and Commitment	-	5.1 Leadership and Commitment	-
6.2 Risks and	-	6.1.2 Significant environmental	6.3.4 Human rights risk situation

GED's ESMS Framework	ADB's Safeguard Policy	ISO 14001	ISO26000
Opportunities		aspects 6.1.4 Risk associated with threats and opportunities, 6.1.5 Planning to take action	6.3.5 Avoidance of complicity
6.3 Change Management	-	6.1 Actions to address 7.4.2 Internal communication 7.5.3 Control of documented information	-
6.4 Compliance	-	6.1.3 Compliance obligations 9.1.2 Evaluation of Compliance	4.6 Respect to the rule of laws 4.7 Respect to international norms of behavior
6.5 Goals and Improvement Plan	-	6.2.1 Environmental objectives 6.2.2 Planning actions to achieve environmental objectives	7.7.3 Reviewing an organization's progress and performance on social responsibility
6.6 Stakeholder Engagement	-	4.2 Understanding the needs and expectations of interested parties	4.5 Respect to stakeholder interests 5.3 Stakeholder identification and engagement 7.5.4 Stakeholder dialogue on communication about social responsibility
6.7 Awareness and Competency	-	7.2 Competency 7.3 Awareness	7.4 Practices for integrating social responsibility throughout an organization
6.8 Contractors and Suppliers	-	8.1 Operational planning and control	6.6.1 Overview of fair operating practices 6.6.6 Fair operating practices issue, 4: Promoting social responsibility in the value chain
6.9 Operational Control & Maintenance	-	8.1 Operational planning and control	6.1 Guidance on social responsibility core subjects – general
6.10 Emergency Preparedness and Response	-	8.2 Emergency preparedness and response	6.5.2.1 Principles and consideration – environmental risk management 6.5.3.1 Environmental issue 1: Prevention of pollution
6.11 Communication	-	7.4.2 Internal communication 7.4.3 External communication 7.5.2 Creating and updating (Documented information) 7.5.3 Control of documented information	6.4.5 Labor practice issue 3: Social dialogue 7.5 Communication on social responsibility
6.12 Incident Management	-	-	6.4.6 Labor practice issue 4: Health and safety at work
6.13 Monitoring and Reporting	-	9.1.1 Monitoring, measurement, analysis (General)	7.7.2 Monitoring activities on social responsibility 7.7.3 Review an organization's progress and performance on social responsibility 7.7.4 Enhancing the reliability of data and information collection and management
6.14 Audit	-	9.2 Internal audit	7.6 Enhancing credibility regarding social responsibility
6.15 Handling of Non-conformities	-	10.1 Non-conformity, corrective action and preventive action	-

GED's ESMS Framework	ADB's Safeguard Policy	ISO 14001	ISO26000
6.16 Management Review	-	10. Improvement	7.7.5 Improving performance



## 7.3 Applicable Environmental and Social Safeguards Requirements

A legal framework detailing the applicable host country legislations is an integral part of compliance as per the ESMS system. It primarily covers the local laws, rules, regulations and policies pertaining to environment, social (labor and community) and health and safety.

### 7.3.1 National and Local Laws

All activities included in the proposed subprojects that will be developed and implemented by the Company will be reviewed and evaluated against the applicable national laws, regulations, and standards on environment, health, safety, involuntary resettlement, indigenous peoples, and labor. Subprojects are also encouraged to apply good international industry practice during construction, operation and maintenance and decommissioning phase of the subprojects. The Company shall ensure compliance to the national and local laws and regulations and conformance to the international standards and systems, which countries of operations are signatory, in all its existing subprojects and its future initiatives. These laws and regulations include but are not limited to:

- Environment and Conservation of the National Environment Quality Act B.E. 2535 (1992), including various Environmental Quality Standards as defined by the Act:
  - Water quality standards for river, canal, swamp, marsh, lake, reservoir and other public inland water sources
  - Water quality standards for coastal and estuarine water areas
  - Groundwater quality standards
  - Atmospheric ambient air standards
  - Ambient standards for noise and vibration
  - Environmental quality standards for other matters
- Department of Labour Regulation (2006)
- Department of Industrial Work Regulation (2003)
- Department of Industrial Estate Authority of Thailand

1. ADB's **Safeguard Policy Statement (SPS), 2009**. The SPS sets out the policy objectives scope and trigger, and principles for following three key safeguard areas: (i) Environmental safeguard; (ii) Involuntary resettlement safeguard; and (iii) Indigenous Peoples safeguard. The objective and scope of above these key areas are briefly described below.
2. Safeguards Requirement 1 (SR1) on Environment. SR1 ensures the environmental soundness and sustainability of subprojects and supports the integration of environmental considerations into the subproject decision-making process. Environmental safeguards are triggered if a subproject is likely to have potential environmental risks and impacts. During the design, construction, and operation of a subproject, the Company will apply technologies and practices consistent with international good practice, as reflected in internationally recognized standards such as the World Bank Group's Environment, Health and Safety Guidelines. (Annex 3).
3. Safeguards Requirement 2 (SR2) on Involuntary Resettlement. SR2 requires avoidance or minimization of involuntary resettlement by exploring subproject design alternatives; to enhance, or at least restore, the livelihoods of all displaced person(s) in real terms relative to pre-project levels; and to improve the standards of living of the displaced poor and other vulnerable groups. The involuntary resettlement safeguards cover physical displacement (relocation loss of residential land or loss of shelter) and economic displacement (loss of land assets, access to assets, income sources, or means of livelihoods) because of involuntary restrictions on land use or on access to legally designated parks and protected areas. It covers them whether such losses and involuntary restrictions are full or partial, permanent or temporary. (Annex 4).
4. Safeguards Requirement 3 (SR3) on Indigenous Peoples. SR3 requires the design and implementation of subprojects in a way that fosters full respect for indigenous peoples' identity, dignity, human rights, livelihood systems, and cultural uniqueness as defined by the indigenous peoples themselves so that they: (i) receive culturally appropriate social and economic benefits, (ii) do not suffer adverse impacts because of subprojects, and (iii) can participate actively in subprojects that affect them. SR3 is triggered if a subproject directly or indirectly affects the dignity, human rights, livelihood systems or culture of indigenous peoples or affects the territories or natural or cultural resources that Indigenous Peoples own, use, occupy, or claim as an ancestral domain or asset. (Annex 5).
5. ADB Policy on Gender and Development (GAD), 1998. ADB's policy on GAD included mainstreaming as a key strategy in promoting gender equity. With respect to subprojects, the GAD Policy requires:
  - Gender analysis: to assess systematically the impact of a subproject on men and women, and on the economic and social relationship between them
  - Gender planning: to formulate specific strategies that aim to bring about equal opportunities for men and women
  - Mainstreaming: to consider gender issues in all aspects of Company operations, accompanied by efforts to encourage women's participation in the decision-making process in development activities
6. **ADB Social Protection Strategy, 2001**. ADB's Social Protection Strategy 2001 requires the Company to comply with applicable labor laws in relation to the subproject, and take measures to comply with the core labor standards. Core

labor standards include a set of four internationally recognized basic rights and principles at work: (i) Freedom of association and the effective recognition of the right to collective bargaining; (ii) Elimination of all forms of forced or compulsory labor; (iii) Effective abolition of child labor; and (iv) Elimination of discrimination in respect of employment and occupation. The Company and its contractors and subcontractors will employ local labor whenever possible and take measures to comply with ADB's Social Protection Requirements (Annex 2).

7. **ADB Public Communications Policy, 2011.** ADB's Public Communications Policy recognizes that transparency and accountability are essential to development effectiveness. The objective of the policy is to enhance stakeholders' trust in and ability to engage with ADB. The policy recognizes the right of people to seek, receive, and impart information about ADB operations. It supports knowledge sharing and enables participatory development or two-way communications with affected people. The policy is based on a presumption in favour of disclosure unless there is a compelling reason for nondisclosure. It commits ADB to disclose subproject-related information proactively on its website, following strictly time limits, and provides mechanisms to handle responses and complaints.

### 7.3.3

#### **International Organization for Standardization**

There exist globally recognized management system standards pertaining to ESMS aspects. Leading among them is the Geneva based International Organization for Standardization (ISO) promoted management system standards covering Quality management systems (ISO 9000 series), Environment (ISO 14000 series) among many other aspects. Among the H&S aspects, the Occupational Health and Safety Management Systems (OHSMS), OHSAS 18001 is the internationally recognized assessment specification for occupational health and safety systems.



**Gulf**

The logo features a stylized checkmark symbol in dark blue to the left of the word "Gulf" in a bold, italicized, dark blue sans-serif font. Below the logo, there are two large, abstract, curved shapes: a light green one on the left and a dark blue one on the right, both curving upwards and to the right.

**APPENDIX 6A**

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**OPINIONS FROM PRE-ENGAGEMENT MEETING**

**Opinions from the Pre-engagement Meeting on  
8 April 2023**

**Table 1: Questions and Recommendations from Pre-engagement Meeting**

Questions/Recommendations	Explanations
<b>1. Project Details</b>	
1.1 Information on design and land use plan of the project should be presented. (Deputy Chief Administrator of Chiang Wang SAO)	- The project will present the information in the next meeting.
1.2 What is a requirement for setback from the project boundary? (Director, Udon Thani Provincial Natural Resources and Environment Office)	- Regarding the design of land use in the project, a setback has been designed according to the building control law. The project will present the information in the next meeting.
1.3 Will the reflection of solar panels have any impact on the people's travel? (Village Headman, Mu 16, Na Kha Subdistrict)	- The project will use non-reflective solar panels which will be installed and orientated to face south. The project area does not adjoin Highway No. 2255 (Na Kha-Sum Sao); therefore, it will not create any impact of reflection on travellers using Highway No. 2255 (Na Kha-Sum Sao).
1.4 Will the project install lights around the project area? There are concerns about an impact of lighting on rice reproduction and ripening phases? (Village Headman, Mu 16, Na Kha Subdistrict)	- The project will only install lights with low light intensity at the project entrance; therefore, lighting will not have any impact on rice cultivation in the surrounding area.
1.5 The project impacts on nearby agricultural land should be presented. (Director, Udon Thani Provincial Natural Resources and Environment Office) (Representative of Ban Non Tum Subdistrict Health Promotion Hospital)	- Solar power generation by ground-mounted solar system will have a low level of impact on the surrounding land and agricultural areas including the environment in comparison with other power generation systems. With strict adherence to the specified environmental impact prevention and correction measures, the project implementation in both construction and operation phases will have low impacts on the environment and communities.
1.6 Will the project implementation have any impact on livestock and insects? (Village Headman, Mu 10, Na Kha Subdistrict)	- Solar power generation is safe and will have no impact on livestock and insects.
1.7 Trees should be planted around the project area. (Village Headman, Mu 16, Na Kha Subdistrict)	- The project accepted the recommendation for further consideration and integration into the project design.
1.8 Which water sources will be used by the project? Will the groundwater be used? (Village Headman, Mu 8, Na Kha Subdistrict) (Deputy Chief Administrator of Chiang Wang SAO)	- In the initial phase, the project will purchase water from the local water supply service for the project use. However, if groundwater use is required, the project will obtain prior permission as required by law prior to drilling and utilization.

<b>Questions/Recommendations</b>	<b>Explanations</b>
1.9 How long is the lifespan of solar panels? (Representative of Ban Non Tum Subdistrict Health Promotion Hospital)	- The useful life of solar panels is more than 25 years. However, during the operation phase, solar panels may be damaged or broken by falling hard objects, bird droppings or leaves, etc.
1.10 Will the solar panels bring about an increase in heat? Will the increasing heat have any impact on paddy fields? (Director, Udon Thani Provincial Natural Resources and Environment Office) (Village Headman, Mu 7, Na Kha Subdistrict)	- Solar power generation process will absorb the sunlight to stimulate the electricity production. Although the heat absorbed by solar panels will accumulate, the heat dissipation from solar panels does not cause any change in ambient temperature.
<b>2. Water Quality and Drainage</b>	
2.1 What type of water will be used by the project for cleaning the solar panels, either clean water or water with chemical addition? If water with chemical addition is used, there are concerns about impacts of chemical-contaminated water flowing into the environment. (Village Headman, Mu 16, Na Kha Subdistrict)	- Only clean water with no chemical addition will be used for solar panel cleaning.
2.2 How will the wash water of solar panels be managed? Will there be any impact on public water sources? (Village Headman, Mu 5, Na Kha Subdistrict)	- The wash water from solar panel cleaning will only be contaminated with the dust accumulated on the solar panel surface. There is no toxicity or dirtiness in the form of organic compounds. The project will use only a small amount of clean water for each panel and all the water will fall to the ground. In case the wash water flows out of the project area into public waterways, it will not cause any environmental impact.
<b>3. Solid Waste Management</b>	
3.1 What is the project's management method for deteriorated or expired solar panels? (Village Headman, Mu 10, Na Kha Subdistrict) (Village Headman, Mu 16, Na Kha Subdistrict) (Representative of Ban Non Tum Subdistrict Health Promotion Hospital)	- The project will collect and store the damaged/deteriorated solar panels in the waste storage area which is roofed and completely covered. The storage duration is not more than 90 days as required by law. The project will coordinate with the industrial waste disposal facility permitted by the Department of Industrial Works to collect and transport the damaged/deteriorated solar panels for proper disposal in line with the technical principles.
3.2 Which agency will handle the disposal of damaged or deteriorated solar panels? (Representative of Ban Non Tum Subdistrict Health Promotion Hospital)	- The project will contact the industrial waste disposal facility permitted by the Department of Industrial Works to collect and transport the damaged/deteriorated solar panels for proper disposal in line with the technical principles.



Questions/Recommendations	Explanations
<b>4. Occupational Health and Safety</b>	
<p>4.1 What is the likelihood of construction accidents? (Representative of Ban Non Tum Subdistrict Health Promotion Hospital)</p>	<p>- Construction accidents may happen at any time. However, the project has set a policy on occupational health and safety requiring strict compliance by contractors and employees. This will help lessen the chance of construction accidents</p>
<b>5. Socio-economics and Public Consultation</b>	
<p>5.1 Details of the Power Development Fund should be clearly presented. (Village Headman, Mu 10, Na Kha Subdistrict) (Energy Technical Officer, Professional Level, Provincial Energy Office)</p>	<p>- The project will present the information in the next meeting.</p>
<p>5.2 The project should clearly present the details of CSR activities and should organize such activities in the long term in order to benefit the communities. (Village Headman, Mu 10, Na Kha Subdistrict) (Energy Technical Officer, Professional Level, Provincial Energy Office)</p>	<p>- The project will present the information in the next meeting.</p>
<p>5.3 In the construction phase, will the community leaders be informed in advance? What is a channel for complaints? (Village Headman, Mu 16, Na Kha Subdistrict)</p>	<p>- Regarding any action which may affect the communities, the project will inform the community leaders and relevant government agencies in advance. Moreover, the project has planned complaint channels and prepared a complaint management plan which will be presented in the next meeting.</p>
<p>5.4 A site visit should be organized for community leaders to visit a solar power plant currently in operation for exchange of knowledge. (Deputy Chief Administrator of Chiang Wang SAO)</p>	<p>- The project accepted the recommendation for further consideration.</p>
<p>5.5 The project should establish a LINE group to be a communication channel. (Secretary to the Chief Executive of Na Kha Subdistrict Administrative Organization)</p>	<p>- The project accepted the recommendation for further consideration.</p>
<p>5.6 As the project will have to cut trees out of the project area. Is it possible for the project to allow the communities to use those trees?</p>	<p>- The project accepted the recommendation for further consideration.</p>

Questions/Recommendations	Explanations
(Secretary to the Chief Executive of Na Kha Subdistrict Administrative Organization)	
<b>6. Others</b>	
6.1 Has the project undertaken similar project development in other areas? What are the actual impacts that have occurred? (Village Headman, Mu 10, Na Kha Subdistrict) (Assistant District Public Health Officer, Phen District Public Health Office)	- Saeng Thai Phalangngan Co., Ltd., which is a member of the Group of Companies, has been operating several solar power plants in the central and eastern regions.
6.2 In the future, can people build their houses close to the project area? (Director, Udon Thani Provincial Natural Resources and Environment Office) (Village Headman, Mu 8, Na Kha Subdistrict)	- Solar power generation has the least impact on the environment in comparison with other types of electricity generation; therefore, people can safely build their houses near the project area.

Source: Fourtier Consultants Co., Ltd., 2023

### Summary of Comments from Post-Meeting Evaluation Form

After the presentation of the project details, an opportunity was provided for participants to give comments in the meeting room as well as additional comments and recommendations in the post-meeting evaluation form. The participants' comments and recommendations in the post-meeting evaluation form were collected. There were a total of 39 respondents or 49.4 percent of the total number of 79 participants (excluding the Project Owner and the Consultant). Key issues are summarized as follows:

#### 1) General Information of the Respondents to the Post-Meeting Evaluation Form

About 53.8 percent of the respondents are male and 46.2 percent are female. Most respondents were government agencies, representing 59.0 percent, followed by village/community representatives, equivalent to 30.8 percent, others 7.7 percent, and persons giving no comment 2.5 percent.

#### 2) Perception of Project Information

Most respondents knew about Phalangngan Rungrueang Power Plant Project of Phalangngan Rungrueang Co., Ltd., for the first time, representing 66.7 percent, and 33.3 percent having information before the meeting. The main source of information was local government agencies 53.8 percent, followed by officers of Phalangngan Rungrueang Co., Ltd., at 38.5 percent, project brochures/public relations documents 15.4 percent, and community leaders, such as subdistrict headman, village headman, etc., 7.7 percent, respectively

When questioned about dissemination of additional project information/public relations, all respondents commented that additional information should be publicized. The information/additional information needed by respondents included environmental impact prevention and correction measures, as mentioned by 89.7 percent of respondents, followed by the advantages-disadvantages of the project implementation by 71.8 percent, safety system of the project by 59.0 percent, knowledge about solar power generation by 51.3 percent, project details by 43.6 percent, and operation period/plan by 30.8 percent,

respectively. The most appropriate channel or method of dissemination of project information was community leaders, e.g. subdistrict headman, village headman, assistant village headman etc., representing 76.9 percent, followed by local government agencies, meetings, and publicity boards in community areas in an equal percentage of 41.0 percent, and letters/documents sent directly to people by 30.8 percent, respectively.

### **3) Opinions about the Project Environmental Impact Assessment**

After listening to the preliminary presentation of the selection of project site and technology, it was found that most participants of the meeting, i.e. 59.0 percent, regarded the matters as suitable/adequate, 20.5 percent considering them to be unsuitable/inadequate and suggesting that additional information should be presented, 12.8 percent expressing uncertainty, and 7.7 percent making no comment.

After listening to the presentation of the scope of environmental study and report preparation, it was found that most participants of the meeting, i.e. 71.8 percent, had good understanding, followed by 12.8 percent of participants who did not understand and suggested that additional information should be presented, and 15.4 percent making no comment.

Moreover, when asked about the concerns about the project implementation, it was found that most participants, i.e. 56.4 percent, expressed concerns, followed by 35.9 percent voicing no concern, 5.1 percent making no comment and 2.6 percent expressing uncertainty, respectively. As for the issues of highest concerns, air quality was cited by 59.1 percent of participants, followed by water use 40.9 percent, noise 36.4 percent, water discharge 31.8 percent, transportation and solid waste in an equal percentage of 27.3 percent, and others 9.1 percent, respectively.

**APPENDIX 6B**

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**INVITATION LETTER TO ATTEND THE PUBLIC  
MEETING**

*[This information has been removed as it falls within the exceptions to disclose specified in paragraph 17(2) of ADB's Access to Information Policy.]*

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**APPENDIX 6C**

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**BROCHURE FOR THE PUBLIC MEETING**

# ขอเชิญ...ท่านผู้สนใจเข้าร่วมประชุม

รับฟังความคิดเห็นและทำความเข้าใจกับประชาชนและผู้มีส่วนได้เสีย

## โครงการโรงไฟฟ้าพลังงานรุ่งเรือง

ของบริษัท พลังงานรุ่งเรือง จำกัด

ตั้งอยู่ที่ตำบลนาข่า อำเภอเมืองอุดรธานี จังหวัดอุดรธานี

วันพฤหัสบดีที่ 15 มิถุนายน พ.ศ. 2566 เวลา 09.00-12.00 น.

ณ อาคารอเนกประสงค์ องค์การบริหารส่วนตำบลนาข่า  
อำเภอเมืองอุดรธานี จังหวัดอุดรธานี

### ติดต่อสอบถามข้อมูลเพิ่มเติม

#### เจ้าของโครงการ

**พลังงานรุ่งเรือง**  
PHALANGKUAN RUNGREANG

บริษัท พลังงานรุ่งเรือง จำกัด

87 อาคารเอ็มไทย ทาวเวอร์ ออลซีซั่นเพลส ชั้น 10 ถนนวิฑู  
แขวงลุมพินี เขตปทุมวัน กรุงเทพมหานคร 10330

[This information has been removed as it falls within the exceptions to disclose specified in paragraph 17(2) of ADB's Access to Information Policy.]

#### บริษัทที่ปรึกษาด้านสิ่งแวดล้อม

**Fourtier**

บริษัท โฟร์ทีเยร์ คอนซัลแตนต์ จำกัด

99/2 หมู่ที่ 8 ตำบลบางเมือง อำเภอเมืองสมุทรปราการ  
จังหวัดสมุทรปราการ 10270

[This information has been removed as it falls within the exceptions to disclose specified in paragraph 17(2) of ADB's Access to Information Policy.]

เอกสารประกอบการประชุม



แอตไลน์



สแกนลงทะเบียน



# ขอเชิญ...ท่านผู้สนใจเข้าร่วมประชุม

รับฟังความคิดเห็นและทำความเข้าใจกับประชาชนและผู้มีส่วนได้เสีย

## โครงการโรงไฟฟ้าพลังงานรุ่งเรือง

ของบริษัท พลังงานรุ่งเรือง จำกัด

ตั้งอยู่ที่ตำบลนาข่า อำเภอเมืองอุดรธานี จังหวัดอุดรธานี

วันพฤหัสบดีที่ 15 มิถุนายน พ.ศ. 2566 เวลา 09.00-12.00 น.

ณ อาคารอเนกประสงค์ องค์การบริหารส่วนตำบลนาข่า  
อำเภอเมืองอุดรธานี จังหวัดอุดรธานี

ติดต่อสอบถามข้อมูลเพิ่มเติม

เจ้าของโครงการ

**พลังงานรุ่งเรือง**

บริษัท พลังงานรุ่งเรือง จำกัด

87 อาคารเอ็มไทย ทาวเวอร์ ออลซีซั่นเพลส ชั้น 10 ถนนวิฑู  
แขวงลุมพินี เขตปทุมวัน กรุงเทพมหานคร 10330

[This information has been removed as it falls within  
the exceptions to disclose specified in paragraph 17(2)  
of ADB's Access to Information Policy.]

