Thuan Binh Wind Power JSC

Environmental and Social Impact Assessment – Volume 3

Loi Hai 2 Wind Power Project, Ninh Thuan province, Vietnam

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CONTENTS

List of Tables

List of Figures

Acronyms and Abbreviations

Name	Description

10. ENVIRONMENTAL IMPACT ASSESSMENT

10.1 Air Quality Impact Assessment

10.1.1 Scope of Assessment

During the project development, construction stage will likely generating more recognizable impacts on ambient air quality in comparison to those that will be generated during e to operation activities. Key sources of air pollution in construction phase include dust suspension from earthworks, construction activities as well as fugitive dust and exhaust from machinery / vehicles. In operation phase, the impact on air quality is mainly from transportation activities which will be really low. Therefore, the scope for this air quality impact assessment is limited to only to the activities during the construction phase.

During the construction phase, key generators of the impacts include demolition, earthworks, and construction and transportation activities[1]. Potential impacts are identified in Table 10.1 below.

Table 10.1 Potential Air Quality Impact in Construction Phase.

Activity	Description	Potential impacts
Demolition	Based on results of the noise impact assessment (see Section 10.3), there are 38 households within the safety zone (300 m from the turbine foundations) which are recommended to be relocated and these to be demolished. These are small-sized, simple-structured houses which are used as temporary place for people to reside while attending to their shrimp ponds. In such case, the demolition will contribute to the overall impacts on the ambient air quality and human health.	Increased dust (e.g. TSP, PM_{10}, $PM_{2.5}$) and exhaust emissions (e.g. SO_x, CO, NO_x). Degraded ambient air quality and affect human health when concentration of these compounds exceeds the allowable limits.
Earthworks	Site clearance and excavation works linked to the area to be occupied by turbines and T-line (total length of 0.55 km).	
Construction	Construction of seven turbine foundations, the 22/110kV substation, the 110kV transmission line (289 m), and the 22 kV upper air transmission line (length of 6.38 km), etc. Construction of 6 km internal roads.	
Track out	Suspension of dust along the transportation routes to be used, especially the internal roads between the turbines locations which were unpaved at the time of this assessment.	Increased level of dust along the transport routes, and subsequently degradation of the air quality and health effects due to increased exposure to PM_{10}.

10.1.2 Impact Assessment

10.1.2.1 Potential Impacts

The impacts to be assessed in this section include:

[1] Institute of Air Quality Management (IAQM), Guidance on the assessment of dust from demolition and construction (2014). [Online] Available at: http://iaqm.co.uk/wp-content/uploads/guidance/iaqm_guidance_report_draft1.4.pdf.

- Impact due to dust generation from house demolition, earthworks and construction activities mainly linked to the establishment of turbines and T-line;
- Impact due to exhaust emissions from house demolition, earthwork and construction activities; and
- Impact from transportation in external and internal routes.

10.1.2.2 Potential Consequences

Air emissions during construction phase of the Project have the potential to directly affect the ambient air quality by:

- Increased dust (e.g. TSP, PM_{10}, $PM_{2.5}$) and exhaust emissions (e.g. SO_x, CO, NO_x).
- Degraded ambient air quality when concentration of these compounds exceeds the permissible limits.
- Increased dust levels along the transport routes, and subsequently degradation of the air quality close to these.

In turn, such emission can adversely affect sensitive receptors (human health, vegetation and crops) if not managed accordingly. The potential effects and consequences of these emissions include:

- Annoyance and nuisance to the general public as a result of dust deposition on properties, crops, dwellings, cultural heritage sites and places of business;
- Increased morbidity due to exposure to NO_2, PM_{10} and $PM_{2.5}$ concentrations; and
- Plant dieback due to reduced photosynthesis.

10.1.2.3 Existing Controls

The EIA report has proposed a set of mitigation measures and a management plan to handle the impacts on air quality from construction activities, which include the following:

- Prohibiting the use of vehicles that do not meet the registration standards;
- Conducting regular maintenance of vehicles and machinery;
- Using suitable fuels for each vehicle and machinery;
- Prohibiting overloaded operation of vehicles and machinery;
- Avoiding transportation during rush hours to reduce exhaust emissions due to transportation;
- Supervising closely the construction activities, watering twice a day areas with high potentials of dust suspension, especially during dry weathers; and
- Covering material stockpiles.

10.1.2.4 Significance of Impact

The significance of each of the above impacts is assessed on the basis of impact magnitude and sensitivity of the human receptors as follows:

Impact due to dust generation from house demolition, earthworks and construction activities: upon recommendation of the noise impact assessment (section 10.3), 38 temporary houses might have to be demolished and relocated. These houses are scattered around the safety zone with low density (less than 4 houses at one place). The total volume of demolition to be performed is therefore, considered minor. Meanwhile, earthwork and construction activities will occur mainly at the site preparation and construction foundations, internal roads, poles of the T-line. These areas are scattered around the project area with great distance (> 300 m) between each other and can be considered as individual sources. Earthwork and construction volume for each location is rather small (< 20,000 tons [1]) and the impact scale is localized. The construction period will be performed in a medium-term (12

months) and intensity is classified as low. On the other hand, the human receptors are located outside of the safety zone and far from the main construction areas. The overall significance of the impact is therefore classified as **Negligible**.

Table 10.2 Impact Due to Dust Generation from House Demolition, Earthworks and Construction Activities.

Impact Description	Impact level			
Impact Nature	Positive		**Negative**	
Impact Type	**Direct**		Indirect	
Impact Duration	Short-term	**Medium-term**	Long-term	Permanent
Impact Extent	**Local**	Regional	Global	
Impact Frequency	One-off	Rarely	Sometimes	**Often**
Impact Magnitude	Negligible	**Small**	Medium	Large
Sensitivity/Vulnerability	**Low**	Medium	High	
Significance	**Negligible**	Minor	Moderate	Major

Impact due to exhaust emissions from house demolition, earthwork and construction activities: due to the scattering nature of the construction layout, only a small number of construction vehicles / machinery will be gathering at one location at any point in time. Consequently, the exhaust emission from house demolition, earthworks and construction activities are likely generated at small scale over a medium-term period during the construction phase, and localized at different construction areas. Moreover, according to the IAQM guidance "*Experience of assessing the exhaust emissions from on-site plant (also known as non-road mobile machinery or NRMM) and site traffic suggests that they are unlikely to make a significant impact on local air quality, and in the vast majority of cases they will not need to be quantitatively assessed*." Overall, the impact is considered **Minor** following the assessment of magnitude duration, scale, intensity, etc. and receptor sensitivity to the impact (Table 10.3).

Table 10.3 Impact Due to Exhaust Emissions from House Demolition, Earthwork and Construction Activities.

Impact Description	Impact level			
Impact Nature	Positive		**Negative**	
Impact Type	**Direct**		Indirect	
Impact Duration	Short-term	**Medium-term**	Long-term	Permanent
Impact Extent	**Local**	Regional	Global	
Impact Frequency	One-off	Rarely	Sometimes	**Often**
Impact Magnitude	Negligible	**Small**	Medium	Large
Sensitivity/Vulnerability	**Low**	Medium	High	
Significance	**Negligible**	Minor	Moderate	Major

Impact from transportation: according to the EIA report, the Project will need approximately 3270 movements of 10-tonne truck to transport all the required materials and equipment for the construction, equivalent to 9 truck movement per day. The construction peak will last approximately 3 months, where the transportation can be considered most intensive. It is estimated that during the construction peak, the number of truck movement will triple the average movement required for the entire construction period (i.e. 27 truck movements per day), which is considered small in terms of impact magnitude. Moreover, the transport of materials will go around the existing residential areas avoiding crossing

these. Therefore, the impact magnitude on human receptors can expect to be generally small with localized scale and short-term duration (3 peak construction months). Outside the peak time, the transport intensity is expected to be much lower. Overall, the transportation during construction phase is likely to generate impacts of **Minor** significance (Table 10.4).

Table 10.4 Impact from Transportation in Construction Phase.

Impact Description	Impact level			
Impact Nature	Positive		**Negative**	
Impact Type	**Direct**		Indirect	
Impact Duration	**Short-term**	Medium-term	Long-term	Permanent
Impact Extent	**Local**	Regional	Global	
Impact Frequency	One-off	Rarely	Sometimes	**Often**
Impact Magnitude	Negligible	**Small**	Medium	Large
Sensitivity/Vulnerability	Low	**Medium**	High	
Significance	Negligible	**Minor**	Moderate	Major

10.1.2.5 Additional Mitigation Measures

Although these impacts are considered of minor significance, the following additional mitigation measures are recommended as good practice based on ESIA requirements:

- Imposing speed limit to trucks and other vehicles wherein the vehicles must not exceed 10 km/h within the project boundary;
- Arranging wheel washing facilities at site exit where heavy trucks are washed before leaving the site;
- Planning traffic routes inside project boundary to minimize the movement of vehicles over the areas of construction, stockpiles and other exposed soils by applying the traffic control management plan;
- Covering trucks during the transportation of construction materials; and
- Prohibiting open burning. If required, cleared vegetation should be transferred to a licensed waste contractor for composting, reusing or treatment in compliance with current regulations in force.

10.1.2.6 Residual Impacts

Upon proper implementation of the above mitigation measures, the residual impacts are expected to be negligible.

10.1.2.7 Monitoring and Reporting

- Monitoring ambient air quality every two months during the construction phase. The monitored parameters include NO_2, SO_2, CO, TSP, PM_{10}, $PM_{2.5}$;
- Regular inspections to monitor dust suspension; record inspection results and make an inspection log available to the local authority when asked. Increase inspection frequency during period of heavy activities occur and during prolonged dry or windy conditions;
- Keeping records of vehicle maintenance and dust control activities on site to show local authorities upon requests in case of complain or grievance.

10.2 Water Quality Impact Assessment

10.2.1 Scope of Assessment

This section discussed the potential impacts of the Project's construction activities to the water resources (surface water and groundwater). The Project will use piped water supplied by the Loi Hai water company fully for domestic use of construction workers and partially for construction activity together with freshwater extracted from the Ba Rau reservoir. Key potential impacts on local water resources likely come from:

- Discharge of domestic and construction wastewater;
- Runoff water over excavated surface and construction area;

Activities during the operation phase is likely to have insignificant impacts on water quantity and quality. Therefore, the scope for impact assessment on water resources is limited to activities in the construction phase for this ESIA.

10.2.2 Impact Assessment

10.2.2.1 Potential Impacts

The impacts to be assessed in this section include:

- Impact on surface water and groundwater quality from wastewater discharge;
- Impact on surface water and groundwater quality from rainwater runoff.

10.2.2.2 Potential Consequences

Construction and domestic wastewater discharges, if not well managed, can flow to nearby water bodies such as irrigation open canals, streams and ponds (Song Trau and Ba Rau irrigation ponds) and affect the water quality. Rainwater runoff can wash over construction areas and take loose materials and waste to the nearby streams and ponds. Soluble pollutants can be washed away by the runoff to infiltrate ground surface and possibly affecting groundwater quality. Overall, the potential consequences are as follows:

- Increased contaminants such as heavy metals, oil and grease, etc. into groundwater and surrounding surface water bodies;
- Increased turbidity in streams and ponds due to suspended sediment washed into these:
- Decreased dissolved oxygen and affected aquatic ecology of surface bodies of water close to the site of interest;

10.2.2.3 Existing Controls

The EIA report has proposed a set of mitigation measures and water management plan to handle the impacts on water resources from the construction activities which includes:

- Designing and constructing open trenches at turbine areas and substation to collect rainwater runoff;
- Assigning personnel to regularly inspect the drainage system;
- Conducting regular dredging of the trenches;
- Clearing construction areas frequently to remove residual materials and wastes;
- Covering construction materials carefully to avoid being washed by rainwater runoff;
- Arranging a sedimentation tank to collect sediment from construction wastewater;

- Arranging sufficient portable toilets around the construction area to collect domestic wastewater from workers' activity;
- The collected domestic wastewater will be treated in 3-compartment septic tanks using anaerobic technology.

10.2.2.4 Significance of Impact

The significance of each of the above impact is assessed as follows:

- **Impact on surface water and groundwater quality from rainwater runoff**: Earthwork and construction activities can release loose earth, materials and hazardous substances (fuel, oil, etc.) on natural surfaces. In rainy days, the solid materials can be carried by runoffs to nearby irrigation open canals and streams whereas the soluble substances could possibly infiltrate to groundwater sources. As a result, the surface water and groundwater quality will be affected by suspended solid (hence increased turbidity) and chemical pollutants. Nevertheless, if the above existing controls are implemented properly, the amount of contaminated runoff is likely insignificant. Therefore, the impact intensity is likely minor, the scale localized and the overall impact significance **Minor** (Table 10.5).

Table 10.5 Impact on Surface Water and Groundwater Quality from Rainwater Runoff.

Impact Description	Impact level			
Impact Nature	Positive		**Negative**	
Impact Type	**Direct**		Indirect	
Impact Duration	Short-term	**Medium-term**	Long-term	Permanent
Impact Extent	**Local**	Regional	Global	
Impact Frequency	One-off	Rarely	Sometimes	**Often**
Impact Magnitude	Negligible	**Small**	Medium	Large
Sensitivity/Vulnerability	Low	**Medium**	High	
Significance	Negligible	**Minor**	Moderate	Major

- **Impact on surface water and groundwater quality from wastewater discharge**: the wastewater to be discharged during the construction phase mainly comprises of domestic wastewater (from workers' accommodations and canteen) and a small portion of construction wastewater. Given the small number of construction workers (water usage at about 4 m^3/d, according to the EIA) and the installation of portable toilets and 3-compartment septic tanks on site, the release of domestic wastewater is considered negligible. Construction wastewater discharge is also negligible due to its small volume (estimated in the EIA report about 2.5 m^3/d over the entire construction areas) and scattering nature. The impact from wastewater discharge is, thus, localized during a medium-term period (12 months of the construction phase). As key receptor of this impact is local vegetation which is considered low in sensitivity, the overall significance is considered **Negligible** (Table 10.6).

Table 10.6 Impact on Surface Water and Groundwater Quality from Wastewater Discharge.

Impact Description	Impact level			
Impact Nature	Positive		**Negative**	
Impact Type	**Direct**		Indirect	
Impact Duration	Short-term	**Medium-term**	Long-term	Permanent
Impact Extent	**Local**	Regional	Global	
Impact Frequency	One-off	Rarely	Sometimes	**Often**
Impact Magnitude	Negligible	**Small**	Medium	Large
Sensitivity/Vulnerability	**Low**	Medium	High	
Significance	**Negligible**	Minor	Moderate	Major

10.2.2.5 Additional Mitigation Measures

Although the impacts are considered of negligible to minor significance, the following additional mitigation measures are recommended as good practice based on ESIA requirements:

- Inspecting the site regularly to detect and resolve blockages in drainage system;
- Collecting and storing solid waste properly in containers and removing waste from the construction site daily;
- Collecting hazardous waste in closed containers and proofed area to avoid exposing to rainy weather;
- Managing and storing correctly hazardous substances in the construction areas;
- Checking vehicles and equipment regularly for oil leakage;
- Avoiding maintenance service of vehicles and machinery on-site, or if unavoidable, conducting the service in an roofed area and with the use of trails for spills;
- Establishing internal rules and activities for environmental protection, including littering and disposal of wastes;
- Prohibiting discharging of waste and wastewater directly into freshwater bodies; and
- Ensuring managing correctly and in accordance with applicable regulations wastewater discharges generated at canteen and worker's accommodations.

10.2.2.6 Residual Impacts

Upon proper implementation of all the aforementioned mitigation measures, the residual impacts are expected to be Negligible.

10.2.2.7 Monitoring and Reporting

The local EIA recommended the following monitoring program for the construction phase:

- For domestic wastewater: sample will be taken at 01 location at downstream of the temporary septic tanks. Details of the proposed monitoring program are as follows:
  - Monitoring parameters: pH, TSS, BOD5, H_2S, NH_4^+, NO_3^-, PO_4^3, and Coliform.
  - Monitoring frequency: every 3 months during the construction phase;
  - Monitoring results: to be compared with the QCVN 14:2008/BTNMT – National Technical Regulation on Domestic Wastewater for compliance.

- Monitoring records: to be kept onsite for authority's inspection upon request.

- For surface water quality: sample will be taken at 01 location at downstream of the temporary septic tanks. Details of the proposed monitoring program are as follows:

  - Monitoring parameters: pH, TSS, TDS, BOD5, COD, DO, H_2S, oil and grease, F^-, Cl^-, NH_4^+, NO_2^-, NO_3^-, PO_4^{3-}, CN^-, As, Cd, Pb, Zn, Cu, Total Surfactants, Total Phenol, Coliform.

  - Monitoring frequency: every 6 months during the construction phase;

  - Monitoring results: to be compared with the QCVN 08-MT:2015/BTNMT – National Technical Regulation on Surface Water Quality for compliance.

  - Monitoring records: to be kept onsite for authority's inspection upon request.

No additional specific monitoring or auditing is recommended.

10.3 Noise Impact Assessment

10.3.1 Summary of Scope of Assessment

Activities of the Project that are likely to cause elevated noise and vibration include:

During the construction phase:

- Land preparation and civil works such as land clearance, demolition, earthworks;
- Construction of substation, transmission line and laydown area;
- Operation of associated facilities such as the batching plant; and
- Transportation of equipment, workers and materials.

During the operation phase:

Activities of the Project that are likely to cause elevated noise during the operational phase are the WTGs and substation.

10.3.2 Relevant Guidelines and Criteria

10.3.2.1 Vietnamese Regulations

- QCVN 26:2010/BNTMT: National Technical Regulation on Noise; and
- QCVN 27:2010/BTNMT: National Technical Regulation on Vibration.

10.3.2.2 International Guidelines

- International Organization for Standardization (ISO) 9613-2:1996 (ISO 9613:2) - *Acoustics - Attenuation of Sound during Propagation Outdoors - Part 2: General Method of Calculation*;
- IFC Performance Standard 3: Resource Efficiency and Pollution Prevention requires the Project to consider ambient conditions and apply technically and financially feasible resource efficiency and pollution prevention principles and techniques that are best suited to avoid, or where avoidance is not possible, minimize adverse impacts on human health and the environment;
- IFC General EHS Guidelines (Section 1.7, 2007): Noise provides recommended ambient noise level and control measures;
- IFC Environmental Health and Safety Guidelines for Wind Energy (2015) provides EHS guidelines for onshore and offshore wind energy facilities. It covers environmental impacts and provides associated recommendations for mitigation measures in the areas of noise and visual impact, biodiversity, water quality, shadow flicker, etc.; and
- ETSU, Report ETSU-R-97, the Assessment and Rating of Noise from Wind Farms (1997).

Table 10.7 Scope of Noise Impact Assessment

Phases	Potential Activities	Potential Impacts	Potential Consequences	Receptor
Construction of wind farm, substation and transmission line	Land preparation and civil works such as land clearance, demolition, earthworks	■ Short-term increase in noise levels	■ Some studies suggested that long-term exposure to noise level exceeding 70 dB ($L_{Aeq, 24h}$) can cause hearing loss. Even chronic low levels of noise can cause disturbances of activity, sleep, and communication, which can trigger a number of emotional responses, including annoyance and subsequent stress ■ High levels of environmental noise lead to mental health symptoms (e.g., depression and anxiety) and the degree of noise annoyance may be directly associated with future development of depression and anxiety disorders as shown by community-based studies. ■ Numerous studies demonstrate that noise plays a role for the development of cardiovascular as well as metabolic disease and changes in immune system and birth effects.	■ Nearby residents ■ Construction workers
	Construction of substation, transmission line and laydown area			
	Operation of associated facilities such as the batching plant			
	Transportation of equipment, workers and materials			
Operation of wind farm and substation	The WTGs and the substation will be sources of noise during the operation of the Project	■ Long-term increase in noise levels		

10.3.3 Assessment of Impacts

10.3.3.1 Construction Phase

10.3.3.1.1 Potential Impact

The following sources of impact were identified:

- Site preparation and building construction works associated with any permanent facilities;
- Construction and installation of the internal electrical network (between turbines) and any associated transmission lines;
- Construction works associated with internal access roads; and
- Movement of Project vehicles to transport WTG parts, construction materials and waste.

The construction activities will involve the operation and movement of many noisy equipment, machines and vehicles such as rollers, bulldozers, excavators, cranes, generators, concrete mixer and dump trucks. Actual measured sound pressure levels generated by typical construction equipment are shown below:

Table 10.8 Noise Levels for Typical Equipment Used during Construction Phase

Equipment	Actual Measured Lmax at 15m (dBA, slow) (Samples Averaged)
Compactor (ground)	83
Air compressor	78
Concrete Mixer Truck	**79**
Concrete Pump Truck	**81**
Crane	**81**
Dozer	**82**
Dump truck	**76**
Excavator	**81**
Generator	**81**
Generator (<25KVA)	**73**
Jackhammer	89
Pumps	81
Roller	**80**

Source: US Federal Highway Administration 2017[2]. Equipment written in bold are the types which will be used for the construction of the wind farm, according to the EIA.

[2] Construction Noise Handbook. Section 9.1: Equipment Type Inventory and Related Emission Level. Available at: https://www.fhwa.dot.gov/environment/noise/construction_noise/handbook/handbook09.cfm. Accessed on 3 February 2021.

Most of residents of Loi Hai commune live in Ba Rau 1, Ba Rau 2, An Dat village (about 1.7 km to the South from nearest WTG), and Suoi Da village (about 1.0 km to the West from nearest WTG) (see Figure 10.2), the construction noise will likely be not a significant issue for residents living there. However, there are 38 barn houses scattered within 300 m from the turbine towers. As a conservative approach, if some equipment are placed near each other and operated concurrently, due to the combined noise effects, the maximum noise level (Lmax) at the distance of 15 m from the construction site would be around 85 dBA.

The inverse square law equation will be used to estimate the noise level at certain distances from the construction site:

$$Lp_2 = \mathrm{Lp}_1 - 20\log\frac{r_2}{r_1} - Ae_{1,2}$$

Where L_{p1} is the sound pressure level estimated at 15 m from the combined sources, $A_{e1,2}$ is attenuation along path r_2 - r_1 between location 1 and 2, and represents factors affecting sound propagation. Such factors include atmospheric absorption, ground attenuation, wind or temperature gradient, trees, barriers or buildings.

While the effects of atmospheric absorption, ground attenuation, wind and temperature gradient are difficult to calculate, thus, excluded in this assessment, it is confirmed by the scoping survey that the construction sites are surrounded by cropland with seasonal crops and scrub (Figure 10.1).

A review by Huddart (1990) shows that in some instances noise can be reduced by 6 dB over a distance of 30 m where vegetation is particularly dense. Leonard and Parr (1970) and Reetholf (1973) found that a dense belt of trees and shrubs between 15 and 30 m wide could reduce sound levels by as much as 6 – 10 dB. Cook and Van Haverbeke (1972) also found reductions in noise level of 5 to 10 dB for belts of trees between 15 – 30 m wide.

While there are no similar research for cropland, the effect of sound attenuation through cropland is considered limited and estimated to be 5 dBA for each 100 m.

Figure 10.1 Landscape of Loi Hai 2 Wind Farm Project Area

Apply the equation above, the Lmax caused by construction equipment would be around 45 dBA at at distance of 300 m, 50 dBA at 200 m and 55 dBA at 100 m. It is noted that these values are Lmax based on a conservative approach. The average noise level Leq could be considerably lower.

10.3.3.1.2 Existing Controls

The following control measures are described in the regulatory EIA:

- Provide proper PPEs to workers who are exposed directly to the sources of loud noise;

- Avoid the operate of many noise equipment at the same time to minimize the combined effects of noise;
- Maintain equipment regularly, periodically lubricate the parts which are likely cause the high noise;
- Develop appropriate work plan which working hours are defined from 06:00 to 22:00, divided into 2 shifts to minimize the operation of too many construction equipment at the same time; and
- Noisy equipment such as graders, excavators and bulldozers are not allowed to operate during the night time (after 22:00) to avoid the disturbance to workers and people living nearby the construction sites;
- Generators will be chosen from reputable manufacturers, and will be maintained regularly to minimize the noise. Generators will also be placed in closed warehouses protected with roofs and walls.

On the other hand, a rule imposed by local authorities requires that trucks with loading capacity larger than 10 tons are not allowed to enter the administrative center of Thuan Bac district, which consists a large part of villages Ba Rau 1, Ba Rau 2 and An Dat.

10.3.3.1.3 Significance of Impacts

The impact of elevated noise in Construction phase will be mainly within Project area, and to some extent, to Ba Rau 1, Ba Rau 2, An Dat and Suoi Da village, especially in the houses that are located close to the roads.

Construction of wind farm is planned to last 12 months, therefore the duration of impact is short-term.

The impact magnitude is small because the residential areas are far from construction sites, thus excessive noise from construction activities are not anticipated in these receptors. However, some scattered barn houses located within Project area and houses located along access road to the sites might be affected by construction noise, nevertheless this impact may be small as authorities do not allowed heavy trucks to circulate in main roads within Loi Hai.

The identified receptors are residential and agricultural and they may be more vulnerable at nights due to sleep disturbance impacts, than during the day time when most of the construction works will typically be carried out. According to the baseline noise levels measured at representative receptors, it is well noted that have largely exceeded the IFC standards at night time due to man-made and natural source of noise. The overall vulnerability is therefore medium.

Overall, the significance of impact is minor.

Table 10.9 Impacts on Noise during Construction Phase

Impact	Disturbance and potential health impact from elevated noise during construction phase				
Impact Nature	**Negative**	Positive	Neutral		
Impact Type	**Direct**	Indirect	Induced		
Impact Duration	Temporary	**Short-term**	Long-term	Permanent	
Impact Extent	**Local**	Regional	Global		
Impact Magnitude	Positive	Negligible	**Small**	Medium	Large
Vulnerability of Receptors	Low	**Medium**	High		
Significance	Negligible	**Minor**	Moderate	Major	

10.3.3.1.4 Additional Mitigation Measures

The following additional measures are proposed to further reduce the impacts of noise in construction phase:

- Use of appropriate noise suppression techniques (such as silencer, noise barrier) where applicable;
- Large sources of noise such as concrete mixing plants, mobile equipment, generators, etc., shall be located at appropriate locations within the worksite, as far away from the receptors as possible;
- When necessary, advise local residents when unavoidable out-of-hours work will occur;
- Develop a traffic management plan to avoid the movement of Project's vehicles through densely populated areas where possible;
- Set traffic speed limits. Provide training and verify drivers' behavior with respect to driving speed and safety;
- Limit working hours of workers who are exposed to excessive noise levels in accordance with applicable regulations or international best practices;
- Provide appropriate training to workers for proper operation of vehicles and construction equipment and minimize unnecessary idling; and
- If any validated noise complaints are received, the problem source and any potential noise reducing measures should be identified and evaluated for implementation during the works. If the noise complaint cannot be validated, no further mitigation or management measures are required.

10.3.3.1.5 Residual Impacts

With the implementation of the above mitigation measures, the residual impacts would be expected to be negligible.

10.3.3.1.6 Monitoring and Auditing

- Daily site inspection shall be implemented to verify the compliance with mitigation measures;
- Noise monitoring shall be conducted monthly at 02 locations: one at center of project area; and one at project boundary adjacent to nearest existing or planned residential area or other sensitive areas located in the area of influence;
- Additional noise monitoring locations near the transportation routes shall be defined in traffic management plan.

10.3.3.2 Operation Phase

10.3.3.2.1 Potential Impact

Potential nuisance impacts to humans are associated with impulsive or tonal characteristics of noise emitted from the wind farm. Similar to construction noise impacts, potential consequences to human health due to chronic exposure can vary depending on noise levels, existing human health conditions and age.

The WTGs and substation will be sources of noise during the operation phase of the Project. The WTG specifications and model (Vestas V150-4.2) were provided by the project developer. The worst case sound power levels occur when the WTGs are operating in standard power operation mode at wind speeds between 3 m/s and 22.5 m/s with no noise reduction modes used. The worst case operating mode has been modelled.

The noise emission model used in this study to predict wind farm noise levels at sensitive receptors is based on ISO 9613.1/2 as implemented within the Predictor V12.0 2019 computer noise modelling software. The model predicts noise level through spherical spreading and includes the effect of air absorption (as per ISO 9613), ground attenuation and shielding.

Predicted L_{eq} noise levels were calculated based upon sound power levels determined in accordance with the recognised standard IEC-61400-11:2002 "*Wind Turbine Generator Systems – Part 11: Acoustic Noise Measurement Techniques*", where available, for the wind range of 3 m/s to 22.5 m/s (representative of WTG cut in and cut out wind speeds) where noise specification data for the V150-4.2 turbine was available. Below 3 m/s significant differences in levels and impacts are not anticipated and above 22.5 m/s noise level results are expected to be equal to that modelled for the 22.5 m/s wind speed scenario.

A total of 1101 nearby receptors have been identified to be within the potential area of influence of the Project (2 km buffer from the WTGs), using satellite image and through site survey. A receptor is defined as any building occupied by human, either whole-day or certain times of day, such as houses, barns, schools, medical facilities, offices, hotels, spiritual places etc. For this assessment, they have been grouped into three Noise Catchment Areas (NCA1 to NCA3), depending on their geographic locations.

Noise levels have been predicted and results provided for all receptors but the focus of the noise modelling was addressing issues at the most affected receptors within each NCA. The predicted noise of the Project at these NCAs provides an indication of worst-case impacts and any required mitigation.

The representative receptors for NCA1 to NCA3 are named NSR1 to NSR3 as described in Table 10.10.

Table 10.10 Representative Sensitive Receptors

Receptor ID	UTM WGS84 North Zone 48 (metres)		Comments
	Easting	Northing	
NSR1	941878	1299105	Representative of properties in villages of Ba Rau 1, Ba Rau 2 and An Dat (NCA1)
NSR2	942534	1301278	Representative of 45 properties located at centre of Project area (NCA2)
NSR3	944424	1302678	Representative of properties in Suoi Da village, located near National Highway 1A (NCA3)

The resultant worst-case noise levels for each RNR and comparison to the project-specific noise limits are presented in Table 10.11 below. Overall noise modelling results are shown in Figure 10.2.

Table 10.11 Predicted Operational Noise Levels at Worst Case Receptors (RNR1 – RNR3)

Receptor ID	Predicted noise level (Leq-1hr, dBA)	Compliance
NSR1	33.4	Yes
NSR2	47.3	No
NSR3	37.2	Yes

The worst-case noise impact from the Loi Hai 2 Wind Farm has been predicted for receptors in NCA2, where worst-case operational noise level is predicted to be 47.3 dBA. Receptors in NCA2 have been assessed to be the most affected as they are the closest to the wind turbines within the Project. These are the worst-case emissions and levels vary depending on wind speed. The predicted operational noise levels were below the wind speed-based noise limits.

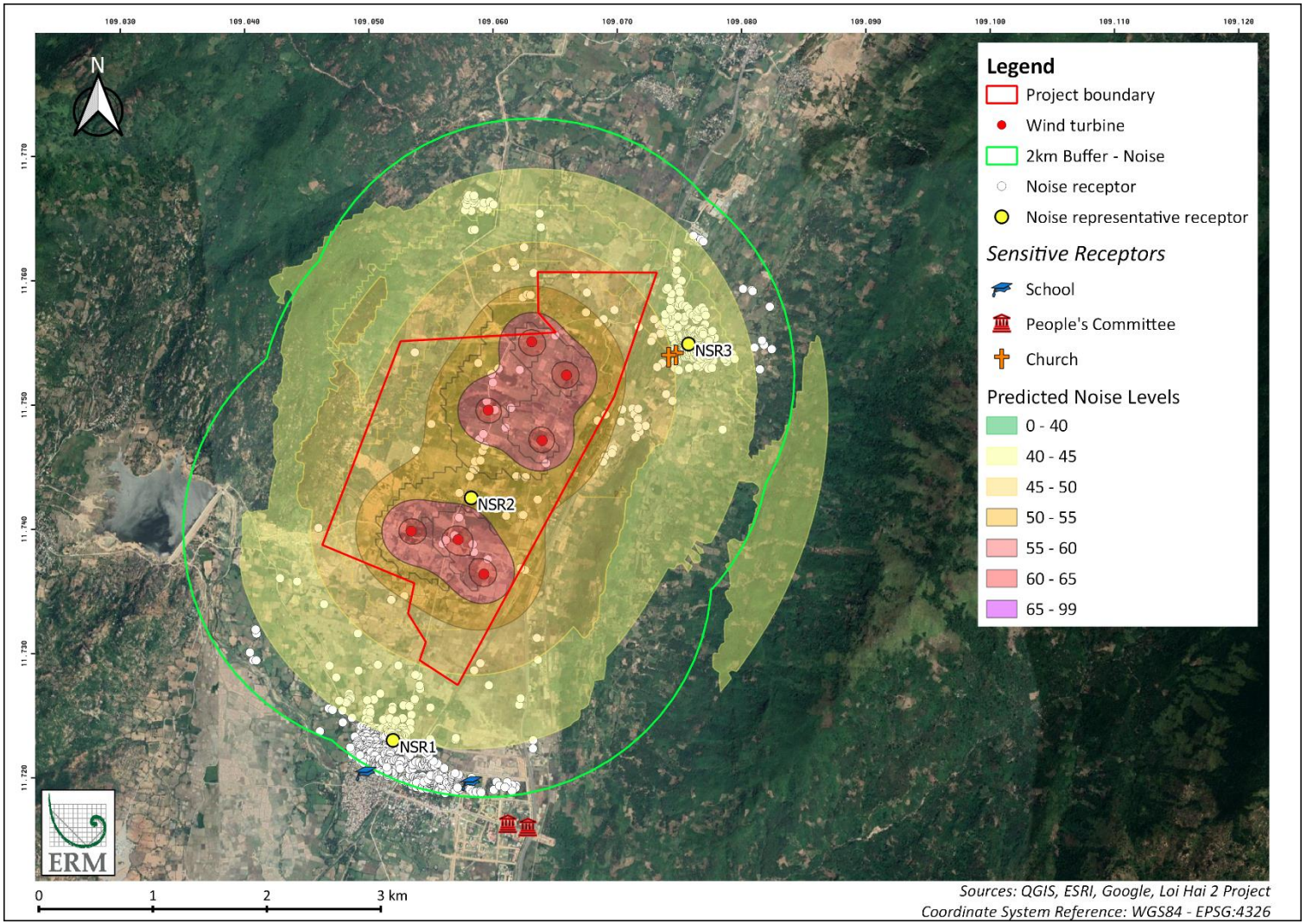


Figure 10.2 Project Locality, Noise Catchment Areas, Representative Receptors and Noise Modelling Results

10.3.3.2.2 Existing Controls

The mitigation measures identified in the locally approved regulatory EIA include:

- The Vestas V150-4.2 WTGs to be installed for the Project are modern, low-noise generating turbines.

10.3.3.2.3 Significance of Impacts

- Disturbance and potential health impacts from elevated noise levels are considered negative.
- The impact duration is long-term during the Project lifetime**;**
- Impacts of noise in operation phase are within the Project area;
- Operational noise levels may occur intermittently or continuously depending on wind conditions and WTG operations;
- The impact magnitude is medium as the predicted noise level generated by the WTGs slightly exceeded the IFC permissible limit at NCA2 for the night time, but below the daytime limit. Predicted noise levels at other densely populated areas (NCA1 and NCA3) are well below the limits.
- While NCA1 and NCA3 are residential areas where people have already been exposed to man-made and natural sources of noise, and the night-time baseline noise levels here are already considerably higher than IFC permissible limits, the NCA2 are scattered barn houses located in agricultural land, where residents tend to be more vulnerable in the night time due to sleep disturbance impacts. The overall vulnerability of receptor is medium;
- The overall Significance of impact is considered moderate.

Table 10.12 Impacts on Noise during Operation Phase

Impact	Disturbance and potential health impact				
Impact Nature	**Negative**	Positive	Neutral		
Impact Type	**Direct**	Indirect	Induced		
Impact Duration	Temporary	Short-term	**Long-term**	Permanent	
Impact Extent	**Local**	Regional	Global		
Impact Magnitude	Positive	Negligible	Small	**Medium**	Large
Vulnerability of Receptors	Low	**Medium**	High		
Significance	Negligible	Minor	**Moderate**	Major	

10.3.3.2.4 Additional Mitigation and Management Measures

The following safeguards are provided:

- **Prior to operation:** if the turbine selection and/or layout are to be changed, noise modelling will have to be run again to verify if noise levels are to increase, and compliance with the noise limits documented in this report would need to be reassessed.
- **During operation:**
  - If the turbines change, and noise levels are anticipated to increase, then compliance with the noise limits documented in this report would need to be reassessed.
  - Routine maintenance of wind turbines should also be conducted, with specific attention to equipment degradation that may cause further noise impacts. Any equipment that is abnormally noisy should be evaluated and repaired as necessary to return emissions to typical operating performance;

10.3.3.2.5 Monitoring and Auditing

It is recommended that if any repeated/validated noise complaints are received then compliance monitoring should be undertaken at the most affected receptors in NCA2 to confirm predicted noise levels. Where noise monitoring occurs the work should be scoped and then conducted by a suitably experienced person. The purpose of the monitoring is to understand in-situ levels and to provide a comparison to predicted levels (from this ESIA) so that any additional controls be identified and then implemented if it is feasible, reasonable and practical to do so. If this is required:

- All Project / site noise levels should be measured in the absence of any influential source not associated with the Project.
- If the measured site noise levels are below the predicted values and comply with the applicable thresholds, limits or criteria identified for each noise aspect, no further noise control is required.
- If the measured site noise levels are above the predicted noise levels or the applicable thresholds, limits or criteria identified for each noise aspect, further noise control or management measures should be considered, and if needed, even considering relocating the households whose owners file the complains and if within these areas noise maximum permissible limits are surpassed, or else, providing compensation packages under agreement with the owners.

In case there are no complaints, the noise levels at sensitive receptors shall be measured once every three months in accordance with Circular 24/2017/TT-BTNMT stipulating environmental monitoring techniques. Monitoring results should be reported in periodic Environmental Monitoring Report submitted to the DONRE.

10.3.3.2.6 Residual Impact

The residual impacts associated with noise from the operation of the Project WTGs and substation are considered minor.

10.4 Visual Impact Assessment

A visual impact assessment is an assessment of the potential impacts of the Project on specific views and on the general visual amenity experienced by people. Landscapes are not static but are dynamic, not least due to the range of natural and human factors that define their characteristics, but also due to the many different pressures that have altered landscapes in the past and will continue to do so in the future. Therefore, determining the significance of visual effects identified can be particularly challenging.

This section provides methodology, an assessment of baseline conditions within Project site and surroundings in relation to landscape and visual amenity and then assesses the anticipated impacts throughout the Project construction and operational phases. Then, a set of management measures (including mitigation measures, additional requirements, etc.) and monitoring measures have been identified to avoid impacts or reduce them to acceptable levels.

10.4.1 Scope of Assessment

The scope of this assessment is limited to the proposed Project wind turbine design and observers in Section 10.8, including a qualitative visual aesthetics assessment and associated reporting to document the methodology, findings and any agreed mitigation measures for the proposed wind farm site or design. The assessment scope included:

- Reviewing existing project information and operational activities to understand site conditions pertaining to visual impacts;
- Identify the closest and/or potentially most affected receptors situated within the potential area of influence of the wind farm and discuss the existing conditions near these receptors.

10.4.2 Consideration and Assumptions

Visual impacts relate to changes that arise in the composition of available views as a result of changes to the landscape, to people's response to any changes, and the overall impacts with respect to visual amenity.

Based on the SRTM (Shuttle Radar Topography Mission) data, it is noted that the Project wind turbines will be located in a raised area where the elevation can be up to 100 m above sea level. It is also noted that the areas where the receptors and the wind turbines are located is distinguished by spread roughness of the terrain.

10.4.3 Assessment Methodology

Visual impacts relate to changes that arise in the composition of available views as a result of changes to the landscape, to people's response to any changes, and the overall impacts with respect to visual amenity. The methodology followed to identify and assess the significance of, and the effect of, changes resulting from the Project on both the landscape as an environmental resource in its own right, and on people's views and visual amenity is presented in the subsequent section. People have different responses to views and visual amenity depending on their context and purpose, with certain activities specifically associated with the enjoyment of the landscape (e.g., the use of footpaths and tourist routes and attractions) generally more susceptible to change. Residents are also considered to be particularly susceptible to change and the combined effects on a number of residents within an area may also be considered.

10.4.4 Visual Baseline

The assessment has been developed according to the following tasks:

- Study area definition;
- Viewshed analysis; and
- Viewpoints and sensitive receptors identification.

10.4.4.1 Study Area Definition and Viewshed

The landscape study area is defined as the area within which the Project could be discernible by the human eye and could interfere with the main sensitives identified in the local context.

To identify the landscape study area, the Zone of Theoretical Visibility (ZTV) has been determined through computer analysis of topographical mapping to establish the theoretical distance from which the wind turbines could be visible in each direction.

This ZTV was determined through a viewshed analysis using the software QGIS 3.14. The viewshed analysis is based only on topography (i.e. digital elevation model), and represents the areas from which the wind farm could be potentially visible. For this specific assessment SRTM (Shuttle Radar Topography Mission) 30 m Digital Elevation has been utilised.

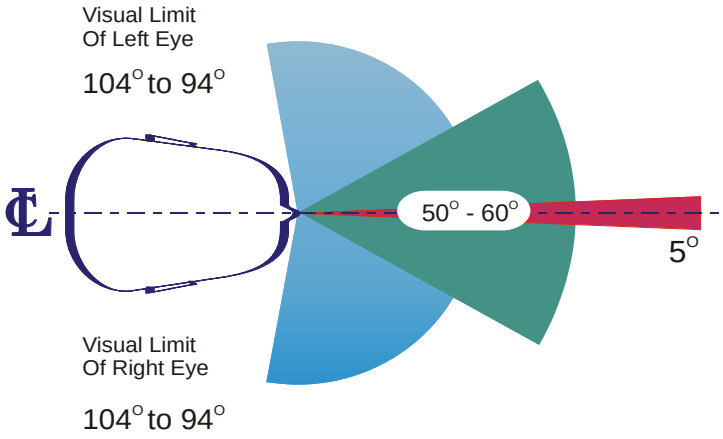
Defining an appropriate viewshed is the starting point to understand the visual impacts of the Project. The area of the viewshed will vary depending on the nature and scale of the proposed facility. The larger (and higher) the facility is, the bigger the viewshed will be, as it may be visible for a greater distance. The viewshed is therefore the area that is most likely to be visually impacted.

The following information[3] explains how a viewshed is defined and identified depending on the horizontal and vertical field of views.

[3] Source: Human Dimension & Interior Space – A Source Book of Design Reference Standards, Julius Panero and Martin Zelnik, The Architectural Press Ltd. London, 1979

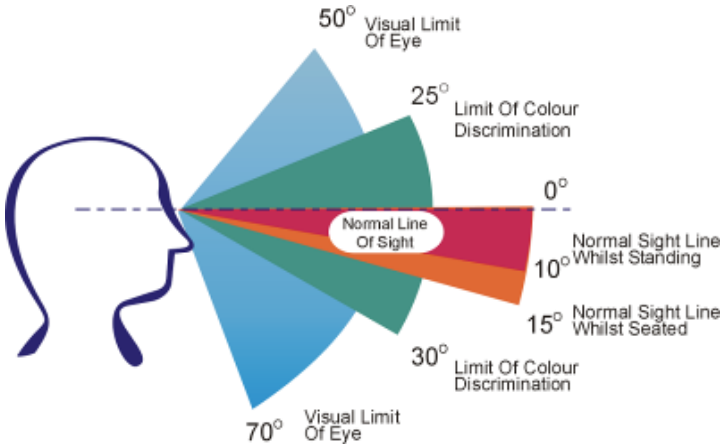
A. Horizontal Field of View

For most people, the horizontal central field of vision covers an angle of between 50° to 60°. Within this angle, both eyes observe an object simultaneously but from a slightly different angle. This creates a central field of greater magnitude than that possible by each eye separately. This central horizontal field of vision is termed the 'binocular field' (see green zone). Within this field images are sharp, depth perception occurs and colour discrimination is possible. Research suggests that the visual impact of a project component will vary according to the proportion the binocular field it occupies. Project components which occupy 5% or 2.5° or less of the horizontal central binocular field of vision are usually perceived as insignificant objects, whereas components which occupy 30° are considered to be visually dominating.



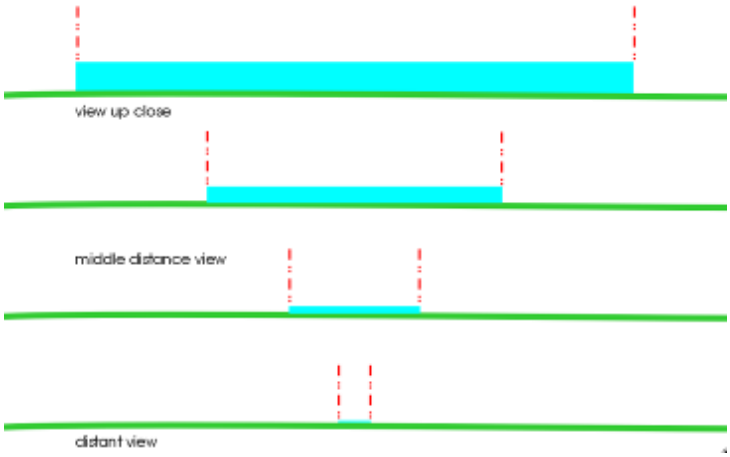
B. Vertical Field of View

The vertical central field of vision has a similar set of parameters. The vertical binocular field is normally 25° above the vertical and 30° below the vertical. When project components exceed the 50° upper visual limit of the eye, they are considered to dominate the vertical central field of vision. When project components occupy 0.5° they are not considered dominant, nor are they usually perceived as a significant change to the existing baseline condition when they are located within an anthropogenically modified landscape.



C. Horizontal versus Vertical Visibility over Distance

As a person moves further away from a project component, the visibility of the vertical dimension tends to reduce more significantly than the visibility of the horizontal dimension. This effect is illustrated below.



10.4.4.2 Visual Baseline

Visual interferences may occur when new elements are introduced into a landscape or existing elements are altered or removed leading to a change in the way that stakeholder's access, perceive or experience landscape resources.

Based on the Project characteristics the main interferences could occur from:

- Installation and operation of turbines;
- Movement of large construction vehicles.

The proposed wind turbines are the major visual element of the proposed development and may visually impact on the surrounding. As the viewer moves further away from these structures the visual impact decreases until it is no longer visible. However, before the point of non-visibility is reached, the wind turbines have reduced in scale such that they no longer have a significant visual impact.

The wind farm is comprised of a number of individual turbines of the same dimensions (200 m height and 150 m width), with relatively small separation distances between each individual turbine, less than 300 m. In assessing the visual impact of the wind turbine, it is therefore assumed that the largest horizontal component is the entire rotor, which would be a maximum of 150 m wide. It has been also evaluated the combined effect of multiple rotors throughout the landscape.

As shown in Table 10.13, calculations suggest that the impact of a 150 m wide wind turbine rotor would reduce to insignificance at about 3.4 km, as it would form less than 5% or 2.5° of the horizontal field of view.

Table 10.13 Horizontal Field of View

Horizontal Field of View	Impact	Distance from Observer to a 150 m Rotor
<2.5° of view	The development will take up less than 5% of the central field of view. The development, unless particularly conspicuous against the background, will not intrude significantly into the view. The extent of the vertical angle will also affect the visual impact.	>3.4 km
2.5° – 30° of view	The development may will have usually a moderate impact that may be not noticeable at the greatest distance of this range.	3.4 km to 280 m

Horizontal Field of View	Impact	Distance from Observer to a 150 m Rotor
>30° of view	Developments that fill more than 50% of the central field of vision will always be noticed and only sympathetic treatments will mitigate visual effects.	<280 m

A similar analysis can be undertaken based upon the vertical field of view for human vision (Table 10.14), shows the relationship between impact and the proportion that the development occupies within the vertical line of sight.

Table 10.14 Vertical Field of View

Vertical Line of Sight	Impact	Distance from Observer to a 200 m Tall Wind Turbine
< 0.5° of vertical angle	A thin line in the landscape	>22.9 km
0.5° – 2.5° of vertical angle	The degree of visual intrusion will depend on the development's ability to blend in with the surroundings	22.9 km to 4.6 km
> 2.5° of vertical angle	Usually visible, however the degree of visual intrusion will depend of the width of the object and its placement within the landscape	<4.6 km

Based on the above, it is reasonable that distances, at which the magnitude of visual impact of the wind turbine will be not significant, can be the ones greater than 22.9 km, where a fully visible wind turbine would be an insignificant element within the landscape.

Generally, the more conservative or worse case distances form the basis for the assessment of visual impacts. Therefore, this development the greater impacts would be associated with the vertical field of view and so it is therefore proposed to use the vertical field of view and extend the view shed to 22.9 km for wind farm.

QGIS 3.14 was used to determine the ZTV for the Project. The current visibility within the ZTV will vary depending on the presence of intervening local topography, and features such as vegetation and buildings. The present view shed analysis has been based solely on topography and did not take into account the potential screening granted by the local vegetation patches, which would further reduce the actual view shed. Moreover, it should be highlighted that a typical view shed assessment does not take typical meteorological conditions into account that can result in changes to real visibility. For example, rainfall and other atmospheric conditions will alter the visibility of the wind farm. The diminution of visual clarity bought about by atmospheric conditions also increases with distance and cloudy days can result in a natural attenuation of the visibility of the Project.

Similar to cloud coverage, rainy days are able to reduce the visibility as the water droplets obscure vision. This varies greatly depending on the heaviness of the precipitation, but even light rain obscures distant objects greatly.

Figure 10.3 shows the ZTV mapping from any points inside the buffer area.

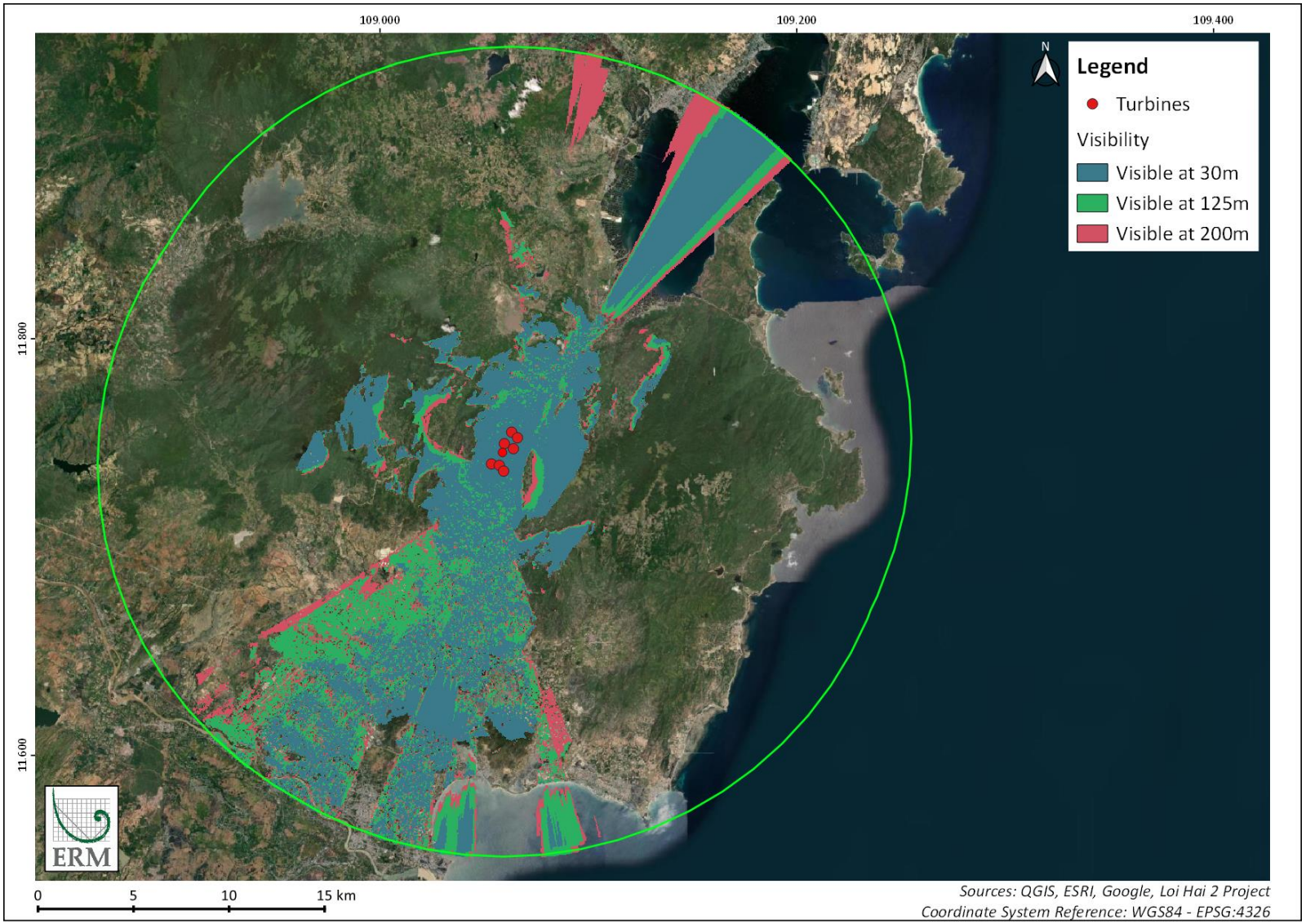


Figure 10.3 Viewshed (22.9 km buffer)

The results of the viewshed assessment as presented in Figure 10.4 show that the visibility is almost open to the whole area because of the morphology of the area. Specifically, the terrain is almost flat posing nearly no obstacles for visibility, shown by 30 m viewshed zone overlapping most of tip height viewshed zone.

It should be emphasized that intervening vegetation is not included in this mapping and is likely to significantly reduce the visibility of wind turbines, in whole or in part, and therefore reduce the impact identified. However, the Project area is analysed and classified as agricultural land, where the vegetation cover is very low. Therefore, the deviation of the assessment from reality is lowered.

Considering the potential visibility from local communities, the Project components, especially the wind turbines will either wholly or partly be visible from the residential areas in vicinity such as Suoi Vang, Suoi Da, Ba Rau 1 and 2, and An Dat villages, Loi Hai Commune. Additionally, the National Road 1A goes through the Project area, this is likely to pose a significant temporary visual impact on mobile receptors.

Various locations within the Project area have been selected as visual sensitive receptors (VSRs), in order to evaluate the significance of impact at different directions. The selection boundary is within the vertical viewshed of the wind turbine's tip (radius 22.9 km) because this is the highest part to be seen. This will cover all the visual perception of people that could be affected by the presence of the Project. After choosing the receptors, a viewshed analysis could be carried out to reflect the view of receptors toward the turbines within field of view.

In order to screen the potential sensitive receptors, the following criteria were used to assess the sensitivity of the VSRs:

- Value and quality of existing views;
- Type and estimated number of receiver population;
- Duration of frequency of view; and
- Degree of visibility.

Figure 10.4 shows the locations of the VSRs which are houses selected for analysis.

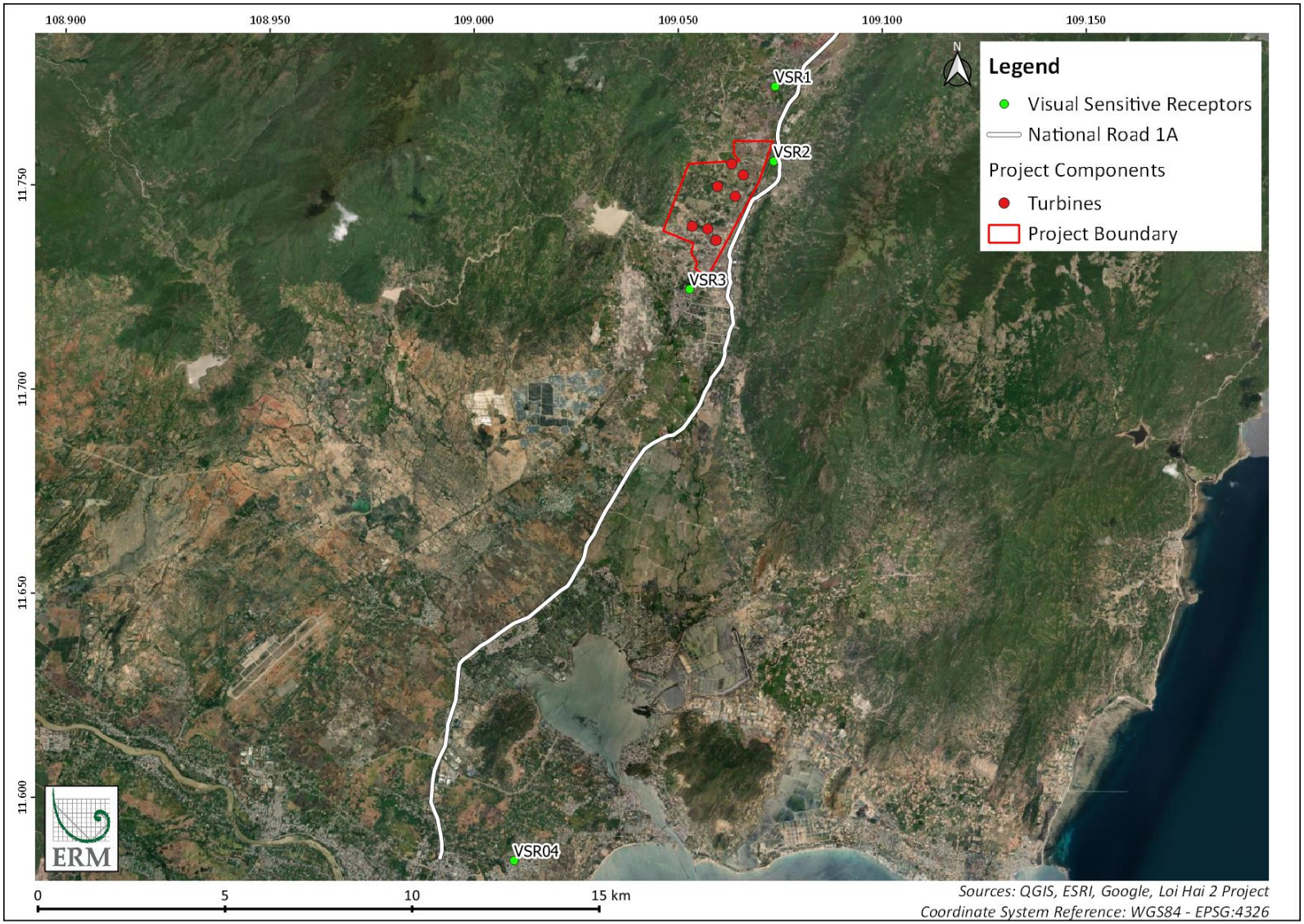


Figure 10.4 Visual Sensitive Receptors Location

10.4.5 Impact Assessment

The assessment of impacts on visual amenity was performed in accordance with accepted methodologies derived from best practice guidelines. Impact significance for visual amenity is generally derived on the basis of the following main factors:

- The quality/importance of the visual amenity as a resource/function that is potentially affected;
- The sensitivity of the visual amenity towards Project activities; and
- The magnitude of change to the receiving visual amenity as a result of the Project.