บริษัทที่ปรึกษาด้านสิ่งแวดล้อม

**Fourtier**

บริษัท โฟร์เทียร์ คอนซัลแตนต์ จำกัด

99/2 หมู่ที่ 8 ตำบลบางเมือง อำเภอเมืองสมุทรปราการ  
จังหวัดสมุทรปราการ 10270

[This information has been removed as it falls within  
the exceptions to disclose specified in paragraph 17(2)  
of ADB's Access to Information Policy.]

เอกสารประกอบการประชุม



แอดไลน์



สแกนลงทะเบียน



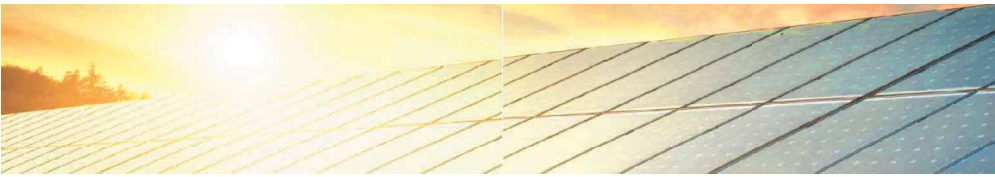


**APPENDIX 6D**

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**PRESENTATION FOR THE PUBLIC MEETING**



การประชุมรับฟังความเห็นและ  
ทำความเข้าใจกับประชาชนและผู้มีส่วนได้เสีย

## โครงการโรงไฟฟ้าพลังงานรุ่งเรือง

ของบริษัท พลังงานรุ่งเรือง จำกัด

ตำบลนาข่า อำเภอเมืองอุดรธานี จังหวัดอุดรธานี

วันพฤหัสบดีที่ 15 มิถุนายน พ.ศ. 2566 เวลา 09.00-12.00 น.

ณ ศาลาอเนกประสงค์ อบต. นาข่า อำเภอเมืองอุดรธานี จังหวัดอุดรธานี

1

## เหตุผลและความจำเป็นของโครงการ

- บริษัท พลังงานรุ่งเรือง จำกัด มีแนวคิดที่จะพัฒนาโครงการโรงไฟฟ้าพลังงานรุ่งเรือง ซึ่งเป็นโครงการผลิตไฟฟ้าจากพลังงานแสงอาทิตย์ด้วยเทคโนโลยีแผงโฟโตโวลเทอิกหรือโซลาร์เซลล์แบบติดตั้งบนพื้นดินเพื่อจำหน่ายไฟฟ้าให้แก่ภาครัฐ
- พื้นที่ตั้งโครงการอยู่ที่ตำบลนาข่า อำเภอเมืองอุดรธานี จังหวัดอุดรธานี
- ขนาดพื้นที่โครงการ 455.68 ไร่
- กำลังการผลิตสุทธิ 77.281 เมกะวัตต์
- ระยะเวลาก่อสร้าง 12 เดือน



3

## วัตถุประสงค์ของการประชุม

- นำเสนอรายละเอียดโครงการ การตรวจวัดคุณภาพสิ่งแวดล้อม การประเมินผลกระทบสิ่งแวดล้อม มาตรการป้องกันและแก้ไขผลกระทบสิ่งแวดล้อม และมาตรการติดตามตรวจสอบผลกระทบสิ่งแวดล้อม ตามประมวลหลักการปฏิบัติ : มาตรการทั่วไป มาตรการระยะเตรียมการก่อสร้าง ระยะก่อสร้าง ระยะดำเนินการ และระยะรื้อถอนบางส่วนหรือทั้งหมด
- นำเสนอผลการรับฟังความเห็นจากขั้นตอนเตรียมความพร้อมชุมชน
- รับฟังความคิดเห็น ประเด็นห่วงกังวล ข้อเสนอแนะต่อการพัฒนาโครงการและมาตรการด้านสิ่งแวดล้อม

2

## การจัดทำรายงานสิ่งแวดล้อม

### (1) รายงาน CoP

เล่ม ๑๓๙ ตอนพิเศษ ๑๕๘ ง	ราชกิจจานุเบกษา	๖ กรกฎาคม ๒๕๖๕
<b>ระเบียบคณะกรรมการกำกับกิจการพลังงาน</b> ว่าด้วยหลักเกณฑ์การจัดทำรายงานประเมินผลการศึกษาปฏิบัติ และรายงานผลการปฏิบัติตามประมวล หลักการปฏิบัติ สำหรับการประกอบกิจการผลิตไฟฟ้า พ.ศ. ๒๕๖๕		

### (2) รายงาน ESA

เล่ม ๑๒๖ ตอนพิเศษ ๑๔๓ ง	ราชกิจจานุเบกษา	หน้า ๓๔	๓๐ กันยายน ๒๕๕๒
<b>ประกาศกระทรวงอุตสาหกรรม</b> เรื่อง การทำรายงานเกี่ยวกับการศึกษามาตรการป้องกันและแก้ไข ผลกระทบต่อคุณภาพสิ่งแวดล้อมและความปลอดภัย พ.ศ. ๒๕๕๒			

เล่ม ๑๓๓ ตอนพิเศษ ๒๘๒ ง	ราชกิจจานุเบกษา	หน้า ๑	๖ ธันวาคม ๒๕๕๙
<b>ประกาศกระทรวงอุตสาหกรรม</b> เรื่อง การทำรายงานเกี่ยวกับการศึกษามาตรการป้องกันและแก้ไขผลกระทบ ต่อคุณภาพสิ่งแวดล้อมและความปลอดภัย (ฉบับที่ ๓) พ.ศ. ๒๕๕๙			

4

# การจัดทำรายงานประมวลหลักการปฏิบัติ (CoP)

(1) เล่ม ๑๓๙ ตอนพิเศษ ๑๕๘ ง ราชกิจจานุเบกษา ๖ กรกฎาคม ๒๕๖๕

ระเบียบคณะกรรมการกำกับกิจการพลังงาน ว่าด้วยหลักเกณฑ์การจัดทำรายงานประมวลหลักการปฏิบัติ และรายงานผลการปฏิบัติตามประมวลหลักการปฏิบัติ สำหรับการประกอบกิจการผลิตไฟฟ้า พ.ศ. ๒๕๖๕

(2) เล่ม ๑๓๙ ตอนพิเศษ ๒๖ ง ราชกิจจานุเบกษา ๓ กุมภาพันธ์ ๒๕๖๕

ระเบียบคณะกรรมการกำกับกิจการพลังงาน ว่าด้วยการรับฟังความเห็นและทำความเข้าใจกับประชาชนและผู้มีส่วนได้เสีย ในการพิจารณาออกใบอนุญาตประกอบกิจการผลิตไฟฟ้า พ.ศ. ๒๕๖๕

(1) ระเบียบคณะกรรมการกำกับกิจการพลังงานว่าด้วยหลักเกณฑ์การจัดทำรายงานประมวลหลักการปฏิบัติ และรายงานผลการปฏิบัติตามประมวลหลักการปฏิบัติ สำหรับการประกอบกิจการผลิตไฟฟ้า พ.ศ. 2565

1. เงื่อนไขการใช้ประมวลหลักการปฏิบัติ
2. กลไกการบังคับใช้
3. คำจำกัดความ
4. ผู้มีสิทธิจัดทำรายงาน
5. การมีส่วนร่วมของประชาชน (2)

ระเบียบคณะกรรมการกำกับกิจการพลังงานว่าด้วยการรับฟังความเห็นและทำความเข้าใจกับประชาชนและผู้มีส่วนได้เสียในการพิจารณาออกใบอนุญาตประกอบกิจการผลิตไฟฟ้า พ.ศ. 2565

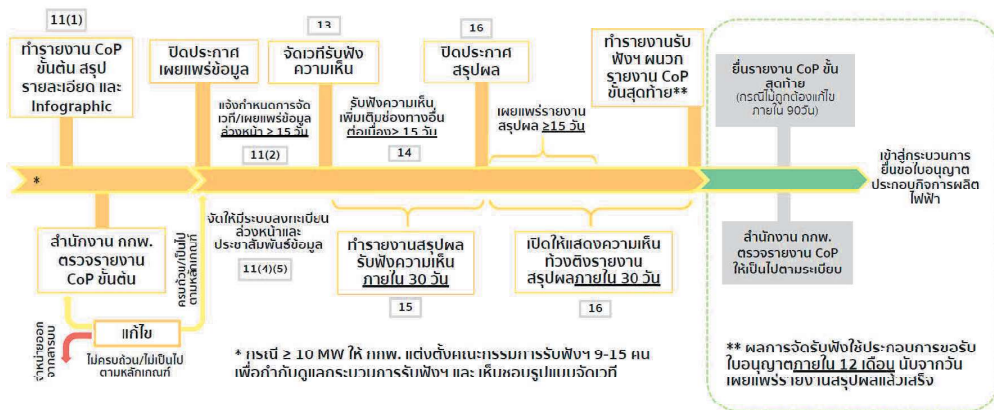
## ประมวลหลักการปฏิบัติ (Code of Practice : CoP)

“ประมวลหลักการปฏิบัติที่นำมาใช้กับโครงการผลิตไฟฟ้าประเภทต่าง ๆ โดยมีมาตรฐานการป้องกัน แก๊ส และติดตามตรวจสอบผลกระทบสิ่งแวดล้อม ความปลอดภัย รวมถึงผลกระทบที่อาจเกิดขึ้นต่อชุมชนพื้นที่ใกล้เคียง”

- ส่วนที่ 1 มาตรการทั่วไป
- ส่วนที่ 2 มาตรการระยะเตรียมการก่อสร้าง
- ส่วนที่ 3 การตรวจวัดคุณภาพสิ่งแวดล้อมพื้นฐานก่อนมีโครงการ
- ส่วนที่ 4 มาตรการระยะก่อสร้าง
- ส่วนที่ 5 มาตรการระยะดำเนินการ
- ส่วนที่ 6 มาตรการระยะรื้อถอนบางส่วน หรือทั้งหมด

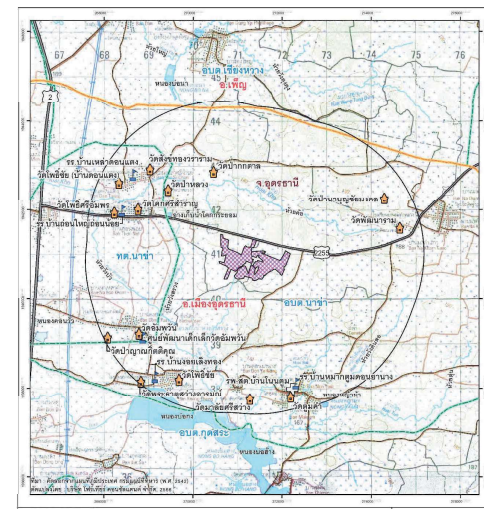
เอกสารแนบ 9 หน้า 2/19

## กระบวนการรับฟังความเห็นและการขอใบอนุญาตประกอบกิจการผลิตไฟฟ้า



## พื้นที่ศึกษาของโครงการ

รัศมี 3 กิโลเมตร จากขอบเขตพื้นที่ตั้งโครงการ



จังหวัด	อำเภอ	ตำบล	หมู่ที่
อุดรธานี	เมืองอุดรธานี	นาข่า	2,3,4,5,6,7,8,9, 10, 13,14,16
	เพ็ญ	เชียงหวาง	3,16

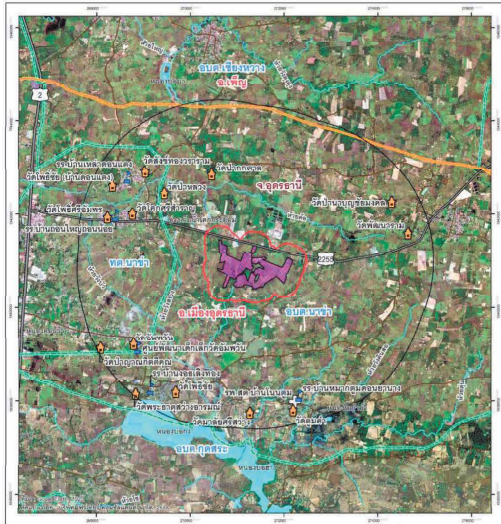
1. กลุ่มผู้ได้รับผลกระทบหรือผู้มีส่วนได้เสีย ประกอบด้วย
  - ประชาชนในพื้นที่ศึกษา
  - ผู้นำชุมชนในพื้นที่ศึกษา
  - กลุ่มเปราะบาง เช่น กลุ่มสตรี เด็ก คนพิการ แรงงานข้ามชาติ เป็นต้น
  - กลุ่มชาติพันธุ์
2. กลุ่มหน่วยงานราชการในระดับต่าง ๆ ที่เกี่ยวข้อง
3. ประชาชนผู้สนใจทั่วไป

# กำหนดการรับฟังความเห็นและทำความเข้าใจ กับประชาชนและผู้มีส่วนได้เสีย

- 27-30 พ.ค. 2566 ● แจ้งกำหนดการ และสถานที่จัดรับฟังความเห็น
- 31 พ.ค. 2566 ●
- 15 มิ.ย. 2566 ●
  - เผยแพร่ข้อมูลโครงการ (15 วัน)
  - จัดประชุมรับฟังความเห็น
  - รับฟังความเห็นเพิ่มเติม (15 วัน)
- 30 มิ.ย. 2566 ●
  - จัดทำรายงานสรุปผลการรับฟังความเห็น
- 6-8 ก.ค. 2566 ●
  - นำส่งรายงานสรุปผลการรับฟังความเห็น
- 8 ส.ค. 2566 ●
  - เผยแพร่สรุปผลการรับฟังความเห็น
  - ให้ประชาชนหรือผู้มีส่วนได้เสียแสดงความเห็นหรือท้วงติงต่อรายงานฯ (30 วัน)
- 16 ส.ค. 2566 ●
  - จบกระบวนการรับฟังความเห็น
  - นำส่งรายงานประมวลหลักปฏิบัติขั้นสุดท้าย ให้สำนักงาน กพท. พิจารณา

## รายละเอียดโครงการ (ต่อ)

### ➤ ขอบเขตพื้นที่ศึกษา



- พื้นที่ศึกษารัศมี 300 เมตร
- พื้นที่ศึกษารัศมี 3 กม.

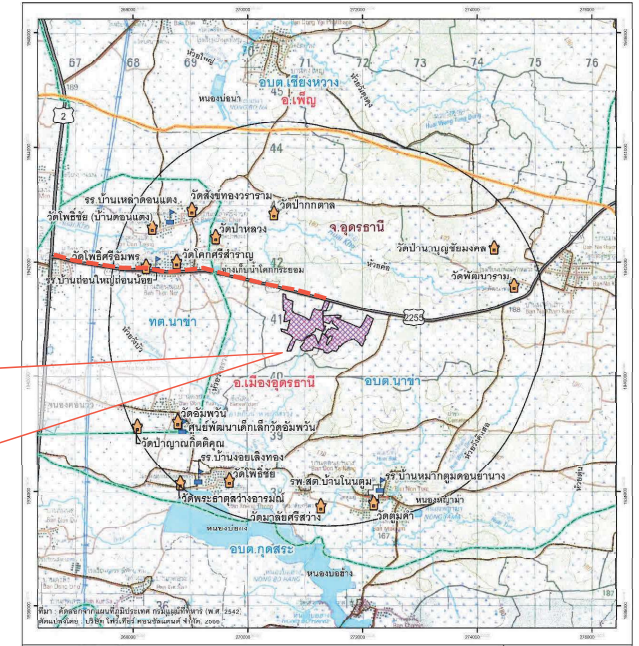
พื้นที่ข้อโน้	พิกัด UTM 48Q	ระยะห่างจากโครงการ (ม.)
1. ระยะ 0 - 300 เมตร		
ไม่มี		
2. ระยะ 300 - 3,000 เมตร		
<b>สถานการศึกษา</b>		
- โรงเรียนบ้านเหล่าคอนแดง	268852E 1942776N	2,373
- โรงเรียนบ้านเขื่อนใหญ่ไชยน้อย	268398E 1941863N	2,428
- โรงเรียนบ้านขยเหล็กทอง	269154E 1938261N	2,673
- โรงเรียนบ้านหมากดุมดอนยานาง	272350E 1938087N	2,452
- ศูนย์พัฒนาเด็กเล็กวัดอัมพวัน	268708E 1939128N	2,387
<b>ศาสนสถาน</b>		
- วัดสังข์ทองวราราม	269033E 1942869N	2,127
- วัดบ้านหลวง	269419E 1942412N	1,537
- วัดโคกศรีสำราญ	268772E 1941979N	1,914
- วัดโพธิ์ชัย (บ้านคอนแดง)	268413E 1942594N	2,481
- วัดโพธิ์ศรีมิตร	268222E 1941885N	2,427
- วัดปากกาด	270463E 1942840N	1,411
- วัดอัมพวัน	268792E 1939194N	2,241
- วัดป่าญาติกิตติคุณ	268125E 1939141N	2,845
- วัดโพธิ์ชัย	269658E 1938217N	2,471
- วัดพระธาตุสว่างอารมณ์	268863E 1938153N	2,928
- วัดมาลัยศรีสว่าง	271313E 193723N	2,660
- วัดตมคำ	272203E 1937824N	2,653
- วัดพัฒนาราม	274668E 1941613N	2,553
- วัดบ้านบุญเยี่ยมมงคล	274356E 1942236N	2,481
<b>สถานพยาบาล</b>		
- รพ.เสด.บ้านโนนดุม	272235E 1937981N	2,546

## รายละเอียดโครงการ

### 1. พื้นที่โครงการ

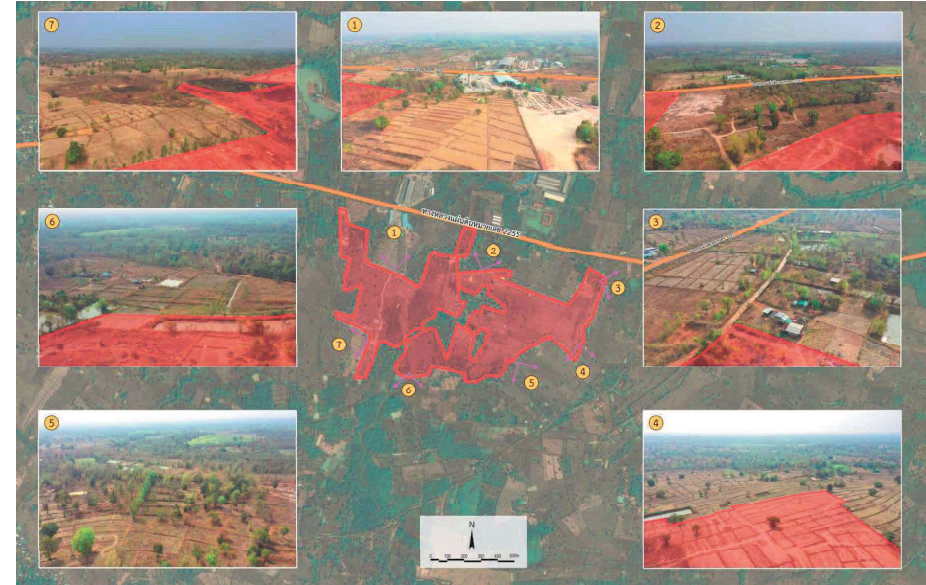
ที่ตั้งโครงการ :  
ตำบลนาข่า อำเภอเมือง  
อุดรธานี จังหวัด  
อุดรธานี

ขนาดพื้นที่ : 455.68 ไร่



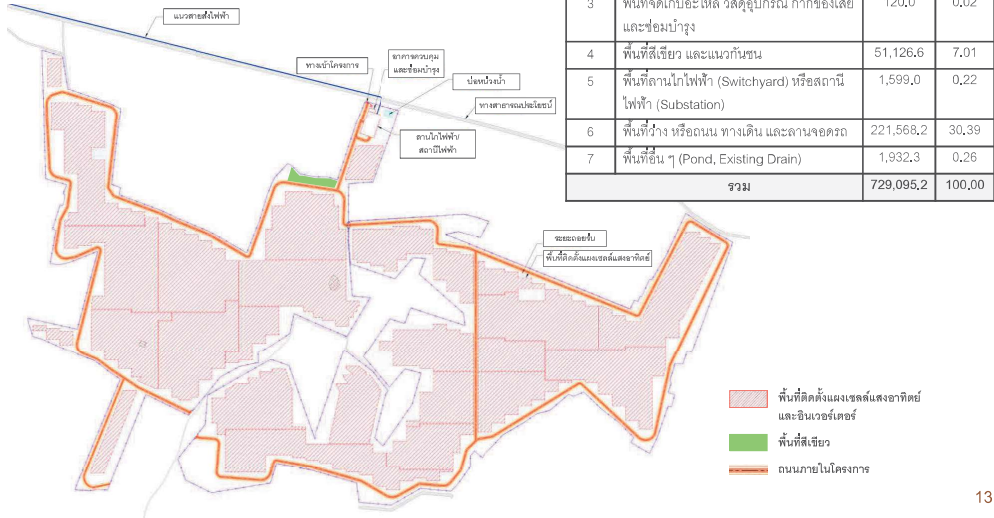
## รายละเอียดโครงการ (ต่อ)

### ➤ พื้นที่โครงการและอาณาเขตติดต่อพื้นที่โดยรอบ



## รายละเอียดโครงการ (ต่อ)

### 2. การออกแบบแผนผังโครงการ



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เอกสารแนบ 9 หน้า 4/19

## รายละเอียดโครงการ (ต่อ)

กำลังการผลิตติดตั้ง : 77.281 เมกะวัตต์  $\rightarrow$  กำหนด **การไฟฟ้าฝ่ายผลิต**

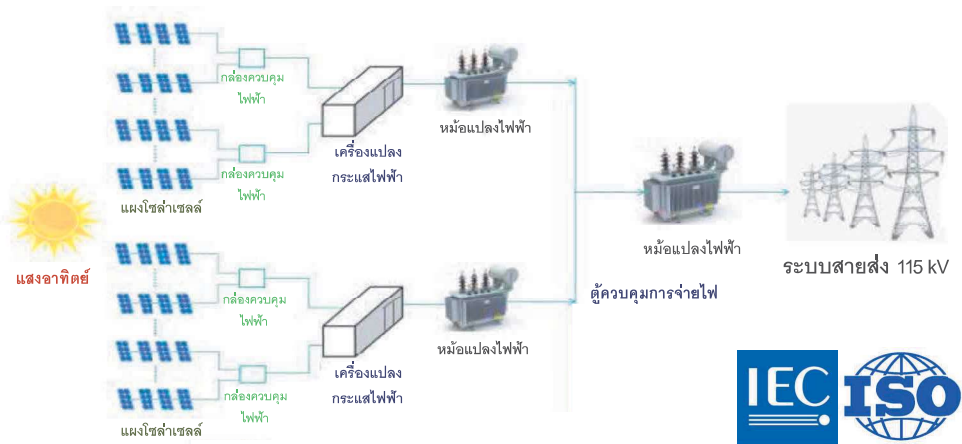
เครื่องจักรหลักที่มีการติดตั้ง

- 
**แผงโซลาร์เซลล์ชนิดซิลิคอน**  
 ขนาด 605 วัตต์/แผง หรือเทียบเท่า  
 ประมาณ 127,738 แผง
- 
**เครื่องแปลงกระแสไฟฟ้า (Inverter)**  
 ขนาด 300 กิโลวัตต์/เครื่อง จำนวน 184 เครื่อง
- 
**หม้อแปลงไฟฟ้า**  
 ขนาด 3.437 เมกะโวลต์แอมแปร์ จำนวน 16 เครื่อง  
 ขนาด 60 เมกะโวลต์แอมแปร์ จำนวน 1 เครื่อง