The visual impact assessment describes changes in the character of the available views to people resulting from a given Project and their visual amenity. To determine the significance of visual effects it is necessary to consider the sensitivity of the visual receptors against the magnitude of visual effects.

10.4.5.1 Methodology

10.4.5.1.1 Sensitivity of Receptors

Visual receptors are people and must be assessed in terms of their sensitivity, combining judgements on their susceptibility to the specific change proposed and the value attached to a view or their visual amenity. Susceptibility refers to the degree to which a particular visual receptor can accommodate change arising from the Project, without detrimental effects on the visual amenity, and will vary with the:

- Occupation or activity of people experiencing the view;
- Location and context of the view; and
- Extent to which their attention or interest may be focused on the view and their visual amenity.

Judgements about the sensitivity of visual receptors should be recorded on a scale (e.g., low, medium and high) with clearly stated criteria. Table 10.15 indicates the relative sensitivities of a number of visual receptors.

Table 10.15 Sensitivity of Visual Receptors

Visual Receptors	Sensitivity
Small number of visitors with interest in their surroundings. Viewers with a passing interest not specifically focussed on the landscape e.g. workers, commuters. The quality of the existing view, as likely to be perceived by the viewer, is assessed as being low	Low
Small numbers of residents and moderate numbers of visitors with an interest in their environment. Larger numbers of recreational road users. The quality of the existing view, as likely to be perceived by the viewer, is assessed as being medium	Medium
Larger numbers of viewers and/or those with proprietary interest and prolonged viewing opportunities such as residents and users of attractive and well-used recreational facilities. The quality of the existing view, as likely to be perceived by the viewer, is assessed as being high	High

10.4.5.1.2 Magnitude of Visual Effects

There is no standard methodology for the scale or magnitude of effects on views and visual amenity. However, it is generally based on the:

- Scale of change relating to the loss or additions of features in the view, including the proportion of the view occupied by the proposed development;
- Degree of contrast or integration of any new feature or changes in the composition of the view;
- Duration of the effect, whether temporary or permanent, intermittent or continuous;

- Angle of view in relation to the main activity of the receptor;
- Distance of the viewpoint from the Project;
- Extent of the area over which the changes would be visible;
- Variation in the degree of visibility of the Project (it is helpful to categorize those variations);
- The extent of the view that would be occupied by the Project: full, partial, glimpse etc.;
- The distance of the viewpoint from the Project and whether the viewer would focus on the Project due to proximity or the Project would form one element in a particular view;
- The proportion of the Project or particular features that would be visible: full, most, small amount, none;
- Whether the view is transient or one of a sequence of views as from a moving vehicle or footpath.

Consideration may also be given to the time of day and seasonal differences in effects. The worst case may need to be demonstrated (i.e., during dry season, when lower moisture levels increases visibility). The typical criteria and thresholds in determining the magnitude of effect on visual receptors are set out in Table 10.16.

Table 10.16 Magnitude of Visual Effect

Typical criteria and thresholds	Visual Magnitude of effect
A change which is barely or rarely perceptible, at very long distance, or visible for a short duration, perhaps at an oblique angle, or which blends in with the existing view. The change may be short term.	Negligible
A subtle change in the view, at long distances, or visible for a short distance, perhaps at an oblique angle, or which blends in with the existing view. The change may be short term.	Small
A noticeable change in the view at an intermediate distance, affecting a substantial part of the view, part a more wide-ranging, less concentrated change across an expansive area. The change may be medium to long term and may not be reversible.	Medium
A clearly evident change in the view at a close distance, affecting a substantial part of the view, continuously visible for a long duration, or obstructing important elements of the view. The change may be medium to long term and would not be reversible.	Large

10.4.5.1.3 Significance of Visual Effect

When determining the significance of visual effects, the following is taken into account:

- Large scale changes which introduce new discordant or intrusive elements into the view are more likely to be significant than small changes or changes involving features already present in the view;
- Changes in views from recognized and important viewpoints or amenity routes are likely to be more significant than changes affecting less important paths and roads; and
- Changes affecting large numbers of people are generally more significant than those affecting a relatively small group of users.

The significance matrix below illustrates the relationship between the sensitivity of a visual receptor and the magnitude of the visual effect. The significance of a visual effect may be adverse or beneficial

dependent upon the nature of the change. Each case is assessed on its own merits using professional judgement and experience, and there is no defined boundary between levels of effects. What level of effect constitutes a significant effect will vary on a project by project basis.

Table 10.17 Significance of Visual Effect

		Sensitivity of Visual Receptor		
		Low	Medium	High
Magnitude of Visual Effect	**Negligible**	Negligible	Negligible	Negligible
	Small	Negligible	Minor	Moderate
	Medium	Minor	Moderate	Major
	Large	Moderate	Major	Major

10.4.5.1.4 Selection of Visual Sensitive Receptors

Villages and major arterial transport routes are considered to be the most sensitive receptors in the Project Area. In this regard, there are five (5) villages, one (1) ward, and one (1) major highway. Visual Sensitive Receptors were selected for assessment based on the extent to which they represent the sensitivity across the Project area. Table 10.18 lists the VSRs selected.

Table 10.18 VSRs Selected for the Visual Impact Assessment

VSR No.	Description	Rationale for Selection
VSR1	A house located in Suoi Vang village, Loi Hai commune, Thuan Bac district, Ninh Thuan province	Suoi Vang is a village located in vicinity of the north of Project. VSR1 is a representative of Suoi Vang village, a small residential area that could be affected
VSR2	A house located in Suoi Da village, Loi Hai commune, Thuan Bac district, Ninh Thuan province	Suoi Da is a village located in vicinity of the east of Project and next to National Road 1A, the trans-Vietnam highway. VSR2 is a representative of Suoi Da village, a moderate residential area that could be affected.
VSR3	A house located in Ba Rau 1 village, Loi Hai commune, Thuan Bac district, Ninh Thuan province	Ba Rau 1 and 2, An Lac is villages located in vicinity of the southwest of Project. VSR3 is a representative of three villages, dense residential areas that could be affected
VSR4	A house located in My Hai ward, Phan Rang – Thap Cham city, Ninh Thuan province	My Hai is a ward located in a visible range which is 18 km to the south of Project. VSR4 is a representative of My Hai ward, a dense residential area

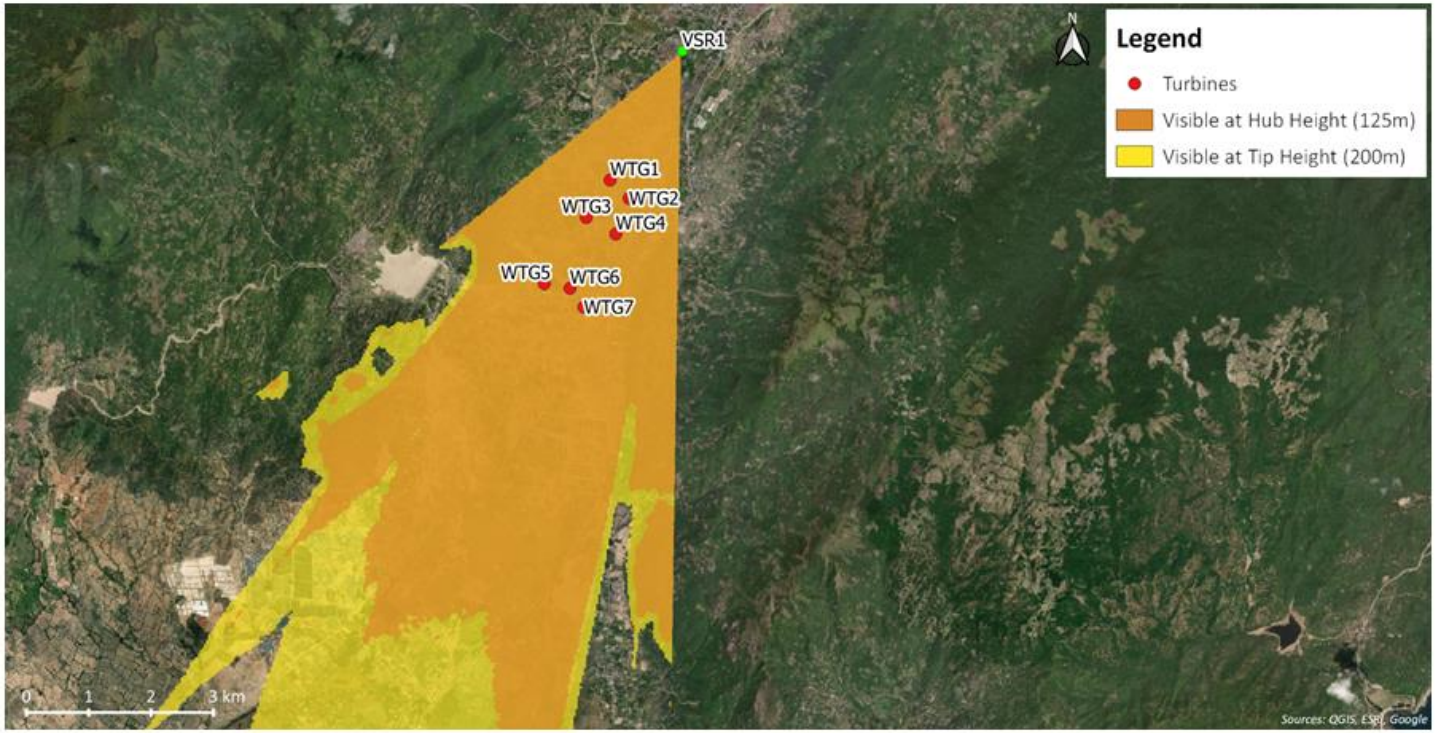
10.4.5.1.5 Identification of Visual Impact

The visual impact is a product of the magnitude of change to the existing baseline conditions, the landscape context and the sensitivities of VSRs.

Figure 10.4 shows the location of the VSRs which have been selected for the analysis and Table 10.19 shows the summary of the visual impacts of the Project at the selected VSRs.

The following pages present the Impact Assessment for each VSR previously identified.

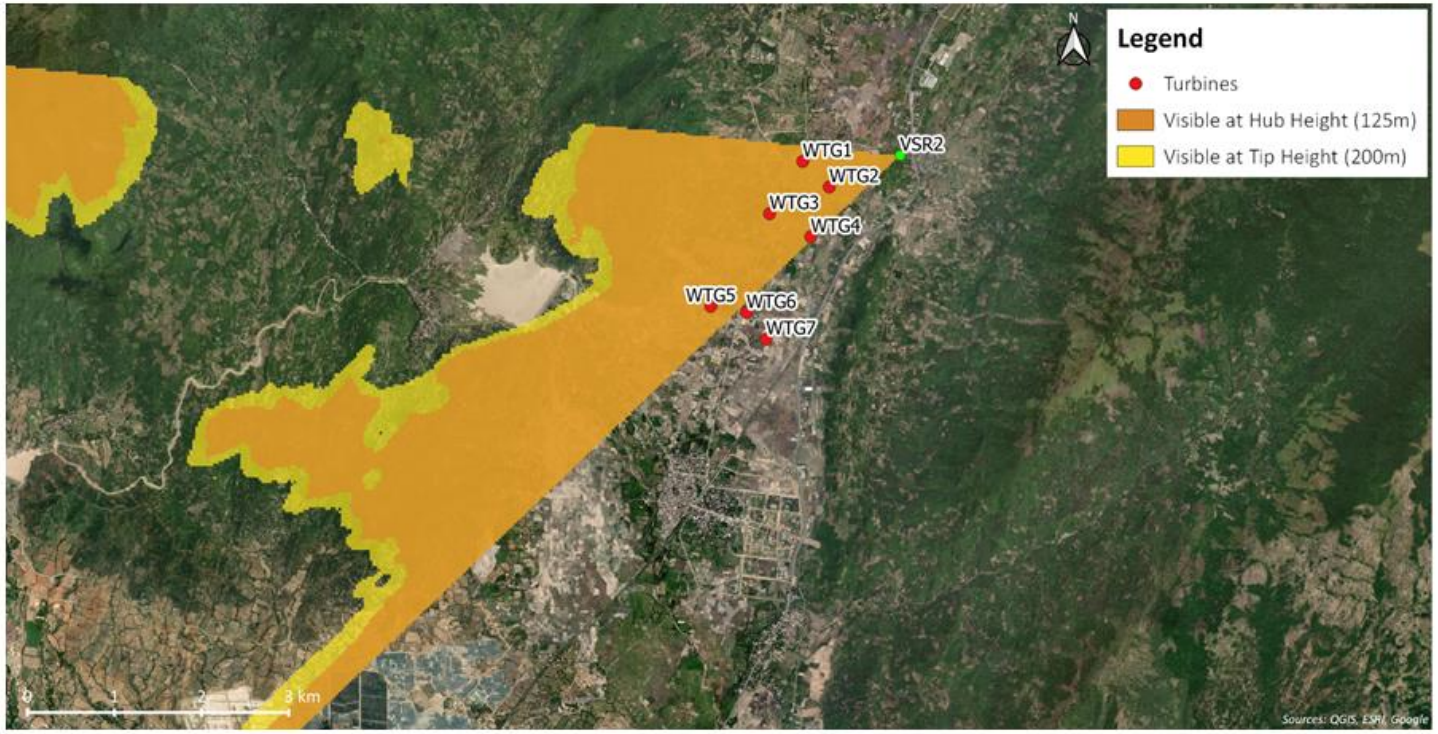
VIEWPOINT VSR01



Viewpoint Location Information									
Latitude	Longitude	Height above ground level (m)	Centre of Panorama – View Direction	Field of View (FoV) (°)	WTG within FoV	Visible WTG at tip height	Visible WTG at hub height	Nearest WTG (m)	Furthest WTG (m)
109.073761	11.773973	1.5	SW	50	7	7	7	2,400	4,475

Visual Sensitivity	Magnitude of Change
The view is taken from Suoi Vang village, Loi Hai commune. Being a small residential area, small number of viewers without interest in their surroundings. The visual sensitivity is considered to be small	Due to the topography is characterized by flat terrain and the distance, from this point of view, all wind turbines are visible. Along this view direction (SW), WTG 1-3-5 and WTG 2-4-7 are arranged in-line. Thus, it is considered that the magnitude of change is medium

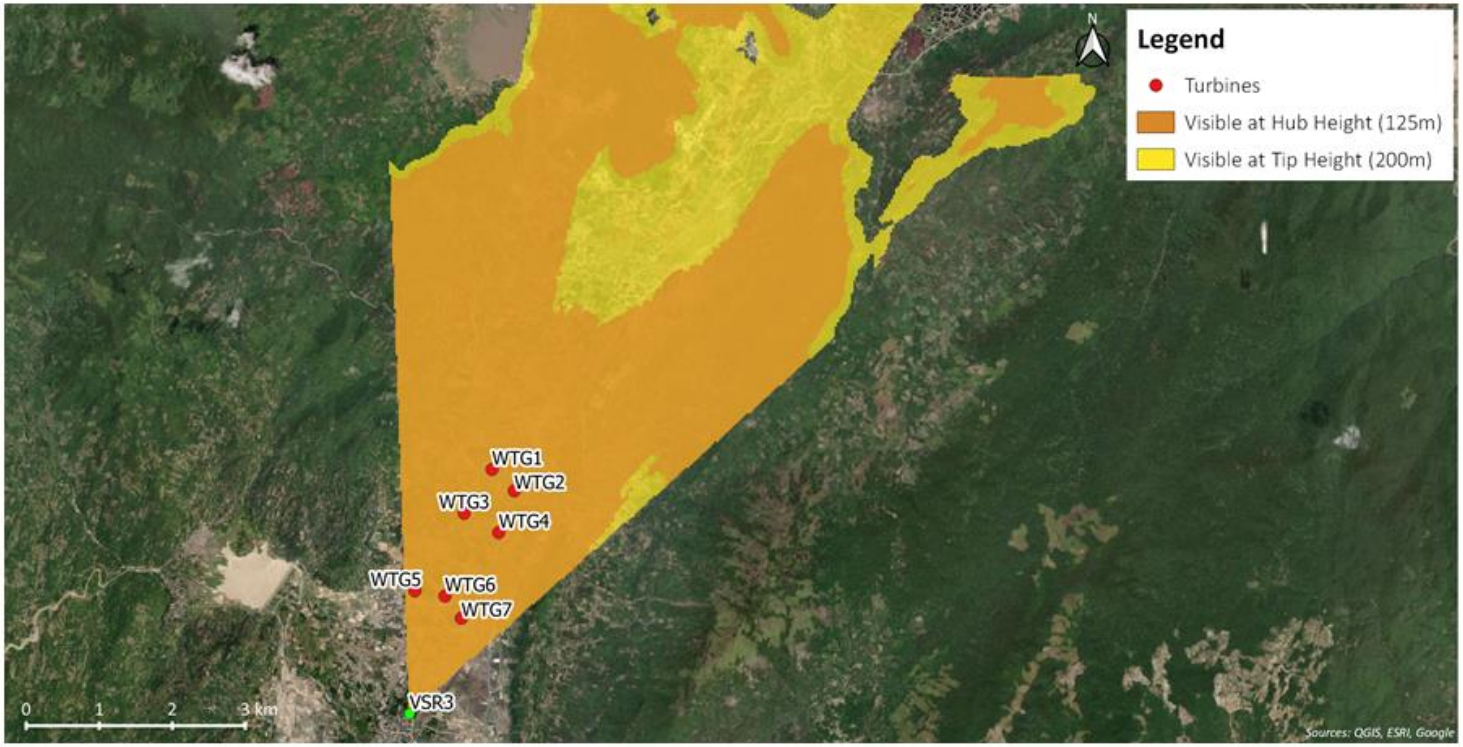
VIEWPOINT VSR02



Viewpoint Location Information									
Latitude	Longitude	Height above ground level (m)	Centre of Panorama – View Direction	Field of View (FoV) (°)	WTG within FoV	Visible WTG at tip height	Visible WTG at hub height	Nearest WTG (m)	Furthest WTG (m)
109.0733870	11.7557629	1.5	WSW	50	5	5	5	900	2,800

Visual Sensitivity	Magnitude of Change
The view is taken from Suoi Da village, Loi Hai commune. Being a small residential area, moderate number of viewers with an interest in their environment. The visual sensitivity is considered to be medium	The change from this point of view is undeniable. The WTGs will become a substantial part of the view. Given the viewers locate within the wind power project, it is considered that the magnitude of change is large

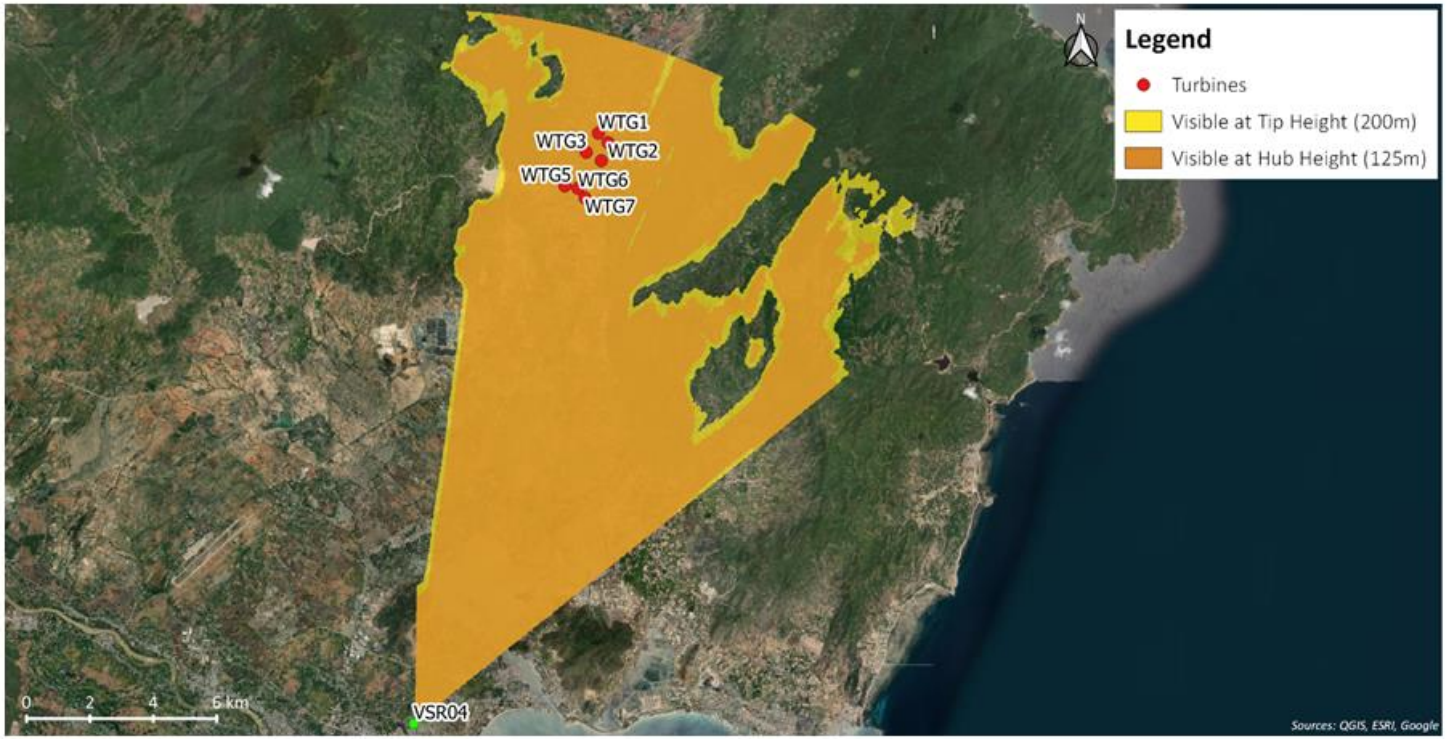
VIEWPOINT VSR03



Viewpoint Location Information									
Latitude	Longitude	Height above ground level (m)	Centre of Panorama – View Direction	Field of View (FoV) (°)	WTG within FoV	Visible WTG at tip height	Visible WTG at hub height	Nearest WTG (m)	Furthest WTG (m)
109.052763	11.724429	1.5	NE	50	7	7	7	1,500	3,800

Visual Sensitivity	Magnitude of Change
The view is taken from Ba Rau 2 village, Loi Hai commune. Being a dense residential area, large number of viewers with prolonged viewing opportunities are involved. The visual sensitivity is considered to be high	Due to the topography is characterized by flat terrain and the distance, from this point of view, all wind turbines are visible. However, along this view direction (NE), WTG 2-4-7 and WTG 1-6 are arranged in-line. Thus, it is considered that the magnitude of change is medium

VIEWPOINT VSR04



Viewpoint Location Information									
Latitude	Longitude	Height above ground level (m)	Centre of Panorama – View Direction	Field of View (FoV) (°)	WTG within FoV	Visible WTG at tip height	Visible WTG at hub height	Nearest WTG (m)	Furthest WTG (m)
109.009675	11.584482	1.5	NNE	50	7	7	7	17,600	19,700

Visual Sensitivity	Magnitude of Change
The view is taken from Phan Rang – Thap Cham city, Binh Thuan province. Being an important residential area, large number of viewers with prolonged viewing opportunities are involved. The visual sensitivity is considered to be high	Due to the topography is characterized by the flat terrain, from this point of view, all wind turbines are visible. However, the distance is relatively long and along this view direction (NNE), WTG 2-4-7 and WTG 1-6 are arranged in-line. Thus, it is considered that the magnitude of change is small

Table 10.19 Summary of Visual Impacts

VSR	Distance to nearest wind turbine	Project visibility	Sensitivity of Receptor	Magnitude of Visual Effect	Significance of Visual Effect – Combined Impact
VSR1	2.4 km	Visible	Low	Medium	Minor
VSR2	0.9 km	Visible	Medium	Large	Major
VSR3	1.5 km	Visible	High	Large	Major
VSR4	17.6 km	Visible	High	Small	Moderate

Three (3) VSRs were selected as representative of five villages around the Project area with Suoi Vang (VSR1), Suoi Da (VSR2), and Ba Rau 1, Ba Rau 2, An Lac (VSR3). The VSR4 was selected as representative of My Hai ward, Phan Rang – Thap Cham city, Binh Thuan province, a dense residential area to verify the visibility from the area which is 18km from the Project.

It should be noted that views of the Project could be filtered through vegetation not included in the present analysis. As shown in Table 10.19, receptors located in vicinity of the Project are likely to be affected by the turbines, whilst the area located far away from the Project is not likely to be affected due to the distance and obstacles (e.g. terrain, vegetation, buildings).

The Project will be visible across an area of 37,300 ha. Within this there are 5 villages, 1 ward and 1 major highway. The four VSRs selected are broadly representative of the landscapes and sensitivities of the Project area. As noted in Table 10.19, two out of four selected VSRs were assessed as being impacted to a Major extent. One VSR will be affected to a Morderate extent and the last one will be Minor. However, as recorded information from social and other surveys, local community confirmed that there was no visual impact to them for existing wind farm projects. Therefore, overall, the significance of visual impact that will result from the installation and operation of the wind turbines has been assessed as **Moderate**.

10.4.5.2 Additional Mitigation Measures

The following identifies mitigation measures to be applied by the Project Owner and EPC contractor:

- Use of materials that will minimise light reflection should be used for all Project components; The replacement of wind turbines with visually different wind turbines can result in visual clutter, so replacing wind turbines with the same or a visually similar model over the lifetime of the project may be an important requirement;
- Existing vegetation should be retained to the greatest extent possible. Vegetation should be retained along roads, substations, and other Project infrastructure.

10.4.5.3 Residual Impact

Following the implementation of these mitigation measures, the significance of residual impact is considered as **Minor** to **Negligible.**

10.4.5.4 Monitoring and Audit

No specific monitoring measures are identified at this stage

10.5 Solid Waste Impact Assessment

10.5.1 Summary of Scope of Assessment

During the construction phase, the main types of waste are construction debris, organic waste from land clearing activities, construction waste and domestic waste from the workers working on site.

In the operation phase, domestic waste will be generated from workers working in the control room and substation, and some hazardous waste, such as spent oil, used batteries, broken fluorescent tubes from maintenance activities of WTGs, substation and transmission line.

10.5.2 Relevant Guidelines and Criteria

10.5.2.1 Vietnamese Regulations

- Law No 55/2014/QH13 dated June 23rd 2014 on Environmental Protection;
- Decree No. 38/2015/ND-CP dated April 24th 2015 on management of waste and discarded materials;
- Decree No. 40/2019/ND-CP dated May 13th 2019 on amendments to Decrees on guidelines for the Law on Environment Protection
- Circular No. 08/2017/TT-BXD dated May 16th 2017 on construction solid waste management;
- Circular No. 36/2015/TT-BTNMT dated June 30th 2015 on hazardous waste management.

10.5.2.2 International Guidelines

- IFC Performance Standard 3: Resource Efficiency and Pollution Prevention;
- IFC Performance Standard 4: Community Health, Safety, and Security;
- IFC General EHS Guidelines 1.6 Waste Management;
- IFC Environmental, Health, and Safety Guidelines for Waste Management Facilities.

10.5.3 Assessment of Impacts

10.5.3.1 Construction Phase

10.5.3.1.1 Sources of Waste

Structures to be demolished (e.g. simple houses, tents and shelters with total of 4,243 m^2) . The land clearance will also remove some trees, vegetation and crops. According to the regulatory EIA, it is estimated that 350 tons of waste will be generated as the result of demolition of existing structures within project footprint, and 16.3 tonnes of organic waste will be generated as a result of land clearance.

During the construction of the wind farm, the main sources of waste are empty cement bags, soil waste from earthworks and groundworks excavations, sand, stones and other waste materials from construction activities.

The construction phase is expected to last for 360 days, and approximately 32 kg of construction waste will be generated per day (VATEC, 2020). Construction wastes are mainly cement bags, soil waste from earthwork, sand, gravel and construction materials. Besides, a smaller amount of domestic waste (20 kg per day) will be generated from the activities of workers on site, mainly plastic bags, food leftovers, used packaging etc.

During this period, hazardous waste, such as spent oil and oily sludge and contaminated rags and sludge, will also be generated from the maintenance of construction machinery and equipment. Based on the waste records of similar-scale wind farm projects, it is estimated that 1,480 kg of hazardous waste will be generated during the construction phase of Loi Hai 2 wind farm.

10.5.3.1.2 Potential Impact

Construction and demolition waste (CDW), if not properly managed, can cause risks to human health and environment, including transportation obstacles (i.e., CDW on roadsides and pavements) leading

to accidents, impacts to the urban landscape, air pollution (due to dust), soil and groundwater contamination, degraded infrastructure (i.e., blocking sewers and canals), and waste of land. Especially, the illegal dumping of CDW on streets causes countless accidents. The dumped CDW in open canals can damage the urban drainage system, contributing to flooding events under heavy rainfall (Van Tuan Nguyen, 2018). In addition, the disposal of CDW can lead to the depletion of natural resources because major components of CDW such as soil, bricks, and concrete can be recycled and reused after proper treatment and management and can be utilized for other construction sites. The use of recycled materials contributes directly to saving natural resources, e.g., natural/virgin soil for producing clay bricks, and natural/virgin gravels and aggregates for roadbed materials and concrete manufacturing.