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## รายละเอียดโครงการ (ต่อ)

### 3. การผลิตไฟฟ้าจากพลังงานแสงอาทิตย์ และการออกแบบระบบผลิตไฟฟ้า พลังงานแสงอาทิตย์



อุปกรณ์ได้รับการรับรองมาตรฐานด้านความปลอดภัยทางไฟฟ้า จากหน่วยงานด้านมาตรฐานภายในประเทศ มาตรฐานสากล และมาตรฐานระหว่างประเทศ

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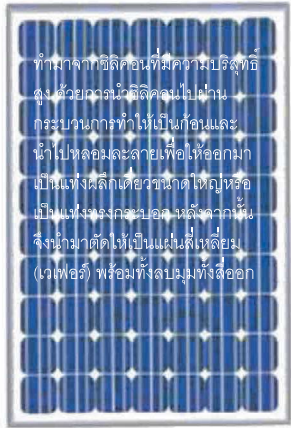
เซลล์แสงอาทิตย์



แผงเซลล์แสงอาทิตย์

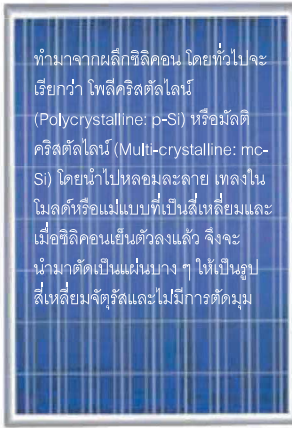
16

## แผงเซลล์แสงอาทิตย์



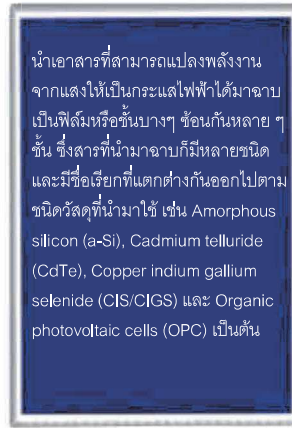
ทำมาจากซิลิคอนที่มีความบริสุทธิ์สูง ด้วยกรรมวิธีที่ซับซ้อนและกระบวนการทำให้เป็นก้อนและนำไปหลอมละลายเพื่อให้ออกมาเป็นแท่งผลึกเดี่ยวขนาดใหญ่หรือเป็นแท่งทรงกระบอก หลังจากนั้นจึงนำมาตัดให้เป็นแผ่นสี่เหลี่ยม (เวเฟอร์) พร้อมทั้งลบมุมทั้งสี่ออก

Monocrystalline Solar Panel



ทำมาจากผลึกซิลิคอน โดยทั่วไปจะเรียกว่า โพลีคริสตัลไลน์ (Polycrystalline: p-Si) หรือมัลติคริสตัลไลน์ (Multi-crystalline: mc-Si) โดยนำไปหลอมละลาย เทลงในโมลด์หรือแม่แบบที่เป็นสี่เหลี่ยมและเมื่อซิลิคอนเย็นตัวลงแล้ว จึงจะนำมาตัดเป็นแผ่นบาง ๆ ให้เป็นรูปสี่เหลี่ยมจัตุรัสและไม่มีการตัดมุม

Polycrystalline Solar Panel



นำเอาสารที่สามารถแปลงพลังงานจากแสงให้เป็นกระแสไฟฟ้าได้มาจากรวมกันเป็นฟิล์มหรือชั้นบางๆ ซ้อนกันหลาย ๆ ชั้น ซึ่งสารที่นำมาจากรวมกันหลายชนิดและมีชื่อเรียกที่แตกต่างกันออกไปตามชนิดวัสดุที่นำมาใช้ เช่น Amorphous silicon (a-Si), Cadmium telluride (CdTe), Copper indium gallium selenide (CIS/CIGS) และ Organic photovoltaic cells (OPC) เป็นต้น

Thin-Film Solar Panel

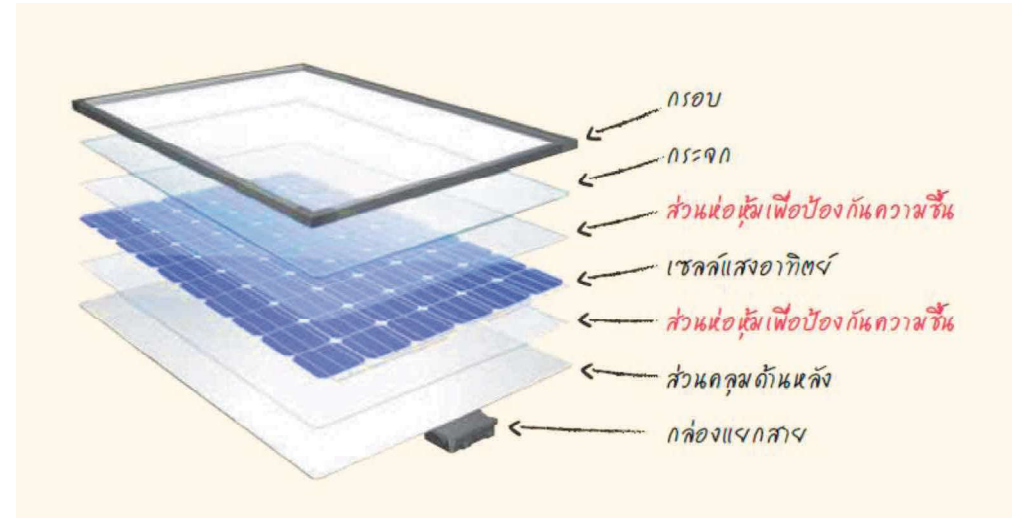
- ประสิทธิภาพสูงสุด
- ราคาสูงสุด

- การผลิตซับซ้อนน้อยกว่า Mono
- ประสิทธิภาพรองลง (ใช้ซิลิคอนน้อย)
- ราคาถูกกว่า

- การผลิตง่ายสุด
- ประสิทธิภาพรองลง (ใช้ซิลิคอนน้อย)
- ราคาถูกสุด

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## ส่วนประกอบของแผงเซลล์แสงอาทิตย์ชนิดผลึกซิลิคอน



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## จำแนกองค์ประกอบของแผงเซลล์แสงอาทิตย์

	ชนิดผลึกซิลิคอน (Crystalline Silicon : C-Si)	ชนิดฟิล์มบางซิลิคอน (Amorphous Silicon Solar Cell : A-Si)	ชนิดแคดเมียมเทลลูไรด์ (Cadmium Telluride : CdTe)	ชนิดคอปเปอร์อินเดียมแกลเลียมไดเซเลไนด์ (Copper Indium Gallium diSelenide: CIGS)
<i>ส่วนประกอบ (ร้อยละโดยประมาณ)</i>				
กระจก	80	85	96	81
กรอบอลูมิเนียม	10	10	<0.01	12
ซิลิคอน	3	<0.1		
วัสดุห่อหุ้ม (EVA)	6.5	5	3.5	6
วัสดุ Tedlar	0.12	<0.1	0.01	0.12
กาวเชื่อมประสาน	<0.1	<0.1	<0.01	<0.1
เอ็มดีไอ				
ทองแดง (Copper)	0.6		1.0	0.85
ดีบุก				0.02
สังกะสี				0.03
ตะกั่ว			0.07	
แคดเมียม (Cadmium)			0.07	
โลหะเงิน (Silver)	<0.006		<0.01	

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## ขั้นตอนการก่อสร้าง



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# ตัวอย่างการทำการเกษตร บริเวณพื้นที่ติดตั้งแผงฯ



โครงการวิจัยการนำโซลาร์เซลล์กึ่งใส มาใช้กับเกษตรกรรมการปลูกข้าว ที่โรงไฟฟ้าพระนครเหนือ อ.บางกรวย จ.นนทบุรี (ไม่มีผลกระทบต่อผลผลิตและระยะเวลาในการปลูก)

ที่มา : <https://www.energynewscenter.com/%E0%B8%81%E0%B8%9F%E0%B8%9C-%E0%B8%A7%E0%B9%BC%E0%B8%87%E0%B8%22%E0%B8%99%E0%B8%A7%E0%B8%B4%E0%B9%BC%E0%B8%11%E0%B8%A2-%E0%B8%95%E0%B8%94%E0%B8%9D%E0%B8%B1%E0%B9%89%E0%B8%A7/>



การปลูกผักปลอดสารพิษบริเวณ โซลาร์ฟาร์มและใต้แผงโซลาร์เซลล์ ที่โรงไฟฟ้าพลังงานแสงอาทิตย์ จ.ลำปาง

ที่มา : <https://www.bangkokpost.com/th/2018/11/energy-absolute-solar-farm/>

# รายละเอียดโครงการ (ต่อ)

## 2.4 จำนวนพนักงานและการบริหารโครงการ

### ระยะก่อสร้าง

- คนงานของบริษัทผู้รับเหมาสูงสุด 618 คน/วัน ระยะเวลา ประมาณ 12 เดือน
- คนงานทั้งหมดจะมีลักษณะการทำงานแบบเข้ามา-เย็นกลับ
- จัดพื้นที่สำนักงานชั่วคราวสำหรับผู้รับเหมาตั้งอยู่ด้านทิศใต้ของโครงการ



### ระยะดำเนินการ

- พนักงานดูแลระบบผลิตไฟฟ้าและพนักงานรักษาความปลอดภัยรวม 5 คน/วัน
  - พนักงานที่เข้ามาเป็นครั้งคราว ได้แก่ พนักงานตรวจสอบและซ่อมบำรุง 2 คน/เดือน และพนักงานของบริษัทผู้รับเหมาเข้ามาล้างทำความสะอาดแผงเซลล์แสงอาทิตย์ครั้งละ 20 คน 2 ครั้ง/ปี
- ดังนั้น ในบางวันที่มีพนักงานที่เข้ามาทำงานในพื้นที่โครงการสูงสุด 27 คน




# รายละเอียดโครงการ (ต่อ)

## 5. น้ำใช้

### ระยะก่อสร้าง

### ระยะดำเนินการ

		
การอุปโภค-บริโภค ของคนงาน	กิจกรรม การก่อสร้าง	น้ำดื่ม สำหรับ คนงาน
43.26 ลบ.ม./วัน	50.00 ลบ.ม./วัน	

	การอุปโภค-บริโภคของพนักงาน
	1.89 ลบ.ม./วัน
	ล้างแผงเซลล์แสงอาทิตย์ (120 วัน/ปี)
	3.19 ลบ.ม./วัน (383.22 ลบ.ม./ปี)
	รดต้นไม้พื้นที่สีเขียว
	8.16 ลบ.ม./วัน

ผู้รับเหมาก่อสร้างโครงการเป็นผู้รับผิดชอบ โดยจะซื้อน้ำใช้ทั้งหมด จากผู้จำหน่ายในพื้นที่ อ.เมืองอุดรธานี

โครงการเป็นผู้รับผิดชอบ โดยจะซื้อน้ำใช้ทั้งหมด จากผู้จำหน่ายในพื้นที่ อ.เมืองอุดรธานี




# รายละเอียดโครงการ (ต่อ)

## 6. น้ำเสีย

### ระยะก่อสร้าง

### ระยะดำเนินการ

	
การอุปโภค-บริโภค ของคนงาน	ล้างอุปกรณ์และ เครื่องจักร
↓ 43.26 ลบ.ม./วัน	↓ 10.00 ลบ.ม./วัน
	
สุขาชั่วคราว	ปล่อยน้ำ
↓	↓
หน่วยงาน ที่ได้รับอนุญาตฯ สุบไปกำจัด	ฉีดพรม พื้นที่ก่อสร้าง

	
การอุปโภค-บริโภค ของพนักงาน	น้ำล้างแผง เซลล์แสงอาทิตย์
↓ 1.89 ลบ.ม./วัน	↓ 3.19 ลบ.ม./วัน
	
ห้องน้ำ-ห้องส้วม	ปล่อยลงสู่พื้นดิน
↓	
หน่วยงาน ที่ได้รับอนุญาตฯ สุบไปกำจัด	

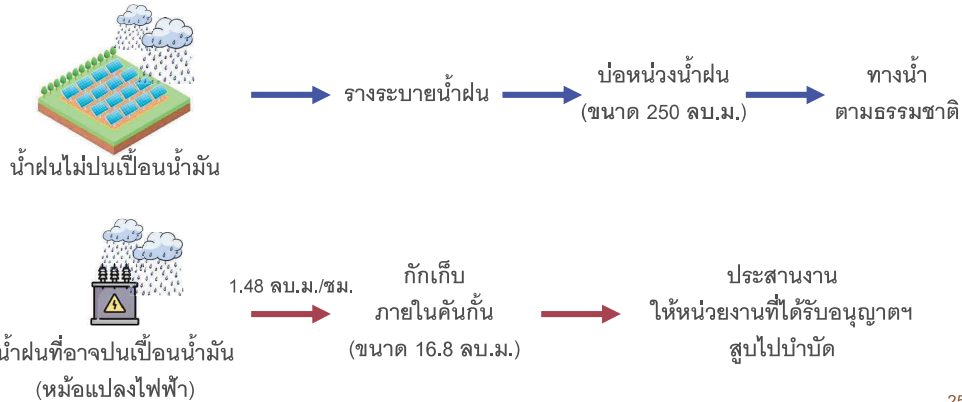
## รายละเอียดโครงการ (ต่อ)

### 7. การระบายน้ำ

#### ระยะก่อสร้าง

ยังคงให้มีสภาพการระบายน้ำเช่นเดียวกับก่อนการพัฒนาโครงการ

#### ระยะดำเนินการ



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## รายละเอียดโครงการ (ต่อ)

### 9. มูลฝอยและกากของเสีย

#### ระยะก่อสร้าง



#### ระยะดำเนินการ



27

## รายละเอียดโครงการ (ต่อ)

### 8. การคมนาคมขนส่ง

#### ระยะก่อสร้าง



ขนส่งในเวลาเร่งด่วน

หลีกเลี่ยงช่วงเวลาเร่งด่วน

#### ระยะดำเนินการ



ขนส่งในเวลาเร่งด่วน

หลีกเลี่ยงช่วงเวลาเร่งด่วน

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## รายละเอียดโครงการ (ต่อ)

### 10. มลพิษทางอากาศ

#### ระยะก่อสร้าง



การฟุ้งกระจายของฝุ่นเกิดขึ้นในช่วงเวลาสั้น ๆ ส่วนใหญ่จะเป็นฝุ่นหนกมักจะตกลงบริเวณใกล้เคียงกับแหล่งกำเนิด

โครงการจะทำการฉีดพรมน้ำบริเวณพื้นที่ถนนทางเข้าพื้นที่ก่อสร้าง เพื่อป้องกันฝุ่นละอองฟุ้งกระจายและลดผลกระทบ

#### ระยะดำเนินการ

ไม่ก่อให้เกิดมลพิษทางอากาศแต่อย่างใด

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## รายละเอียดโครงการ (ต่อ)

### 11. เสียง

#### ระยะก่อสร้าง

แหล่งกำเนิดเสียง :



เตรียมพื้นที่



ติดตั้งแผงฯ



ก่อสร้างอาคาร/  
สถานีไฟฟ้า



รถขนส่ง

- หลีกเลี่ยงการก่อสร้าง ในช่วง 20.00-07.00 น.
- เลือกลำโพงและเครื่องจักร ในการก่อสร้างที่มีระดับเสียงต่ำ
- บำรุงรักษาเครื่องจักรอุปกรณ์ ก่อสร้างต่าง ๆ ให้อยู่ในสภาพพร้อมใช้งาน

#### ระยะดำเนินการ

ไม่ก่อให้เกิดเสียงดังแต่อย่างใด

## รายละเอียดโครงการ (ต่อ)

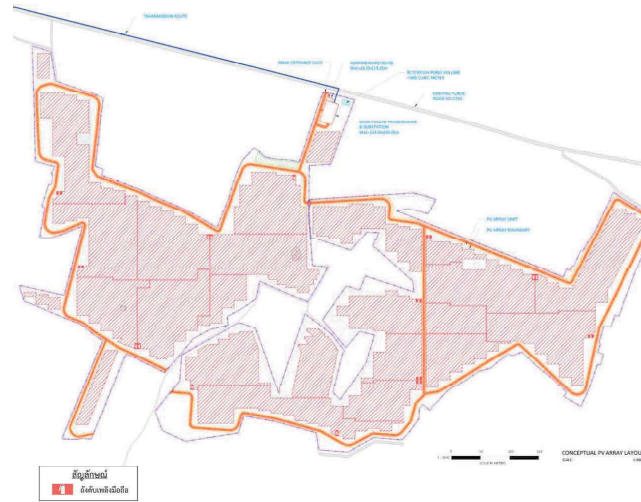
### 12. อาชีวอนามัยและความปลอดภัย

#### ระยะก่อสร้าง

กำหนดแนวทางการดำเนินงาน เพื่อควบคุมงานก่อสร้างให้เกิดความปลอดภัยในการทำงานสูงสุด และสอดคล้องกับกฎหมายที่เกี่ยวข้อง

#### ระยะดำเนินการ

- กำหนดนโยบายด้านความปลอดภัย อาชีวอนามัย และสภาพแวดล้อมในการทำงาน
- ติดตั้งอุปกรณ์ดับเพลิง ได้แก่ เครื่องดับเพลิงแบบมือถือตามจุดต่าง ๆ



## รายละเอียดโครงการ (ต่อ)

### 13. เศรษฐกิจ สังคม และการมีส่วนร่วมของประชาชน

#### 1. การประชาสัมพันธ์และชุมชนสัมพันธ์

จัดให้มีแผนการดำเนินงาน

- 1) ด้านการอนุรักษ์สิ่งแวดล้อม
- 2) ด้านสังคม
- 3) ด้านสุขภาพ
- 4) ด้านวัฒนธรรมและประเพณี

#### 2. การรับเรื่องร้องเรียนและข้อเสนอแนะ

จัดตั้ง "ศูนย์รับเรื่องร้องเรียนและข้อเสนอแนะ"

- องค์กรปกครองส่วนท้องถิ่นที่เกี่ยวข้อง (ระยะก่อสร้าง)
- ที่ทำการผู้ใหญ่บ้านในพื้นที่ตั้งโครงการ (ระยะก่อสร้าง)
- สำนักงานของโครงการ (ระยะก่อสร้างและระยะดำเนินการ)

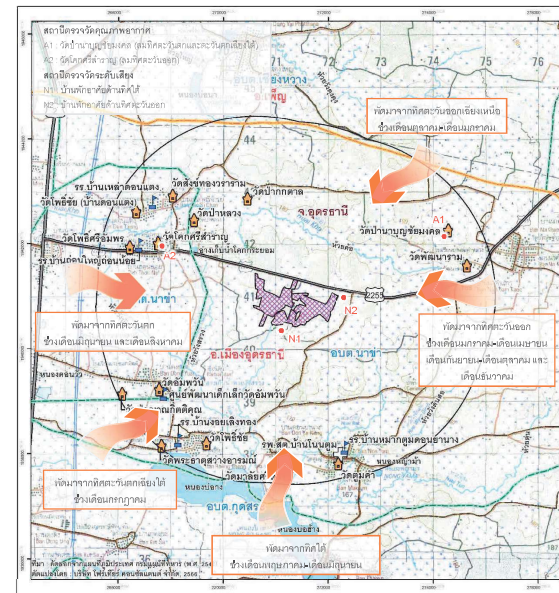
#### 3. จัดตั้งคณะกรรมการตรวจสอบผลกระทบสิ่งแวดล้อม

เพื่อเป็นศูนย์กลางในการสื่อสาร ติดตาม ตรวจสอบ ควบคุม และดำเนินการใด ๆ เพื่อลดข้อวิตกกังวล และก่อให้เกิดความเข้าใจที่ถูกต้องชัดเจน โดยจะดำเนินการให้แล้วเสร็จก่อนการก่อสร้างอย่างน้อย 1 เดือน



## การตรวจวัดคุณภาพสิ่งแวดล้อมพื้นฐานก่อนมีโครงการ

กำหนดการตรวจวัดคุณภาพสิ่งแวดล้อม ช่วงวันที่ 6-11 มิถุนายน 2566



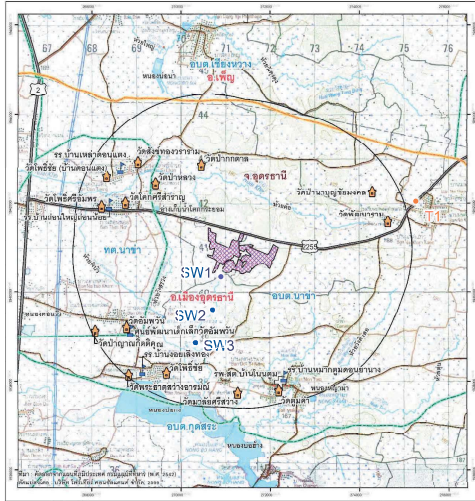
#### คุณภาพอากาศ

- ฝุ่นละอองรวม (TSP) เฉลี่ย 24 ชั่วโมง
- ฝุ่นละอองขนาดเล็กไม่เกิน 10 ไมครอน (PM<sub>10</sub>) เฉลี่ย 24 ชั่วโมง
- ทิศทางและความเร็วลม

#### เสียง

- ระดับเสียงเฉลี่ย 24 ชั่วโมง (L<sub>eq</sub> 24 hr)
- ระดับเสียงสูงสุด (L<sub>max</sub>)
- ระดับเสียงเฉลี่ย 5 นาที (L<sub>eq</sub> 5 min)
- ระดับเสียงกลางวัน-กลางคืน (L<sub>dn</sub>)
- ระดับเสียงพื้นฐาน (L<sub>90</sub>)

# การตรวจวัดคุณภาพสิ่งแวดล้อมพื้นฐานก่อนมีโครงการ (ต่อ)



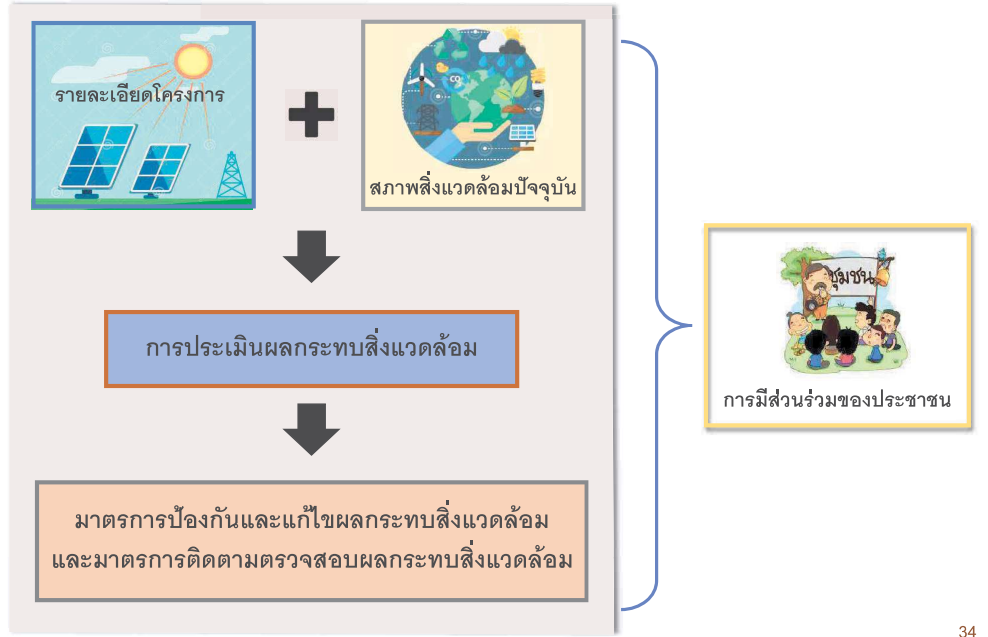
- คุณภาพน้ำผิวดิน**
- อัตราการไหล
  - อุณหภูมิ
  - ความเป็นกรดเป็นด่าง
  - ออกซิเจนละลายน้ำ
  - ของแข็งแขวนลอย
  - ของแข็งละลายน้ำ
  - บีโอดี
  - ซีโอดี
  - โคลิฟอร์มทั้งหมดและฟีคัลโคลิฟอร์ม
- นิเวศวิทยาทางน้ำ**
- แพลงก์ตอนพืช
  - แพลงก์ตอนสัตว์
  - สัตว์หน้าดิน
  - พืชน้ำ
- คมนาคม**
- ชนิด และปริมาณของยานพาหนะ
- จุดเก็บตัวอย่างคุณภาพน้ำผิวดินและนิเวศวิทยาทางน้ำ**
- SW1 ทางน้ำสาธารณะด้านทิศใต้ของโครงการ
  - SW2 ทางน้ำสาธารณะด้านทิศใต้ของโครงการ 1 กิโลเมตร
  - SW3 ทางน้ำสาธารณะด้านทิศใต้ของโครงการ 2 กิโลเมตร
- จุดตรวจนับปริมาณจราจร**
- T1 ทางหลวงหมายเลข 2255 นาข้าว-สุ่มเกล้า
  - ช่วงปี พ.ศ. 2561-2565 มีปริมาณจราจรเฉลี่ย 4,554 คัน/วัน

ทรัพยากรดินบริเวณพื้นที่โครงการ ประกอบด้วย ดินชุดใหญ่ และดินชุดโคราช จากการประเมินการชะล้างพังทลายของดิน พบว่า มีอัตราการการสูญเสียดินอยู่ในระดับปานกลาง

## ผลกระทบสิ่งแวดล้อม

ผลกระทบ	ระยะก่อสร้าง	ระยะดำเนินการ
1. ด้านคุณภาพอากาศ	อาจเกิดการฟุ้งกระจายของฝุ่นละอองจากกิจกรรมการก่อสร้าง ในช่วงเวลาสั้น ๆ โครงการจะฉีดพรมน้ำบริเวณพื้นที่โครงการและถนนทางเข้าพื้นที่ก่อสร้าง ดังนั้น ผลกระทบด้านคุณภาพอากาศจึงอยู่ในระดับต่ำ	ไม่ก่อให้เกิดมลพิษทางอากาศ
2. ด้านเสียง	อาจก่อให้เกิดผลกระทบด้านเสียงจากกิจกรรมการก่อสร้าง ซึ่งเกิดขึ้นเพียงชั่วคราว โครงการกำหนดให้ดกิจกรรมการก่อสร้างที่ก่อให้เกิดเสียงดัง ในช่วงเวลา 20.00-07.00 น. และเลือกใช้อุปกรณ์และเครื่องจักรที่มีระดับเสียงต่ำ รวมถึงบำรุงรักษาให้อยู่ในสภาพพร้อมใช้งานอยู่เสมอ ดังนั้น ผลกระทบด้านเสียงจึงอยู่ในระดับต่ำ	ไม่ก่อให้เกิดเสียงดัง

# การประเมินผลกระทบสิ่งแวดล้อม



## ผลกระทบสิ่งแวดล้อม (ต่อ)

ผลกระทบ	ระยะก่อสร้าง	ระยะดำเนินการ
3. ด้านการใช้น้ำ	มีการใช้น้ำของคนงาน และการก่อสร้าง บริษัทผู้รับเหมาก่อสร้างรับผิดชอบจัดหาน้ำ โดยจะซื้อจากผู้จำหน่ายในพื้นที่ อ.เมืองอุดรธานี ดังนั้น ผลกระทบด้านการใช้น้ำจะอยู่ในระดับต่ำ	มีการใช้น้ำของพนักงาน ล้างแรงแ้ง และรดน้ำต้นไม้ โครงการจะจัดหาน้ำใช้จากผู้จำหน่ายในพื้นที่ อ.เมืองอุดรธานี ดังนั้น ผลกระทบด้านการใช้น้ำจะอยู่ในระดับต่ำ
4. ด้านคุณภาพน้ำและการระบายน้ำ	<b>คุณภาพน้ำ</b> เกิดน้ำเสียจาก - คนงานก่อสร้าง : ผู้รับเหมาใช้สุขาชั่วคราวที่ถูกละเลยขณะและเพียงพอ - การก่อสร้าง : รวบรวมลงสู่บ่อพักน้ำทิ้งและนำไปใช้ฉีดพรมพื้นที่ก่อสร้าง ดังนั้น ผลกระทบด้านคุณภาพน้ำจะอยู่ในระดับต่ำ <b>การระบายน้ำ</b> มีการปรับระดับพื้นที่เพียงเล็กน้อย สภาพการระบายน้ำเช่นเดียวกับก่อนการพัฒนาโครงการ ดังนั้น ผลกระทบด้านการระบายน้ำจะอยู่ในระดับต่ำ	<b>คุณภาพน้ำ</b> เกิดน้ำเสียจาก - พนักงาน : บำบัดน้ำเสียจากห้องน้ำห้องส้วมด้วยถังบำบัดน้ำเสียสำเร็จรูปแบบแอมโมเนีย-ไนโตรเจน - การล้างแรงแ้ง : ปล่อยน้ำลงสู่พื้นดิน ดังนั้น ผลกระทบด้านคุณภาพน้ำจะอยู่ในระดับต่ำ <b>การระบายน้ำ</b> น้ำฝนบนเบื่อนบริเวณหม้อแปลงไฟฟ้าจะถูกกักเก็บภายในคันกัน และสูบไปบำบัด ดังนั้น ผลกระทบด้านการระบายน้ำจะอยู่ในระดับต่ำ

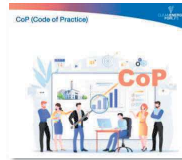
## ผลกระทบสิ่งแวดล้อม (ต่อ)

ผลกระทบ	ระยะก่อสร้าง	ระยะดำเนินการ
5. ด้านการจัดการ มูลฝอยและกากของเสีย	มูลฝอยเกิดขึ้นจาก - คนงานก่อสร้าง : ผู้รับเหมาจัดเตรียมภาชนะ รองรับอย่างเพียงพอ - กิจกรรมการติดตั้งแผงฯ : คัดแยก ส่วนที่ จำหน่ายไม่ได้จะเก็บรวบรวมและประสานงาน ให้หน่วยงานที่ได้รับอนุญาตมารับไปกำจัด ดังนั้น ผลกระทบด้านการจัดการมูลฝอย และกากของเสียจะอยู่ในระดับต่ำ	มูลฝอยเกิดขึ้นจาก - พนักงาน : โครงการจะจัดเตรียมภาชนะ รองรับอย่างเพียงพอ - ระบบผลิตไฟฟ้า : จัดเตรียมพื้นที่สำหรับ รวบรวมและจัดเก็บกากของเสียไว้ภายในอาคาร สำนักงานและเก็บวัสดุ ดังนั้น ผลกระทบด้านการจัดการมูลฝอย และกากของเสียจะอยู่ในระดับต่ำ
6. ด้านทรัพยากรดิน	อัตราการสูญเสียดินมีความรุนแรงของการ ชะล้างพังทลายในระดับปานกลาง	ปัญหาการชะล้างพังทลายของดินบริเวณพื้นที่ โครงการจะลดลงจากสภาพพื้นที่ในปัจจุบัน
7. ด้านการคมนาคม ขนส่ง	ปริมาณการจราจรเพิ่มขึ้นจากการขนส่งวัสดุ- อุปกรณ์ก่อสร้าง คนงานก่อสร้าง น้ำใช้ และ ขยะมูลฝอยและกากของเสีย ผลกระทบด้าน คมนาคมขนส่งจะอยู่ในระดับต่ำ	ปริมาณการจราจรเพิ่มขึ้นจากการขนส่ง พนักงาน น้ำใช้ล้างแผง และกากของเสีย ปริมาณการจราจรจะเพิ่มขึ้นเป็นบางวันของแต่ละ เดือน ดังนั้น ผลกระทบด้านคมนาคมขนส่ง จะอยู่ในระดับต่ำ

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## มาตรการทั่วไป

- ให้ปฏิบัติตามมาตรการป้องกันและแก้ไขผลกระทบสิ่งแวดล้อมและ  
มาตรการติดตามตรวจสอบผลกระทบสิ่งแวดล้อมในประมวลหลักการปฏิบัติ  
(Code of Practice: CoP) ในระยะต่าง ๆ อย่างเคร่งครัด
- ให้นำรายละเอียดมาตรการในประมวลหลักการปฏิบัติ (Code of Practice: CoP) ฉบับนี้ไปกำหนดเป็น  
เงื่อนไขขั้นต้นในสัญญาจ้างบริษัทผู้รับจ้าง และให้ถือปฏิบัติโดยเคร่งครัดเพื่อให้เกิดประสิทธิผลในทางปฏิบัติ
- กรณีที่ผลการติดตามตรวจสอบผลกระทบสิ่งแวดล้อมมีแนวโน้มที่จะเกิดปัญหา รวมถึงกรณีที่มีการ  
ร้องเรียนจากชุมชนที่มีเหตุมาจากการดำเนินโครงการ ให้โครงการปรับปรุงแก้ไขปัญหาดังกล่าวโดยเร็ว และ  
แจ้งให้สำนักงาน กกพ. ทราบทุกครั้ง เพื่อให้ประสานความร่วมมือในการแก้ไขปัญหา
- กรณีที่มีการเปลี่ยนแปลงรายละเอียดโครงการที่มีความแตกต่างไปจากเดิมที่มีผลต่อการเปลี่ยนแปลง  
มาตรการให้ดำเนินการแจ้งขอเปลี่ยนแปลงก่อนการดำเนินการทุกครั้ง โดยนำเสนอรายงานการเปลี่ยนแปลง  
มาตรการ ให้นำเสนอรายละเอียดเฉพาะส่วนที่เกี่ยวข้องหรือส่วนที่ได้รับผลกระทบต่อมาตรการจากการ  
เปลี่ยนแปลงดังกล่าว พร้อมทั้งเสนอเหตุผลความจำเป็น สรุปภาพรวมของการดำเนินการโครงการปัจจุบัน  
เปรียบเทียบกับภายหลังการเปลี่ยนแปลงและสรุปผลการปฏิบัติตามประมวลหลักการปฏิบัติ (CoP) ที่ผ่าน  
มาอย่างน้อย 3 ปี (ถ้ามี) เพื่อประกอบความเข้าใจต่อการพิจารณารายงานฯ ในภาพรวมด้วย



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## ผลกระทบสิ่งแวดล้อม (ต่อ)

ผลกระทบ	ระยะก่อสร้าง	ระยะดำเนินการ
8. ด้านอาชีวอนามัย และความปลอดภัย	อาจเกิดอุบัติเหตุของคนงานก่อสร้าง กำหนดมาตรการด้านอาชีวอนามัยและความ ปลอดภัยในช่วงการก่อสร้างเพื่อใช้เป็นแนวทาง ปฏิบัติสำหรับผู้รับเหมา ดังนั้น ผลกระทบด้าน อาชีวอนามัยและความปลอดภัยจะอยู่ใน ระดับต่ำ	อาจเกิดอุบัติเหตุในการทำงาน กำหนดนโยบายและมาตรการด้านความ ปลอดภัยในการทำงาน ดังนั้น ผลกระทบด้าน อาชีวอนามัย ความปลอดภัย และสุขภาพที่ อาจเกิดขึ้นในระยะดำเนินการจะอยู่ใน ระดับต่ำ
9. ด้านเศรษฐกิจ-สังคม	ผลกระทบด้านบวก เช่น การจ้างงาน กระตุ้น เศรษฐกิจในพื้นที่ เป็นต้น ผลกระทบด้านลบ เช่น การทะเลาะวิวาทของ คนงานก่อสร้าง หรือการรบกวนชุมชน เป็นต้น กำหนดให้มีการประชาสัมพันธ์แผนการ ก่อสร้าง มีศูนย์ประสานงานการรับข้อเสนอนะ และข้อร้องเรียน แต่งตั้งคณะกรรมการร่วมกับ ชุมชน รวมทั้ง พิจารณารับคนในท้องถิ่นเข้า ทำงานในอันดับแรก ดังนั้น ผลกระทบด้านเศรษฐกิจและสังคม ที่จะเป็นผลกระทบด้านลบจะอยู่ในระดับต่ำ	ผลกระทบด้านบวก เช่น การจ้างงาน กระตุ้น เศรษฐกิจในพื้นที่ เป็นต้น ผลกระทบด้านลบ เช่น ความวิตกกังวลของ ชุมชน เป็นต้น กำหนดให้มีแผนการรับเรื่องร้องเรียน งานด้าน มวลชนสัมพันธ์ รวมทั้ง แต่งตั้งคณะกรรมการ ร่วมกับชุมชน ดังนั้น ผลกระทบด้านเศรษฐกิจและสังคม ที่จะเป็นผลกระทบด้านลบจะอยู่ในระดับต่ำ

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## มาตรการป้องกันและแก้ไขผลกระทบสิ่งแวดล้อม และมาตรการติดตามตรวจสอบผลกระทบสิ่งแวดล้อม

เกณฑ์การปฏิบัติ	มาตรการป้องกันและแก้ไขผลกระทบสิ่งแวดล้อม และมาตรการติดตามตรวจสอบผลกระทบสิ่งแวดล้อม		
	ระยะ ก่อสร้าง	ระยะ ดำเนินการ	ระยะรื้อถอน บางส่วน หรือทั้งหมด
1. ด้านคุณภาพอากาศ	✓		✓
2. ด้านเสียง	✓		✓
3. ด้านคุณภาพน้ำ การระบายน้ำ และการป้องกัน	✓	✓	✓
4. ด้านคมนาคมขนส่ง	✓		✓
5. ด้านการจัดการมูลฝอยและกากของเสีย	✓	✓	✓
6. ด้านอาชีวอนามัย สุขภาพ และความปลอดภัย	✓	✓	✓
7. ด้านเศรษฐกิจ สังคม และการมีส่วนร่วมของ ประชาชน	✓	✓	✓
8. พื้นที่สีเขียว		✓	
9. ด้านการฟื้นฟูสภาพพื้นที่			✓

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# มาตรการป้องกันและแก้ไขผลกระทบสิ่งแวดล้อม และมาตรการติดตามตรวจสอบผลกระทบสิ่งแวดล้อม ระยะก่อสร้าง

เกณฑ์การปฏิบัติ	มาตรการป้องกัน และแก้ไขผลกระทบ สิ่งแวดล้อม (ข้อ)	มาตรการติดตาม ตรวจสอบผลกระทบ สิ่งแวดล้อม (ข้อ)
1. ด้านคุณภาพอากาศ	4	2
2. ด้านเสียง	5	2
3. ด้านคุณภาพน้ำ การระบายน้ำ และการป้องกัน	5	-
4. ด้านคมนาคมขนส่ง	3	-
5. ด้านการจัดการมูลฝอยและกากของเสีย	2	1
6. ด้านอาชีวอนามัย สุขภาพ และความปลอดภัย	4	1
7. ด้านเศรษฐกิจ สังคม และการมีส่วนร่วมของ ประชาชน	6	3

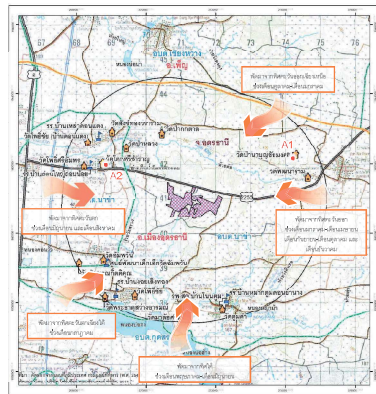
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## มาตรการระยะก่อสร้าง (ต่อ)

### เกณฑ์การปฏิบัติด้านคุณภาพอากาศ

#### ↳ มาตรการติดตาม

- ดำเนินการตรวจวัดคุณภาพอากาศในบรรยากาศ จำนวน 2 สถานี โดยความถี่ในการตรวจวัดปีละ 2 ครั้ง ตลอดระยะก่อสร้าง ใน 2 ช่วงทิศทางลมหลัก และทำการตรวจวัดติดต่อกันอย่างน้อย 5 วัน ครอบคลุมวันทำการและวันหยุด
- พารามิเตอร์ที่กำหนด ได้แก่
  - ฝุ่นละอองรวม (TSP) เฉลี่ย 24 ชั่วโมง
  - ฝุ่นละอองขนาดไม่เกิน 10 ไมครอน (PM<sub>10</sub>) เฉลี่ย 24 ชั่วโมง
  - ทิศทางและความเร็วลม (อย่างน้อยจำนวน 1 สถานี)
- สถานีตรวจวัด ได้แก่
  - สถานีที่ 1 วัดบ้านบุญชัยมงคล (A1)
  - สถานีที่ 2 วัดโคกศรีสำราญ (A2)



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## มาตรการระยะก่อสร้าง

### เกณฑ์การปฏิบัติด้านคุณภาพอากาศ

#### ↳ มาตรการป้องกัน

- ฉีดพรมน้ำในบริเวณพื้นที่ที่มีการเปิดหน้าดิน กองวัสดุ และบริเวณถนนทางเข้าพื้นที่ก่อสร้าง อย่างน้อยวันละ 2 ครั้ง (เช้า-บ่าย) หรือพิจารณาตามความเหมาะสมกับสภาพภูมิอากาศ โดยควบคุมให้ผิวดินมีความเปียกชื้น เพื่อป้องกันฝุ่นละอองฟุ้งกระจายและลดผลกระทบต่อชุมชนที่อยู่ใกล้เคียง
- จัดเก็บวัสดุอุปกรณ์ก่อสร้างให้เป็นระเบียบ ส่วนใดที่ก่อให้เกิดฝุ่นฟุ้งกระจายต้องมีวัสดุคลุมปิดทับ
- เครื่องจักรและอุปกรณ์ที่นำมาใช้ในโครงการมีการตรวจสอบสภาพและบำรุงรักษาอย่างสม่ำเสมอให้สามารถทำงานได้ดี และลดอัตราการระบายมลพิษทางอากาศ
- ก่อนนำรถออกจากพื้นที่ก่อสร้างให้ล้างทำความสะอาดตัวรถและล้อรถที่มีเศษหิน ดินโคลน หรือทรายที่อาจจะก่อให้เกิดสภาพที่เป็นอันตรายและความสกปรกบนถนน

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## มาตรการระยะก่อสร้าง (ต่อ)

### เกณฑ์การปฏิบัติด้านเสียง

#### ↳ มาตรการป้องกัน

- แจ้งแผนการก่อสร้างที่อาจก่อให้เกิดเสียงดังให้ชุมชนทราบอย่างน้อย 2 สัปดาห์ ก่อนดำเนินการ
- กิจกรรมการก่อสร้างที่อาจก่อให้เกิดผลกระทบด้านเสียงต่อชุมชนหรือสิ่งมีชีวิตที่อยู่บริเวณโดยรอบ ให้มีการดำเนินการเฉพาะในช่วงเวลากลางวัน ยกเว้นกิจกรรมที่จำเป็นต้องดำเนินการต่อเนื่องไปแล้วเสร็จจะต้องแจ้งให้ผู้นำชุมชนในพื้นที่ทราบก่อนดำเนินการในกิจกรรมนั้น ๆ อย่างน้อย 7 วัน
- ให้ติดตั้งกำแพงหรือรั้วที่มีลักษณะเป็นแผ่นหนาทึบหรือวัสดุอื่นที่ให้ผลเทียบเท่าและให้มีความสูงกว่าระดับสายตา บริเวณริมรั้วพื้นที่ก่อสร้างด้านที่อยู่ติดหรือใกล้เคียงกับชุมชนหรือพื้นที่อ่อนไหว ทั้งนี้ กำแพงกันเสียงควรติดตั้งในบริเวณที่ใกล้ที่สุดกับแหล่งกำเนิดเสียงเท่าที่จะทำได้
- เลือกใช้อุปกรณ์และเครื่องจักรในการก่อสร้างที่มีระดับเสียงต่ำและตรวจสอบบำรุงรักษาอุปกรณ์และเครื่องจักรให้มีประสิทธิภาพในการใช้งานให้ดีอยู่เสมอ
- จัดให้มีอุปกรณ์ป้องกันเสียงให้แก่คนงานที่ทำงานบริเวณที่มีเสียงดัง และควบคุมระดับเสียงทั่วไปให้อยู่ในเกณฑ์มาตรฐาน

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## มาตรการระยะก่อสร้าง (ต่อ)

### เกณฑ์การปฏิบัติด้านเสียง

#### ↳ มาตรการติดตามฯ

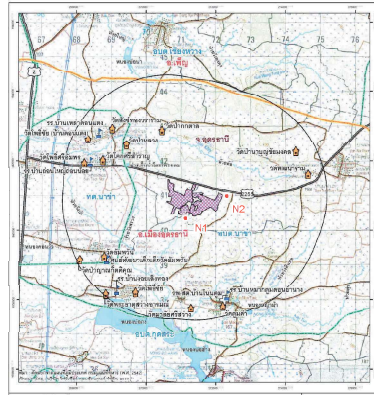
- ดำเนินการตรวจวัดระดับเสียงในบริเวณใกล้เคียงพื้นที่ตั้งโครงการ จำนวน 2 สถานี ความถี่ในการตรวจวัดปีละ 2 ครั้ง ตลอดระยะก่อสร้าง และทำการตรวจวัดติดต่อกันอย่างน้อย 5 วัน ครอบคลุมวันทำการและวันหยุด