As reported by MONRE, in 2019, 35,624 tons of municipal waste are generated in urban areas of Vietnam every day, while in rural areas, it was 28,394 tons per day. The collection rate in urban areas was 92%, while in rural areas it was only 66%. 71% of municipal waste were dumped in the landfills, however only 20% of the landfills were considered meeting the hygienic standards (MONRE, 2019). The poor management of waste has been contaminating the world's oceans, clogging drains, generating floods, and transmitting infections via the breeding of vectors. Furthermore, it also causes rises in respiratory issues through airborne particles resulting from the burning of waste, harm to creatures that consume waste unknowingly, and effects on economic development, such as reduced tourism (Silpa Kaza, 2018)

Improper management of hazardous wastes such as oil and grease from maintenance activities, as cleaning machinery and equipment, could cause soil contamination when infiltrating into soil or bodies of water.

10.5.3.1.3 Existing Controls

The following control measures are described in the regulatory EIA:

Construction waste

- Segregate CDW and maximise the reuse of CDW for other construction activities;
- Accumulate soil, broken bricks, gravel at temporary storage areas arranged near turbine foundations and substation, and reuse them as backfilling materials;
- Organic soils from earthwork will be reused for backfilling of turbine foundations, consolidating internal access roads, levelling of laydown areas;
- CDW, such as broken bricks and concrete, cement bags, wood waste, unused soils and stones etc., will be collected and accumulated in designated places, and will be removed every day by a licensed waste treatment company.

Domestic waste

- Prioritise the recruitment of local workers who do not need to stay in worker's camp, and as the result, less domestic waste will be generated inside Project area;
- Establish the internal rules of order, hygiene and environmental protection, which all Project's employees have to follow;
- Arrange waste bin for each worker's camp (03 bins, capacity 60 L each for each camp). Waste from these camps will be collected, treated and disposed in accordance with legal requirements.

Hazardous waste

- Minimise the repair and maintenance of machinery and equipment on site;
- Waste oil and other hazardous waste generated in Project area will be collected, treated and disposed in accordance with Circular 36/2015/TT-BTNMT on Hazardous waste management;
- Dedicated hazardous storages will be arranged next to construction waste storages, and will be built in accordance with legal requirements (the storage must be roofed, the floor must be

impervious, secondary containment must be provided etc.). Inside the storage, hazardous waste bins will be arranged and labelled to accommodate each type of waste.

10.5.3.1.4 Significance of Impact

Impact	Environmental and health impacts from generation, storage and disposal of CDW, domestic waste and hazardous waste				
Impact Nature	**Negative**	Positive	Neutral		
	Environmental and health impacts are considered **Negative**.				
Impact Type	**Direct**	Indirect	Induced		
	Improper waste management cause **direct** environmental and health impacts.				
Impact Duration	Temporary	**Short-term**	Long-term	Permanent	
	The impact duration is **Short-term** because the duration of construction is 12 months				
Impact Extent	**Local**	Regional	Global		
	Impacts are within the Project area.				
Impact Frequency	Waste will be generated during works at certain times of day. As such, impact frequency is expected to be intermittent over the construction period.				
Impact Magnitude	Positive	Negligible	**Small**	Medium	Large
	Considering the amount of waste to be generated, the impact magnitude is **Small**.				
Vulnerability of Receptors	Low	**Medium**	High		
	The identified receptors are rural residential areas, where waste has not been well managed. Only 66% of solid waste are collected in rural areas of Vietnam, and open burn of waste is still a common practice. However, the Project area is located near the administrative centre of the District. The overall vulnerability is therefore **Medium**.				
Significance	Negligible	**Minor**	Moderate	Major	
	The significance is **Minor.**				

10.5.3.1.5 Additional Measures

The following additional measures should be implemented:

- Domestic waste shall be further categorised into 1) Recyclable/Reuse waste, 2) Organic waste and 3) Other waste. Separated bins for type of waste shall be allocated and placed at strategic areas within the project footprint;
- Avoid waste accumulation in open areas, especially those close to adjacent communities or roads;
- Waste storages shall be protected from physical elements (e.g. direct sunlight, wind, rain, storms, etc.) and keep away from natural drainage canals;
- Workers shall be trained on waste management practices (e.g. handling, storing and disposal) as a part of environmental awareness program;
- Access to hazardous waste storage areas shall be limited to employees who have received proper training.

10.5.3.1.6 Residual Impacts

With the implementation of the above mitigation measures, the residual impacts would be expected to be **Negligible.**

10.5.3.1.7 Monitoring and Auditing

- Daily site inspection shall be implemented to verify the compliance with mitigation measures;
- Waste manifests or other records that document the amount of waste generated by the project and along with the storage practices, management and final destination shall be kept and maintained on site in accordance with the legal requirements;

- Planned and unplanned audits to onsite waste storage areas and waste treatment contractor's facility shall be implemented to ensure compliance with legal requirements.

10.5.3.2 Operation Phase

10.5.3.2.1 Sources of Waste

Domestic waste

According to the EIA, it is expected that 10 staff will be working permanently throughout the operation phase of the wind farm. It is estimated that each person will generate around 0.25 to 0.30 kg of domestic waste per day, making the sum of 2.5 to 3.0 kg of waste to be generated every day from the wind farm. The waste will mainly comprise of:

- Organic waste such as discarded vegetables, leftovers;
- Food and drink packaging;
- Discarded plastic and glass products;
- Metals, such as empty food cans.

Hazardous waste

The main sources of hazardous waste in operation phase are:

- Spent oil from maintenance and repair of WTGs and transformers;
- Oil-contaminated cloth:;
- Discarded ink cartridges, broken fluorescent lamps, used batteries from office activities.

According to the EIA, the WTGs and transformers will be maintained once every four to five years. Expected amount of waste oil to be generated in each maintenance is 350 litres, while the amount of oil-contaminated cloth is estimated to be 2 kg.

Office activities are expected to generate about 3 kg of hazardous waste on a monthly basis.

10.5.3.2.2 Existing Controls

The following control measures are mentioned in the EIA:

- Domestic waste will be collected and disposed every day by a local waste treatment company;
- Hazardous waste will be collected and treated by an authorised waste treatment company in accordance with legal requirements.

10.5.3.2.3 Significance of Impacts

Impact	Environmental and health impacts from generation, storage and disposal of domestic waste and hazardous waste in operation phase			
Impact Nature	**Negative**	Positive	Neutral	
	Environmental and health impacts are considered **Negative**.			
Impact Type	**Direct**	Indirect	Induced	
	Improper waste management cause **direct** environmental and health impacts.			
Impact Duration	Temporary	Short-term	**Long-term**	Permanent
	The impact duration is **Long-term** because it lasts throughout the operation phase of 20 years			
Impact Extent	**Local**	Regional	Global	
	Impacts are within the Project area.			
Impact Frequency	Domestic waste will be generated during works at certain times of day. Hazardous waste from maintenance activities will be generated once every 04 to 05 years. Impact frequency is therefore **Intermittent.**			

Impact Magnitude	Positive	**Negligible**	Small	Medium	Large
	Considering the amount of wastes to be generated, the impact magnitude is **Small**.				
Vulnerability of Receptors	Low	**Medium**	High		
	The identified receptors are rural residential areas, where waste has not been well managed. However, the Project area is located near the administrative centre of the District. The overall vulnerability is therefore **Medium**.				
Significance	**Negligible**	Minor	Moderate	Major	
	The significance is **Negligible.**				

10.5.3.2.4 Additional Measures

- Domestic waste shall be further categorised into 1) Recyclable/Reuse waste, 2) Organic waste and 3) Other waste. Separated bins for each type of waste shall be arranged accordingly.
- Workers shall be trained on waste management and storage practices (e.g. handling, storing and disposal) as a part of environmental awareness program;
- Before the scheduled maintenance, the waste treatment company shall be informed in advance to ensure that they are able to handle a large volume of waste oil and other hazardous waste.

10.5.3.2.5 Residual Impacts

With the implementation of the above mitigation measures, the residual impacts would be expected to be **Negligible.**

10.5.3.2.6 Monitoring and Auditing

- Waste manifests or other records that document the amount of waste generated and its destination shall be kept and maintained in accordance with the legal requirements.
- Planned and unplanned audits to onsite waste storage areas and waste treatment contractor's facility shall be implemented to ensure compliance with legal requirements, especially before and after scheduled maintenance of the wind farm.

10.6 Greenhouse Gases Assessment

This Section will assess the impact of greenhouse gas emissions in construction phase and operation phase of Loi Hai 2 wind farm. Construction of Loi Hai 2 wind farm will result in emissions associated with the combustion of fuel from the transportation of materials and WTG parts to site, transportation of excavated materials and use of construction equipment; and emissions released from biogenic carbon contained within the vegetation that is cleared for construction of foundations of WTGs and access roads. The operation of the wind farm will not produce direct GHG emissions during its entire lifetime (Ramchandra Bhandari, 2020), therefore, in terms of GHG emission, it will have positive impacts.

GHG emissions are divided into three categories, or Scopes:

- Scope 1 emissions: Direct GHG emissions; defined as those emissions that occur from sources that are owned or controlled by the reporting entity.
- Scope 2 emissions: A category of indirect emissions that accounts for GHG emissions from the generation of purchased energy products (principally electricity, steam/heat and reduction materials used for smelting) by the entity.
- Scope 3 emissions: Those emissions that are a consequence of the activities of an entity, but which arise from sources not owned or controlled by the Company. Examples of Scope 3 activities include extraction and production of purchased materials, transportation of purchased fuels, and use of sold products and services.

Scope 1 and Scope 2 emissions for the Project's Construction phase was estimated and based on conservative assumptions (e.g. maximum fuel consumption). As such, they represent the maximum

expected emissions for the activities identified in this assessment. The IFC Performance Standard 3 requires projects which emit more than 25,000 t CO_2 per year to quantify direct emissions within the physical boundary and indirect emissions associated with the off-site production of energy used by the Project.

This study does not include an assessment of Scope 3 emissions associated with the production and transport of WTG parts from suppliers by sea to Cam Ranh Port in Vietnam. Emissions associated with the production and transport of WTGs could be significant, but represent a source of indirect emissions that are not under the Project's operational control (Scope 3), and at present details on the source and transport of WTGs have not yet been confirmed. Considering the information available at the time of this assessment, the likely magnitude of the different emissions sources (with the bulk of life cycle emissions likely coming from the production of WTGs), and also guidance from the IFC Performance Standards (Performance Standard 3 on Resource Efficiency and Pollution Prevention states that 'the Client will quantify direct emissions from the facilities owned or controlled within the physical project boundary, as well as indirect emissions associated with the off-site production of energy used by the Project and therefore focuses on Scope 1 and 2 emissions), this study therefore focuses on an assessment of Scopes 1 and 2 GHG emissions for the wind farm.

10.6.1 Methodology

10.6.1.1 Carbon Footprint Methodology

The latest 2019 Refinement to 2006 IPCC Guidelines for National GHG Inventories are used to estimate GHG emissions for the Project. These Guidelines are the current guidelines and further refinement of these guidelines is not scheduled to take place until 2019. It is noted that the 2006 IPCC Guidelines were advised to provide a technically sound methodological basis for evaluating national GHG inventories, and therefore fundamental revision is unnecessary. However, to maintain the scientific validity of the 2006 IPCC Guidelines, certain refinements may be required to take into account scientific and other technical advances that have been developed since 2006 (IPCC, 2018).

It is noted that Vietnam ratified the Kyoto Protocol and is an Annex I Party to the UNFCCC (UNFCCC, 2018a). The UNFCCC reporting guidelines on annual inventories for Annex I Parties (decision 24/CP.19) requires the use of the 2006 IPCC Guidelines for National GHG Inventories (UNFCCC, 2018b). As such, the 2006 IPCC guidelines are considered appropriate for estimating GHG emissions for the Project.

As the effects of GHGs are assessed on a global scale, the use of dispersion modelling does not provide a useful analysis. GHG emissions are therefore considered in terms of total emissions based on a methodology consistent with the 2006 IPCC Guidelines. These guidelines consist of a three-tier approach to estimating emissions from fossil fuel combustion, as shown in Table 10.20 below.

Table 10.20 Methodology Tiers for Estimation of GHG Emissions by Fossil Fuels

Scope	Description	Treatment in this assessment
Tier 1 Approach	Calculates emissions by multiplying estimated fuel consumed with a default emission factor. For CO_2, emission factors mainly depend upon the carbon content of the fuel and therefore emissions can be estimated fairly accurately using this method. Emission factors for CH_4 and N_2O depend on the combustion technology and operating conditions and vary significantly. As such, large uncertainties are anticipated from this method.	Approach used for CO_2, CH_4, and N_2O (e.g. mobile combustion).
Tier 2 Approach	The approach is the same as Tier 1 but country-specific emission factors are used in place of the Tier 1 defaults.	Not used in this assessment as no country-specific published data are available.

Scope	Description	Treatment in this assessment
Tier 3 Approach	Technology-specific emission factors.	Approach used for CH_4, and N_2O for stationary combustion (e.g. LNG combustion).

Global Warming Potential (GWP) is a measure of the total energy that a gas absorbs over a specified period of time (usually 100 years), compared to carbon dioxide. Carbon dioxide equivalent (CO_2-e) is a metric measure used to compare the emissions from various GHGs based on their GWP (USEPA, 2017). The GWP values used for this assessment are presented in Table 10.21 and were obtained from the IPCC Fifth Assessment Report (IPCC 2014). These values are recommended for use by the Greenhouse Gas Protocol (GHG Protocol 2018).

Table 10.21 100-Year Global Warming Potential (GWP) Values

Greenhouse Gas	Global Warming Potential Values
Carbon dioxide (CO_2)	1
Methane (CH_4)	28
Nitrous oxide (N_2O)	265

Source: the IPCC Fifth Assessment Report (IPCC 2014)

10.6.1.2 Impact Assessment Methodology

A traditional impact assessment is conducted by determining how the proposed activities will affect the state of the environment prior to development of a project. In the case of GHG emissions, this process is complicated by the fact that the impact of GHG emissions on the environment cannot be quantified within a defined space and time.

The greenhouse effect occurs on a global basis and the geographical source of GHG emissions is irrelevant when considering the future impact on the climate. It is not possible to link emissions from a single source – such as the Project - to particular impacts in the broader study area.

As such, this study does not consider the physical impacts of climate change resulting from increasing GHG emissions, but instead will assess the impact of the Project's GHG emissions by way of:

- Understanding the scale of the Project's GHG emissions by comparing total emissions to GHG magnitude ratings and scales for projects (developments) that have been developed by various international lender organisations or groupings, including the IFC, the EBRD, and the EP;
- Assessing the GHG performance of the Project relative to reference benchmarks on the GHG intensity of electricity production, including the GHG intensity of Vietnam's grid electricity and of other LNG-fired power plants; and
- Understanding of the impact of the Project on Vietnam's national GHG emissions inventory, and consideration of the alignment of the Project with the country's climate policy and international GHG reduction commitments.

The Project in the context of this study refers to the proposed 3x750 MW LNG-fired Power Plant and the Project's impact, in terms of GHG emissions (and contribution to global climate change), reflects GHG emissions from the Plant throughout its life cycle.

To assess the significance of GHG emissions impacts, the following criteria are used:

- Type: indicate the relationship of the impact to the Project (in terms of cause and effect);
- Extent: indicate the 'reach' of the impact;
- Duration: indicate the time period over which a resource / receptor is affected;
- Scale: indicate the size of the impact; and

- Frequency: give a measure of the constancy or periodicity of the impact.
- Magnitude: is a function of extent, duration, scale and frequency and it describes the degree of change that the impact is likely to impart on the resource / receptor; and
- The sensitivity/vulnerability/importance of the impacted resource/receptor.

Significance is subsequently assessed on the basis of the magnitude rating of the impact, and the sensitivity/vulnerability/importance rating for the resource/receptor, and ranked as either Negligible, Minor, Moderate, or Major.

In the context of climate change impacts associated with GHG emissions from the Project (this study), extent, duration, and frequency are the same irrespective of the Project context and the scale of its GHG emissions, and therefore do not form a good basis on which to assess the significance of the impacts associated with GHG emissions. Specifically, the extent of GHG (climate change) impacts is global, the duration of the impact is permanent, and the frequency of the impact is constant since GHG emissions will be produced throughout the lifetime of the Plant.

As such, GHG impact significance is determined on the basis of the assessment of the scale of the GHG emissions from the plant using benchmarks from international lender standards, further informed by reference benchmarks on the GHG intensity of electricity production for similar facilities and according to the grid emissions factor in Vietnam, as well as an analysis of the Project's alignment with Vietnam's energy and climate change policies.

10.6.1.3 Magnitude and Scale from International Lender Standards

An additional perspective on the magnitude of the Project's GHG emissions is provided by standards that are applied to developments at an international level. Table 10.22 shows a magnitude scale for project-wide GHG emissions that is derived from, and in line with, a number of current international lender organisations or groupings, such as International Finance Corporation (IFC) standards, the European Bank for Reconstruction and Development's (EBRD) GHG assessment methodology and the Equator Principles (EP).

Table 10.22 Magnitude Scale for Project-wide GHG Emissions Based on Wider Standards

GHG Emissions Thresholds per annum	Magnitude Rating
>1,000,000 tonnes CO_2-e	Very Large
100,000 – 1,000,000 tonnes CO_2-e	Large
25,000 – 100,000 tonnes CO_2-e	Medium
5,000 – 25,000 tonnes CO_2-e	Small
<5,000 tonnes CO_2-e	Negligible

10.6.1.3.1 IFC reporting Thresholds

The IFC's Performance Standard 3: Resource Efficiency and Pollution Prevention defines a reporting threshold for annual GHG emissions of 25,000 t CO_2-e, and requires clients to "…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." (IFC, 2012).

10.6.1.3.2 Equator Principles (IV)

The EPs require all project owners, in all locations, to conduct an alternatives analysis to evaluate less GHG intensive alternatives when combined Scope 1 and Scope 2 operational emissions are expected to be more than 100,000 t of CO_2-e annually. In addition, the EPs require that the Client (should) report

combined Scope 1 and Scope 2 emissions, publicly on an annual basis, during the operational phase for projects emitting over 100,000 t of CO_2-e annually. It notes further that clients would be 'encouraged' to report publicly on projects emitting over 25,000 t of CO_2-e (EP IV, 2019).

10.6.1.4 Assumptions

The following should be noted with respect to any assumptions made for the purposes of this assessment:

- This study uses information and data on the Project given in the local Environmental Impact Assessment (VATEC, 2020) and Feasibility Study (PECC3, 2017).
- This study refers to a variety of policy documents published by the Vietnam government in order to undertake an analysis of Vietnam's energy and climate policy, to describe Vietnam's current national GHG emissions and inventory, and to project the country's GHG emissions towards 2050. In the absence of any information to suggest otherwise, the study assumes that existing policies and plans for both the energy sector and with respect to climate change mitigation will be implemented as described in existing policy documents. Any key assumptions made either in the policy documents or in any related analysis have been stated in the report;
- It is assumed that the entire biomass is removed in the year of conversion. The recommended default assumption for the Tier 1 calculation is that all carbon in biomass is released to the atmosphere through decay processes either on- or off-site.

10.6.2 Assessment of Impacts

10.6.2.1 Construction Phase

10.6.2.1.1 Site Clearance - Scope 1

The Project's area subject for site clearance is estimated to be 8.14 ha of cropland which grows cashew, vegetables and other plants (VATEC, 2020). The clearing of vegetation in this area can result in a change in carbon stocks from the removal of living biomass.

The land use category is classified to be cropland in line with the IPCC categories (IPCC, 2006). GHG emissions from land clearance is estimated using the Equation 10.1 (IPCC, 2003) and the parameters summarised in Table 10.23. Total GHG emissions from vegetation clearing are presented in Table 10.24.

Equation 10.1 Change in Biomass Carbon Stocks on Land Converted to another Land Category

$$\Delta C_{LO_{LB}} = A_{Conversion} \times \left(B_{After} - B_{Before}\right) \times CF$$

where:

$\Delta C_{LO_{LB}}$	=	Annual change in carbon stocks in living biomass in land converted to 'other land'	(t C/year)
$A_{Conversion}$	=	Area of land converted to 'other land' from some initial land uses	(ha/year)
B_{After}	=	Amount of living biomass immediately after conversion to 'other land'	(tonnes d.m./ha)
B_{Before}	=	Amount of living biomass immediately before conversion to 'other land'	(tonnes d.m./ha)
CF	=	Carbon fraction of dry matter (default = 0.5)	(tonnes C/tonnes d.m.)

Table 10.23 Amount of Living Biomass Before and After Land Conversion

Description	Amount of Living Biomass (tonnes d.m./ha)
Before	2.6 [a]
After	0 [b]

a. Carbon stock in biomass for perennial cropland for tropical, moist climate region from Table 3.3.8 from Chapter 3.3 of Good Practice Guidance for Land use, Land-use Changes and Forestry (IPCC, 2003).
b. Default assumption of 0 was assumed when converted to other land as per Section 3.7.2.1.1.1 from Good Practice Guidance for Land use, Land-use Changes and Forestry (IPCC, 2003).

Table 10.24 Annual GHG Emissions from Land Clearing in the Preparation Phase

Phase	Description	GHG Emissions (t CO_2-e/year) [c]	
		CO_2	**Total**
Preparation phase	Land clearing	10.6	10.6

Note for c. It is assumed that the entire biomass is removed in the year of conversion

10.6.2.1.2 Mobile Combustion for Site Clearance - Scope 1

A number mobile equipment including bulldozers, excavators and graders will be mobilized. According to the EIA, the maximum fuel consumption of these equipment is estimated to be 528 liters per day. The preparation phase is expected to last one month (30 days), making the total fuel consumption in preparation phase of 15,840 liters (or 15.84kL).

GHG emissions from mobile combustion are estimated using Equation 10.2, the GWP values in Table 10.21, default emissions factors and energy content factors in Table 10.25. Resultant emissions from mobile combustion during the construction phase are presented in Table 10.26.

Equation 10.2 Fuel Combustion

$$E_j = \frac{Q_i \times EC_j \times EF_{ijoxec}}{1000}$$

where:

E_j	=	Estimated emissions of gas type j (CO_2, CH_4 or N_2O) from fuel type (i)	(t CO_2-e)
Q_i	=	Estimated quantity of fuel type (i)	(kL)
EC_j	=	Energy content factor of fuel (j)	(GJ/kL)
EF_{ijoxec}	=	Emission factor for each fuel type (j)	(kg CO_2-e/GJ)

Table 10.25 Default Emissions Factors and Energy Content Factor for Diesel Combustion in Mobile Equipment and Vehicles

Description	Value	Units
Energy content factor for diesel	43 [a]	MJ/kg or GJ/t
	35.9 [b]	GJ/kL
Diesel density [c]	0.840	kg/L or t/kL
Tier 1 CO_2 emission factor - diesel [d]	74.1	kg CO_2-e/ GJ
Tier 1 CH_4 emission factor - diesel [d]	4.15	kg CH_4/ TJ
	0.12	kg CO_2-e/ GJ
Tier 1 N_2O emission factor - diesel [d]	28.6	kg N_2O/ TJ
	7.6	kg CO_2-e/ GJ

a. (IPCC, 2006) - Table 1.2 (default net calorific values (NCVs) and lower and upper limits of the 95% confidence intervals), page 1.18, Volume 2 (Energy), Chapter 1 (Introduction).
b. Estimated by ERM based on the diesel density.
c. (STAMEQ, 2018) – TCVN 5689:2018, Table 1 (Diesel fuel oil - Specifications and test methods), Diesel density
d. (IPCC, 2006) - Table 3.3.1 (default emission factors for off-road mobile sources and machinery), page 3.36, Volume 2 (Energy), Chapter 3 (Mobile Combustion).

Table 10.26 GHG Emissions from Mobile Combustion for Site Clearance

Description	GHG Emissions (t CO2-e)			
	CO_2	**CH_4**	**N_2O**	**Total**
Diesel combustion in mobile equipment	42.14	0.067	4.32	46.53

10.6.2.1.3 Mobile Combustion for Construction - Scope 1

According to the EIA, the following mobile equipment will be mobilized in construction phase:

Table 10.27 Mobile Equipment to be Mobilised for Construction

Equipment	Engine rating (Horsepower)	Quantity
Grader	320	2
Excavator	315	3
Compactor	200	11
Concrete mixer	235	4

In the conservative case, when all equipment is operated concurrently, the total fuel consumption of these equipment is estimated to be 3,922 of liters of diesel per day. The construction phase is expected to last 360 days, making the sump of fuel consumption of 1,411,920 liters (or 1,142 kL).

Using the Equation 10.2, the GHG emissions from mobile combustion for construction is as follows:

Table 10.28 GHG Emissions from Mobile Combustion in the Construction Phase

Description	GHG Emissions (t CO2-e)			
	CO_2	**CH_4**	**N_2O**	**Total**
Diesel combustion in mobile equipment	3037.94	4.92	311.58	3354.44

10.6.2.1.4 Mobile Combustion for Transportation - Scope 1

According to the EIA, 99 round trips will be made to transport WTG parts from Cam Ranh port to the site (29 km). Therefore, the HGVs will travel around 5,800 km in total. The fuel consumption of HGV is estimated to be 40 litres of diesel per 100 km (ICCT, 2015), making the total fuel consumption for transportation of WTG parts of 2,320 litres.

Most of workers (80/84 persons) are locals from Loi Hai commune, therefore their daily commuting distance will be short, and as a common practice in Vietnam, they will use motorcycles to go to work. Therefore, GHG emission from workers' daily commuting to work is insignificant and not accounted.

Using the Equation 10.2, the GHG emissions from mobile combustion for transportation of WTG parts is:

Table 10.29 GHG Emissions from Mobile Combustion for Transportation of WTG parts

Description	GHG Emissions (t CO2-e)			
	CO_2	**CH_4**	**N_2O**	**Total**
Diesel combustion for transportation of WTG parts from Cam Ranh port to construction sites	6.17	0.01	0.63	6.81

10.6.2.1.5 Purchased Electricity - Scope 2

No information about number of purchased electricity consumption was given by the Project owner, except that electricity will be supplied from the nearby national grid. Therefore, the GHG emissions from purchased electricity was not calculated.

10.6.2.1.6 Summary of Emissions

A summary of the estimated annual GHG emissions for the construction and operation phases are presented in Table 10.30.

Table 10.30 Summary of GHG Emissions in Construction Phase

Description	**GHG Emissions (t CO2-e)**				
Emissions in construction phase	**Site clearance**	**Mobile combustion for site clearance**	**Mobile combustion for construction**	**Mobile combustion for transportation of WTG parts**	**Total**

Description	GHG Emissions (t CO2-e)				
	10.62	46.53	3354.44	6.18	3418.40

10.6.2.1.7 Significance of Impacts

The ADB Environmental Safeguards require the application of pollution prevention and control technologies and practices consistent with international good practice. Pollution prevention and abatement is said to be required if the project is emitting GHGs. As such the client is required to promote the reduction of GHG emissions from the project. The Loi Hai 2 Wind Farm Project is considered as an insignificant producer of GHGs given it is emitting less than 100,000 tonnes CO_2-e during its 12-month construction period and zero emission during its operational years. IFC requires projects that are expected to produce more than 25,000 tonnes of CO_2-e annually to also quantify direct emissions from its facilities as well as indirect emissions associated with the off-site production of energy used by the project. As such, the Project is not required to quantify its GHG emissions during construction phase.

The emissions from construction phase (Scope 1 and 2) estimated from the project are anticipated to be 3,500 tonnes CO_2-e over the 12-month period. The Project is therefore anticipated to contribute only 0.001 percent of Vietnam's national GHG emissions (293.3 Mt CO2-e excluding LULUCF (MONRE, 2017) annually and 0 percent of global anthropogenic emissions (53,526 Mt CO_2-e excluding LULUCF (WB 2013) over the same period.

Magnitude of GHG emissions impact

The construction phase (including site clearance) is anticipated to last 12 months so the duration for GHG emissions is considered short-term. GHG emissions are greatly mobile due to its long lasting existence (up to thousands of years) in the atmosphere and high mixing capacity[12]. GHG emissions contribute to climate change that has the potential to result in significant environmental effects. Given that GHG emissions from the Project will account for 0.001% of the national emissions and 0% of the global emissions, the intensity of GHG emissions is assessed to be **Negligible** at both national level and global level. The magnitude of the combined effect is therefore to be **Negligible** at both national level and global level.

Sensitivity of national and global GHG emissions inventories

Total GHG emissions reported at the national and global levels are 53,526 Mt and 284 Mt CO_2-e, respectively. Therefore, GHG emissions are redundant and thereby have low irreplaceability. In addition, GHG emissions are projected to keep rising (e.g. 466 Mt CO_2-e in 2020 and 760.5 Mt CO_2-e in 2030 under the BAU scenario (MONRE, 2016) so they are resilient and in a steady growth. For this reason, the vulnerability of the national and global GHG inventories is likely to be low. Moreover, GHG emissions contributes to global warming which impacts multiple resources, human activities and ecological systems and therefore are considered providing no services, leading to its low influence. The combined sensitivity of GHG emissions is to be low at both the national and global scales.