พารามิเตอร์ที่กำหนด ได้แก่

- ระดับเสียงในบรรยากาศ เฉลี่ย 24 ชั่วโมง ( $L_{eq} 24 \text{ hr}$ )
- ระดับเสียงพื้นฐาน ( $L_{90}$ )
- ระดับเสียงเฉลี่ยกลางวัน-กลางคืน ( $L_{dn}$ )
- ระดับเสียงสูงสุด ( $L_{max}$ )

สถานีตรวจวัด ได้แก่

- สถานีที่ 1 บ้านพักอาศัยด้านทิศใต้ (N1)
- สถานีที่ 2 บ้านพักอาศัยด้านทิศตะวันออก (N2)



## มาตรการระยะก่อสร้าง (ต่อ)

### เกณฑ์การปฏิบัติด้านคมนาคมขนส่ง

#### ↳ มาตรการป้องกันฯ

- จัดให้มีป้ายหรือสัญญาณเตือนที่เห็นได้ชัดเจนตลอดเวลาทั้งกลางวันและกลางคืนก่อนถึงพื้นที่ก่อสร้างอย่างน้อย 100 เมตร
- อบรมและควบคุมพนักงานขับรถที่เกี่ยวข้องกับการก่อสร้างทุกชนิดให้ปฏิบัติตามกฎจราจรอย่างเคร่งครัด
- หากกิจกรรมการก่อสร้าง ทำให้ป้าย สัญญาณไฟ หรือผิวถนนชำรุดต้องรีบดำเนินการซ่อมแซมอย่างเร่งด่วน



## มาตรการระยะก่อสร้าง (ต่อ)

### เกณฑ์การปฏิบัติด้านคุณภาพน้ำ การระบายน้ำ และการป้องกัน

#### ↳ มาตรการป้องกันฯ

- ให้ตั้งสำนักงานสนามชั่วคราวและที่พักคนงาน ห้องน้ำห้องส้วมที่ถูกสุขลักษณะเพียงพอแก่คนงานก่อสร้างห่างจากแหล่งน้ำอย่างน้อย 30 เมตร
- ติดตั้งระบบบำบัดน้ำเสียสำเร็จรูปจากห้องน้ำห้องส้วม เพื่อบำบัดน้ำเสียให้ได้ตามมาตรฐานน้ำทิ้งที่ราชการกำหนดก่อนระบายออกสู่ภายนอก โดยห้ามระบายของเสียใด ๆ ที่ยังมีได้มีการบำบัดลงสู่แหล่งน้ำ และจะต้องมีการสูบน้ำเสียหรือของเสียดังกล่าวไปทิ้งหรือบำบัดให้ถูกต้องตามกฎหมายว่าด้วยโรงงาน
- หากกิจกรรมการก่อสร้างมีการใช้น้ำใต้ดิน จะต้องได้รับอนุญาตจากกรมทรัพยากรน้ำบาดาลหรือสำนักงานทรัพยากรธรรมชาติและสิ่งแวดล้อมจังหวัด หรือหน่วยงานอนุญาตที่เกี่ยวข้อง (แล้วแต่กรณี) ก่อนดำเนินการขุดเจาะ
- ห้ามทิ้งขยะหรือเศษวัสดุจากการก่อสร้างลงในท่อระบายน้ำ หรือแหล่งน้ำสาธารณะ โดยเด็ดขาด
- จัดทำรางระบายน้ำชั่วคราวและบ่อดักตะกอน ให้แล้วเสร็จในช่วง 1 เดือนแรกของการก่อสร้าง เพื่อควบคุมการระบายน้ำจากการก่อสร้างไม่ให้เกิดผลกระทบต่อพื้นที่โดยรอบ

## มาตรการระยะก่อสร้าง (ต่อ)

### เกณฑ์การปฏิบัติด้านการจัดการมูลฝอยและกากของเสีย

#### ↳ มาตรการป้องกันฯ

- จัดเตรียมวัสดุอุปกรณ์รองรับขยะที่เกิดขึ้นจากคนงานไว้ตามบริเวณพื้นที่ปฏิบัติงานให้พอเพียงและประสานกับหน่วยงานท้องถิ่นเพื่อดำเนินการกำจัดขยะ
- กรณีกิจกรรมการก่อสร้างมีของเสียอันตราย ที่มีลักษณะและคุณสมบัติตามที่กำหนดในประกาศกระทรวงอุตสาหกรรม เรื่อง การกำจัดสิ่งปฏิกูลหรือวัสดุที่ไม่ใช้แล้ว พ.ศ. 2548 ให้หน่วยงานที่ได้รับอนุญาตจากกรมโรงงานอุตสาหกรรมมารับไปกำจัดอย่างถูกต้อง และกำหนดวิธีปฏิบัติงานเรื่องการแยกทิ้งขยะ หรือของเสียอันตราย และอบรมให้คนงานที่เกี่ยวข้องทราบห้ามทิ้งมูลฝอยลงในทางระบายน้ำ ท่อน้ำทิ้ง และแหล่งน้ำในบริเวณใกล้เคียงพื้นที่ก่อสร้าง

#### ↳ มาตรการติดตามฯ

- บันทึกชนิดปริมาณ เศษวัสดุจากกิจกรรมก่อสร้างและวิธีการจัดการกากของเสียของโครงการ โดยระบุหัวข้อในการเก็บบันทึกข้อมูล เช่น ชนิด ปริมาณ และวิธีการกำจัด เป็นต้น เดือนละ 1 ครั้ง และจัดทำสรุป ข้อมูลเป็นรายเดือนและรายงานผลการดำเนินการทุก 1 ปี

## มาตรการระยะก่อสร้าง (ต่อ)

### เกณฑ์การปฏิบัติด้านอาชีวอนามัย สุขภาพ และความปลอดภัย

#### ↳ มาตรการป้องกันฯ

- จัดให้มีการบริหารจัดการความปลอดภัยในการทำงานตามข้อกำหนดของกฎหมายว่าด้วยความปลอดภัย อาชีวอนามัย และสภาพแวดล้อมในการทำงานเกี่ยวกับการก่อสร้างอย่างเป็นระบบและมีประสิทธิภาพ
- ติดตั้งป้ายประกาศเตือนแนวเขตพื้นที่ก่อสร้างของโครงการในสถานที่ที่มองเห็นได้ชัดเจนและรับทราบได้ง่ายชัดเจน
- จัดแบ่งเขตในบริเวณพื้นที่ก่อสร้างอย่างเป็นสัดส่วน โดยแบ่งออกเป็นเขตก่อสร้าง เขตพักผ่อนในช่วงพักกลางวัน เขตจัดเก็บเครื่องมือและวัสดุอุปกรณ์ และเขตกองเก็บวัสดุอุปกรณ์ที่ไม่ใช้แล้ว
- จัดเตรียมอุปกรณ์ปฐมพยาบาลเบื้องต้น รวมทั้งรถฉุกเฉินจำนวน 1 คันหรือเบอร์ติดต่อสถานพยาบาลใกล้เคียงที่มีรถพยาบาลสำหรับกรณีฉุกเฉิน พร้อมทั้งผู้ที่สามารถให้การปฐมพยาบาลได้ประจำพื้นที่ให้พร้อมสำหรับเคลื่อนย้ายผู้ได้รับบาดเจ็บไปส่งยังโรงพยาบาลใกล้เคียงตลอดเวลา

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## มาตรการระยะก่อสร้าง (ต่อ)

### เกณฑ์การปฏิบัติด้านอาชีวอนามัย สุขภาพ และความปลอดภัย

#### ↳ มาตรการติดตามฯ

- บันทึกสถิติการเกิดอุบัติเหตุ โดยระบุสาเหตุ ลักษณะของอุบัติเหตุ ผลต่อสุขภาพ จำนวนผู้ปฏิบัติงานที่ได้รับบาดเจ็บหรือเสียชีวิต พร้อมทั้งระบุวิธีการแก้ไขปัญหาและข้อเสนอแนะ และให้สรุปข้อมูล เป็นรายเดือนและรายงานผลการดำเนินการทุก 1 ปี

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## มาตรการระยะก่อสร้าง (ต่อ)

### เกณฑ์การปฏิบัติด้านเศรษฐกิจ สังคม และการมีส่วนร่วมของประชาชน

#### ↳ มาตรการป้องกันฯ

- ประชาสัมพันธ์และเผยแพร่ข้อมูลที่เกี่ยวข้องกับแผนการก่อสร้าง โดยการติดป้ายประกาศบริเวณพื้นที่ตั้งโครงการ หรือรูปแบบอื่นที่เหมาะสม เพื่อให้ประชาชนและผู้มีส่วนได้เสียรับทราบโดยทั่วกันล่วงหน้าอย่างน้อย 7 วัน ก่อนการดำเนินการก่อสร้าง
- จัดให้มีเจ้าหน้าที่ของโครงการลงพื้นที่เป็นระยะ ๆ ตลอดช่วงก่อสร้าง เพื่อสอบถามและรับฟังความเห็นจากชุมชนใกล้เคียงถึงผลกระทบด้านสิ่งแวดล้อมที่ได้รับจากกิจกรรมการก่อสร้าง
- จัดให้มีศูนย์ประสานงานการรับข้อเสนอแนะและข้อร้องเรียนเกี่ยวกับความเดือดร้อนที่ได้รับจากการก่อสร้างโครงการ
- ในกรณีที่มีการร้องเรียนจากประชาชนเกี่ยวกับผลกระทบจากกิจกรรมการก่อสร้างโครงการจะต้องทำการตรวจสอบและแก้ไขทันที
- แต่งตั้งคณะกรรมการร่วมกับชุมชน เพื่อให้ชุมชนได้มีส่วนร่วมในการดำเนินโครงการ และมีส่วนร่วมในการพัฒนาชุมชนและสิ่งแวดล้อมร่วมกับโครงการ
- พิจารณารับคนในท้องถิ่นที่มีคุณสมบัติเหมาะสมตามความต้องการเข้าทำงานในอันดับแรก

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## มาตรการระยะก่อสร้าง (ต่อ)

### เกณฑ์การปฏิบัติด้านเศรษฐกิจ สังคม และการมีส่วนร่วมของประชาชน

#### ↳ มาตรการติดตามฯ

- บันทึกปัญหาข้อร้องเรียนต่าง ๆ ที่เกิดขึ้นของชุมชนที่มีต่อโครงการ รวมทั้งวิธีการและระยะเวลาในการดำเนินการแก้ไข โดยให้มีการสรุปข้อมูลเป็นรายเดือนและรายงานผลการดำเนินการทุก 1 ปี
- บันทึกกิจกรรมที่โครงการดำเนินการร่วมกับชุมชนในพื้นที่ โดยให้มีการสรุปข้อมูลเป็นรายเดือนและรายงานผลการดำเนินการทุก 1 ปี
- ให้บันทึกผลการดำเนินงานของคณะกรรมการร่วมกับชุมชน โดยให้มีการสรุปผลการดำเนินการทุก 1 ปี

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## มาตรการป้องกันและแก้ไขผลกระทบสิ่งแวดล้อม และมาตรการติดตามตรวจสอบผลกระทบสิ่งแวดล้อม ระยะดำเนินการ

เกณฑ์การปฏิบัติ	มาตรการป้องกันและ แก้ไขผลกระทบ สิ่งแวดล้อม (ข้อ)	มาตรการติดตาม ตรวจสอบผลกระทบ สิ่งแวดล้อม (ข้อ)
1. ด้านคุณภาพน้ำ	4	2
2. ด้านการจัดการมูลฝอยและกากของเสีย	2	1
3. ด้านอาชีวอนามัย สุขภาพ และความปลอดภัย	8	4
4. ด้านเศรษฐกิจ สังคม และการมีส่วนร่วมของ ประชาชน	7	3
5. พื้นที่สีเขียวและสุนทรียภาพ	2	-

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### มาตรการระยะดำเนินการ (ต่อ)

#### เกณฑ์การปฏิบัติด้านคุณภาพน้ำ

↳ มาตรการติดตามฯ

#### 1. การใช้น้ำ

- **บันทึกข้อมูลปริมาณน้ำที่โครงการนำมาใช้ในโครงการ** เพื่อเปรียบเทียบกับปริมาณน้ำที่ได้รับ อนุญาตจากหน่วยงานผู้อนุญาต รวมทั้งปัญหาอุปสรรคจากการใช้น้ำของโครงการทุก 6 เดือน ตามรอบปฏิทิน (ถ้ามี)

#### 2. การระบายน้ำทิ้ง

- **แสดงผังสมดุลน้ำใช้-น้ำทิ้ง (Water balance)** พร้อมแสดงข้อมูลระบบบำบัดน้ำเสีย และการระบายน้ำทิ้ง

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### มาตรการระยะดำเนินการ

#### เกณฑ์การปฏิบัติด้านคุณภาพน้ำ

↳ มาตรการป้องกันฯ

- การใช้น้ำ**
  - หากในอนาคตโครงการจะใช้น้ำบาดาลจะต้องปฏิบัติตามเงื่อนไขการให้ **อนุญาต** ของหน่วยงานอย่างเคร่งครัด และให้ระบุปริมาณที่สูบน้ำจริงเทียบกับปริมาณที่ได้รับอนุญาต (ระบุในหน่วยลูกบาศก์เมตรต่อเดือน)
- การระบายน้ำฝน**
  - **ควบคุมอัตราการระบายน้ำฝนจากบ่อหนองน้ำหรือพื้นที่โครงการ** ให้มีอัตราการระบายไม่เกินกว่าอัตราการระบายน้ำฝนในพื้นที่ก่อนพัฒนาโครงการ
  - **ให้มีหญ้าหรือพืชคลุมดินเพื่อลดการชะล้างพังทลายของดิน**
- การบำรุงรักษาระบบบำบัดน้ำเสีย**
  - **บำรุงรักษาระบบบำบัดน้ำเสียให้มีประสิทธิภาพ** ในการบำบัดเพียงพอในการบำบัดน้ำเสียทั้งหมด รวมถึงกากตะกอนของโครงการให้เป็นไปตามเกณฑ์มาตรฐานก่อนนำไปกำจัดภายนอกพื้นที่โครงการ หรือนำมาใช้ประโยชน์ภายในพื้นที่โครงการ

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### มาตรการระยะดำเนินการ (ต่อ)

#### เกณฑ์การปฏิบัติด้านการจัดการมูลฝอยและกากของเสีย

↳ มาตรการป้องกันฯ

- **การจัดเก็บและส่งกำจัดอุปกรณ์ที่ชำรุดหรือหมดอายุการใช้งาน** ให้ดำเนินการตามประกาศกระทรวงอุตสาหกรรม เรื่องการกำจัดสิ่งปฏิกูลหรือวัสดุที่ไม่ใช้แล้ว พ.ศ. 2548 หรือกฎหมายที่มีผลบังคับใช้ฉบับล่าสุด รวมถึงให้ปฏิบัติตามแนวทาง ดังต่อไปนี้
  - กรณีส่งออกไปจัดการนอกประเทศ ต้องปฏิบัติให้เป็นไปตามกฎหมายว่าด้วยวัตถุอันตราย และข้อกำหนดระหว่างประเทศ ทั้งนี้ เมื่อดำเนินการแล้วเสร็จให้แจ้งสำนักงาน กกพ. ทราบภายใน 30 วัน นับจากที่มีการส่งออกไปจัดการนอกประเทศ
  - กรณีการจัดการภายในประเทศ ต้องดำเนินการฝังกลบในหลุมฝังกลบของเสียอันตราย (Secure Land Fill) หรือเผาทำลายด้วยเตาเผาเฉพาะของเสียอันตราย
- **ตรวจสอบสถานที่จัดเก็บขยะมูลฝอย และวัสดุที่ไม่ใช้แล้วเป็นประจำ** เพื่อป้องกันผลกระทบที่อาจเกิดขึ้นจากการปนเปื้อนหรือฟุ้งกระจายของกากของเสีย

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## มาตรการระยะดำเนินการ (ต่อ)

### เกณฑ์การปฏิบัติด้านการจัดการมูลฝอยและกากของเสีย

#### ↳ มาตรการติดตามฯ

- **บันทึกชนิดปริมาณและจัดการของเสียของโครงการ** โดยสรุปข้อมูลผลการดำเนินงานทุก 1 ปี ตามแบบบันทึกของกรมโรงงานอุตสาหกรรม (แบบ สก.)

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## มาตรการระยะดำเนินการ (ต่อ)

### เกณฑ์การปฏิบัติด้านอาชีวอนามัย ความปลอดภัย และสุขภาพ

#### ↳ มาตรการป้องกันฯ

- **ตรวจสอบการทำงานของระบบเตือนภัยต่าง ๆ** เป็นประจำทุกปี
- **ฝึกซ้อมแผนปฏิบัติการกรณีเกิดเหตุฉุกเฉินภายในพื้นที่โครงการ** โดยอาจแบ่งแผนเป็น 3 ระดับ ตามความรุนแรงของเหตุฉุกเฉิน และให้มีช่องทางการประสานงานขอความช่วยเหลือจากหน่วยงานภายนอก ทั้งนี้ แผนต้องมีขั้นตอนการดำเนินการ และผู้รับผิดชอบที่ชัดเจนตลอดจนมีความถี่ในการฝึกซ้อมเป็นไปตามที่กฎหมายกำหนด
- **ดำเนินการตามแผนการตรวจสอบสภาพการใช้งานของอุปกรณ์เครื่องจักร และระบบไฟฟ้าต่าง ๆ อย่างสม่ำเสมอ**
- **การใช้งานระบบไฟฟ้าในโรงงาน** ต้องดำเนินการให้เป็นไปตามหลักวิชาการหรือมาตรฐานที่ยอมรับ
- **ให้มีการตรวจสอบระบบไฟฟ้าในโรงงาน** และรับรองความปลอดภัยของระบบไฟฟ้าในโรงงานเป็นประจำทุกปีตามหลักเกณฑ์ที่กฎหมายกำหนด

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## มาตรการระยะดำเนินการ (ต่อ)

### เกณฑ์การปฏิบัติด้านอาชีวอนามัย ความปลอดภัย และสุขภาพ

#### ↳ มาตรการป้องกันฯ

- **ดำเนินการตามแผนงานที่กำหนด** สำหรับพื้นที่ที่มีความเสี่ยงต่อการเกิดอันตรายของโครงการ และหาแนวทางป้องกันและแก้ไขความเสี่ยงในแต่ละพื้นที่
- **ดำเนินการตามกฎหมาย** ข้อกำหนดด้านอาชีวอนามัยและความปลอดภัย หรือกฎหมายแรงงานอื่น ๆ ที่เกี่ยวข้อง และเป็นปัจจุบัน
- **จัดให้มีการอบรม** เกี่ยวกับทางด้านอาชีวอนามัยและความปลอดภัยอย่างเหมาะสม และเพียงพอกับลักษณะงาน เช่น
  - การฝึกซ้อมและใช้อุปกรณ์ผจญเพลิง
  - กฎระเบียบเกี่ยวกับการทำงานในบริเวณที่มีโอกาสเกิดอันตราย
  - การตรวจสอบความปลอดภัยในสถานที่ทำงาน
  - การฝึกใช้อุปกรณ์ป้องกันอันตรายส่วนบุคคล
  - การป้องกันอันตรายจากเครื่องจักร ความร้อนและไฟฟ้า
  - การทำงานบนที่สูงตั้งแต่ 2 เมตรขึ้นไป

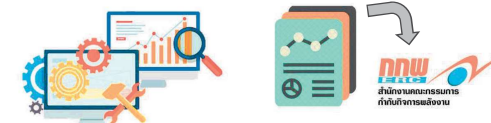
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## มาตรการระยะดำเนินการ (ต่อ)

### เกณฑ์การปฏิบัติด้านอาชีวอนามัย ความปลอดภัย และสุขภาพ

#### ↳ มาตรการติดตามฯ

- **บันทึก-สถิติการเกิดอุบัติเหตุ** โดยระบุสาเหตุ ลักษณะของอุบัติเหตุ ผลต่อสุขภาพ จำนวนผู้ปฏิบัติงานที่ได้รับบาดเจ็บหรือเสียชีวิต พร้อมทั้งระบุวิธีการแก้ไขปัญหาและข้อเสนอแนะเดือนละ 1 ครั้ง และรายงานผลการดำเนินการทุก 1 ปี
- **แสดงผลการตรวจสอบระบบไฟฟ้า** ในโรงงานและรับรองความปลอดภัยของระบบไฟฟ้าในโรงงานเป็นประจำทุกปี
- **แสดงผลฝึกซ้อมดับเพลิงและเหตุฉุกเฉิน** อย่างน้อยปีละ 1 ครั้ง หรือตามที่กฎหมายกำหนด
- **แสดงผลการตรวจสอบการทำงานของระบบเตือนภัยและอุปกรณ์ป้องกันและระงับอัคคีภัย** ต่าง ๆ เป็นประจำทุกปี



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## มาตรการระยะดำเนินการ (ต่อ)

### เกณฑ์การปฏิบัติด้านเศรษฐกิจ สังคม และการมีส่วนร่วมของประชาชน

#### ↳ มาตรการป้องกันฯ

- เปิดโอกาสให้ชุมชนเข้ามาเยี่ยมชมโครงการ เพื่อคลายความวิตกกังวล
- กำหนดให้มีแผนการรับเรื่องร้องเรียน โดยระบุช่องทางการรับเรื่องร้องเรียน ขั้นตอน และระยะเวลาในการดำเนินการแก้ไขปัญหาเรื่องร้องเรียน รวมทั้งผู้รับผิดชอบ พร้อมแผนผังประกอบให้ชัดเจน ทั้งนี้ ในกรณีแก้ไขปัญหายังไม่แล้วเสร็จ ให้มีการแจ้งความก้าวหน้าในการแก้ไขปัญหาให้กับผู้ร้องเรียนทราบเป็นระยะทุก 7 วัน
- จัดให้มีผู้รับผิดชอบงานด้านมวลชนสัมพันธ์ของโครงการในการเข้าร่วมกิจกรรมมวลชนสัมพันธ์ต่าง ๆ กับชุมชนรวมทั้งติดตามรับเรื่องร้องเรียนและความเดือดร้อนรำคาญที่เกิดขึ้นเกี่ยวกับโครงการ
- เผยแพร่ข้อมูลข่าวสารและประชาสัมพันธ์รายละเอียดโครงการและผลการดำเนินการตามประมวลหลักการปฏิบัติให้กับชุมชนในพื้นที่และคณะกรรมการร่วมกับชุมชนรับทราบ พร้อมเปิดโอกาสให้ ชุมชนเข้ามามีส่วนร่วมในการติดตามตรวจสอบโครงการตลอดอายุการดำเนินการ

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## มาตรการระยะดำเนินการ (ต่อ)

### เกณฑ์การปฏิบัติด้านเศรษฐกิจ สังคม และการมีส่วนร่วมของประชาชน

#### ↳ มาตรการติดตามฯ

- บันทึกปัญหาข้อร้องเรียนต่าง ๆ ที่เกิดขึ้นของชุมชนที่มีต่อโครงการ รวมทั้งวิธีการและระยะเวลาในการดำเนินการแก้ไข โดยให้มีการสรุปข้อมูลเป็นรายเดือนและรายงานผลการดำเนินการทุก 1 ปี
- บันทึกกิจกรรมที่โครงการดำเนินการร่วมกับชุมชนในพื้นที่ โดยให้มีการสรุปข้อมูลเป็นรายเดือนและรายงานผลการดำเนินการทุก 1 ปี
- บันทึกผลการดำเนินงานของคณะกรรมการร่วมกับชุมชน โดยให้มีการสรุปผลการดำเนินการ ทุก 1 ปี

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## มาตรการระยะดำเนินการ (ต่อ)

### เกณฑ์การปฏิบัติด้านเศรษฐกิจ สังคม และการมีส่วนร่วมของประชาชน

#### ↳ มาตรการป้องกันฯ (ต่อ)

- ส่งเสริมกิจกรรมชุมชนสัมพันธ์ และการดำเนินงานเพื่อส่งเสริมกิจกรรมต่าง ๆ ของชุมชน เพื่อสร้างความสัมพันธ์ที่ดีกับชุมชนในพื้นที่
- แต่งตั้งคณะกรรมการร่วมกับชุมชน เพื่อให้ชุมชนได้มีส่วนร่วมในการดำเนินโครงการ และมีส่วนร่วมในการพัฒนาชุมชนและสิ่งแวดล้อมร่วมกับโครงการ
- ในกรณีพิสูจน์ได้ว่ามีความเสียหายเกิดขึ้นจากการดำเนินงานของโครงการ ให้คณะกรรมการร่วมกับชุมชนที่แต่งตั้งขึ้น มีอำนาจหน้าที่ในการพิจารณาจ่ายค่าเสียหายที่เกิดขึ้น

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## มาตรการระยะดำเนินการ (ต่อ)

### เกณฑ์การปฏิบัติด้านพื้นที่สีเขียวและสุนทรียภาพ

#### ↳ มาตรการป้องกันฯ

- ให้ปฏิบัติตามมาตรการป้องกันและแก้ไขผลกระทบสิ่งแวดล้อม โดยมีการบำรุงรักษาและการปลูก ทดแทนในกรณีที่ต้นไม้ตายเพื่อให้เป็นพื้นที่สีเขียวที่ยั่งยืน ทั้งนี้ ให้พิจารณาปลูกไม้ยืนต้นในพื้นที่สีเขียวของโครงการเป็นหลักตามความเหมาะสม
- ห้ามใช้สารกำจัดวัชพืชภายในพื้นที่โครงการ

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## มาตรการป้องกันและแก้ไขผลกระทบสิ่งแวดล้อม และมาตรการติดตามตรวจสอบผลกระทบสิ่งแวดล้อม ระยะรื้อถอนบางส่วนหรือทั้งหมด

เกณฑ์การปฏิบัติ	มาตรการป้องกันและ แก้ไขผลกระทบ สิ่งแวดล้อม (ข้อ)	มาตรการติดตาม ตรวจสอบผลกระทบ สิ่งแวดล้อม (ข้อ)
1. ด้านคุณภาพอากาศ	4	-
2. ด้านเสียง	5	-
3. ด้านคุณภาพน้ำ	4	-
4. ด้านคมนาคมขนส่ง	3	-
5. ด้านการจัดการมูลฝอยและกากของเสีย	2	1
6. ด้านอาชีวอนามัย สุขภาพ และความปลอดภัย	2	1
7. ด้านเศรษฐกิจ สังคม และการมีส่วนร่วมของ ประชาชน	3	1
8. ด้านการฟื้นฟูสภาพพื้นที่	1	-

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## มาตรการระยะรื้อถอนบางส่วน หรือทั้งหมด (ต่อ)

### เกณฑ์การปฏิบัติด้านการฟื้นฟูสภาพพื้นที่

#### ↳ มาตรการป้องกันฯ

- ภายหลังการรื้อถอนอุปกรณ์ต่างๆ แล้วเสร็จ ต้องดำเนินการปรับสภาพพื้นที่โครงการให้มีลักษณะที่เหมาะสมต่อการพัฒนาการใช้ประโยชน์ที่ดินให้สอดคล้องกับสภาพแวดล้อมปัจจุบันให้มากที่สุด โดยไม่เป็นอุปสรรคในประเด็นด้านสิ่งแวดล้อมและความปลอดภัย

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## มาตรการระยะรื้อถอนบางส่วน หรือทั้งหมด

### เกณฑ์การปฏิบัติด้านคุณภาพอากาศ

#### ↳ มาตรการป้องกันฯ

- ติดตั้งแผงพลาสติก รั้ว หรือผ้าใบ เพื่อลดการฟุ้งกระจายของฝุ่นละออง
- ปิดคลุมส่วนท้ายยานพาหนะที่ใช้ในการขนส่งวัสดุอุปกรณ์ใด ๆ จากการรื้อถอน

### เกณฑ์การปฏิบัติด้านเสียง

#### ↳ มาตรการป้องกันฯ

- หลีกเลี่ยงการทิ้งสิ่งของจากที่สูง หากจำเป็นต้องมีวัสดุรองรับเพื่อลดเสียงกระทบกันของสิ่งของกับพื้นซึ่งมีการรื้อถอน โดยอาจใช้แผ่นยาง หรือพรม เป็นต้น

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## การรับฟังความคิดเห็นของประชาชนและผู้มีส่วนได้เสีย ที่ผ่านมา

### บรรยายภาคการประชุม

8 เมษายน 2566 เวลา 09.00-12.00 น. ณ ศาลาอเนกประสงค์ อบต.นาข่า



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## ผลการรับฟังความเห็นจากขั้นตอนเตรียมความพร้อมชุมชน

### ประเด็นการประชุม

- โครงการใช้น้ำสะอาดหรือน้ำผสมสารเคมีในการล้างทำความสะอาดแผงเซลล์แสงอาทิตย์ หากใช้น้ำผสมสารเคมี กังวลผลกระทบต่อสุขภาพจากการชะล้างสารเคมีลงสู่สิ่งแวดล้อม
- แผงเซลล์แสงอาทิตย์จะทำให้เกิดความร้อนเพิ่มขึ้นจากเดิมหรือไม่ และความร้อนดังกล่าวมีผลกระทบต่อনাข้าวหรือไม่
- โครงการจะมีวิธีการจัดการแผงเซลล์แสงอาทิตย์ที่เสื่อมสภาพหรือหมดอายุใช้งานแล้วอย่างไร
- อยากให้โครงการนำเสนอรายละเอียดการจัดทำกิจกรรมมวลชนสัมพันธ์ (CSR) ให้ชัดเจน และอยากให้จัดทำกิจกรรม CSR ระยะยาว ให้เกิดประโยชน์แก่ชุมชน
- อยากให้นำเสนอรายละเอียดเงินกองทุนพัฒนาไฟฟ้าให้ชัดเจน

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## กองทุนพัฒนาไฟฟ้า

### ❖ การจ่ายเงินเข้ากองทุน

ระหว่างก่อสร้าง : 50,000 บาท/กำลังการผลิตไฟฟ้า เมกะวัตต์/ปี  
หรือไม่น้อยกว่า 50,000 บาท/ปี  
ระหว่างการผลิต : 1 สตางค์/หน่วย

### ❖ พื้นที่รอบโรงไฟฟ้าที่ได้รับเงินกองทุน

สำนักงานคณะกรรมการกำกับกิจการพลังงาน (กกพ.) เป็นผู้กำหนดเขตพื้นที่ประกาศ

### ❖ การนำเงินกองทุนไปใช้ประโยชน์

มุ่งเน้นการพัฒนา 7 ด้าน ได้แก่ ด้านการศึกษา ด้านสิ่งแวดล้อม ด้านพลังงานชุมชน ด้านสาธารณสุข ด้านเศรษฐกิจชุมชน ด้านสาธารณูปโภค และด้านอื่น ๆ

### ❖ การบริหารจัดการกองทุน

ตามหลักเกณฑ์ที่คณะกรรมการกำกับกิจการพลังงาน (กกพ.) กำหนด



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## โครงการชุมชนสัมพันธ์

### แนวทางการจัดทำโครงการชุมชนสัมพันธ์ มีดังนี้

- **แผนด้านการอนุรักษ์สิ่งแวดล้อม** เช่น โครงการโรงเรียนในโรงไฟฟ้า จัดกิจกรรมโครงการศึกษาดูงานด้านสิ่งแวดล้อม หรือการสนับสนุนกิจกรรมด้านสิ่งแวดล้อมของชุมชน
- **แผนด้านสังคม เด็ก และเยาวชน** เช่น สนับสนุนกิจกรรมของสถาบันการศึกษาในพื้นที่ โครงการสนับสนุนกิจกรรมกีฬาในพื้นที่ เป็นต้น
- **แผนด้านสุขภาพ** เช่น โครงการพัฒนาศักยภาพอาสาสมัครสาธารณสุขประจำหมู่บ้าน (อสม.) เป็นต้น
- **แผนด้านวัฒนธรรมและประเพณี** เช่น สนับสนุนงานทำบุญทอดกฐิน/ สนับสนุนประเพณีสงกรานต์ เป็นต้นไป

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## ช่องทางแสดงความคิดเห็น / สอบถามเพิ่มเติม

### พลังงานรุ่งเรือง

บริษัท พลังงานรุ่งเรือง จำกัด (เจ้าของโครงการ)

87 อาคารเอ็มไทย ทาวเวอร์ ออลซีซั่นเพลส ชั้น 10 ถนนวิทญู แขวงลุมพินี เขตปทุมวัน กรุงเทพมหานคร 10330

[This information has been removed as it falls within the exceptions to disclose specified in paragraph 17 (2) of ADB's Access to Information Policy.]

### Fourtier

บริษัท ไฟร์เทียร์ คอนซัลแตนต์ จำกัด (บริษัทที่ปรึกษาด้านสิ่งแวดล้อม)

99/2 หมู่ที่ 8 ตำบลบางเมือง อำเภอเมืองสมุทรปราการ จังหวัดสมุทรปราการ 10270

ติดต่อ คุณจันทร์ทิพย์ ออติ (นักวิชาการสิ่งแวดล้อม)  
[This information has been removed as it falls within the exceptions to disclose specified in paragraph 17 (2) of ADB's Access to Information Policy.]

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**APPENDIX 6E**

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**OPINIONS FROM PUBLIC MEETING**

**Opinions from the Public Meeting on  
15 June 2023**

**Table 2: Questions and Recommendations from Public Meeting  
and Form of Additional Public Comments**

Questions/Recommendations	Explanations/Measures
<b>1. Project Details</b>	
<ul style="list-style-type: none"> <li>- The project should coordinate with the Public Works and Town &amp; Country Planning Provincial Office prior to submission of application for license because the revision of Mueang Udon Thani Comprehensive Plan is currently underway (Town Planning Analyst, Professional Level, Udon Thani Public Works and Town Plan Office).</li> </ul>	<ul style="list-style-type: none"> <li>- The project will coordinate with Udon Thani Public Works and Town Plan Office prior to submission of application for license.</li> </ul>
<ul style="list-style-type: none"> <li>- The project's land title deeds should be submitted to the Group of Town Planning, Udon Thani Public Works and Town Plan Office, to check the color zone under the Provincial Comprehensive Plan in which the project site is located. (Post-meeting evaluation form)</li> </ul>	<ul style="list-style-type: none"> <li>- Phalangngan Rungrueang Company Limited had already checked the land use and category according to the Ministerial Regulation on Udon Thani Comprehensive Plan, B.E. 2560 (2017). The National and Regional Planning Bureau, Department of Public Works and Town &amp; Country Planning, informed the company of the results of land use examination as per the letter No. Mor Thor 0711.7/1592 dated 17 October 2022 that the company's project site can be located in the Area No. 3.9 under the Udon Thani Comprehensive Plan, B.E. 2560 (2017) which is designated as Rural and Agricultural Zone (Green) where the permitted land use categories include agriculture or agriculture-related activities, residential areas, educational institutes, religious institutes, government institutes, public utilities and amenities. The List of Prohibited Factory Category or Type in the Annex to the Ministerial Regulation on Udon Thani Comprehensive Plan, B.E. 2560 (2017) does not prohibit the establishment of solar power plants (Factory No. 88).</li> </ul>
<ul style="list-style-type: none"> <li>- Does the project have a plan for future expansion? (Representative of Mu 3, Na Kha Subdistrict)</li> </ul>	<ul style="list-style-type: none"> <li>- If the electricity demand in Udon Thani province rises in the future and the Energy Regulatory Commission (ERC) announces power purchase from independent power producers, it will be an opportunity for the company to propose a solar power plant project in line with the power purchase announcement.</li> </ul>
<ul style="list-style-type: none"> <li>- Concerns were voiced about impacts on the areas near the project area, e.g. heat, electricity, etc. What will the project's corrective actions be? (Representative of Mu 3, Na Kha Subdistrict)</li> </ul>	<ul style="list-style-type: none"> <li>- The project has designed a setback distance of not less than 6 meters from the project boundary line for solar panel installation.</li> <li>- Solar panels accumulate and dissipate heat all the time. They will not cause a rise in ambient temperature.</li> </ul>

Questions/Recommendations	Explanations/Measures
	<ul style="list-style-type: none"> <li>- The design of solar power generation system and connection to the grid of the electricity authority will comply with the standard prescribed by the electricity authority and will be certified by electrical engineer.</li> </ul>
<ul style="list-style-type: none"> <li>- As for the generation technology to be used by the project, has it been used before? Is there any research which certifies that it will not cause any temperature increase in the area? (Environmental Officer, Senior Professional Level, Udon Thani Provincial Natural Resources and Environment Office)</li> </ul>	<ul style="list-style-type: none"> <li>- Solar photovoltaic (PV) power generation technology has been earlier and widely used</li> <li>- Solar power generation is the process of converting energy from the sun into electricity using solar panels. Solar panels accumulate and dissipate heat all the time, but they will not cause any increase in ambient temperature</li> </ul>
<ul style="list-style-type: none"> <li>- At the middle of the project area where there will be no installation of solar panels, does the land belong to local people? (Environmental Officer, Senior Professional Level, Udon Thani Provincial Natural Resources and Environment Office)</li> </ul>	<ul style="list-style-type: none"> <li>- The land plot at the middle of the project is not within the project area and it will be public land and private land, and the company does not have the documents of right. Therefore, the company has not purchased those land parcels. Besides, entry and exit from those lands can be normally done. The project has not blocked the public road which is the entry and exit to the area.</li> </ul>
<ul style="list-style-type: none"> <li>- After the completion of construction, will there be office workers routinely working throughout the project period of 25 years or only security guards? (Agricultural Extensionist, Professional Level, Mueang Udon Thani District Agriculture Office)</li> </ul>	<ul style="list-style-type: none"> <li>- During the operation phase, there will be a total of 5 office workers, i.e. electricity generation system operators and security guards</li> </ul>
<b>2. Air Quality</b>	
<ul style="list-style-type: none"> <li>- Will the project carry out monitoring of PM<sub>2.5</sub> during pre-project, construction and post-construction phases? (Form of Additional Public Comments)</li> </ul>	<ul style="list-style-type: none"> <li>- When considering the air quality impact from the project construction, the impacts are generally due to the site preparation for solar panel installation and buildings including transportation of construction materials and equipment, vehicles transporting construction workers, etc., which may cause dust dispersion. However, dust diffusion occurs for a short period of time and large dust particles mostly fall close to the point source or within 6-9 meters from the construction site. Consequently, monitoring of particulate matters smaller than 2.5 microns (PM<sub>2.5</sub>) is not stipulated for the construction phase.</li> </ul>
<ul style="list-style-type: none"> <li>- Will the project cause air pollution which is harmful to the local people engaging in agricultural practice near the project? (Post-meeting evaluation form)</li> </ul>	<ul style="list-style-type: none"> <li>- During the construction phase, air quality impacts may occur due to the construction activities which cause air pollution, e.g. site preparation for solar panel installation and buildings including transportation of construction materials and</li> </ul>



Questions/Recommendations	Explanations/Measures
	equipment, vehicles transporting construction workers, etc., which causes dust dispersion. However, dust diffusion occurs for a short period of time and large dust particles mostly fall close to the point source or within 6-9 meters from the construction site. Therefore, air quality impact during the construction phase is low.
<ul style="list-style-type: none"> <li>- Frequency of water spraying should be increased to 8 times/day during the construction phase or every time when dust dispersion occurs. (Post-meeting evaluation form)</li> </ul>	<ul style="list-style-type: none"> <li>- The project has already set down a measure for spraying water over the areas where topsoil is excavated, piles of construction materials, and access road to the construction site, at least twice a day (morning-afternoon) or as deemed appropriate for the weather conditions to maintain the ground surface moisture in order to prevent dust diffusion and reduce impacts on nearby communities.</li> </ul>
<b>3. Water Quality and Drainage</b>	
<ul style="list-style-type: none"> <li>- Will the project carry out land levelling? Concerns were voiced about water flow obstructions. After the end of the 25-year project period, how will the project manage the land area? (Environmental Officer, Senior Professional Level, Udon Thani Provincial Natural Resources and Environment Office)</li> </ul>	<ul style="list-style-type: none"> <li>- The project area is mostly used for solar panel installation, road, and vacant land within the project area. These areas will remain open ground and drainage conditions will be the same as the pre-project conditions. The project area where changes are to take place will cover about 1,935 square meters, i.e. power station area, office building, storage buildings, etc. These changes will result in the alteration of drainage conditions in the aforesaid areas. The project will design drain ditches for collecting stormwater runoff in those areas to a retention pond before being discharged from the retention pond to a natural waterway outside of the project (south of the project area) at a rate of flow not exceeding the pre-project flow rate.</li> </ul>
<b>4. Transportation</b>	
<ul style="list-style-type: none"> <li>- Concerns about truck traffic which may worsen road damage and cause traffic congestion in some areas. There should be an online complaint system or group. (Post-meeting evaluation form)</li> </ul>	<ul style="list-style-type: none"> <li>- In the construction phase, a coordination center will be set up for receiving suggestions and complaints about disturbances from the project construction (electronic media is available); and in case of complaints by people about impacts from the project construction activities, the project will promptly investigate and take remedial action.</li> </ul>
<b>5. Solid Waste Management</b>	
<ul style="list-style-type: none"> <li>- Has the project coordinated or entered into a contract with a waste disposal facility? Concerns were voiced about the waste volume which may exceed the capacity of the waste disposal facility.</li> </ul>	<ul style="list-style-type: none"> <li>- At present, the project has not yet selected a hazardous waste disposal facility. However, in the selection process, the capabilities of hazardous waste disposal facility will be considered.</li> </ul>

Questions/Recommendations	Explanations/Measures
(Environmental Officer, Senior Professional Level, Udon Thani Provincial Natural Resources and Environment Office)	
<ul style="list-style-type: none"> <li>- How will the electronic waste and hazardous waste generated by the project have an impact on the local people's health? What is the project's policy or approach to waste management? (Village Headman, Mu 10, Na Kha Subdistrict)</li> </ul>	<ul style="list-style-type: none"> <li>- Hazardous waste generated by the project will have a low level of health impact because the project will collect and store the hazardous waste in a building specifically provided for such purpose. The project's hazardous waste management will be in compliance with the Ministry of Industry's Notification on Management of Waste or Unused Materials, B.E. 2566 (2023) or the latest law in force. The project will coordinate with the hazardous waste disposal facility permitted by the Department of Industrial Works to collect the hazardous waste for proper disposal according to the technical principles.</li> </ul>
<ul style="list-style-type: none"> <li>- Concerns about the disposal of solar panels in the long term. There are 4 solar panel disposal methods, i.e. incineration, recycling, landfill and export to disposal facilities in other countries. Thailand will have a solar PV panel disposal facility in Chachoengsao province, which is the first one in Thailand. As for recycling, it is unsure whether there is a recycling facility. Regarding export to disposal facilities in other countries, costs may be high. Which disposal method will be used by the project? In which province will the disposal site be located? In case of landfill, will there be any contamination of groundwater? The project is requested to confirm that the landfill site will not be in Na Kha subdistrict. (Village Headman, Mu 15, Na Kha Subdistrict)</li> </ul>	<ul style="list-style-type: none"> <li>- Damaged or expired solar panels are classified as hazardous waste. The project will coordinate with the hazardous waste disposal facility permitted by the Department of Industrial Works to collect the hazardous waste for proper disposal in line with the technical principles according to the Ministry of Industry's Notification on Management of Waste or Unused Materials, B.E. 2566 (2023) or the latest law in force.</li> <li>- At present, the project has not yet selected a hazardous waste disposal facility. Therefore, it is unable to explain disposal methods of waste disposal facility. However, in the selection process, the project will consider and select the method with the least environmental impact.</li> <li>- Regarding the hazardous waste disposal site (landfill), it must be located in the area where hazardous waste landfill by hazardous waste disposal facility is permitted by Department of Industrial Works. There is no hazardous waste landfill in Na Kha subdistrict. Therefore, it is confirmed that no hazardous waste of the project will be disposed of in landfills in Na Kha subdistrict.</li> </ul>
<ul style="list-style-type: none"> <li>- Clarification should be given regarding the waste disposal, method and disposal site. (Post-meeting evaluation form)</li> </ul>	
<ul style="list-style-type: none"> <li>- After the end of the 25-year project period, does the project have a plan to continue the operation? Will there be a solar panel disposal facility?</li> </ul>	<ul style="list-style-type: none"> <li>- The project will remove solar panels and a hazardous waste disposal facility permitted by Department of Industrial Works will collect the removed solar panels for disposal in line with the</li> </ul>