Overall, the significance of GHG emissions impact identified by combining the magnitude of the GHG emissions impact and the sensitivity of the national global emissions inventories to be **Negligible** for the national emissions and **Negligible** for the global emissions inventory.

Table 10.31 Assessment of Increased GHG Emissions in Construction Phase

Impact	Environmental and health impacts from emission of GHG in construction phase			
Impact Nature	**Negative**	Positive	Neutral	
	Environmental and health impacts are considered **Negative**.			
Impact Type	**Direct**	**Indirect**	Induced	
	GHG emissions cause both **direct** and **indirect** environmental and health impacts.			
Impact Duration	Temporary	Short-term	**Long-term**	Permanent
	The impact duration is **Long-term** because GHG has long-lasting effects			

Impact Extent	Local	Regional	**Global**		
	GHG impacts are considered having global effects				
Impact Frequency	Not applicable				
Impact Magnitude	Positive	**Negligible**	Small	Medium	Large
	Considering the amount of GHG emissions, the impact magnitude is **Negligible**.				
Vulnerability of Receptors	**Low**	Medium	High		
	The combined sensitivity of GHG emissions is to be low at both the national and global scales.				
Significance	**Negligible**	Minor	Moderate	Major	
	The significance is **Negligible.**				

10.6.2.2 Operation Phase

In operation phase, Loi Hai 2 Wind Farm is expected to give an annual electricity output of 92 GWh. As wind power generators do not emit greenhouse gases during its operation, the Project will help to save around 84,000 tCO_{2-e} annually comparing to thermal power generation[4]. Therefore, the impact nature is considered **Positive**. Considering that the scale of Project is 29 MW, while Vietnam is expected to have 1,000 MW of wind power generation by the end of 2020[5], the significance of positive impact of the Project in terms of GHG reduction is considered **Small**.

10.7 Electromagnetic Interference Impact Assessment

The transport of electricity through undersea inter-array cables and overhead transmission line has potential to emit a localized Electromagnetic Fields (EMF) which could potentially affect some marine benthic species, intertidal and subtidal habitat and human health. EMFs have both electric measured in kilovolts per metre (kV/m) and magnetic components measured in micro tesla (μT). While the direct electric field is mostly blocked with the use of conductive sheathing, the magnetic field can penetrate most materials, thus is emitted into the natural terrestrial and aquatic environment.

10.7.1 Scope of Assessment

Activities causing the potential impacts to electromagnetic interference that are likely to negatively impact receptors during the operation phase include:

- Electrical current flowing through conducting wire of the wind turbines transformers, transmission line and substation transformers when the wind turbines are in operation.

10.7.2 Relevant Guidelines and Criteria

10.7.2.1 Vietnamese Regulations

- The Law on Electricity No. 28/2004/QH11 was approved by the National Assembly of the Socialist Republic of Vietnam at its 6th session on 03 December, 2004;
- Decree No. 14/2014/ND-CP dated February 26, 2014 stipulates in detail the implementation of The Law on Electricity, especially regarding electricity safety;
- Decree No 51/2020/ND-CP dated 21 April, 2020 on amending a number of Articles of the government's Decree No 14/2014/ND-CP dated February 26, 2014 stipulating implementation of electricity law regarding electrical safety;

[4] Grid emission factor of Vietnam is 0.981 tCO2/ MWh as announced by Department of Climate Change in Notice No. 263/BDKH-TTBVTOD.

[5] Vietnam aims to install 1,000 MW of wind power by 2020. Voice of Vietnam, 9 April 2019. Available at https://vov.vn/kinh-te/viet-nam-phan-dau-tong-cong-suat-dien-gio-nam-2020-dat-khoang-1000mw-896030.vov. Accessed on 2 March 2021.

- Circular No. 31/2014/TT-BCT dated 02 October, 2014 regulating details on electrical safety;
- QCVN 25/2016/BYT – National Technical Regulation on Industrial Frequency Electromagnetic Fields – Permissible Exposure Level of Industrial Frequency Electromagnetic Fields in the Workplace; and
- QCVN 21:2016/BYT - National Technical Regulation on High Frequency Electromagnetic - Permissible Exposure Level of High Frequency Electromagnetic Intensity in the Workplace

10.7.2.2 International Guidelines

IFC Environmental Health and Safety Guidelines for Electric Power Transmission and Distribution (2007) provides guidelines to manage potential environmental and community health and safety impacts from power construction facilities, including electric and magnetic fields.

As mentioned in the above section, electric fields are normally measured in kilovolts per metre (kV/m), while magnetic fields are defined by magnetic flux density, measured in micro-Tesla (μT) or milli-Gauss (mG). The World Bank Group's (WBG) Environmental, Health and Safety (EHS) Guideline[6] for Power Transmission and Distribution (WBG, 2007) refers to the International Commission on Non-Ionizing Radiation Protection (ICNIRP)[7] [8] for health and safety standards relative to exposure to EMF. The World Health Organization (WHO)[9] refers to ICNIRP EMF standards as short-term and high level exposure limits. At present, ICNIRP limits consider the scientific evidence related to possible health effects from long-term, low level exposure to EMF fields insufficient to justify lowering these quantitative exposure limits. The ICNIRP EMF exposure limits are instantaneous and not averaging and it refers to Basic Restrictions and Reference Levels for both magnetic and electric fields under General Public and Occupational exposure conditions (see Table 10.32). Basic Restrictions are the fundamental limits on exposure and are based on the internal electric currents or fields that cause established biological effects in humans. They are impractical to measure. Therefore, Reference Levels of exposure to the external fields, which are simpler to measure, are provided as an alternative means of showing compliance with the Basic Restrictions. The Reference Levels have been conservatively formulated such that the Reference Levels will ensure compliance with the Basic Restrictions. In summary, these limits can be considered as chronic exposure standards and there are no health risks associated with short-term exposure to these levels.

Table 10.32 Basic Restrictions and Reference Levels for Exposure to 50 Hz EMF at the Edge of Right of Way (ROW)

Exposure Characteristics	Electric field (kilo volts per meter, kV/m)	Magnetic flux intensity		
		Micro-Tesla (μT)	Milli-Gauss (mG)	Ampere/m (A/m)
Occupational	10 kV/m	1,000 (500 prior to 2010)	10,000 (5,000 prior to 2010)	798 (399 prior to 2010)
General Public	5 kV/m	200 (100 prior to 2010)	2,000 (1,000 prior to 2010)	160 (80 prior to 2010)

[6] EHS Guidelines for Power Transmission and Distribution, April 30, 2007

[7] The ICNIRP Guidelines (2010) for limiting exposure to time-varying electric, magnetic and electromagnetic field (up to 300GHz) (http://www.icnirp.de/PubEMF.htm)

[8] These values represent the ICNIRP occupational exposure limits.

[9] WHO 2007, Extremely Low Frequency Fields – Environmental Health Criteria, Monograph No. 238 March 2007

10.7.3 Assessment Methodology

The calculation of Electro Magnetic Field (EMF) is one of the factors which must be considered during the design process especially for high voltage transmission lines to determine Right of Way (ROW) of the power line such that there will not be danger for the people and surrounding environment.

An excel based software developed by EEP Portal[10] for the calculation of electromagnetic field (EMF) around transmission and distribution overhead lines was used to calculate EMF for the 110kV transmission line proposed for the current study. The tool can be used to calculate one or two circuit lines in which ground wires can be incorporated for the EMF calculations. In addition, the tool allows combining and creating examples of power lines where two independent power lines can interact on each other. The EMF calculations used in this tool uses the analytical approach described in EPRI Red Book "Transmission Line Reference Book".

10.7.4 Impact Assessment

10.7.4.1 EMF from 110kV Overhead Transmission Line

Input data

The input data used for EMF calculation, setting up the transmission tower and circuit lines is given for Tower N122-29C shown in Table 10.33 and Tower D111-30A shown in Table 10.34. The selected circuit line is ACSR/Mz-300/39.

Table 10.33 Transmission Line Parameter for Tower N122-29C

			X [m]	Y [m]	Umax [kV]	I[A]	rA [mm]	dA [mm]	n	Ph-seq
Line 1	Circuit 1	L1	-3.5	23.5	121	680	12	0	1	1
		L2	-3.5	19.5	121	680	12	0	1	2
		L3	-3.5	15.5	121	680	12	0	1	3
		g.w	-3.5	29.7	0	0	6	0	1	0
		g.w	3.5	29.7	0	0	6	0	1	0
	Circuit 2	L3	3.5	15.5	121	680	12	0	1	3
		L2	3.5	19.5	121	680	12	0	1	2
		L1	3.5	23.5	121	680	12	0	1	1

X [m] – horizontal length from the middle of the line; Y [m] – height in which wires are suspended; Umax [kV] – maximum permissible line voltage; I [A] – maximum permissible line current (in case of bundle it is; determined for all wires); r_A [mm] – wire radius; d_A [mm] – distance between wires in bundle; n – number of wires in bundle; Ph-seq – phase sequence. 1 – L1, 2 – L2, 3 – L3, 0 – Ground Wire

[10] http://electrical-engineering-portal.com/download-center/electrical-ms-excel-spreadsheets/emf-td-overhead-lines

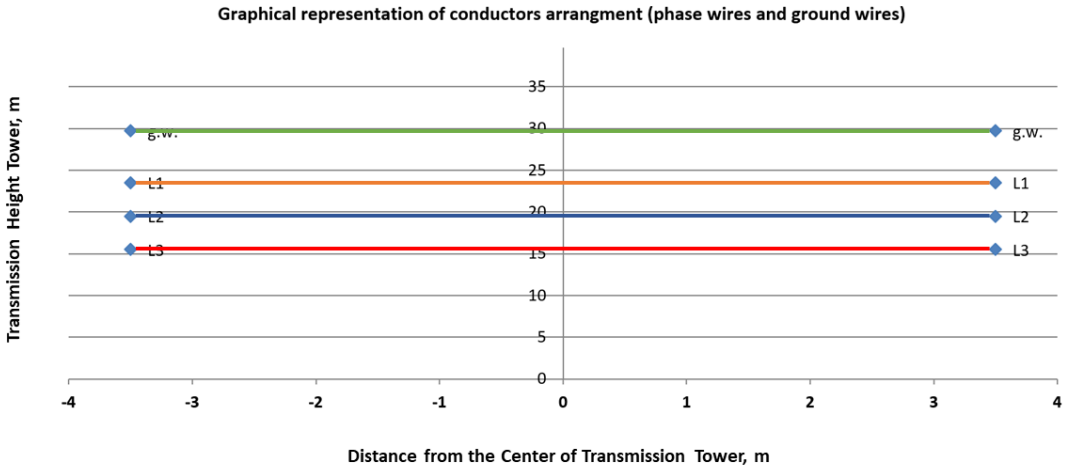


Figure 10.5 Schematic Representation of Transmission Tower with Power Line Arrangement (for Tower N122-29C)

Table 10.34 Transmission Line Parameter for Tower D111-30A

			X [m]	Y [m]	Umax [kV]	I[A]	rA [mm]	dA [mm]	n	Ph-seq
Line 1	Circuit 1	L1	-2.6	38.7	121	680	12	0	1	1
		L2	-2.6	35	121	680	12	0	1	2
		L3	-2.6	31	121	680	12	0	1	3
	Circuit 2	L3	2.6	31	121	680	12	0	1	3
		L2	2.6	35	121	680	12	0	1	2
		L1	2.6	38.7	121	680	12	0	1	1

X [m] – horizontal length from the middle of the line; Y [m] – height in which wires are suspended; Umax [kV] – maximum permissible line voltage; I [A] – maximum permissible line current (in case of bundle it is; determined for all wires); r_A [mm] – wire radius; d_A [mm] – distance between wires in bundle; n – number of wires in bundle; Ph-seq – phase sequence. 1 – L1, 2 – L2, 3 – L3, 0 – Ground Wire

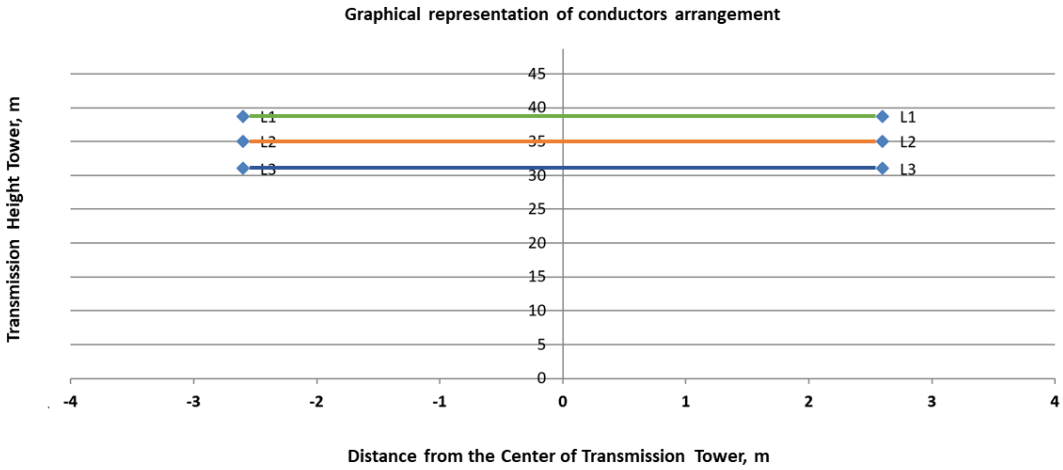


Figure 10.6 Schematic Representation of Transmission Tower with Power Line Arrangement (for Tower D111-30A)

The proposed minimum horizontal free space for the 110 kV double-circuit is 8 m (4 m on either side of the transmission tower). It is expected that the tower type and land area required for the development of 110 kV transmission line will comply with Decree No.14/2014/ND-CP, dated February 26th, 2014 on Stipulating in detail the implementation of electricity law regarding electricity safety as required.

10.7.4.1.1 Potential Impact

EMF can affect human health directly and indirectly. Direct effects result from direct interactions of fields with the body; indirect effects involve interactions with a conduction object where the electric potential of the object is different from that of the body. Exposure to low-frequency electric fields may cause well-defined biological responses, ranging from perception to annoyance, through surface electric-charge effects due to stimulation of central and peripheral nervous tissues and the induction in the retina of phosphenes, a perception of faint flickering light in the periphery of the visual field.

10.7.4.1.2 Existing Controls

The mitigation measures identified in the approved EIA included:

- Design electrical equipment and transmission line in accordance with Vietnam Regulation (Decree No. 14/2014/ND-CP dated on 26 February 2014) including
  - (1) the safety corridor of the 110kV line should be 8 m for the double circuits (4m of each side of the line);
  - (2) the safety corridor for the 22kV line is 2m (1m of each side of the line);
  - (3) the distance from the lowest point of 110kV transmission lines to the ground is at least 15m.
- When detecting any points with electric field exceeding the permitted level (5 kV/m) , it is necessary to relocate structures out of the area;
- Vehicles moving under transmission line needs to ensure that the distance from the lowest point of transmission lines to the highest point of vehicle must not be less than the permissible value according to the electricity industry standards,

- Measuring electromagnetic field in case of grievance;
- Regularly check any violation in safety corridor of the high-voltage grid;
- Check, repair and maintain the power grid on time. Do not operate overloaded transmission line above houses, construction works;
- Chopping trees to ensure the safety of high-voltage grid shall be carried out by the authorized units who managing and operating the high-voltage grid and must notify the management organization prior five (05) working days by direct notification.
- Equip staffs who come in contact with electromagnetic fields (EMF), with PPE;
- Put up warning signs for high voltage areas;
- Provide staff with training on electromagnetic fields (EMF); and
- Exclude staff who have health problems such as cardiovascular and congenital diseases from working in areas with EMF.

10.7.4.1.3 Significance of Impact

Operation of the Project will result in the formation of EMF along the transmission line and at the substations. Although high-voltage transmission lines do generate higher EMFs, this effect is offset by the fact that the towers are higher, the ROW is wider, and phase cancellation shielding is applied, all of which lower EMF levels, as typically measured at the edge of the ROW.

Based on the EPP model, the electric and magnetic fields calculated at the distance from the transmission line at 1m above the ground for two type of transmission towers (N122-29C and D111-30A) are presented in Figure 10.7 - Figure 10.10. The maximum electric, magnetic fields are 0.91 kV/m, 0.27kV/m, 4.11 A/m and 1.26 A/m respectively at 1 m above the ground.

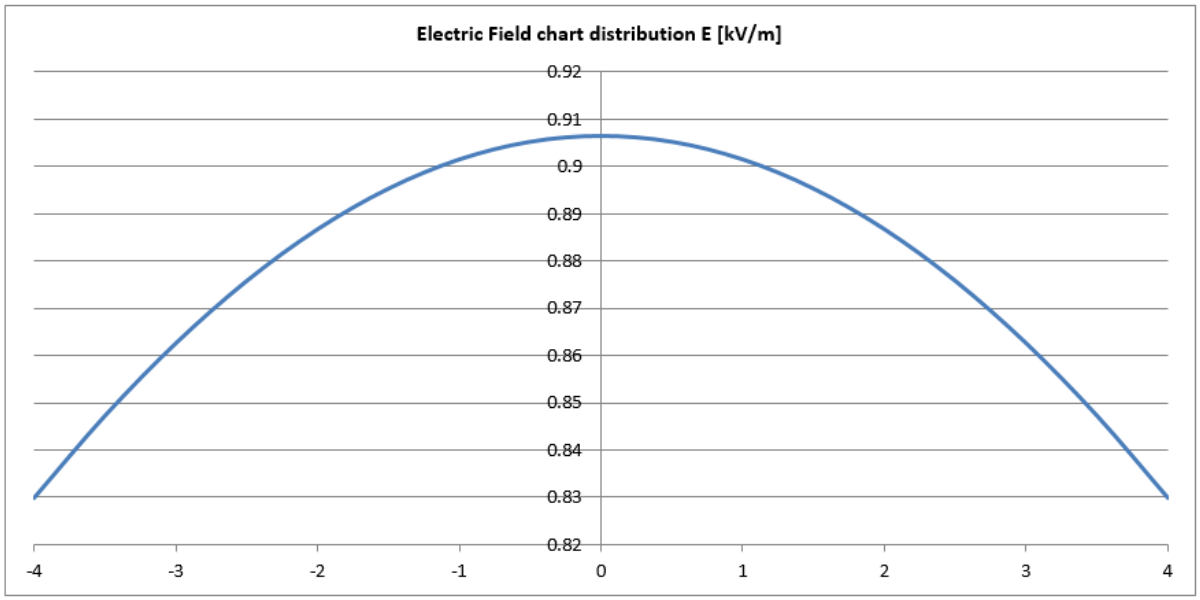


Figure 10.7 Electric Field Distribution for the N122-29C Transmission Tower at 1 m above the Ground

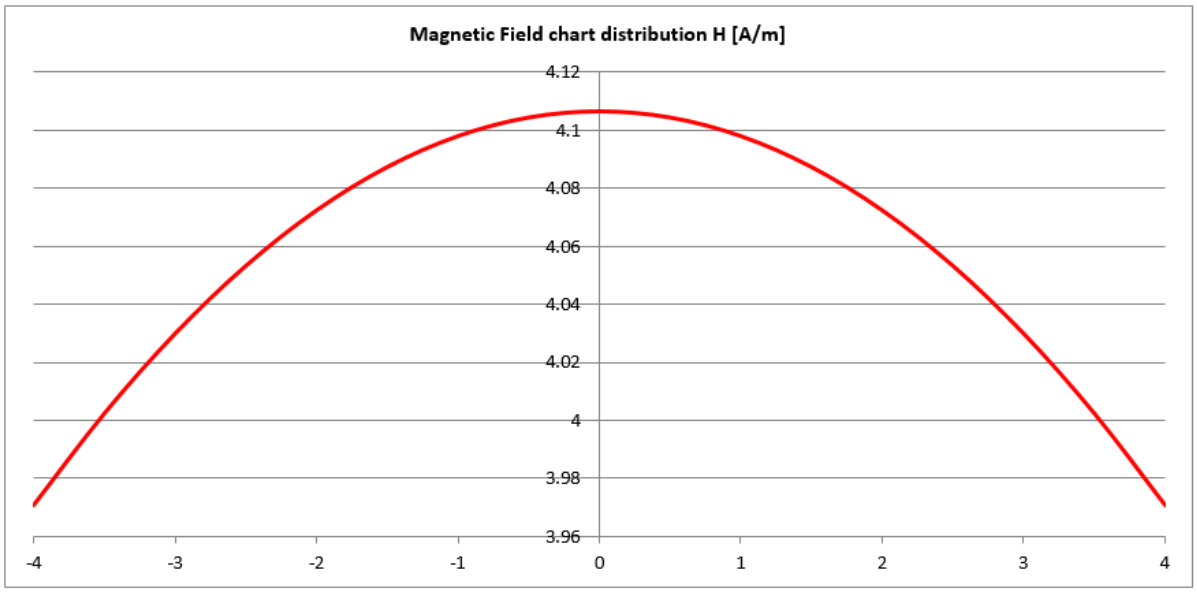


Figure 10.8 Magnetic Field Distribution for the N122-29C Transmission Tower at 1m above the Ground

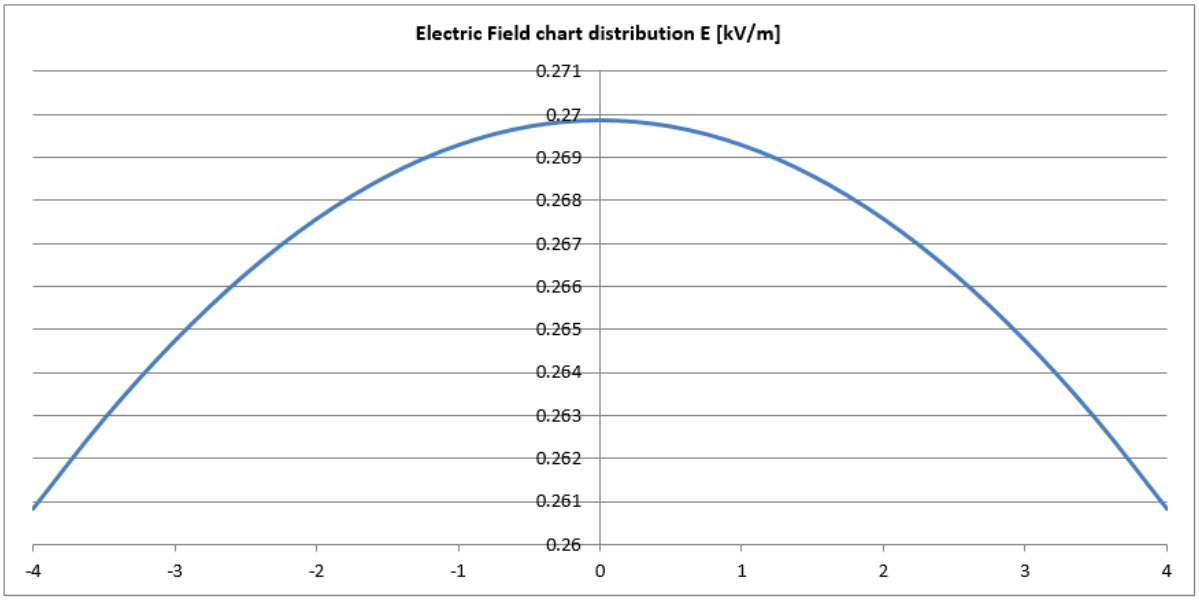


Figure 10.9 Electric Field Distribution for the D111-30A Transmission Tower at 1 m above the Ground

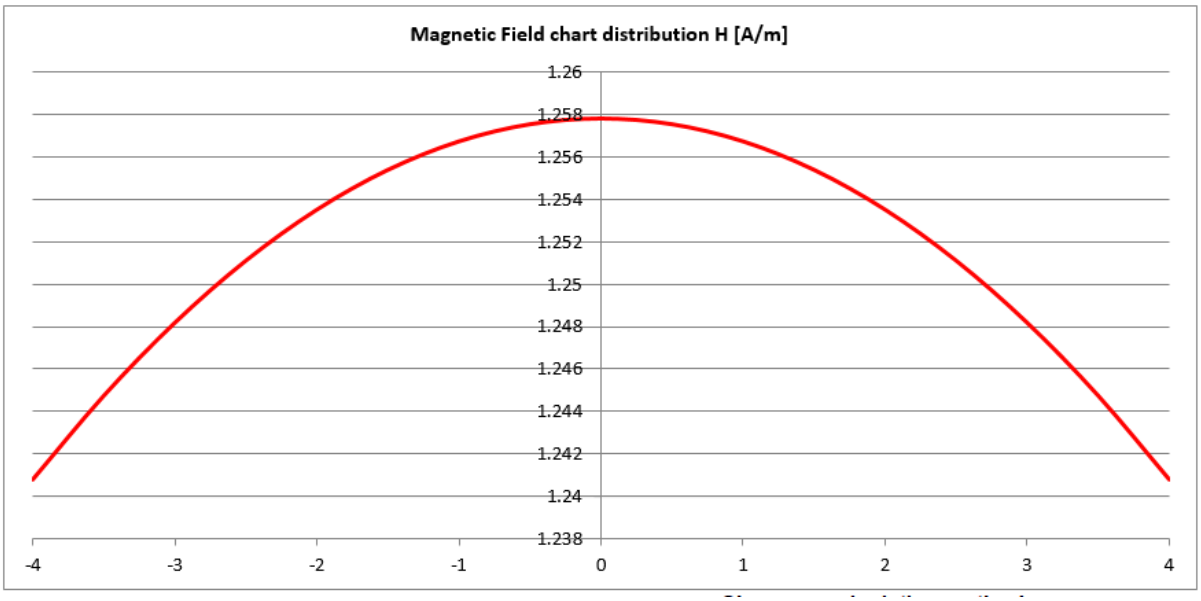


Figure 10.10 Magnetic Field Distribution for the D111-30A Transmission Tower at 1m above the Ground

The maximum calculated electric field and magnetic field inside the ROW for Transmission Tower N122-29C and D111-30A do not exceed the recommended ICNIRP occupational exposure limits. The calculations were performed considering a safety corridor of 8m within the ROW that is 4m on each side, and a distance from the lowest point of 110kV transmission line to the ground of 15.5m. All parameters comply with the National regulation (Decree 14/2014/ND0-CP on Electricity Safety.

The EMF for the proposed 110 kV tower configuration reduce rapidly with distance from the lines. The EMF caused negative and direct impact on health of residences within the ROW. The EMF impact is expected to be localized and occurs in long-term within the ROW through all its life cycle. The impact magnitude is considered as Small and limited to the ROW. The sensitivity of receptors is Low given the 110kV transmission line is relatively short (25m long), passing by agricultural land. According to findings from Scoping Site visit in September 2020, there is no household residing within ROW of transmission line. Additionally, the estimated EMF level is below the recognized international exposure limits, so it seems that it does not contribute to adverse health effects. As such, the significance of EMF caused by the Project is considered to be negligible (See Table 10.35).

Table 10.35 Impacts of EMF during Operation Phase from the 110kV Overhead Transmission Line

Impact	**Health Impact due to EMF from 110 kV overhead Transmission Line**			
Impact Nature	**Negative**	Positive	Neutral	
	Impacts on health is considered **Negative**			
Impact Type	**Direct**	Indirect	Induced	
	Health of livelihoods or residences within the ROW			
Impact Duration	Temporary	Short-term	**Long-term**	Permanent
	The impact duration is **Long-term** within the ROW.			
Impact Extent	**Local**	Regional	Global	
	Impacts are within the ROW.			

Impact Frequency	The impact frequency is closely related to the operation of the wind farm and substation, and assumed to be **continuous** during operation as a worst case.				
Impact Magnitude	Positive	Negligible	**Small**	Medium	Large
	The impact magnitude is **Small**.				
Sensitivity of Receptors	**Low**	Medium	High		
	The sensitivity of receptor is **Low** as explained above, where electric safety design for T-line and mitigation measures are applied in compliance of national regulatory requirements.				
Significance	**Negligible**	Minor	Moderate	Major	
	The significance is **Negligible.**				

10.7.4.1.4 Additional Mitigation Measures

Electric fields can be easily shielded by trees, fences, buildings and most other structures. However magnetic fields are much more difficult to shield than electric fields.

Other additional mitigations measures are based on ESIA requirements to minimise impacts associated with EMF include:

- Avoid schools, hospitals, health clinics, and other sensitive buildings and maintains at least a 24 m buffer to all schools and health clinics;
- Implement all H&S measures as specified in the applicable regulations including earthing of buildings that are metal clad and directly below the transmission line;
- Conduct regular clearance of the clear zone to ensure the area is safe as required by the regulation;
- Conduct regular checking/ maintenance to ensure the safe condition of the tower and the cable;
- The proposed design indicates a free space and minimum free distance of 8 m around the transmission line (i.e. 4 m ROW on either side of the transmission line). Update the EMF study should the ROW width change and against the population growth surrounding the ROW every 5 years. The ROW width should ensure EMF levels meet international safety standards at the ROW edge;
- Conduct a series of H&S focused consultation activities with the affected villages and schools, church that are located closed to the transmission line to discuss the design, H&S management measures and their potential concerns and socialize the project's grievance mechanism to the community to enable them to submit;
- Tower Safety features – place warning signs prohibiting climbing on towers and incorporate design elements that prevent climbing of the towers; and
- Emergency contact information – provide signage at each tower with emergency phone numbers.

10.7.4.1.5 Residual Impact

The residual impact to occupational and public from the transmission of power through the proposed 110 kV voltage transmission line is considered to be **Negligible.**

10.7.4.1.6 Monitoring and Auditing

The electromagnetic field strength in the area of local households and other structures located in the safety corridors of the 110kV transmission line should be monitored.

- Location: 03 locations (households or school or church) at nearest residential area that are close to 110kV transmission line;

- Frequency: Every 6 months
- Parameter: Electric and magnetic field
- Regulation: QCVN 25/2016/BYT – National Technical Regulation on Industrial Frequency Electromagnetic Fields – Permissible Exposure Level of Industrial Frequency Electromagnetic Fields in the Workplace; Decree No. 14/2014/ND-CP dated February 26, 2014 stipulates in detail the implementation of The Law on Electricity, especially regarding electricity safety (Article 13, item 4)

Should there be violations, the Project Owner will implement corrective actions to reduce the effects, such as technical solution and translocation of affected households. Translocation shall comply with the Law, including issues around land acquisition, compensation, support and resettlement.

As there is the potential for buildings within the ROW, it is proposed that EMF monitoring is carried out by measuring at discrete distances from the transmission lines within the first year of the operation on a quarterly basis. Should thresholds be exceeded, further mitigation options should be review and considered.

10.7.4.2 EMF from 22kV Underground Transmission Line

10.7.4.2.1 Potential Impact and Consequences

Electromagnetic filed from 22kV underground transmission line.

10.7.4.2.2 Existing Control

There is no existing controls.

10.7.4.2.3 Significance of Impact

Based on Feasibility Study, the 22kV underground cables are low-voltage and are buried directly underground with a depth of 1m. The EMF emission will be highly localised in terms of spatial extent. However, the underground cables use HDPE insulation so EMF would be of limited emission to surrounding environment where they pass through cable protection materials. The Feasibility Study design has shown that electric field exists between high- voltage conductive cores and earthling amour. So there is expected no E-field leaked by the cable as a result of cable shielding. So the EMF levels expected at underground are comparatively small and the predicted magnetic fields are also expected to rapidly decrease both vertically and horizontally. Therefore, the magnitude of potential EMF impact is expected to be **Small.**

Additionally, the nearest residential area is Suoi Da village, which is approximately 700m to the North East from the nearest turbine (turbine No.2). Their livelihood activities of local community have been identified to be within and surround the Projects' areas such as agricultural fields, gazing areas. So, the sensitivity of receptors is considered **Medium.**

In consideration of the above, the negative impact is assessed to be of **Minor** significance, as shown in Table 10.36.

Table 10.36 Impacts of EMF during Operation Phase from the 22kv Underground Transmission Line

Impact	**Health Impact due to EMF from 22kV underground Transmission Line**		
Impact Nature	**Negative**	Positive	Neutral
	Impacts on human who access to the Project site for agricultural activities is considered **Negative**		
Impact Type	**Direct**	Indirect	Induced

Impact Duration	Temporary	Short-term	**Long-term**	Permanent	
	The impact duration is **Long-term** within the ROW.				
Impact Extent	**Local**	Regional	Global		
	Impacts are within the ROW.				
Impact Frequency	The impact frequency is closely related to the operation of the wind farm and substation, and assumed to be **continuous** during operation as a worst case.				
Impact Magnitude	Positive	Negligible	**Small**	Medium	Large
	The impact magnitude is **Small**.				
Sensitivity of Receptors	Low	**Medium**	High		
	The vulnerability of receptor is **Medium** as explained above.				
Significance	Negligible	**Minor**	Moderate	Major	
	The significance is **Minor.**				

10.7.4.2.4 Additional Mitigation Measures

Some mitigation measures will be proposed in the ESIA, as follows:

- Cable specification will be used to reduce EMF emissions as per industrial standards and best practice such as relevant IEC (International Electro technical Commission) specifications;
- Place warning signs of underground power cable;
- Prohibit other construction works in safety corridors (at least 1.5m in depth and width) of underground power cables.

10.7.4.2.5 Monitoring and Auditing

It is proposed that EMF monitoring is carried out by using suitable magnetic and electric filed sensors within the first year of the operation on a quarterly basis. Should thresholds be exceeded, further mitigation options should be review and considered.

10.7.4.3 EMF from Substation

Substations are part of the electricity supply network that enables the widespread use of electricity for public and industrial use. Inside the substation, there are switches, connections and a transformer. The transformer steps up voltage coming from wind farms and transforms them to the higher voltage of 110kV used by transmission lines. Transformer is the main unit where EMF will be of similar magnitude as the transmission lines and hence it has to be located at a height similar to the transmission line and provide sufficient buffer around it to minimize occupational and public hazards. EMF from other elements in a substation will be small and standard mitigation methods are available to reduce both electric and magnetic fields generated by them, as described below. The electric and magnetic field (EMF) levels within the fenced area of a substation depends on the number of transformers used in the substation. However, these EMF levels decrease rapidly with distance from the transformers and other electrical equipment. Most of the time, EMF levels drop to the same as surrounding background levels at a distance of 30 to 60 m from the fenced area.

10.7.4.3.1 Potential Impact

- Electromagnetic fields from transformers in substations.

10.7.4.3.2 Existing Control

There is no existing control

10.7.4.3.3 Significance of Impact

Predicting magnetic field profiles for substations is a complex exercise given the multitude of time varying sources orientated in multiple directions. As a result, the magnetic field profile is highly dependent on the particular circumstances. In order to understand the magnetic field pattern in the proposed step up substation, similar substation modelling performed elsewhere Tarmizi et al. (2016) was identified for discussion. Tarmizi et al. modelled magnetic field variability in a substation that had the 400kV side connected to three loads, a shunt reactance and an autotransformer to step down the voltage to 220kV. The substation considered by Tarmizi et al. was 280 m long, 140 m wide and the conductors are located at the height of 12m above the ground (on the 400kV side). The normal operating currents at frequency of 50Hz for each load. The magnetic field distribution was calculated at the height of 1.7m where measurements were available for comparison. The computed results for the normal operating currents are presented in Figure 10.11.

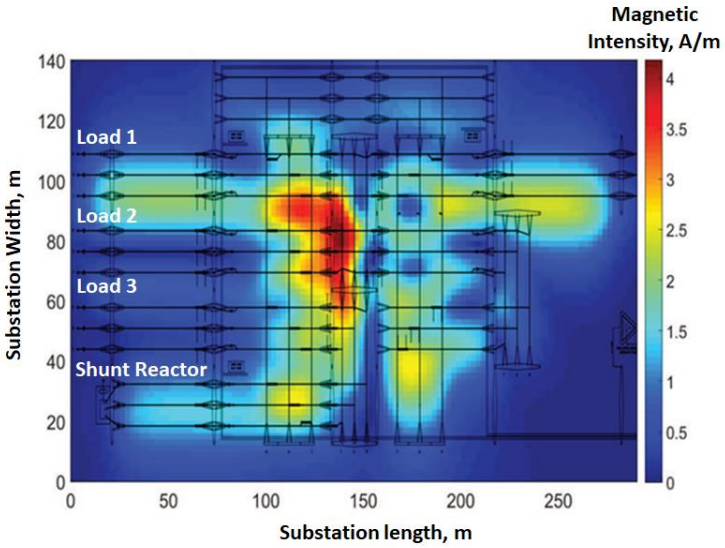


Figure 10.11 Magnetic Field Distribution in the Substation Studied by Tamrizi et al. (2016) for a 400kV Substation (280m long, 140m wide)

Figure 10.11 shows that the predicted highest value of the magnetic field was 4.164A/m located along busbar 1. For the normal operation conditions of the substation, the maximum values of the magnetic field were found to be below public exposure limits proposed by ICNIRP. In addition, it clearly shows that the magnetic field decreases rapidly within the perimeter of the substation. However, for a lightning strike scenario, the magnetic field in the substation exceeded the public and the occupational exposure limit set by ICNIRP. The voltages and size of the substation used in the study by Tarmizi et al. were much higher than the proposed substation (voltage of 123 kV; capacity 40MVA and size up to 69m long by 50m wide) and hence the EMF impact is anticipated to be contained within the substation.

Additionally, another study by Grbic et al., (2017)[11] concluded that within two 110/x kV substations the measured and maximum values of electric fields are lower than the low AL (Action Levels) of 10kV/m (i.e. ICNIRP ELF exposure limits for occupational exposure); and the measured and maximum values of magnetic flux density are lower than the low AL of 1mT (796 A/m, ICNIRP ELF exposure limits for

. [11] Levels of electric and magnetic fields inside 110/X kV substations. Maja Grbic´ ✉, Aleksandar Pavlovic´, Dejan Hrvic´, Branislav Vulevic (24th International Conference & Exhibition on Electricity Distribution (CIRED), 12-15 June 2017). IET Journal.

occupational exposure). ALs are action levels prescribed by Directive 2013/35/EU[12], which states the minimum health and safety requirements regarding the exposure of workers to the risks arising from physical agents (EMF).

Based on the analysis the assessment of impacts of EMF from substation during operation phase is shown in Table 10.37.

Table 10.37 Impacts of EMF during Operation Phase from the Substation

Impact	**Health Impact due to EMF from Substation**				
Impact Nature	**Negative**	Positive	Neutral		
	Impacts on health is considered **Negative**				
Impact Type	**Direct**	Indirect	Induced		
	Health of livelihoods or residences within the substation				
Impact Duration	**Temporary**	Short-term	Long-term	Permanent	
	The impact duration is **Temporary** within the substation				
Impact Extent	**Local**	Regional	Global		
	Impacts are within the substation.				
Impact Frequency	The impact frequency is closely related to the operation of the wind farm, and assumed to be continuous during operation as a worst case.				
Impact Magnitude	Positive	Negligible	**Small**	Medium	Large
	The impact magnitude is **Small**.				
Vulnerability of Receptors	**Low**	Medium	High		
	The vulnerability of receptor is **Low** as explained above.				
Significance	**Negligible**	Minor	Moderate	Major	
	The significance is **Negligible**				

10.7.4.3.3.1 Additional Mitigation and Management Measures

Some additional mitigation measures could be applied to reduce EMF impacts from substation to human health, as follows:

- Security fence line should be installed surrounding the substation.
- Locating major magnetic field sources within the substation to increase separation distances. Key magnetic field sources include the transformer secondary terminations, cable runs to the switch room, capacitors, reactors, busbars, and incoming and outgoing feeders.
- Staff in contact with electromagnetic fields (EMF) needs to be provided with PPE;
- Place warning signs at high voltage areas;
- Use ferromagnetic and conductive materials for shielding as a barrier to reduce the field strength at the source.

[12] Directive 2013/35/EU of the European Parliament and of the Council of 26 June 2013 on the minimum health and safety requirements regarding the exposure of workers to the risks arising from physical agents (electromagnetic fields) (20th individual Directive within the meaning of Article 16(1) of Directive 89/391/ EEC) and repealing Directive 2004/40/EC, Official Journal of the European Union, 29 June 2013 2.

- Limit staff who have health problems such as cardiovascular and congenital diseases to work in areas with EMF.

10.7.4.3.3.2 Residual Impact

With appropriate mitigation measures, the occupational and human exposure can be minimized to fall under ICNIRP standards, therefore the residual impact to occupational and public from the substation is considered to be **Negligible.**

10.7.4.3.3.3 Monitoring and Auditing

The electromagnetic filed should be monitored at the vicinity of the substation. The EMF monitoring survey should be conducted every 6 months during the operation phases. The EMF result must comply with Decree No.14/2014/ND-CP, dated February 26th, 2014 on Stipulating in detail the implementation of electricity law regarding electricity safety and National Technical Regulation QCVN 25:2016/BYT on Industrial Frequency Electromagnetic Fields – Permissible Exposure Level of Industrial Frequency Electromagnetic Fields in the Workplace. Should thresholds be exceeded, further mitigation options should be reviewed and considered.

10.7.4.4 EMF from Wind Turbines

10.7.4.4.1.1 Significance of Impacts

EMF from the step up transformer either in the nacelle of the turbine rotor unit or at some height below it in wind turbines, which increases the voltage to 22kV with rated capacity of 3,200kW, are expected to be lower than the 110kV transmission line. The maximum electric and magnetic fields are unlikely to be assessed quantitatively due to insufficient data of transformer.

However, referred to EMF results from empirical studies of Canadian 27MW wind farm by McCallum et al. (2014)[13], EMF were collected during three operational scenarios to characterize potential EMF exposure: “high wind” (generating power), “low wind” (drawing power from the grid, but not generating power), and “shut off” (neither drawing, nor generating power). Magnetic field levels detected at the base of the turbines under both “high wind” and “low wind” conditions were low (0.9 mG) and rapidly diminished with distance, become indistinguishable from background within 2m of the base. This source appeared to have no influence magnetic field level at nearby sensitive receptors as located over 1km from the closet turbine. The study also concluded that magnetic field levels in the vicinity of wind turbines were lower than those produced by many common household electrical devices (See Figure 10.12). Furthermore, when compared to ICNIRP guidelines, the levels of EMF measured around wind turbines were all well below levels known to cause harm to public and occupational health.

[13] McCallum Lindsay, Aslund M.L.W, Knopper L D, Ferguson G M and Ollson C A. 2014. Measuring electromagnetic fields (EMF) around wind turbines in Canada: is there a human health concern? Environmental Health 2014, 13:9

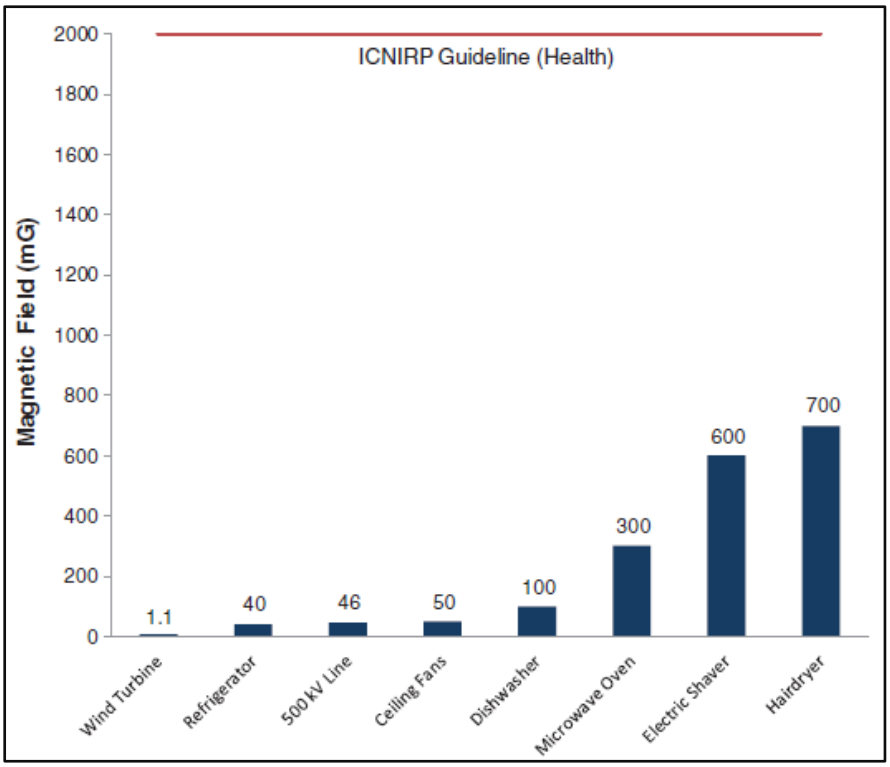


Figure 10.12 Magnetic Fields Comparison from Wind Turbines and 500 kV Power Lines with Common Household Electrical Devices (Source: McCallum et al. 2011)

The maximum calculated electric field occurs directly under the base of the turbine and decreases outwards does not exceed the recommended ICNIRP occupational exposure limits. The EMF impact from the wind turbines are considered **Negligible.**

10.7.4.4.1.2 Additional Mitigation Measures

Whilst no EMF specific additional mitigation and management measures are recommended; to enhance safety, it is recommended to place warning signs prohibiting climbing on wind turbines and incorporating design elements that prevent climbing of the wind turbines. It is also recommended to provide emergency contact information by placing signage at each wind turbine containing emergency phone numbers.

10.7.4.4.1.3 Residual Impact

The residual impact to occupational and public from the substation is considered to be negligible.

10.7.4.4.1.4 Monitoring and Auditing

No specific monitoring and auditing is recommended.

10.8 Shadow Flickering Impact Assessment

10.8.1 Scope of Assessment

Within windfarms, shadow flickering may be one of the most significant impacts on surrounding communities; we have therefore included this section to address this particular impact. The likelihood and duration of the flickering effect depends usually upon a number of factors, including:

- The direction and distance of the property relative to the turbine (the further the observer is from the turbine, the less pronounced the effect will be);
- Turbine height and rotor diameter;
- Time of the day and year linked to climatology conditions in the area;
- Wind direction (that affect potential wind turbine orientation);
- General weather conditions (presence of cloud cover, fog, humidity reduces the occurrence of shadow flicker as the visibility itself of the turbine is reduced);
- Windows structure (e.g. window direction, window coverings, materials); and

Topography and presence of natural or anthropic barriers (i.e. vegetation, other buildings etc.).

In general, shadow flickering effect occurs during clear sky conditions, when the sun is low on the horizon (sunrise and sunset). As the angle of elevation from the horizon of the sun during midday changes throughout the year plus the topographical relief, each location is experienced and influenced by the shadow flickering effect phenomenally different. Hence, specific shadow receptors can be disturbed in different periods of the day or year.

The theoretical number of hours of experienced shadow flickering effect each year at a given location can be calculated by utilising modelling packages (e.g. Shadow model in windRPO 3.4) incorporating the sun path, topographical relief over the Project site, and rotor diameter and hub height details of wind turbine model.

When assessing shadow flickering impacts, the worst case and/or real case impacts are determined:

- **Worst Case Scenario:** the possibility of astronomical shadow flickering duration at maximum is defined when the sun is lastingly shining during daylight hours (i.e. the sky is always clear), the wind turbine is always operating, the rotor is always is always perpendicular to the line from the WTG to the sun; and
- **Real Case Scenario:** the expected shadow flickering duration is when average sunshine hour probabilities and wind statistics at a certain region include turning off periods (low winds and high winds) are taking into account.

10.8.2 Applicable Standards

In August 2015, the World Bank Group published the Environmental, Health and Safety (EHS) Guidelines for Wind Energy. In addition, it is also applied the EHS Guidelines of IFC for Shadow Flicker impact assessment[14]. These are technical reference documents containing examples of good industry practice.

The definition adopted in the EHS guidelines states that shadow flicker occurs when the sun passes behind the wind turbine and casts a shadow. As the rotor blades rotate, shadows pass over the same point causing an effect termed shadow flicker. Shadow flicker may become a problem when potentially sensitive receptors (e.g. residential properties, workplaces, educational and/or healthcare spaces/facilities) are located nearby, or have a specific orientation to the wind energy facility.

Key points identified in the guidelines include:

- Potential shadow flicker issues are **more likely occurred at higher latitudes** where the sun is lower and closer to the skyline; therefore shadows will be casted and extended the radius in which potentially receptors will be experienced consequential shadow flicker impacts.
- In case of the possibilities of modifying the wind turbines' locations where neighbouring receptors experience no shadow flicker effects are low, it is recommended that the predicted duration of shadow

[14] EHS Guidelines of IFC: https://www.ifc.org/wps/wcm/connect/topics_ext_content/ifc_external_corporate_site/sustainability-at-ifc/policies-standards/ehs-guidelines

flickering effects experienced at a sensitive receptor **should not exceed 30 hours per year and 30 minutes per day on the worst affected days, based on a worst-case scenario**.

- Recommended preventative and mitigative measures to avoid substantial shadow flicker impacts include **systematising wind turbines' arrangement appropriately** to avoid shadow flicker being experienced or to meet duration limits of shadow casting continuously on the shadow sensitive receptor, as set out in the paragraph above, or scheduling wind turbines to **shut down at intervals where shadow flicker limits are exceeded**.

10.8.3 Receptors

The Project is located in the north of Loi Hai commune, Thuan Bac district, Ninh Thuan province with most of dense residential area concentrated in Ba Rau 1, Ba Rau 2, and An Dat villages (approximately 800 m to the south of the Project) but there are some dwellings within the Project area which belong to Ba Rau 1 village; and Suoi Da village (approximately 300 m to the northeast of the Project). The Project location is characterised by the presence of flat terrain with most of agricultural land. There is a total of 417 potential receptors within the 1.5 km radio (area of impact)[15] that could potentially experience the shadow flickering event. Figure 10.13 presents the location of such receptors.

[15] Shadow Flicker Impact in EHS Guidelines of IFC:
https://www.ifc.org/wps/wcm/connect/topics_ext_content/ifc_external_corporate_site/sustainability-at-ifc/policies-standards/ehs-guidelines
Area of Influence for Shadow Flicker impact:
https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/48052/1416-update-uk-shadow-flicker-evidence-base.pdf

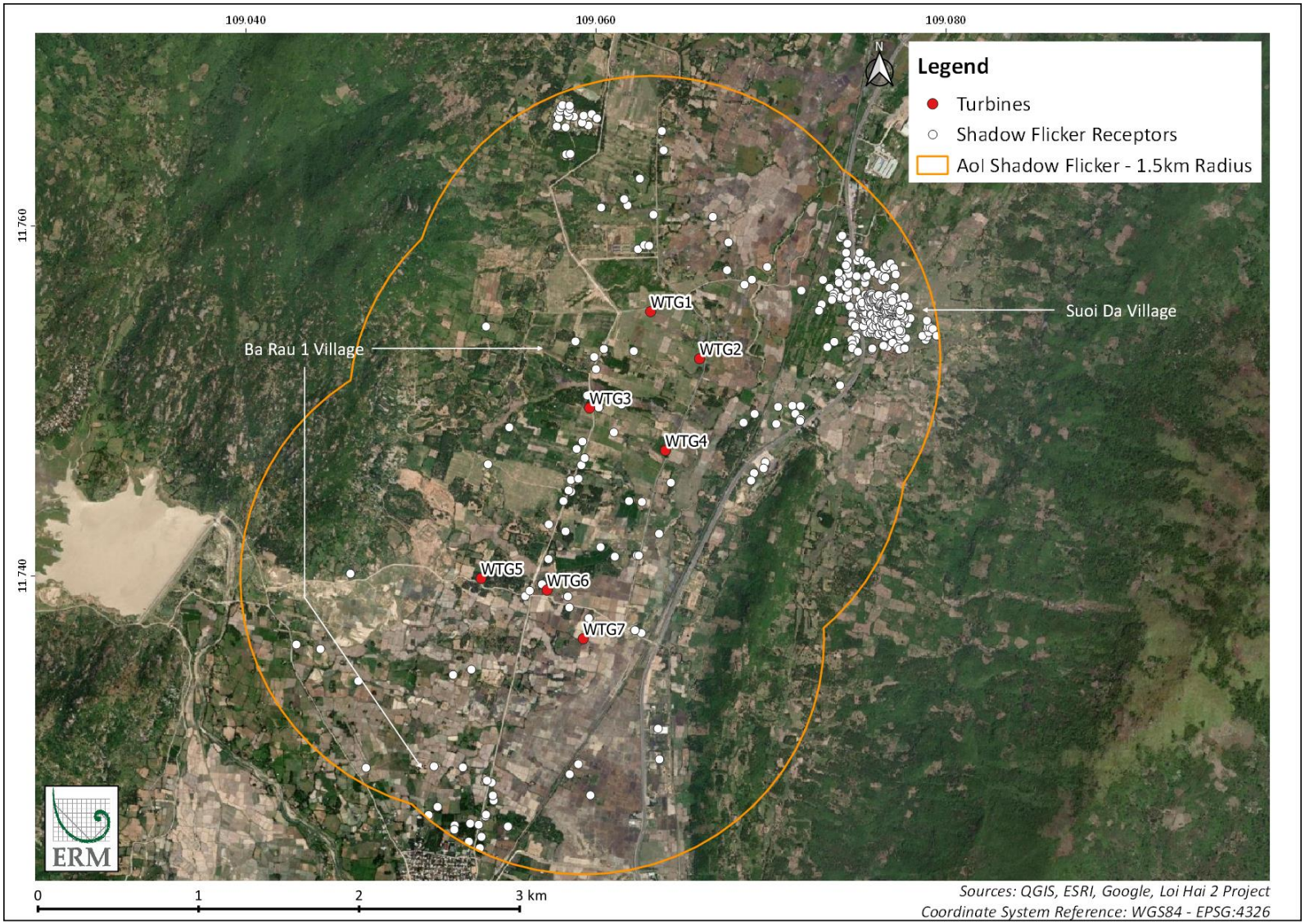


Figure 10.13 Location of Main Receptors

10.8.4 Shadow Flickering Analysis

10.8.4.1 windPRO Model: Scenarios and Input Criteria

This assessment was performed using windPRO 3.4©; a computer software which is widely used by the wind industry. The software package includes a Shadow Flicker Module (SHADOW) that calculates the frequencies and the intervals in which a specific neighbouring receptor or area will be affected by one or more wind turbines.

Two scenarios have been considered and modelled: Worst Case Scenario and Real Case Scenario.

- **Worst Case Scenario:** the calculation is based on the following key assumptions:
  - The presence of physical barriers is not considered;
  - Natural vegetation screening is not included;
  - Cloudiness, humidity are not considered;
  - The sun is shining all the day, from sunrise to sunset;
  - Rotor is always in operation and refrained from turning off during low winds or high winds, and
  - Shadow receptors are modelled using the “greenhouse” mode, meaning that shadow flicker effect to each receptor at all directions (visibility 360 degrees).
- **Real Case Scenario:** is designed by considering planned turbines, the calculations are based on a more realistic situation where publicly available dataset of sun shining probability is applied. However, it should be noted that real case scenario still ignores other relevant conditions of the local settings, which will theoretically lead to an overestimation of the shadow flickering occurrence.

All scenarios have been carried out with a chronological resolution of 1 minute (if shadow flicker is predicted to occur in any 1-minute period, the model records this as 1 minute of shadow flicker).

Independent of the selected scenario, the model calculates outputs according to the principles presented in the following Figure 10.14.

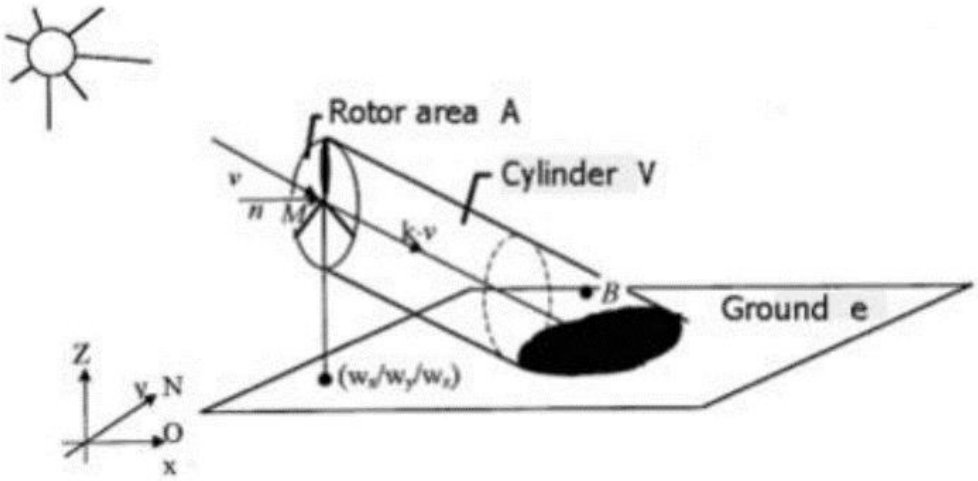


Figure 10.14 Shadow Flickering Theory

All receptors in both scenarios, assuming dwellings/groups of dwellings, within 1.5 km of Project’s WTGs have been modelled are taken into account the following characteristics:

- Single storey building. Therefore, shadow flicker has been calculated at a height of 1 m (equivalent to the ground floor windows);
- Slope of the window has been set to 90°;

- The identified receptors are simulated as fixed points with the 360° viewpoint which represented an unrealistic scenario as real windows would only face a particular direction[16].

10.8.4.2 Worst Case Scenario

The following assumptions have been reflected in the modelling setting for the Worst Case Scenario:

- Rotors are always rotating;
- The Sun is shining all the day, from sunrise to sunset;
- Local topography has been obtained from SRTM DTM;
- No cloud cover or any other meteorological conditions that could potentially reduce visibility and the sunlight have been assumed;
- Receptors modelled using greenhouse mode;
- No physical barriers are considered.

10.8.4.3 Real Case by Statistics Scenario

The following assumptions have been considered in the modelling setting for Real Case Scenario:

- Public data of average daily sunshine hours at Phan Rang meteorological station (approximately 28 km from the Project):

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
6.94	7.86	6.61	6.50	5.65	5.33	4.03	4.19	3.33	4.68	5.67	6.13

- Local topography has been obtained from SRTM DTM;
- No cloud cover or any other meteorological conditions that could potentially reduce visibility and the sunlight have been assumed;
- Receptors modelled using greenhouse mode;
- No physical barriers are considered;
- Rotors are always rotating; and
- The probability distribution of wind direction according to data recorded the Project's measurement tower at the height of 95 m from 2015 to 2016:

N	NNE	ENE	E	ESE	SSE	S	SSW	WSW	W	WNW	NNW	Sum
49.6%	14.9%	4.4%	2.7%	1.9%	1.7%	1.6%	1.2%	1.2%	1.1%	1.1%	18.6%	100%
4347	1305	385	237	166	149	140	105	105	96	96	1629	8,760

It should be noted that even the assessment performed with such assumptions is leading to an overestimation in terms of annual number of hours of shadow flicker at a specific location mainly because of the following local conditions have not been included:

- The occurrence of cloud cover has the potential to significantly reduce the number of shadow flickering hours that the observer can be experienced;
- The presence of aerosols in the atmosphere have the ability to influence the flickering duration as the length of the shadow cast by a WTG depends on the angle of direct sunlight hits, which is strictly determined by the amount of fine solid particles/liquid droplets in between the observer and the rotor; and
- The analysis has not considered the presence of vegetation or any other physical barriers around a receptor that are able to block the view (at least partially) of the turbine.