Questions/Recommendations	Explanations/Measures
(Post-meeting evaluation form)	technical principles according to the Ministry of Industry's Notification on Management of Waste or Unused Materials, B.E. 2566 (2023) or the latest law in force.
<b>6. Occupational Health and Safety</b>	
<ul style="list-style-type: none"> <li>- During a thunderstorm or lightning, will the project be affected, such as short circuits, or cause power outage in nearby areas? How will the project prevent such incidents? (Village health volunteer (VHV), Mu 2, Na Kha Subdistrict)</li> </ul>	<ul style="list-style-type: none"> <li>- The project will design and install lightning protection system in accordance with the standards prescribed by the electricity authority for the project safety.</li> </ul>
<b>7. Socio-economics and Public Consultation</b>	
<ul style="list-style-type: none"> <li>- How much is the local tax per year to be paid by the project to Na Kha SAO? Which variables will be considered in calculating the amount? (Assistant District Chief Officer, Mueang Udon Thani District Office)</li> </ul>	<ul style="list-style-type: none"> <li>- The project will pay local land and buildings tax to the subdistrict administrative organizations (SAOs) as required by law. The project is coordinating with SAOs regarding the details of tax calculations. SAOs will survey and consider the tax rates according to land uses and then inform the project of the tax rates and total amount to be paid.</li> </ul>
<ul style="list-style-type: none"> <li>- The project should take part in merit-making and traditional events or other activities together with communities. (Village Headman, Mu 16, Na Kha Subdistrict)</li> </ul>	<ul style="list-style-type: none"> <li>- The project is willing to participate in community activities as appropriate in order to build good relationship with local communities.</li> </ul>
<ul style="list-style-type: none"> <li>- The project should allocate a budget to support the community activities and traditional events at least once a year throughout the project period. (Post-meeting evaluation form)</li> </ul>	<ul style="list-style-type: none"> <li>- The project accepted the recommendation for further consideration and action.</li> </ul>
<ul style="list-style-type: none"> <li>- A community fund should be established for enhancing the project sustainability, with a joint committee between communities and the company. (Post-meeting evaluation form)</li> </ul>	<ul style="list-style-type: none"> <li>- The project accepted the recommendation for further consideration and action.</li> </ul>
<ul style="list-style-type: none"> <li>- The project should provide solar energy equipment to local government agencies, e.g. temples, schools, subdistrict health promotion hospitals, etc. (Post-meeting evaluation form)</li> </ul>	<ul style="list-style-type: none"> <li>- The project accepted the recommendation for further consideration and integration into community relations activities</li> </ul>
<ul style="list-style-type: none"> <li>- The project should indicate the beneficial areas of the Power Development Fund. (Environmental Officer, Senior Professional Level, Udon Thani Provincial Natural Resources and Environment Office)</li> </ul>	<ul style="list-style-type: none"> <li>- On the day of public consultation, a clear answer could not be given regarding the area and size of a community development fund for the surrounding communities of the power plant. This is because the Office of Energy Regulatory Commission will determine the size of area and fund after the</li> </ul>

Questions/Recommendations	Explanations/Measures
	project has been granted a license for electricity generation business
<p>- The size of the Fund depends on the electricity supplied to the grid in each year. It is noticeable that when the project submits a lower quantity of solar panels, the Fund will decrease. In case the private operator cannot supply electricity as per the agreement, will there be any fines? (Deputy Chief Administrator of Chiang Wang SAO)</p>	<p>- If the project fails to supply electricity in accordance with the Power Purchase Agreement, the project must pay fines.</p>
<p>- A community committee should be set up to jointly make decisions on the allocation of benefits from the Power Development Fund. (Post-meeting evaluation form)</p>	<p>- The project accepted the recommendation for further consideration and action.</p>
<p>- A guideline or example of the management of Power Development Fund which has already been implemented should be presented to inform the people of the details and operational procedure and for the benefit of the beneficial communities. (Post-meeting evaluation form)</p>	<p>- The project accepted the recommendation for further consideration and action.</p>
<p>- The project gave explanations to the comments from the first public consultation forum, hence greater clarity. However, no clear explanation was given on the recommendation for Na Kha SAO to prepare for the committee operation and nomination of representatives to be members of the committee which will monitor the environmental aspect and complaints. It was recommended that people living close to the project area should be nominated. (Deputy Chief Administrator of Chiang Wang SAO)</p>	<p>- After the project has been granted a license, the project will coordinate with Na Kha SAO to set up a committee for environmental impact monitoring.</p>
<p>- During the construction, will there be an office building for coordination or receiving complaints? (Agricultural Extensionist, Professional Level, Mueang Udon Thani District Agriculture Office)</p>	<p>- The office building will be located in the front part of the project area and will serve as a coordination and complaint center, with a clear signboard, during the construction and operation phases.</p>

Questions/Recommendations	Explanations/Measures
<p>- The project should provide clear information on the care and support for communities as local people in the area are directly impacted by the project. A community fund should be set up for local people. The fund committee should consist of village committee members, the company or various networks. Funding should be provided by the company as appropriate. The fund committee should jointly carry out planning and consider the fund disbursement so as to solve problems in the area. The objectives of fund disbursement must be clearly specified, i.e. educational support, occupational promotion, assistance to elderly or disabled persons, construction of building for common use, and promotion of volunteer activities. (Director, Division of Social Welfare, Na Kha SAO)</p>	<p>- During the project construction and operation phases, the project will set down measures for promoting community relations activities and community engagement to promote community activities so as to build good relationship with local communities. The project and local communities will jointly consider community relations activities to create maximum benefit for the communities. The project accepted the issue of community fund for further consideration.</p>
<p>- Additional clarification should be given about the planning for implementation of socio-economic and public participation activities of local people in the area (Post-meeting evaluation form)</p>	<p>- The project accepted the recommendation for further consideration and action.</p>
<p>- The project should keep the communities continuously informed of the project information. (Post-meeting evaluation form)</p>	<p>- The project accepted the recommendation for further consideration and integration into community relations activities</p>
<p>- The project should explain the importance of the use of renewable energy or clean energy to the local people in order to build understanding and ease concerns about the project and also motivate the use of renewable energy or clean energy. (Agricultural Extensionist, Professional Level, Mueang Udon Thani District Agriculture Office)</p>	<p>- Owing to the current global warming, the government has increasingly supported and purchased electricity generated from clean energy or renewable energy (solar energy, wind energy whereby no fuel is used) so as to reduce the proportion of power generation from fossil fuel combustion, contributing to the global warming mitigation. However, the purchase of electricity generated from clean energy or renewable energy from independent power producers must comply with the requirements relating to environmental impact prevention, correction and monitoring measures (Code of Practice) in order to prevent impacts which may arise and affect the communities and environment.</p>
<p>- Local employees or labourers or contractors should be employed in order to promote occupations for the</p>	<p>- In the construction phase, the project will give priority to employment of local people with qualifications suitable for the requirements. This</p>

Questions/Recommendations	Explanations/Measures
communities and improve the local economy. (Post-meeting evaluation form)	measure has been set down for the construction phase.
- Representatives of Na Kha subdistrict should be selected to join a visit to the project site for firsthand learning about impacts in the area so that they can answer the questions of local people (Village Headman, Mu 16, Na Kha Subdistrict)	- The project accepted the recommendation for further consideration and integration into community relations activities
<b>8. Green Areas</b>	
- Does the project have a plan to expand green areas and how many rai per year? (Natural Resources and Environmental Protection Volunteers (NEV) Network)  - Does the project have a plan for planting replacement trees and where will it take place? (Secretary to Mayor, Na Kha Subdistrict Municipality)	- The project accepted the recommendation for expansion of green areas within communities for consideration and integration into community relations activities
- What is the percentage of green area coverage and where will the green areas be sited? (Post-meeting evaluation form)	- The project will provide green areas and buffer zone within the project area, covering about 26,808.5 square meters or equivalent to 4.09 percent of the total area. The green areas will be about 1,625 square meters or 0.22 of the total area.
<b>9. Others</b>	
- Is it possible to disclose the results of environmental quality survey around the project area to the communities and local officers? This will enable them to know the changes in the environmental quality and the impact monitoring committee can use them as baseline data of the area (Deputy Chief Administrator of Chiang Wang Subdistrict Administrative Organization)	- Environmental quality measurements were conducted as proposed during 6-11 June 2023, with the results presented in the <b>attachment</b> .
- Where will the construction workers' camp be located? (Environmental Officer, Senior Professional Level, Udon Thani Provincial Natural Resources and Environment Office)	- The project will employ local workers to avoid negative impacts on the communities; as a result, there will be no workers' camp in the project area. There will be only a temporary site office.
- The project should not use herbicide. (Director, Division of Social Welfare, Na Kha SAO)	- The project has set down a measure prohibiting the use of herbicide within the project area.

Questions/Recommendations	Explanations/Measures
<ul style="list-style-type: none"> <li>- The project should allow the communities to use the existing medium-sized trees in the area. (Secretary to Mayor, Na Kha Subdistrict Municipality)</li> </ul>	<ul style="list-style-type: none"> <li>- The project accepted the recommendation for further consideration and action.</li> </ul>
<ul style="list-style-type: none"> <li>- Can the packaging waste generated in the construction phase be sold to local buyers? This will help increase the income of local small entrepreneurs. (Post-meeting evaluation form)</li> </ul>	<ul style="list-style-type: none"> <li>- In case the packaging waste generated in the construction phase is not classified as hazardous waste as prescribed by law, it can be sold to local buyers as it falls under the category of construction waste according to the Public Health Act, B.E. 2535 (1992).</li> </ul>
<ul style="list-style-type: none"> <li>- Environmental impacts in the long term should be considered as well as co-existence with communities. (Post-meeting evaluation form)</li> </ul>	<ul style="list-style-type: none"> <li>- The project will strictly comply with the environmental impact prevention and correction measures, and environmental impact monitoring measures as required for each phase in order to minimize impacts on the communities and environmental conditions</li> </ul>
<ul style="list-style-type: none"> <li>- A process beneficial to local people should be established such as provision of grass from the project area to local people for use as animal feeds or for compost fertilizer production (Post-meeting evaluation form)</li> </ul>	<ul style="list-style-type: none"> <li>- The project accepted the recommendation for further consideration and integration into community relations activities</li> </ul>
<ul style="list-style-type: none"> <li>- Electricity supply should be provided to the unelectrified homes in Na Kha-Sum Sao so that it can be used for agricultural production. (Post-meeting evaluation form)</li> </ul>	<ul style="list-style-type: none"> <li>- The project accepted the recommendation for further consideration and integration into community relations activities</li> </ul>
<ul style="list-style-type: none"> <li>- A process should be established in order to drive a rigorous and strict operation of the monitoring and complaint committee, with more concrete results than the plan. (Post-meeting evaluation form)</li> </ul>	<ul style="list-style-type: none"> <li>- The project accepted the recommendation for further consideration and action.</li> </ul>
<ul style="list-style-type: none"> <li>- Electricity prices for people should be lower than the existing ones. (Post-meeting evaluation form)</li> </ul>	<ul style="list-style-type: none"> <li>- The project will only generate electricity for supply to the electricity authority's grid according to the Power Purchase Agreement. However, solar power generation has no fuel cost; as a result, the project will have positive impacts on the electricity prices in the future.</li> </ul>
<ul style="list-style-type: none"> <li>- A village development fund should be established. (Natural Resources and Environmental Protection Volunteers (NEV) Network)</li> </ul>	<ul style="list-style-type: none"> <li>- The project accepted the recommendation for further consideration and action.</li> </ul>
<ul style="list-style-type: none"> <li>- A fund should be set up to support the NEV operation in the area. (Post-meeting evaluation form)</li> </ul>	<ul style="list-style-type: none"> <li>- The project accepted the recommendation for further consideration and integration into community relations activities</li> </ul>

Questions/Recommendations	Explanations/Measures
- Job creation for communities should be promoted in a concrete manner. (Post-meeting evaluation form)	- The project accepted the recommendation for further consideration and integration into community relations activities
- The project should conduct site visits in villages to build people’s understanding as some people do not understand the benefits and will feel concerned. (Post-meeting evaluation form)	- The project accepted the recommendation for further consideration and integration into community relations activities

Source: Fournier Consultants Co., Ltd., 2023

After the presentation of the project details, an opportunity was provided for participants to give comments in the meeting room as well as in the form of additional public comments and post-meeting evaluation form. There were a total of 265 respondents or 93.31 percent of the total number of 284 participants (excluding the Project Owner and the Consultant). Key issues are summarized as follows:

**(1) General Information of the Respondents to the Post-Meeting Evaluation Form**

About 42.26 percent of the respondents are male and 57.36 percent are female while 0.38 percent made no comment. Most respondents were village/community representatives, representing 61.89 percent, followed by government agencies 32.08 percent, and private organizations and others in an equal percentage of 2.64 percent, and mass media and educational institutes in an equal percentage of 0.38 percent.

**(2) Perception of Project Information**

Most respondents knew about Phalangngan Rungrueang Power Plant Project of Phalangngan Rungrueang Co., Ltd., with 43.83 percent learning about the project for the first time and 56.17 percent having information before the meeting. The main source of information was community leaders, such as subdistrict headman, village headman, etc., representing 39.54 percent, followed by officers of Phalangngan Rungrueang Co., Ltd., at 25.86 percent, local government agencies 18.25 percent, project brochures/public relations documents 8.75 percent, and relative/neighbor/co-worker 7.60 percent, respectively.

When questioned about dissemination of additional project information/public relations, most respondents, i.e. 96.75 percent, commented that additional information should be publicized, whereas only 3.25 percent stated that additional public relations was not necessary. The information/additional information needed by respondents was the advantages-disadvantages of the project implementation as mentioned by 20.00 percent of respondents, followed by environmental impact prevention and correction measures, and environmental impact monitoring measures by 18.54 percent, safety system of the environmental project by 16.97 percent, project details by 16.07 percent, knowledge about solar power generation by 14.94 percent, and operation period/plan by 13.48 percent, respectively. The most appropriate channel or method of dissemination of project information was community leaders, e.g. subdistrict headman, village headman, assistant village headman etc., representing 38.24 percent, followed by publicity boards in community areas as cited by 21.83 percent, local government agencies by 19.81 percent, letters/documents sent directly to people by 11.15 percent, and meetings by 8.98 percent, respectively.



### **(3) Opinions about the Project Environmental Impact Assessment**

After listening to the presentation of the study results and preparation of Code of Practice (CoP) report, it was found that most participants of the meeting, i.e. 87.55 percent, had good understanding, followed by 6.79 percent of participants who did not understand and suggested that additional information should be presented, 30.2 percent expressing uncertainty and 2.64 percent making no comment, respectively.

After the aforesaid presentation, it was found that most participants, i.e. 51.70 percent, voiced no concern, followed by 46.79 percent expressing concerns, and 0.75 percent making no comment and voicing uncertainty in equal proportions. As for the issues of highest concerns, air quality was cited by 34.85 percent of participants, followed by water discharge by 16.60 percent, water use 13.28 percent, solid waste 12.03 percent, noise 10.37 percent, transportation 7.88 percent, and others (safety, heat, green areas) 4.98 percent, respectively.

The suitability/adequacy of environmental impact prevention and correction measures, and environmental impact monitoring measures during pre-construction, construction, operation, and decommissioning phases is summarized as follows:

a) Pre-construction Phase: 78.11 percent of participants regarded the measures as suitable/adequate, followed by 10.19 percent making no comment, 6.04 percent considering them to be unsuitable/inadequate and suggesting that additional information should be presented, and 5.66 percent expressing uncertainty, respectively;

b) Construction Phase: 77.74 percent of participants considered the measures to be suitable/adequate, followed by 8.68 percent voicing uncertainty, 7.55 percent having no comment, and 6.04 percent stating that they were unsuitable/inadequate and additional information should be presented, respectively;

c) Operation Phase: 76.98 percent of participants regarded the measures as suitable/adequate, followed by 9.81 percent giving no comment, 7.92 percent expressing uncertainty, and 5.28 percent stating that they were unsuitable/inadequate and additional information should be presented, respectively; and

d) Decommissioning Phase: 70.94 percent of participants considered that the measures were suitable/adequate, followed by 10.94 percent expressing uncertainty, 10.19 percent making no comment, 7.92 percent taking the view that they were unsuitable/inadequate and suggesting that additional information should be presented, respectively.

**APPENDIX 6F**

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**LETTER FOR SUBMITTING THE SUMMARY  
OF PUBLIC MEETING**

*[This information has been removed as it falls within the exceptions to disclose specified in paragraph 17(2) of ADB's Access to Information Policy.]*

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**APPENDIX 6G**

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**STAKEHOLDER ENGAGEMENT FOR  
TRANSMISSION LINE**

**ตารางสรุปการลงพื้นที่ปฏิบัติงานด้วยชุมชนสัมพันธ์**  
**บริษัท พลังงานรุ่งเรือง จำกัด**

วันที่เวลาที่เข้าพบ	บุคคล/หน่วยงานที่เข้าพบ	ข้อมูลที่ตัวแทนโครงการชี้แจง	ประเด็นสอบถาม / ข้อเสนอแนะ	หมายเหตุ
21 พ.ย. 66 เวลา 10.40 น.	ผู้ใหญ่บ้าน หมู่ที่ 7 ตำบลนาข่า อำเภอเมือง อุดรธานี จังหวัดอุดรธานี  <i>[This information has been removed as it falls within the exceptions to disclose specified in paragraph 17(2) of ADB's Access to Information Policy.]</i> 	<b>ข้อมูลแผนการดำเนินงานสายส่งไฟฟ้าของโครงการบริษัท พลังงานรุ่งเรือง จำกัด</b> • ข้อมูลงานก่อสร้าง ระยะเวลาดำเนินการก่อสร้าง (10 เดือน) - เริ่มดำเนินการก่อสร้าง 1 มกราคม 2567 - สิ้นสุดการก่อสร้าง 31 ตุลาคม 2567 • แนวการสายส่งไฟฟ้า (โดยดำเนินการตามแนวสายส่งปัจจุบันของการไฟฟ้าส่วนภูมิภาค (PEA)) <input type="checkbox"/> - ออกจากถนนโครงการเลี้ยวซ้ายไปยังทางหลวงหมายเลข 2255 จนถึงถนนทางหลวงหมายเลข 2 - เลี้ยวซ้ายเพื่อไปเชื่อมต่อสายส่งบริเวณแยกบ้านผือ ในการส่งไฟฟ้าไปยังสถานีไฟฟ้าบ้านผือ และ สถานีไฟฟ้าอุดรธานี 1 • ผู้ดำเนินการก่อสร้างและผู้รับผิดชอบ : การไฟฟ้าส่วนภูมิภาค (กฟภ.) • เชื่อมต่อสถานีไฟฟ้า : สถานีไฟฟ้าบ้านผือ และสถานีไฟฟ้าอุดรธานี 1 • หมายเหตุ : การก่อสร้างของโครงการดำเนินการในพื้นที่เขตทางหลวงเดิม ( Right – of – Way)	<b>ความวิตกกังวล</b> - การวางสายส่งไฟฟ้าจะมีอันตรายไหม เช่น ไฟช็อต เป็นต้น <b>ตอบ</b> งานก่อสร้างสายส่งไฟฟ้าจะเป็นหน้าที่ของการไฟฟ้าส่วนภูมิภาค (PEA) ซึ่งจะมีการประชาสัมพันธ์การวางสายส่งผ่านผู้นำชุมชนล่วงหน้า และจะมีมาตรการด้านความปลอดภัยของการไฟฟ้าส่วนภูมิภาค มีการวางกรวยวางป้องกันเขตพื้นที่ก่อสร้าง อีกทั้งจัดให้มีเจ้าหน้าที่สำหรับอำนวยความสะดวกแก่ชุมชน <b>ข้อเสนอแนะ</b> - ไม่มี	
21 พ.ย. 66 เวลา 11.25 น.	กำนันตำบลนาข่า อำเภอเมืองอุดรธานี จังหวัด อุดรธานี  <i>[This information has been removed as it falls within the exceptions to disclose specified in paragraph 17(2) of ADB's Access to Information Policy.]</i> 	<b>ข้อมูลแผนการดำเนินงานสายส่งไฟฟ้าของโครงการบริษัท พลังงานรุ่งเรือง จำกัด</b> • ข้อมูลงานก่อสร้าง ระยะเวลาดำเนินการก่อสร้าง (10 เดือน) - เริ่มดำเนินการก่อสร้าง 1 มกราคม 2567 - สิ้นสุดการก่อสร้าง 31 ตุลาคม 2567 • แนวการสายส่งไฟฟ้า (โดยดำเนินการตามแนวสายส่งปัจจุบันของการไฟฟ้าส่วนภูมิภาค (PEA)) <input type="checkbox"/> - ออกจากถนนโครงการเลี้ยวซ้ายไปยังทางหลวงหมายเลข 2255 จนถึงถนนทางหลวงหมายเลข 2 - เลี้ยวซ้ายเพื่อไปเชื่อมต่อสายส่งบริเวณแยกบ้านผือ ในการส่งไฟฟ้าไปยังสถานีไฟฟ้าบ้านผือ และ สถานีไฟฟ้าอุดรธานี 1 • ผู้ดำเนินการก่อสร้างและผู้รับผิดชอบ : การไฟฟ้าส่วนภูมิภาค (กฟภ.) • เชื่อมต่อสถานีไฟฟ้า : สถานีไฟฟ้าบ้านผือ และสถานีไฟฟ้าอุดรธานี 1 • หมายเหตุ : การก่อสร้างของโครงการดำเนินการในพื้นที่เขตทางหลวงเดิม ( Right – of – Way)	<b>ความวิตกกังวล</b> - ไม่มี <b>ข้อเสนอแนะ</b> - ไม่มี	