[16] Worst Case Scenario in windPRO 3.4 software based on EHS Wind Energy Guidelines

10.8.4.4 Setting Summary of Scenarios

The following table is reporting the modelling settings adopted per each scenario. However, it should be noted that the performed calculations did not consider the actual location and orientation of windows of the possible affected house, or the screening effects associated with existing, site-specific conditions and obstacles like other buildings, leading to potential of over-estimating the duration of occurrences when shadow flicker might be experienced at a specific location.

Table 10.38 windPRO Shadow Module Inputs (in bold the differences among Worst Case and Real Case Scenario)

	Worst Case Scenario	Real Case Scenario
Wind Turbine location	See Figure 10.13	See Figure 10.13
Rotor diameter and hub height	150m/ 125m	150m/ 125m
Wind Turbine Operation	Rotors are always rotating	Rotors are always rotating
Wind Turbine Visibility	A WTG will be visible if it is visible from any part of the receiver window (greenhouse mode)	A WTG will be visible if it is visible from any part of the receiver window (greenhouse mode)
Window stories dimensions	1m height / 1m large / 1m from the ground floor	1 m height / 1m large / 1m from the ground floor
Cloudiness	Not considered	Not considered
Physical barriers (i.e. vegetation)	Not considered	Not considered
Minimum sun height over horizon for influence	3°	3°
Day step for calculation	1 day	1 day
Time step for calculation	1-minute	1-minute
Shining period	**The sun is always shining all day, from sunrise to sunset**	**The sun is shining as per available local sunshine data (Phan Rang meteorological station)**
Height contour	SRTM DTM	SRTM DTM
Eye Height	1.5 m	1.5 m

10.8.5 Model Results

As presented above, two scenarios have been modelled using SHADOW module of windPRO software to identify the receptors potentially affected by the shadow flickering. The following sections are reporting the number of potentially affected receptors per each scenario.

10.8.5.1 Worst Case Scenario

As aforementioned, the modelling package was calculating the predicted shadow flickering durations at receptors. Worst case scenario had considered a fully worst case scenario with unrealistic conditions which led to a potential of 180 (around 46.17 %) impacted receptors out of 417 mapped receptors. IFC maximum permissible thresholds have been exceeded for both parameters: hours/year and min/day at these receivers with the most impacted receptor (370) experiences 899 hours per year (versus 30 hours per year) with the maximum of 253 minutes per shadow day (versus 30 minutes per day). The key potentially impacted area is mainly located in Suoi Da and the north of Ba Rau 1 villages, Loi Hai

commune with a large number belongs to Suoi Da village (account for approximately 68.33 % out of total 180 impacted receptors).

The following maps present the influencing areas where shadow flickering is occurring based on the Worst Case Scenario setting (Figure 10.15 to Figure 10.17).

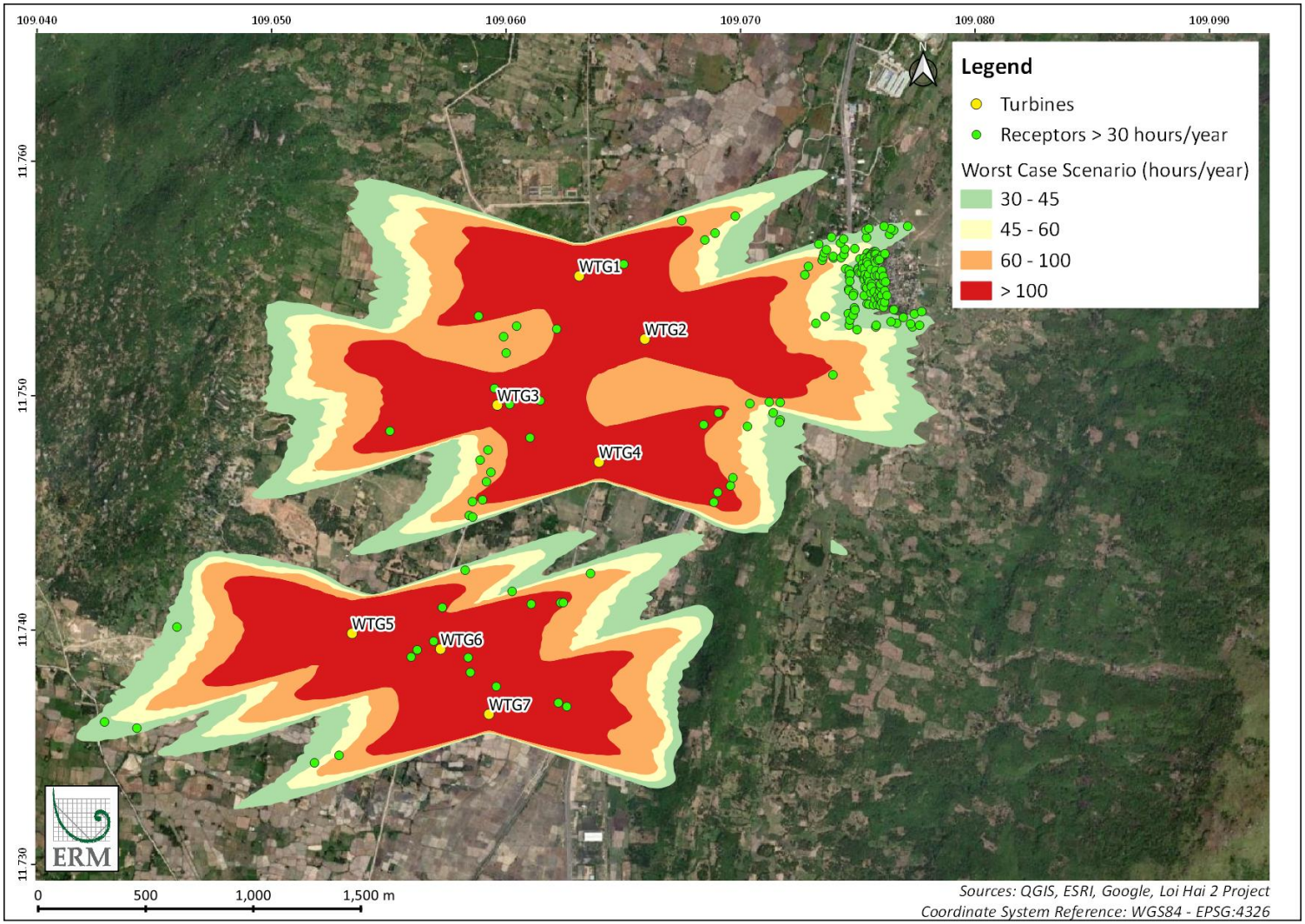


Figure 10.15 Map of Predicted Shadow Flicker (hours/year) for the Project – Worst Case Scenario

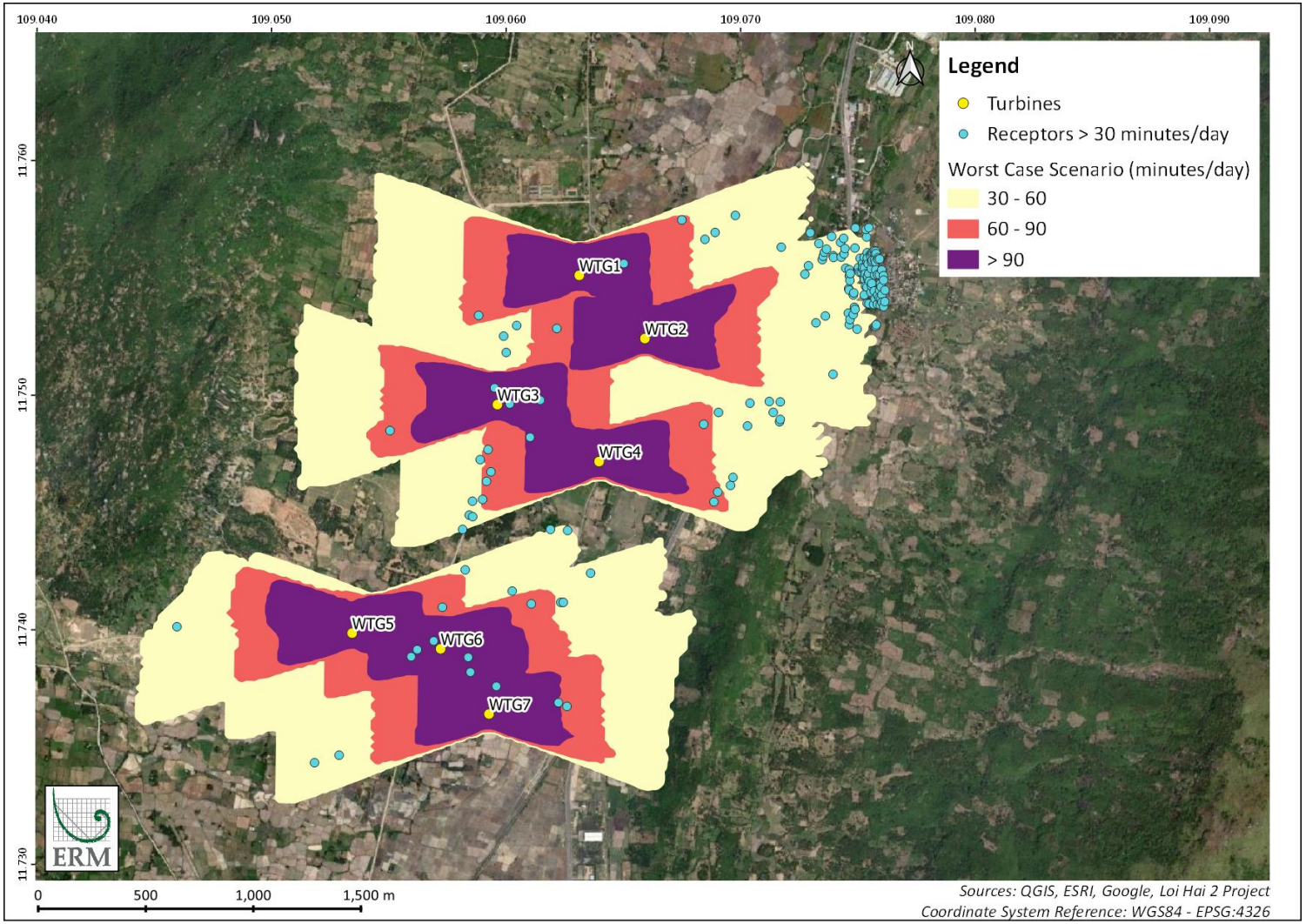


Figure 10.16 Map of Predicted Shadow Flicker (minutes/day) for the Project - Worst Case Scenario

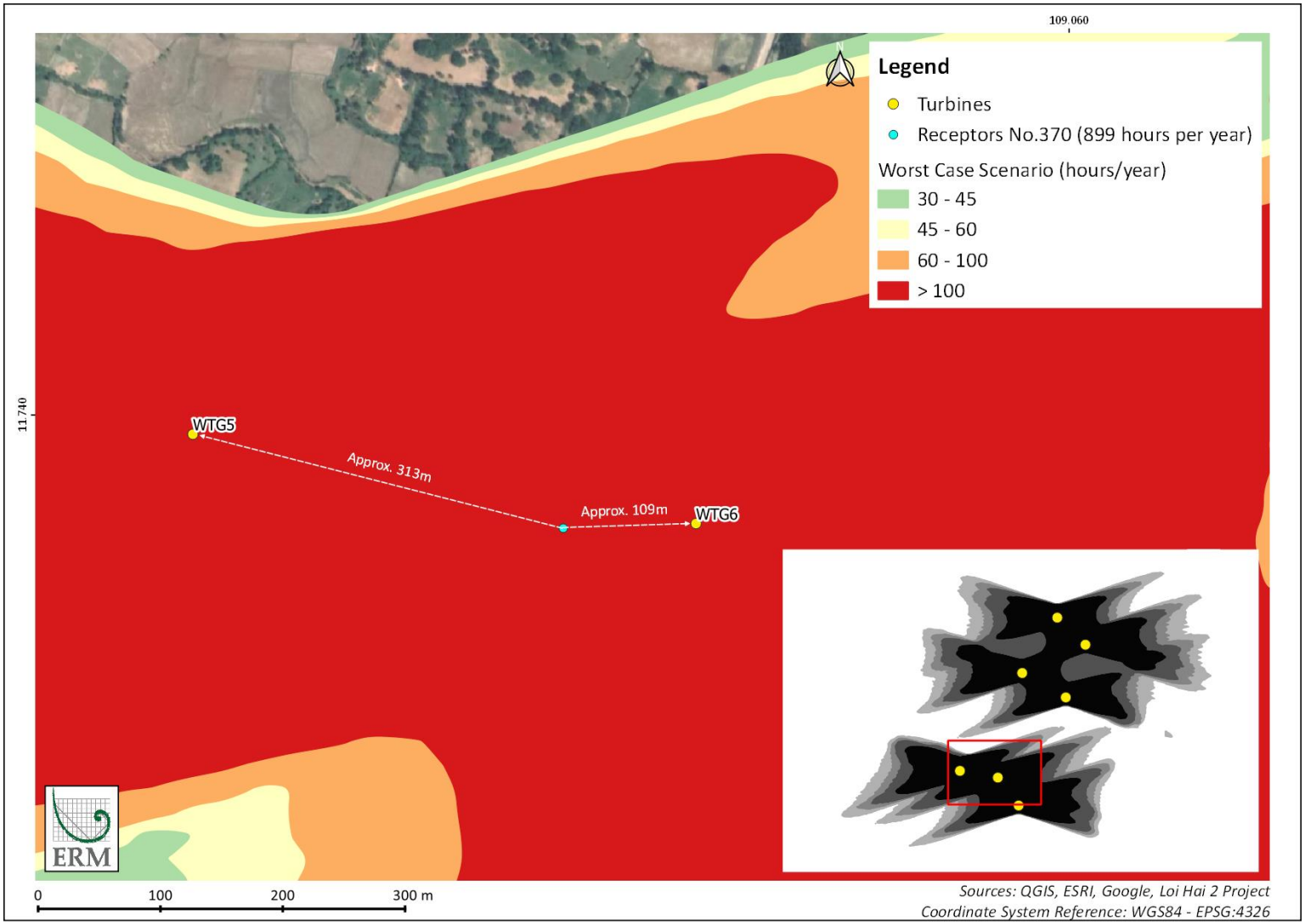


Figure 10.17 Map of Predicted Shadow Flickers (hours/year) at Receptor no. 370 – Worst Case Scenario

10.8.5.2 Real Case by Statistic Scenario

In order to assess the shadow flickering occurrence taking into account local conditions for few parameters, a second scenario has been calculated.

The predicted shadow flicker durations at receptors are presented Figure 10.18 and Figure 10.20.

Based on Figure 10.18 to Figure 10.20, the results confirmed that with the input of local conditions (wind directions and average daily sunshine hours) on the modelling, the number of impacted receptors have been reduced to 14 instead of 180, furthermore, most of the impacted houses fall in the range of greater than 100 hours hours per year. For further detail modelling result, please refer to Appendix B.

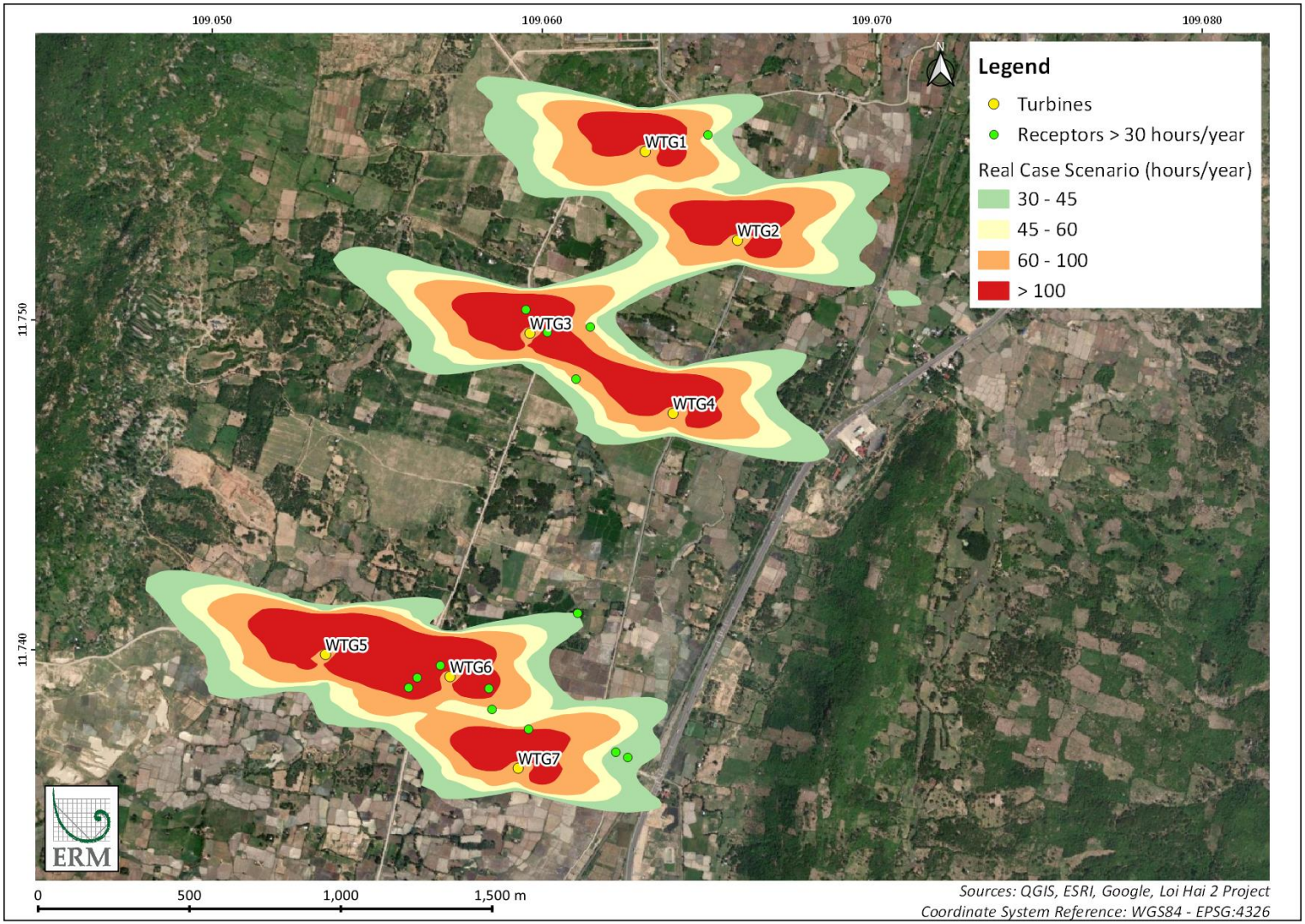


Figure 10.18 Map of Predicted Shadow Flicker (hours/year) for the Project– Real Case Scenario

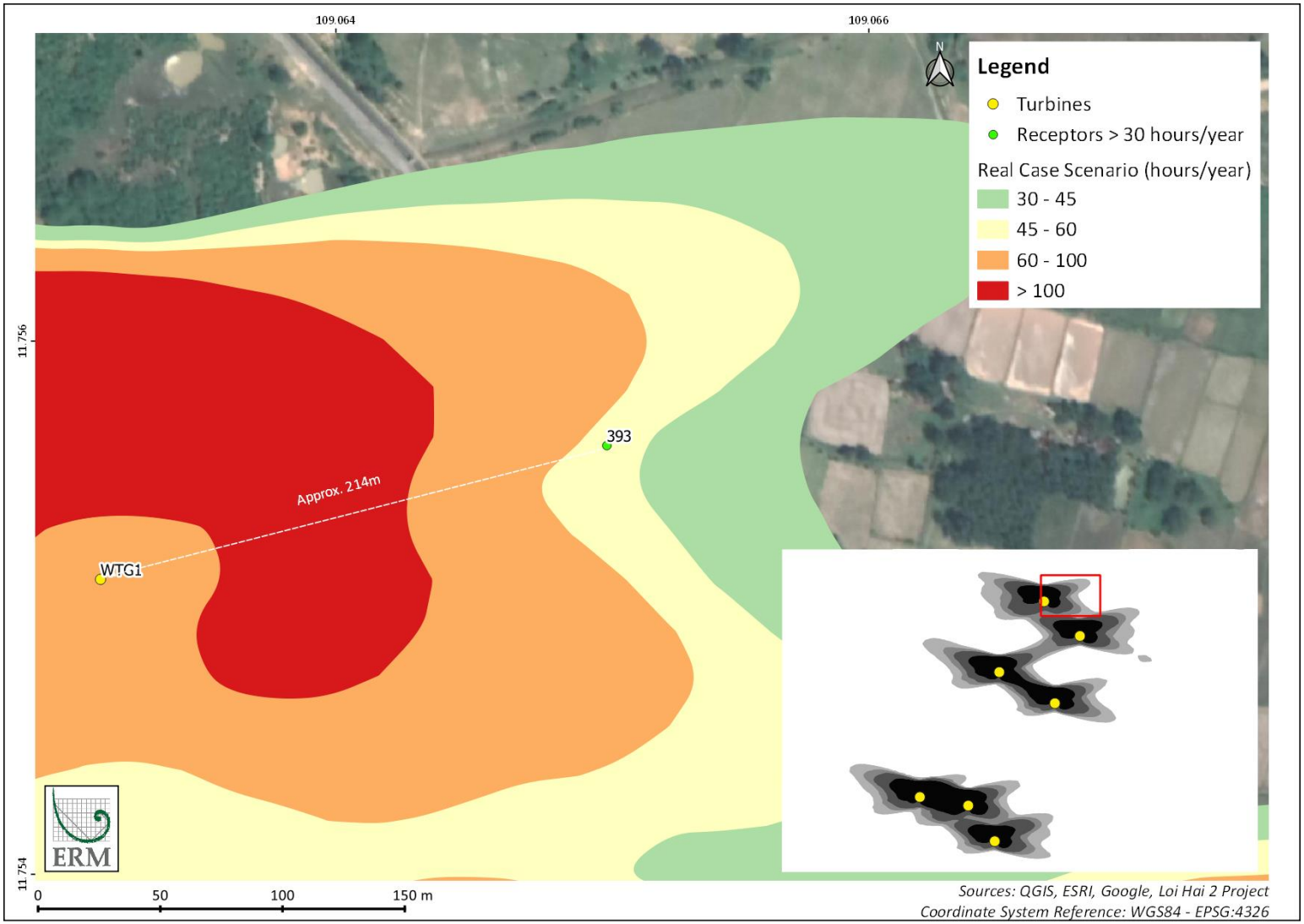


Figure 10.19 Map of Predicted Shadow Flicker at Receptor no. 393 (hours/year) – Real Case Scenario

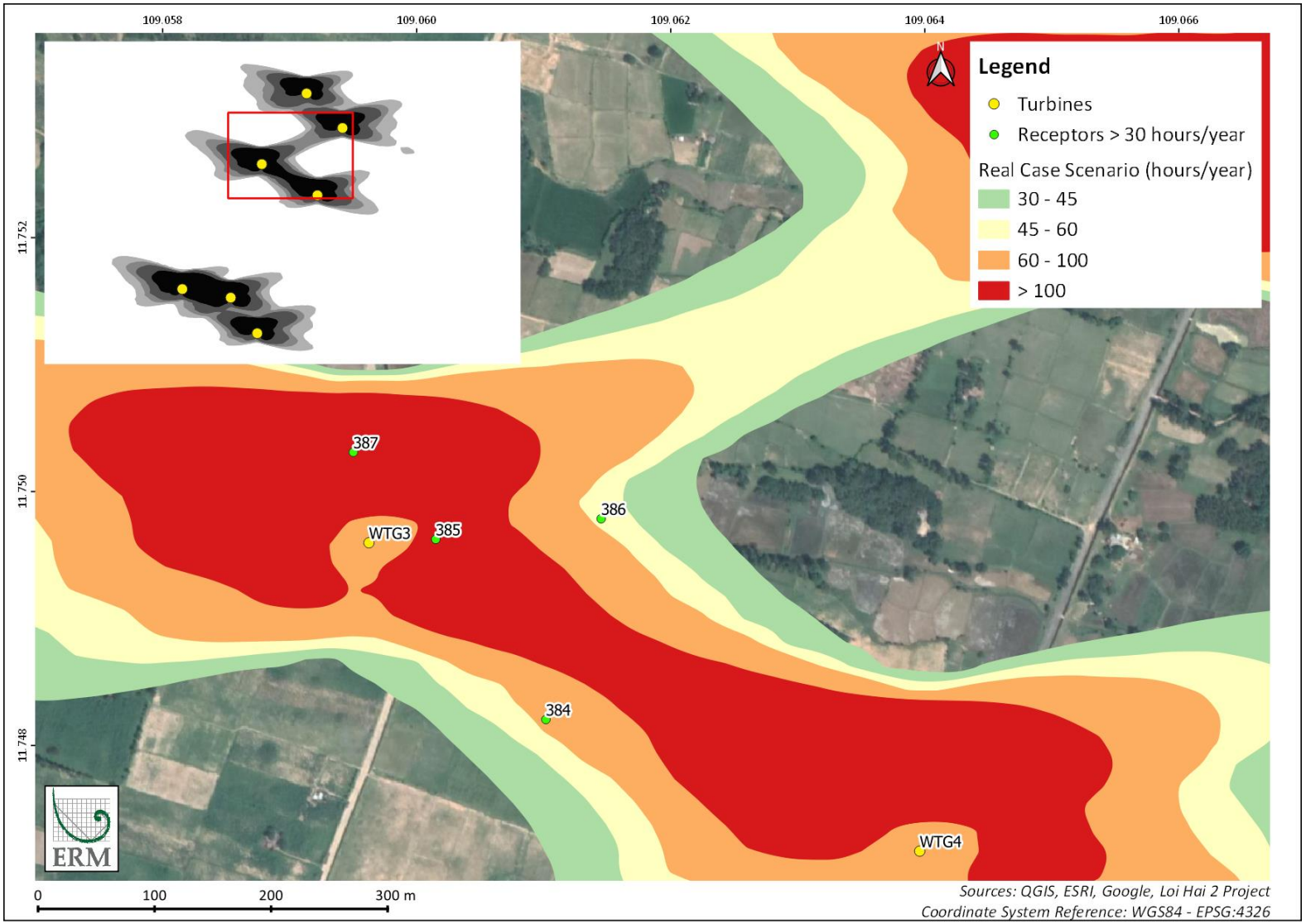


Figure 10.20 Map of Predicted Shadow Flicker at Receptors from no. 384 to 387 (hours/year) – Real Case Scenario

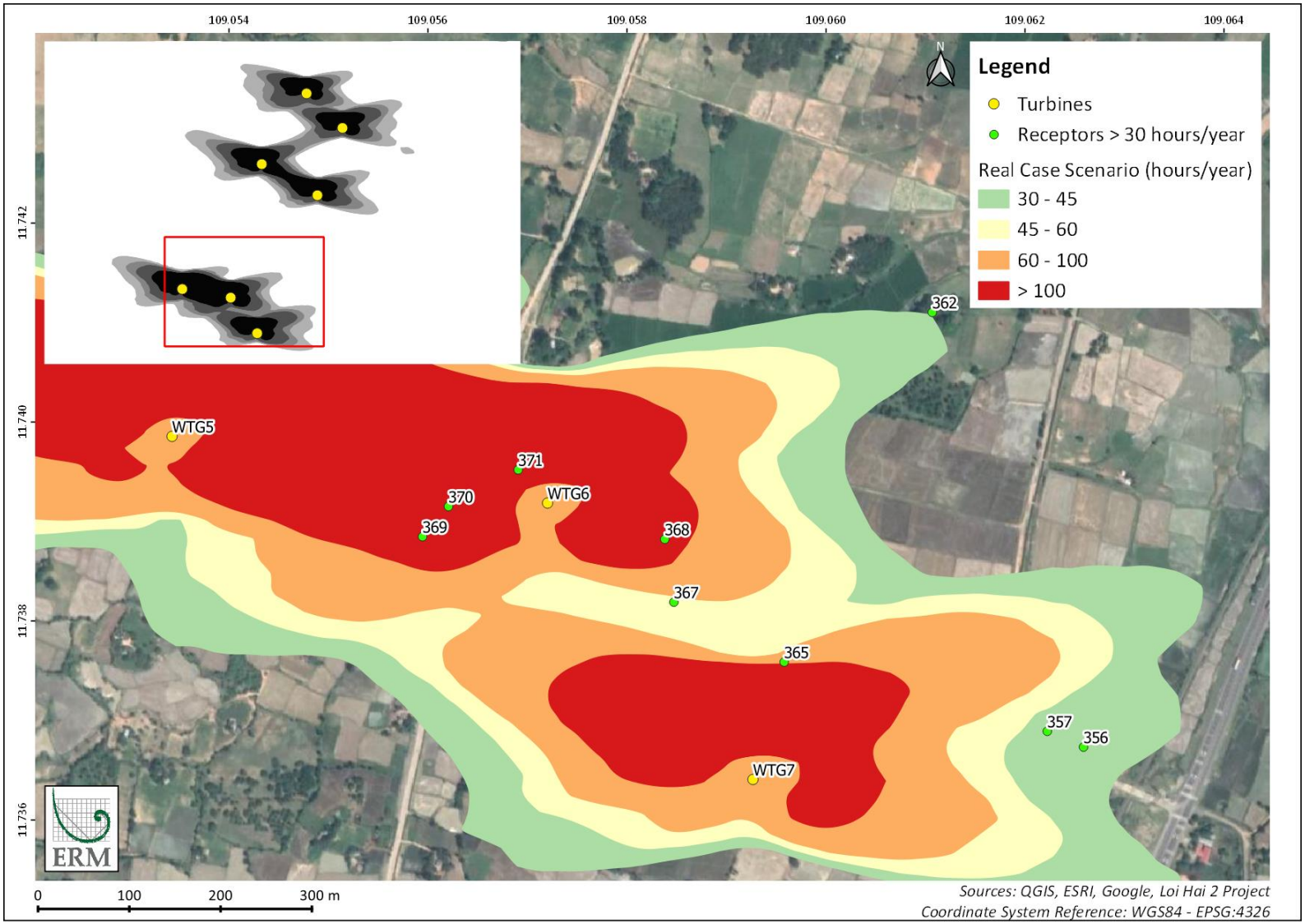


Figure 10.21 Map of Predicted Shadow Flicker at Receptors no. 356, 357, 362, 365 and from no. 367 to 371 (hours/year) – Real Case Scenario

10.8.6 Impact Assessment

10.8.6.1 Potential Impacts

The association between shadow flicker caused by wind turbines and the effects on human health is highly debated.