**ตารางสรุปการลงพื้นที่ปฏิบัติงานด้วยชุมชนสัมพันธ์**  
**บริษัท พลังงานรุ่งเรือง จำกัด**

วันที่เวลาที่เข้าพบ	บุคคล/หน่วยงานที่เข้าพบ	ข้อมูลที่ตัวแทนโครงการชี้แจง	ประเด็นสอบถาม / ข้อเสนอแนะ	หมายเหตุ
21 พ.ย. 66 เวลา 13.30 น.	นายกองค์การบริหารส่วนตำบลนาข่า อำเภอเมือง อุดรธานี จังหวัดอุดรธานี  <i>[This information has been removed as it falls within the exceptions to disclose specified in paragraph 17(2) of ADB's Access to Information Policy.]</i> 	<b>ข้อมูลแผนการดำเนินงานสายส่งไฟฟ้าของโครงการบริษัท พลังงานรุ่งเรือง จำกัด</b> • ข้อมูลงานก่อสร้าง ระยะเวลาดำเนินการก่อสร้าง (10 เดือน) - เริ่มดำเนินการก่อสร้าง 1 มกราคม 2567 - สิ้นสุดการก่อสร้าง 31 ตุลาคม 2567 • แนวการสายส่งไฟฟ้า (โดยดำเนินการตามแนวสายส่งปัจจุบันของการไฟฟ้าส่วนภูมิภาค (PEA)) <input type="checkbox"/> - ออกจากถนนโครงการเลี้ยวซ้ายไปยังทางหลวงหมายเลข 2255 จนถึงถนนทางหลวงหมายเลข 2 - เลี้ยวซ้ายเพื่อไปเชื่อมต่อสายส่งบริเวณแยกบ้านผือ ในการส่งไฟฟ้าไปยังสถานีไฟฟ้าบ้านผือ และ สถานีไฟฟ้าอุดรธานี 1 • ผู้ดำเนินการก่อสร้างและผู้รับผิดชอบ : การไฟฟ้าส่วนภูมิภาค (กฟภ.) • เชื่อมต่อสถานีไฟฟ้า : สถานีไฟฟ้าบ้านผือ และสถานีไฟฟ้าอุดรธานี 1 • หมายเหตุ : การก่อสร้างของโครงการดำเนินการในพื้นที่เขตทางหลวงเดิม ( Right – of – Way)	<b>ความวิตกกังวล</b> - ไม่มี <b>ข้อเสนอแนะ</b> - ไม่มี	
21 พ.ย. 66 เวลา 16.50 น.	ผู้ใหญ่บ้าน หมู่ที่ 3 ตำบลนาข่า อำเภอเมือง อุดรธานี จังหวัดอุดรธานี  <i>[This information has been removed as it falls within the exceptions to disclose specified in paragraph 17(2) of ADB's Access to Information Policy.]</i> 	<b>ข้อมูลแผนการดำเนินงานสายส่งไฟฟ้าของโครงการบริษัท พลังงานรุ่งเรือง จำกัด</b> • ข้อมูลงานก่อสร้าง ระยะเวลาดำเนินการก่อสร้าง (10 เดือน) - เริ่มดำเนินการก่อสร้าง 1 มกราคม 2567 - สิ้นสุดการก่อสร้าง 31 ตุลาคม 2567 • แนวการสายส่งไฟฟ้า (โดยดำเนินการตามแนวสายส่งปัจจุบันของการไฟฟ้าส่วนภูมิภาค (PEA)) <input type="checkbox"/> - ออกจากถนนโครงการเลี้ยวซ้ายไปยังทางหลวงหมายเลข 2255 จนถึงถนนทางหลวงหมายเลข 2 - เลี้ยวซ้ายเพื่อไปเชื่อมต่อสายส่งบริเวณแยกบ้านผือ ในการส่งไฟฟ้าไปยังสถานีไฟฟ้าบ้านผือ และ สถานีไฟฟ้าอุดรธานี 1 • ผู้ดำเนินการก่อสร้างและผู้รับผิดชอบ : การไฟฟ้าส่วนภูมิภาค (กฟภ.) • เชื่อมต่อสถานีไฟฟ้า : สถานีไฟฟ้าบ้านผือ และสถานีไฟฟ้าอุดรธานี 1 • หมายเหตุ : การก่อสร้างของโครงการดำเนินการในพื้นที่เขตทางหลวงเดิม ( Right – of – Way)	<b>ความวิตกกังวล</b> - ไม่มี <b>ข้อเสนอแนะ</b> - อยากรู้หากบริษัทฯ ช่วยติดตั้งโคมไฟถนนควบคู่ไปกับเสาไฟฟ้า เพื่อเพิ่มความปลอดภัยและความสะดวกในการเดินทางของคนในชุมชน เนื่องจากบริเวณชุมชนมีอุบัติเหตุเกิดขึ้นบ่อย	

ลงชื่อ ..... ผู้บันทึกรายการ  
ลงชื่อ ..... ผู้รับรองรายการ

**APPENDIX 6H**

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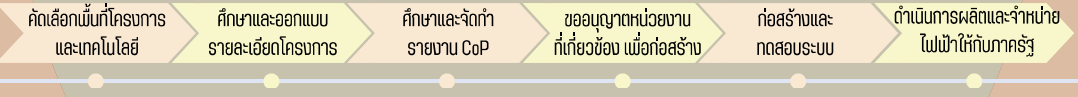
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**BROCHURE FOR DISSEMINATE  
TRANSMISSION LINE INFORMATION**

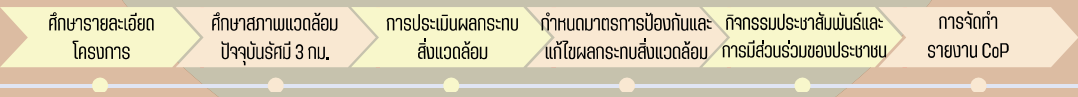
### 10 ระยะเวลาการก่อสร้าง

ระยะเวลาการก่อสร้าง : ตั้งแต่ดำเนินการก่อสร้าง จนถึงจ่ายไฟฟ้าเข้าระบบใช้ระยะเวลา 12 เดือน (1 มกราคม - 31 ธันวาคม 2567)

### 11 วิธีการดำเนินงานของโครงการ



### 12 ขอบเขตการศึกษาและจัดทำรายงาน



### 13 การดำเนินกิจกรรมด้านการประชาสัมพันธ์และการมีส่วนร่วมของประชาชน

#### กลุ่มผู้มีส่วนได้เสียของโครงการ

- ผู้ที่ได้รับผลกระทบหรือผู้มีส่วนได้เสีย
- ประชาชนในพื้นที่ศึกษา
- ผู้นำชุมชนในพื้นที่ศึกษา
- กลุ่มเปราะบาง เช่น กลุ่มสตรี เด็ก คนพิการ เป็นต้น
- กลุ่มชาติพันธุ์ (ถ้ามี)

- กลุ่มที่ 2 : หน่วยงานราชการในระดับต่างๆ ที่เกี่ยวข้อง
- กลุ่มที่ 3 : ประชาชน และผู้สนใจทั่วไป

#### การเผยแพร่และประชาสัมพันธ์โครงการ

โครงการได้ดำเนินการเผยแพร่ข้อมูลโครงการ ตามสถานที่ดังต่อไปนี้

- ๑ บริเวณพื้นที่ที่จะดำเนินการก่อสร้างโครงการ
- ๑ สำนักงานคณะกรรมการกำกับกิจการพลังงานประจำเขต 4 ขอนแก่น
- ๑ สำนักงานอุตสาหกรรมจังหวัดอุดรธานี
- ๑ สำนักงานพลังงานจังหวัดอุดรธานี
- ๑ สำนักงานทรัพยากรธรรมชาติและสิ่งแวดล้อมจังหวัดอุดรธานี
- ๑ สำนักงานประชาสัมพันธ์จังหวัดอุดรธานี
- ๑ ที่ว่าการอำเภอในพื้นที่ศึกษา
- ๑ องค์กรปกครองส่วนท้องถิ่นในพื้นที่ศึกษา
- ๑ ที่ทำการกำนัน / ผู้ใหญ่บ้านในพื้นที่ศึกษา
- ๑ โรงเรียน / ศาสนสถาน ในพื้นที่ศึกษา



#### ช่องทางติดต่อสื่อสาร



#### เจ้าของโครงการ

#### บริษัท พลังงานรุ่งเรือง จำกัด

เลขที่ 87 อาคารเอ็มไทย ทาวเวอร์ ออลซีชั้น พลัส ชั้น 10 ถนนวิบูลย์ แขวงลุมพินี เขตปทุมวัน กรุงเทพมหานคร 10330

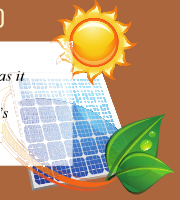
[This information has been removed as it falls within the exceptions to disclose specified in paragraph 17(2) of ADB's Access to Information Policy.]

#### บริษัทที่ปรึกษาด้านสิ่งแวดล้อม

#### บริษัท ทีแอลที คอนซัลแตนท์ จำกัด

151 อาคารทีบี ชั้น 13 (ฝ่ายสิ่งแวดล้อม) ถนนบวรจันทร์ แขวงบวรจันทร์ เขตปทุมวัน กรุงเทพมหานคร 10230

[This information has been removed as it falls within the exceptions to disclose specified in paragraph 17(2) of ADB's Access to Information Policy.]



# โครงการโรงไฟฟ้า พลังงานรุ่งเรือง ของบริษัท พลังงานรุ่งเรือง จำกัด

## ตำบลนาซ่า อำเภอเมืองอุดรธานี จังหวัดอุดรธานี

### 1 เหตุผล ความจำเป็นโครงการ

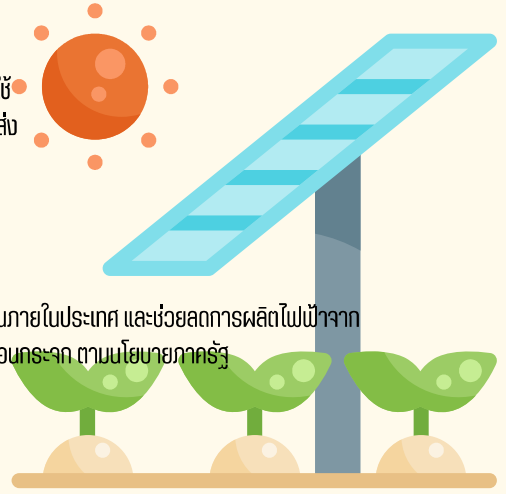
บริษัท พลังงานรุ่งเรือง จำกัด มีแนวคิดที่จะพัฒนาโครงการโรงไฟฟ้า พลังงานรุ่งเรือง ซึ่งเป็นโครงการผลิตไฟฟ้าจากพลังงานแสงอาทิตย์ ด้วยเทคโนโลยีแผงโซลาร์เซลล์แบบติดตั้งบนพื้นดิน เพื่อจำหน่ายไฟฟ้าให้แก่ภาครัฐ ตามนโยบายให้การสนับสนุนการผลิตไฟฟ้าจากพลังงานทดแทนหรือพลังงานสะอาด โดยพลังงานแสงอาทิตย์เป็นหนึ่งในพลังงานสะอาดที่สามารถนำมาใช้งานได้โดยไม่จำกัด ไม่ก่อให้เกิดมลภาวะทางสิ่งแวดล้อม และช่วยเสริมสร้างความมั่นคงด้านพลังงานในระยะยาว ทั้งนี้ การพัฒนาดังกล่าวเข้าข่ายต้องจัดทำรายงานประมวลผลการปฏิบัติ (CoP) สำหรับโรงไฟฟ้าประเภทไม่เผาไหม้เชื้อเพลิง

### 2 วัตถุประสงค์ของโครงการ

- ๑ เพื่อส่งเสริมการผลิตไฟฟ้าจากพลังงานหมุนเวียน ตามแผนการเพิ่มการผลิตไฟฟ้าจากพลังงานสะอาดภายใต้แผนพัฒนากำลังผลิตไฟฟ้าของประเทศไทย พ.ศ. 2561-2580 ฉบับปรับปรุงครั้งที่ 1 (PDP2018 Rev.1) ในช่วงปี พ.ศ. 2564-2573
- ๑ เพื่อสนับสนุนให้ประเทศไทยสามารถมุ่งสู่พลังงานสะอาดและลดการปล่อยคาร์บอนไดออกไซด์สุทธิเป็นศูนย์ภายในปี พ.ศ. 2608 โดยการเพิ่มสัดส่วนการผลิตไฟฟ้าจากพลังงานทดแทน

### 3 ประโยชน์ที่ชุมชนหรือประชาชนจะได้รับ

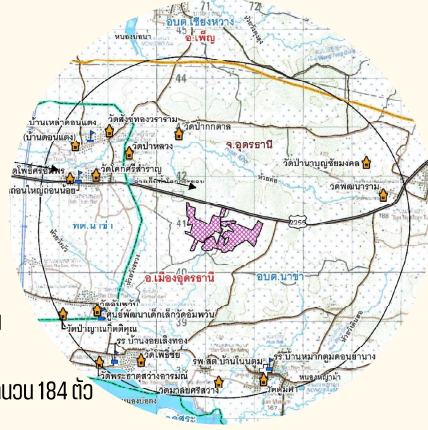
- ๑ การพัฒนาโครงการพลังงานแสงอาทิตย์เป็นการใช้ทรัพยากรธรรมชาติที่มีอยู่เป็นวัตถุดิบพลังงานจึงส่งผลกระทบต่อชุมชนรอบพื้นที่โครงการค่อนข้างต่ำ
- ๒ เงินกองทุนพัฒนาไฟฟ้า ตามระเบียบสำนักงานคณะกรรมการกำกับกิจการพลังงาน
- ๓ การสนับสนุนงบประมาณในการพัฒนาชุมชน
- ๔ เพิ่มสัดส่วนกำลังผลิตไฟฟ้าจากพลังงานหมุนเวียนภายในประเทศ และช่วยลดการผลิตไฟฟ้าจากเชื้อเพลิงฟอสซิลที่เป็นต้นเหตุของการปล่อยก๊าซเรือนกระจก ตามนโยบายภาครัฐ
- ๕ การจ้างแรงงาน
- ๖ ภาษีโรงเรือนและที่ดิน และภาษีป้าย



### 4 รายละเอียดโครงการ

**เจ้าของโครงการ :** บริษัท พลังงานรุ่งเรือง จำกัด  
**พื้นที่ตั้งโครงการ :** ต.มาข่า อ.เมืองอุดรธานี จ.อุดรธานี  
**ขนาดพื้นที่โครงการ :** 455 ไร่ 2 งาน 73.8 ตารางวา  
**ประเภทโครงการ :** ผลิตไฟฟ้าจากพลังงานแสงอาทิตย์แบบติดตั้งบนพื้นดิน (เป็นโรงไฟฟ้าประเภทไม่เผาไหม้เชื้อเพลิง)  
**กำลังการผลิตติดตั้ง :** 55,200 MWac (77,281 MWp)  
**พลังงานไฟฟ้าที่ผลิตได้ต่อปี :** 126,428 จิกะวัตต์-ชั่วโมงต่อปี  
**เครื่องจักรหลักที่มีการติดตั้ง :**

- **แผงเซลล์แสงอาทิตย์ :** ขนาด 605 วัตต์ต่อแผง หรือเทียบเท่า ประมาณ 127,738 แผง
- **เครื่องแปลงกระแสไฟฟ้า :** ขนาด 300 กิโลวัตต์ต่อตัว หรือเทียบเท่า จำนวน 184 ตัว
- **หม้อแปลงไฟฟ้า :** ขนาด 60 เมกะโวลต์แอมแปร์ จำนวน 1 ตัว



### 5 กระบวนการผลิตกระแสไฟฟ้า :

เริ่มจากแสงอาทิตย์ซึ่งเป็นคลื่นแม่เหล็กไฟฟ้ามากระทบที่แผงเซลล์แสงอาทิตย์ที่มีสารกึ่งตัวนำ จะเกิดอนุภาคที่มีประจุไฟฟ้าบวกและลบ เคลื่อนที่ไปในทิศทางที่ตรงข้ามกัน ทำให้เกิดไฟฟ้ากระแสตรงขึ้น และส่งเข้าอุปกรณ์ที่เรียกว่า “เครื่องแปลงกระแสไฟฟ้า (Inverter)” เมื่อแปลงไฟฟ้ากระแสตรงให้เป็นไฟฟ้ากระแสสลับ แล้วส่งเข้าสู่หม้อแปลงไฟฟ้าเมื่อแปลงเป็นไฟฟ้าแรงดันสูง ก่อนจ่ายไฟฟ้าเข้าสู่ระบบสายส่งเพื่อจำหน่ายให้แก่การไฟฟ้าฝ่ายผลิตต่อไป

ทั้งนี้ โครงการจะจ่ายไฟฟ้าให้การไฟฟ้าส่วนภูมิภาค (กฟภ.) ผ่านสายส่งจากสถานีไฟฟ้าย่อย (Sub-station) ของโรงไฟฟ้า พลังงานรุ่งเรือง ไปทำการเชื่อมต่อสายส่งระหว่างสถานีไฟฟ้าแรงสูงอุดรธานี 1 ของ กฟภ. และสถานีไฟฟ้าบ้านผือ ของ กฟภ. แผนดำเนินการก่อสร้างวางแนวสายส่ง ระหว่างวันที่ 1 มกราคม -31 ตุลาคม 2567 โดยจะอ้างอิงตามแนวสายส่งปัจจุบัน และอยู่ในเขตทางเดิม (Right-of-Way)

### 6 พื้นที่ศึกษา :

รัศมี 3 กิโลเมตร จากขอบเขตพื้นที่โครงการครอบคลุมพื้นที่บางส่วนของ อบต. มาข่า ต. มาข่า อ.เมืองอุดรธานี และ อบต. เชียงหวาง อ.เพ็ญ จ.อุดรธานี

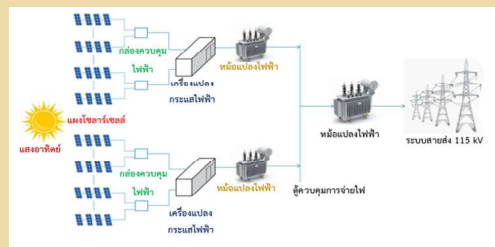
อำเภอ	อบต./ก.ต.	หมู่บ้าน
เมืองอุดรธานี	อบต. มาข่า	หมู่ที่ 2, 4, 5, 6, 7, 9, 10, 13, 14 และ 16
	ก.ต. มาข่า	หมู่ที่ 3 และ 8
เพ็ญ	อบต. เชียงหวาง	หมู่ที่ 3 และ 16

### 7 การคัดเลือกพื้นที่ และเทคโนโลยี

**พื้นที่ :** กำหนดให้พื้นที่โครงการต้องไม่ขัดต่อกฎหมายใดๆ เกี่ยวกับเรื่องทำเลที่ตั้งที่มีผลบังคับใช้ในปัจจุบัน

- ไม่ขัดกฎหมายผังเมือง
- ไม่ขัดกฎหมายส่งเสริมและรักษาคุณภาพสิ่งแวดล้อมแห่งชาติ
- ไม่ขัดกฎหมายโบราณสถานและโบราณวัตถุ
- ไม่ขัดต่อมติคณะรัฐมนตรี

**โครงการตั้งอยู่ที่ ต.มาข่า อ.เมืองอุดรธานี จ.อุดรธานี ไม่ขัดต่อกฎหมายใดๆ ที่มีผลบังคับใช้ในปัจจุบัน**



### 7 การคัดเลือกพื้นที่ และเทคโนโลยี (ต่อ)

**เทคโนโลยี :** เลือกใช้แผงซิลิคอน ชนิดโมโนคริสตัลไลน์ เนื่องจากเป็นเทคโนโลยีที่มีประสิทธิภาพการผลิตไฟฟ้าได้ดีที่สุด

แผงซิลิคอนชนิดโมโนคริสตัลไลน์	แผงซิลิคอนชนิดโพลีคริสตัลไลน์	แผงชนิดอะมอร์ฟัส
<ul style="list-style-type: none"> <li>- ผลิตไฟฟ้าได้ดีที่สุด</li> <li>- ใช้พื้นที่น้อย</li> <li>- ใช้ชน &gt;25 ปี</li> <li>- ผลิตไฟฟ้าในอากาศร้อนได้ดีกว่าเมื่อเทียบกับเทคโนโลยีอื่น</li> </ul>	<ul style="list-style-type: none"> <li>- ผลิตไฟฟ้าน้อยกว่าโพลีคริสตัลไลน์</li> <li>- ราคาถูกกว่าโพลีคริสตัลไลน์</li> <li>- ใช้ชน &gt;25 ปี</li> </ul>	<ul style="list-style-type: none"> <li>- อุ่นหภูมิและเบา</li> <li>- มีผลต่อการผลิตไฟฟ้าได้น้อย</li> </ul>

### 8 ผลกระทบด้านสิ่งแวดล้อมและการจัดการ

	ปัจจัย	กิจกรรมที่ก่อให้เกิดผลกระทบ	การจัดการ
ระยะก่อสร้าง	<b>คุณภาพอากาศ</b>	การปรับพื้นที่	จัดระบบน้ำในบริเวณพื้นที่ที่มีการเปิดหน้าดิน
	<b>เสียง</b>	การปรับพื้นที่ การก่อสร้างโครงสร้างหรืออาคาร	ดำเนินการเฉพาะในช่วงเวลากลางวัน ยกเว้นกิจกรรมที่ต้องดำเนินการต่อเนื่อง ต้องแจ้งให้ผู้อยู่อาศัยก่อนดำเนินการอย่างน้อย 7 วัน
	<b>การใช้น้ำ/น้ำทิ้ง</b>	การก่อสร้าง การอุปโภคและบริโภคของพนักงาน	ติดตั้งระบบบำบัดน้ำเสียสำหรับจากห้องน้ำห้องส้วม จัดทำธารระบายน้ำชั่วคราวและปิดกั้นถนน และตรวจสอบประสิทธิภาพการระบายน้ำชั่วคราวเป็นประจำ
	<b>คมนาคมขนส่ง</b>	การขนส่งอุปกรณ์ก่อสร้างเครื่องจักร / อุปกรณ์ การรับส่งคนงาน	จัดให้มีป้ายหรือสัญญาณเตือนที่เห็นได้ชัดเจนทั้งเวลากลางวันและกลางคืนก่อนถึงพื้นที่ก่อสร้างอย่างน้อย 100 เมตร
	<b>มูลฝอยและกากของเสีย</b>	การก่อสร้าง การอุปโภคและบริโภคของพนักงาน	จัดเตรียมวัสดุอุปกรณ์รองรับขยะไว้ตามบริเวณพื้นที่ปฏิบัติงานให้พอเพียงและประสานกับหน่วยงานท้องถิ่นเมื่อดำเนินการกำจัดขยะ
ระยะดำเนินการ	<b>การใช้น้ำ/น้ำทิ้ง</b>	การอุปโภคและบริโภคของพนักงาน การล้างแผงเซลล์แสงอาทิตย์	บำรุงรักษาระบบบำบัดน้ำเสียให้มีประสิทธิภาพในการบำบัด ให้เป็นไปตามเกณฑ์มาตรฐานก่อนระบายออกนอกพื้นที่โครงการหรือนำมาใช้ประโยชน์ภายในพื้นที่โครงการ
	<b>มูลฝอยและกากของเสีย</b>	การอุปโภคและบริโภคของพนักงาน อุปกรณ์ในการผลิตไฟฟ้าแผงเซลล์แสงอาทิตย์ที่ชำรุด	จัดเตรียมวัสดุอุปกรณ์รองรับขยะไว้ตามบริเวณพื้นที่ปฏิบัติงานให้พอเพียงและประสานกับหน่วยงานท้องถิ่นเมื่อดำเนินการกำจัดขยะ

### 9 การศึกษาสภาพแวดล้อมปัจจุบัน

ศึกษารัศมี 3 กม. จากขอบเขตพื้นที่โครงการ โดยดำเนินการตรวจวัดภาคสนาม ดังนี้

- **คุณภาพอากาศ** ตรวจวัด 5 วันต่อเนื่อง จำนวน 2 สถานี ได้แก่ (A1) วัดป่าบุญญชัยมงคล และ (A2) วัดโคกศรีสำราญ
- **เสียง 2 สถานี** ตรวจวัด 5 วันต่อเนื่อง จำนวน 2 สถานี ได้แก่ (N1) บ้านพักอาศัยด้านทิศใต้ และ (N2) บ้านพักอาศัยด้านทิศตะวันออก
- **คุณภาพน้ำผิวดิน และนิเวศวิทยาทางน้ำ 3 สถานี** ได้แก่ (SW1) ทางน้ำสาธารณะด้านทิศใต้ของพื้นที่โครงการ (SW2) ทางน้ำสาธารณะด้านทิศใต้ของพื้นที่โครงการ ที่ระยะห่าง 1 กิโลเมตร และ (SW3) ทางน้ำสาธารณะด้านทิศใต้ของพื้นที่โครงการ ที่ระยะห่าง 2 กิโลเมตร