Certain studies suggested that flicker from turbines poses a potential risk of inducing photosensitive seizures (Harding et al, 2008; Smedley et al., 2010).

However, in 2011, the UK Department of Energy and Climate Change concluded in their Update Shadow Flicker Evidence Base report that “On health effects and nuisance of the shadow flicker effect, it is considered that the frequency of the flickering caused by the wind turbine rotation is such that it should not cause a significant risk to health”.

Despite such conclusions, other reports state that although shadow flicker from wind turbines is unlikely to lead to a risk of photo-induced epilepsy, the potential for annoyance and disturbance are still present leading to stress and therefore, this physical phenomenon should be considered when evaluating impacts on sur-rounding communities (Cope et al., 2009; Minnesota Department of Health, 2009; National Research Council, 2007).

10.8.6.2 Existing/ In-Place Control

There are no suggested existing controls in the local EIA report.

10.8.6.3 Significance of Impacts

The shadow flickering assessment has considered two scenarios as previously mentioned: a worst-case scenario and a more realistic one embedding local meteorological conditions. In both scenarios, even though the amount of receptors in real case scenario had been significantly reduced comparing to worst case scenario (14 versus 180 shadow receivers), these are still considered to be potentially impacted by shadow flickering exceeding the international maximum permissible limits. It should be noted that:

- Based on available satellite imagery, the potential impacted households located within the range of impact (1.5 km from wind turbines) are characterised in one of impacted group by the presence of dense residential areas. However, most of receptors located in agricultural area are surrounded by high and dense trees with original purpose is minimizing light from the sun (obtained from interviewing people). These conditions can reduce the potential for households located behind these directly affected receptors and to experience shadow flicker in real conditions (Figure 10.19 to Figure 10.24);
- In addition, it should be noted that receptors have been identified using satellite imagery and confirmed through a site visit. Some of them are not representing dwellings where people permanently resided therefore it would be good if the affected households could be verify through fieldwork (e.g. receptors no 360 (animal cage), no 367 (shack) as presented in the Appendix A); and
- The performed calculations do not take into account the actual location and orientation of win-dows, as we really do not have yet that type of information, or the screening effects associated with existing, site-specific conditions and obstacles like other buildings, leading to overestimate the duration of occurrences when shadow flicker might be experienced at a specific location;

Shadow flicker impacts are negative, direct and long-term during the Operation Phase of the Project. The impact scale is within 1,500 m of the WTGs on the receptors in the northeast-southwest and south of the WTGs. Impact magnitude varies based on distance of receptors from the WTGs and their orientations. Therefore, a shadow flicker survey was performed for 14 affected receptors in real case scenario to obtain detailed information on the window structure including the direction of window relative

to the turbine, curtain or wind blind, materials, and presence of natural or man-made barrier. The result of the survey for 14 receptors is presented in Table 10.39 and Figure 10.22 to Figure 10.24.

Table 10.39 Result of Surveyed Receptors

No.	Receptor	Type of receptor	Window type	Window size (width x height) (m)	Window covering type	Amount of window(s)	Direction of window (south clockwise)	Distance to the nearest turbine (m)	Affected by	Remark (current receptor conditions)
1	356	Dwelling				0	100	370 (WTG7)	WTG5, WTG6, WTG7	Natural barrier (high and dense trees)
2	357	Dwelling	Glass with steel frame, double casement	0.8 x 1.4	No	1	260	330 (WTG7)	WTG5, WTG6, WTG7	Natural barrier (trees) (mostly 1.8m height), window does not face to turbines
3	362	Dwelling				0	345	470 (WTG6)	WTG5, WTG6	Natural barrier (high and dense trees)
4	365	Dwelling				0	210	140 (WTG7)	WTG5, WTG6, WTG7	No barrier
5	367	Shack						180 (WTG6)	WTG5, WTG6	Shack
6	368	Dwelling	Full wood, double casement	0.6 x 1.0		2	310	140 (WTG6)	WTG5, WTG6	Natural barrier (high and dense trees), no window faces to turbines
7	369	Dwelling	Glass with steel frame, double-hung	0.4 x 0.2	Curtain	2	100	140 (WTG6)	WTG5, WTG6, WTG7	Natural barrier (high trees), no window faces to turbines
8	370	Livestock shelter						110 (WTG6)	WTG5, WTG6	Cage, high and dense trees around

No.	Receptor	Type of receptor	Window type	Window size (width x height) (m)	Window covering type	Amount of window(s)	Direction of window (south clockwise)	Distance to the nearest turbine (m)	Affected by	Remark (current receptor conditions)
9	371	Dwelling	Full wood, double casement	0.8 x 1.2		2	350	50 (WTG6)	WTG5, WTG6	Natural barrier (high trees), no window faces to turbines
10	384	Shack						220 (WTG3)	WTG4	Natural barrier (high and dense trees)
11	385	Dwelling	Full wood, double casement	0.8 x 1.2		1	20	60 (WTG3)	WTG2, WTG3, WTG4	Natural barrier (low and dense trees), window does not face to turbines
12	386	Dwelling	Full wood, double casement	0.8 x 1.2		1	30	200 (WTG3)	WTG3, WTG4	Natural barrier (high and dense trees), window does not face to turbines
13	387	Dwelling	Full wood, double casement	0.5 x 0.3		2	10	80 (WTG3)	WTG2, WTG3	No barrier, no window faces to turbines
14	393	Dwelling	Full wood, double casement	0.8 x 1.2		1	20	380 (WTG1)	WTG1	Man-made barrier (brick fence with a height of 1.6m), window does not face to turbines

In accordance with recorded information from the survey, there are 3 receptors which are not dwellings (receptors no. 367 and 384 are shacks, receptor no. 370 is livestock shelter). 8 out of 11 dwellings use full wooden and glass with steel frame windows. Only receptor no. 357 use glass with steel frame window without window covering. Furthermore, distance of the head height of windows from ground level is approximately 1.3 – 1.5 m in average. Natural barriers are all trees around receptors with an average height from 2 m and could go up to 10 m considered as high and dense trees. Hence, these conditions will reduce the impact of shadow flickering.

Apart from the surveyed receptors presented in the table above, the rest of receptors are mostly dense residential areas including Suoi Da and Ba Rau 1 villages. These villages are characterised by dense density of population and buildings. Therefore, receptors within these residential areas are not likely to be affected by shadow flickering.

Figure 10.22 Environmental Setting at Shadow Receptor No. 393

Figure 10.23 Environmental Setting at Shadow Receptors from No. 384 to 387

Figure 10.24 Environmental Setting at Shadow Receptors no. 356, 357, 362, 365 and from No. 367 to 371

As aforementioned, there are 8 dwellings with windows. Figure 10.25 to Figure 10.32 generally describe surrounding and window features.

Receptor no. 357 has one (1) window with height of around 1 m above ground floor but not facing to wind turbine WTG7. Plus, there is natural barrier (high and dense trees) between WTG7 and the receptor. Hence, receptor no. 357 will likely be not affected by flickering shadow effect.

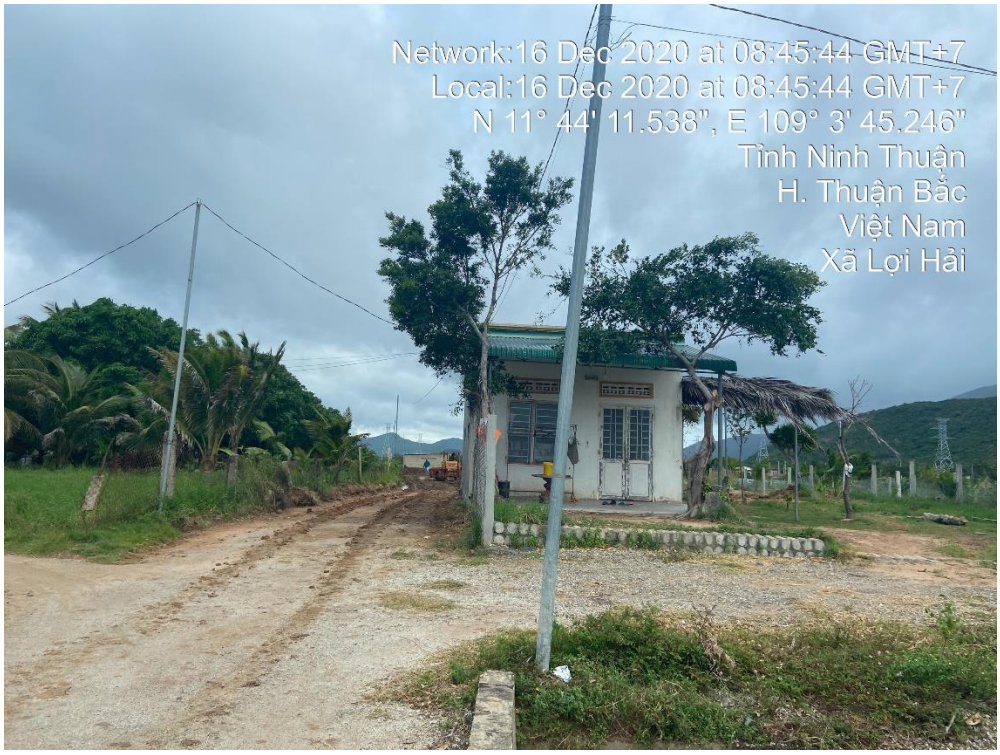


Figure 10.25 Receptor No. 357

Receptor no. 368 has a window with height of around 1.3 m above ground floor but one of them is not facing to wind turbine WTG5 and WTG6 as presented in Figure 10.26. Moreover, the natural barrier (trees) surrounding the windows is around 5 m and rather dense. Therefore, it could be concluded that the receptor no. 368 will likely be not affected by flickering shadow effect.

Figure 10.26 Receptor No. 368

Receptor no. 369 has two (2) window with height of around 1.6 m above ground floor and facing to wind turbine WTG5. However, there is natural barrier (high and dense trees) between WTG5 and the receptor. Hence, receptor no. 369 will likely not be affected by flickering shadow effect.

Figure 10.27 Receptor No. 369

Receptor no. 371 has two (2) window with height of around 1.6 m above ground floor but not facing to wind turbine WTG6. There is natural barrier (high and dense trees) between WTG6 and the main door of the receptor. Hence, receptor no. 371 will likely not be affected by flickering shadow effect.

Figure 10.28 Receptor No. 371

Receptor no. 385 one (1) window not facing to any wind turbines in the Project area. However, there is a wind turbine (WTG3) nearby is 60 m from the west of the receptor no. 385 and there is neither natural nor man-made barries between the wind turbine and the receptor (Figure 10.23). Hence, receptor no. 385 is likely to be affected by flickering effect partially from the wind turbine WTG3.

Figure 10.29 Receptor No. 385

Receptor no. 386 has one (1) window with height of around 1.2 m above ground floor but not facing to wind turbine WTG3 and WTG4. There is natural barrier (high and dense trees) between WTG3 and the receptor. Hence, receptor no. 371 will likely not be affected by flickering shadow effect.

Figure 10.30 Receptor No. 386

Receptor no. 387 has two (2) window with height of around 1.4 m above ground floor but not facing to wind turbine WTG3. There is natural barrier (high and dense trees) around the receptor. Hence, receptor no. 387 will likely not be affected by flickering shadow effect.

Figure 10.31 Receptor No. 387

Receptor no. 393 has one (1) window with height of around 1.2 m above ground floor but not facing to wind turbine WTG1. There is natural barrier (high and dense trees) around the receptor. Hence, receptor no. 393 will likely not be affected by flickering shadow effect.

Figure 10.32 Receptor No. 393

Table 10.40 Impacts of Shadow Flickering

Impact	Shadow flickering impacts during Operation Phase			
Impact Nature	**Negative**	Positive	Neutral	
Impact Type	**Direct**	Indirect	Induced	
Impact Duration	Temporary	Short-term	**Long-term**	Permanent
Impact Extent	**Local**	Regional	Global	
Impact Frequency	The shadow flickering impact could potentially occur up to 10 hours/day			
Impact Magnitude	Positive	Negligible	Small	**Medium**	Large
Receptors Sensitivity	Low	**Medium**	High	
Significance	Negligible	Minor	**Moderate**	Major
	The significance is **Moderate**			

10.8.6.4 Additional Mitigation Measures

As per the outcomes of the modelling, with specific regards to the residual potential impacted receptors identified by the real case scenario (11 dwellings) and in the event that on-site residents will be really affected by shadow-flickering once the turbines are under operation, it is suggested the Project proponent will assess the situation on a case-by-case basis and work according to the following mitigation scheme:

- Visual Screening (Natural) – Assess potential sensitive receptors, for which shadow flicker modelling indicates could exceed 30 hours per year, in order to ascertain the extent of existing natural visual screening in place. If not existing, the occurrence of shadow flickering during

operation could be furtherly investigated, and if confirmed, increasing natural screening could be considered to minimise the effect; and

- Visual Screening (Architectural / Structural) - If grievances are received linked to this impact or if natural visual screening at potential sensitive receptors are found to be insufficient to mitigate the shadow effect, further assessments will have to be performed and apply certain mitigation actions as installation of blinds, window shades, window tinting, awnings or fences at affected receptors, which will help to minimize the effect of shadow flicker.
- Relocation – If visual screening, both natural and architectural / structural fail to mitigate shadow flicker impact at sensitive receptors, then relocation of affected households would have to be considered and evaluated and had to be openly presented to local community by the Client for prior consent. Any relocation process will have to be performed in accordance with international IFC standards / principles stip (IFC PS-5) related to resettlement. This would include as well undertaking a socio-economic census prior commencing with the windfarm construction. If applicable, any land or residence replacement, including farmland,, would have to be provided by the Client. However, it is important to have in mind, that Project developer will not be responsible for any affected set-tlements which are constructed after the commencement of wind farm construction and once the fieldwork to confirmed affected households has concluded.

10.8.6.5 Residual Impacts

The mitigation measures above will be implemented for identified receptors that experience shadow flicker. Residual impact following the implementation of these mitigation measures is likely to be **Minor**.

10.8.6.6 Monitoring and Audits

Periodically monitoring the grievance mechanism and reporting needs to be performed implementing a process to identify the real occurrence of the shadow flickering at surrounding houses located within the impacted radius (1.5 km from wind turbines) to mitigate or eliminate in the best way possible the phenomena. In case of dwellings experienced shadow flickering, a detailed grievance mechanism should be available and displayed to local community who must be aware of how to use this mechanism to submit their complaints regarding nuisances related to shadow flicker from tur-bines. Ensuring performing close monitoring through engagement with local stakeholders that could be affected throughout the operational phase where there are possibilities to face these.

10.9 Visual Amenity Impact Assessment

10.10 Biodiversity Impact Assessment

In accordance with IFC PS1 and PS6, the impact assessment (IA) process aims to predict and assess the Project's potential adverse impacts and risks to biodiversity values, in both it's the contruction and operational phase. The objectives of the biodiversity IA are to identify and quantify potential Project impacts; identify likely residual impacts; and design measures to avoid, minimise, remediate or offset the potential adverse impacts. The key objectives of this section include:

- An IA that assess the extent and complexity of potential adverse impacts to habitat areas and conservation significant species;
- Development of mitigation measures to avoid and minimise potential adverse impacts to biodiversity with priority given to impacts on features with significant biodiversity values; and
- Determination of residual impacts, which will determine if additional measures are required.

10.10.1 Summary of Scope of Assessment

With accordance to IFC PS6, Table 10.41 describes the potential impacts to biodiversity caused by the Projects' activities. Table 10.42 identifies the Project's phases (construction and/or operation phases) that the effects are likely to present.

Table 10.41 Definition of Potential Impacts on Biodiversity.

Impacts	Definition
Loss of Habitat	Permanent loss of habitats (such as foraging, breeding, wintering habitats) due to permanent or temporary land-use requirements.
Degradation	Introduction or spreading of alien species, introduction of air and water pollutants into the habitats/ ecosystems and make them less sustainable and available for many species.
Disturbance and/or Displacement of Fauna	Impacts from noise, vibration and light sources on surrounding habitats causing disturbance, displacement and changes in behaviour.
Barrier creation, fragmentation and edge effects	■ Creation of barriers to the movements of animals, especially those with limited dispersal range. ■ Fragmentation of habitat, or permanent/ temporary severance of wildlife corridors between isolated habitats of biodiversity importance due to Project's components e.g. the transmission line and/or subsea cables. ■ Edge effects may be generated when vegetation clearing or land disturbance occurs at the boundary of two or more habitats. ■ These effects can result in increased risk of parasitism or disease, increased risk of predation, adverse microclimate conditions (including drying out and subsequent fire risks) and competition.
Direct mortality	Direct mortality events for some fauna species due to: ■ Vehicles, vessel or machinery strikes or falling debris during clearing activities. ■ Worker influx and increased hunting/ poaching pressures. Other mortality events for avifauna include: ■ Collision and electrocution with transmission line. ■ Collision with and flight through the Rotor Swept Zone (RSZ) of turbine blades.

Table 10.42 Scoping of Impacts during Project Phases.

Impacts	Construction Phase	Operation Phase
Loss of habitat	Yes	Continuing from construction phase
Degradation	Yes	Continuing from construction phase

Disturbance and/or displacement of fauna	Yes	Reassessed for operation phase
Barrier creation, fragmentation and edge effects	Yes	Continuing from construction phase
Direct Mortality	Yes	Reassessed for operation phase

Note:
***Yes**: likely to be induced by the Project activities during this phase.*
***No**: not likely to be induced by the Project activities during this phase.*
***Continuing from construction phase**: impact is likely to continue from the construction into the operation phase; thus, mitigation measures defined for the construction phase can also be applied for the operation phase.*
***Reassessed for operation phase**: impact is likely to be different during the phases. Hence, it should be reassessed and additional mitigation measures should be defined for the operation phase when appropriate.*

10.10.2 Relevant Guidelines and Criteria

10.10.2.1 Vietnamese Regulations

- The Law of Biodiversity No. 20/2008/QH12 dated November 13, 2008 on biodiversity conservation and sustainable development (according to Document 32/VBHN-VPQH, Biodiversity Law no.20/2008/QH12 dated 13 November 2008 has been approved to be combined with Law no.335/2018/QH14 dated 20 November 2018);
- The Law on Environmental Protection (LEP) No. 55/2014/QH13 dated June 23, 2014 is the main piece of environmental legislation currently in force for the local regulatory ESIA;
- The Law on Forest Protection and Development No. 29/2004/QH11 dated December 3, 2004 on the management, protection, development and use of forests; and forest owners' rights and obligations;
- Decree No. 23/2006/ND-CP dated March 3, 2006 on the implementation of the Law on Forest Protection and Development;
- Decree No. 99/2010/ND-CP dated September 24, 2010 on the policy on payment for forest environment services;
- Decree No. 18/2015/ND-CP and No. 19/2015/ND-CP dated February 14, 2015 on environmental protection planning, strategic environmental assessment, environmental IA and environmental protection plans;
- Decree No. 06/2019/ND-CP dated January 22, 2019 of the Government on the management of endangered, precious and rare forest plants and animals and implementation of the Convention of International Trade in Endangered Species of Wild Fauna and Flora; and

10.10.2.2 International Guidelines

- IFC Performance Standard 6: Biodiversity Conservation and Sustainable Management of Living Natural Resources recognises that protecting and conserving biodiversity, maintaining ecosystem services and sustainably managing living natural resources are fundamental to sustainable development;

Vietnam has also ratified several international conventions including:

- UNEP Convention on Conservation of Biological Diversity (CBD), ratified in 1994;
- CITES (the Convention on International Trade in Endangered Species of Wild Fauna and Flora), an international agreement between governments which aims to ensure international trade in specimens of wild animals and plants does not threaten their survival. This came into force in Vietnam in 1994; and

- Ramsar (the Convention on Wetlands of International Importance), an intergovernmental treaty providing the framework for national action and international cooperation for the conservation and wise use of wetlands and their resources. This came into force in Vietnam in 1989.

10.10.2.3 Impact Assessment Criteria

In order to assess the significance of impacts due to the Project before and after mitigation, the Impact Assessment matrices have been used to evaluate the severity of impacts to habitats (Table 10.44) and species (Table 10.45). The matrices outline the sensitivity of the receptors and the magnitude of effects caused by the Project.

Table 10.43 Definition of the Impact Type

Type	Definition
Direct	Potential impacts that result from a direct interaction between the Project and a resource/receptor (for example, between occupation of a plot of land and the provisional service e.g farming, aquaculture which are affected).
Indirect	Potential impacts that follow on from the direct interactions between the Project and its environment because of subsequent interactions within the environment (for example, viability of new plots of land for provisional services which may impact on other existing users and /or natural habitat).
Induced	Potential impacts that result from other activities (which are not part of the Project) that happen because of the Project (for example, influx of people looking for work).

Table 10.44 Impact Assessment Matrix for Habitat

Habitat Sensitivity/Value		Magnitude of Effect			
		Negligible	**Small**	**Medium**	**Large**
		Effect is within the normal range of variation	Affects a small area of habitat, but without the loss of viability/ function of the habitat	Affects a sufficient proportion of the habitat to the extent that the viability/ function of part of the habitat or the entire habitat is reduced, but does not threaten the long-term viability of the habitat or species dependent on it.	Affects the entire habitat or a significant proportion of the habitat to the extent that the viability/ function of the entire habitat is reduced and the long-term viability of the habitat and the species dependent on it are threatened.
Low	Habitats with no or local designation/ recognition; habitats of significance for species of Least Concern (LC); habitats which are common and widespread within the region.	Negligible	Negligible	Minor	Moderate
Medium	Habitats within nationally designated or recognised areas; habitats of significant importance to globally Vulnerable (VU), Near Threatened (NT) or Data Deficient (DD) species; habitats of significant importance for nationally restricted range species; habitats supporting nationally significant concentrations of migratory species and/or congregatory species; nationally threatened or unique ecosystems.	Negligible	Minor	Moderate	Major
High	Habitats within internationally designated or recognised areas; habitats of importance to globally Critically Endangered (CR) or Endangered species (EN); habitats of importance to endemic and/or globally restricted-range species; habitats supporting globally significant concentrations of migratory species and/ or congregatory species; highly threatened and/ or unique ecosystems, areas associated with key evolutionary species.	Negligible	Moderate	Major	Critical

Table 10.45 Impact Assessment Matrix for Species.

Species Sensitivity/Value		Magnitude of Effect			
		Negligible	**Small**	**Medium**	**Large**
		Effect is within the normal range of variation.	Affects a small proportion of a population, but does not substantially affect other species dependent on it, or the populations of the species itself	Affects a sufficient proportion of a species population that it may bring about a substantial change in abundance and /or reduction in distribution over one or more generations, but does not threaten the long-term viability of that population or any population dependent on it.	Affects an entire population or species at sufficient scale to cause a substantial decline in abundance and/or change in distribution beyond with natural recruitment (reproduction, immigration from unaffected areas) so that that it may not return that population or species, or any population or species dependent upon it, to its former level within several generations, or when there is no possibility of recovery.
Low	Species which are included on the IUCN Red List of Threatened Species as Least Concern (LC).	Negligible	Negligible	Minor	Moderate
Medium	Species included on the IUCN Red List of Threatened Species as Vulnerable (VU), Near Threatened (NT) or Data Deficient (DD). Species protected under national legislation. Nationally restricted range species. Nationally important number of migratory or congregatory species.	Negligible	Minor	Moderate	Major
High	Species included on the IUCN Red List of Threatened Species as Critically Endangered (CR) or Endangered (EN). Species having a globally Restricted Range (i.e. plants endemic to a site or found globally at fewer than 10 sites, fauna having a distribution range (or globally breeding range for bird species) of less than 50,000 km^2. Internationally important numbers of migratory or congregatory species. Key evolutionary species.	Negligible	Moderate	Major	Critical

10.10.3 Assessment of Impacts

The biodiversity impact assessment will identify the effects arising from the projects, and how these may impact biodiversity receptors i.e. species and habitats. The assessment will take into account existing controls and mitigation, and identify any residual impacts on species or habitats that require additional measures.

10.10.3.1 Loss of Habitat

10.10.3.1.1 Potential Impacts

- Impact of flora;
- Loss of terrestrial habitat; and
- Loss of airspace associated with wind turbines.

10.10.3.1.2 Existing Controls

There are no existing controls outlined in the local regulatory ESIA.

10.10.3.1.3 Significance of Impacts

A total of 22 flora species has been recorded within the Project area in the field surveys. The vegetation in the area is mainly mix of grass (e.g Goosegrass, Broom weed, Carpet-grass) and some fruit trees (e.g Mango, Papaya). None of the species are considered to be native in Vietnam. The sensitivity of receptor is considered to be Low.

The Project area is approximately 7.5241 ha in size. Overall, the Project is located in agricultural land that is considered as modified habitats (Table 10.46).

The fix-term loss is considered permanent while the temporary loss is short-term. Construction of the turbine foundations, internal roads and 22kV underground cable, 110kV substation and operation house may lead to the permanent, direct loss of habitat. The total fix-term habitat loss within the Project will therefore be 5.0988 ha of modified habitat. A total of 2.4253 ha will be temporarily loss due to the existence of laydown area and construction site during the construction phase. The loss of modified habitats is predicted that cause the effect within the normal range of variation. Hence, the impact magnitude is projected to be Negligible.

Table 10.46 Land Area in the Project Area

Item	Type of habitat	Natural/ Modified Habitat	Number of items	Total area (ha)	Percentage (%)
Fixed-term land occupation: 5.0988 ha total					
Turbine foundations	Agricultural Land	Modified Habitat	7	0.8796	11.7%
Internal roads and 22kV underground cable			-	2.9530	39.3%
110kV Substation & Operation house			1	1.2662	16.8%
Temporary land occupation: 2.4253 ha total					
Laydown area (blades and towers)	Agricultural Land	Modified Habitat	7	1.8826	25%
Construction site (Crane installation area)			7	0.5427	7.2%
25m Transmission Line/Safety Corridor					

Item	Type of habitat	Natural/ Modified Habitat	Number of items	Total area (ha)	Percentage (%)
(Activities will be restricted on the land under the transmission line and in the safety corridor)					
Transmission line 110kV for connection			1	-	
Total				**7.5241**	**100%**

Air space associated with the turbine layout is considered to be a natural habitat that utilises this habitat, being birds and bats. Impacts of air space loss during the operation phase are long-term. The loss of the natural habitat is a subject for no net loss requirement complying with IFC PS6. Based on the literature review, desktop screening and field survey, it is unlikely that the airspace area either is nationally designated or recognised or is habitat of significant importance for threatened species. Almost all recorded birds and bats species within the EAAA1 are Least Concern (LC), some are Near Threatened (NT) and one Data Deficient (DD). Migratory species were recorded and are considered to be widespread with huge number of global population. The receptor sensitivity, therefore, is considered to be Medium and the magnitude impact is likely to be Small as small area of airspace may be affected but no loss of viability/ function of habitat.

Generally, the impact significance is forecasted to be Negligible-Minor.

Table 10.47 IA of Direct Loss of Habitat

Impact Type	**Direct**		Indirect		Induced
Impact Duration	Temporary	**Short-term**		**Long-term**	**Permanent**
Impact Extent	**Local**		Regional		International
Impact Frequency	Impacts are restricted to the local boundaries as the area is not nationally/ internationally designated or recognized.				
Impact Magnitude	Positive	**Negligible**	Small	Medium	Large
Receptor Sensitivity	**Low**		**Medium**		High
Impact Significance	**Negligible**	**Minor**		Moderate	Major

10.10.3.1.4 Additional Mitigation Measures

The following additional mitigation measures are to minimise impacts associated with habitat loss:

- The planned area for vegetation clearance linked to the construction works shall be clearly identified and marked prior commencing;
- Clearing vegetation outside of designated areas will be prohibited for Project staff, workers, all contractors and personnel engaged in/or associated with the Project, with sanctions, including fines and dismissal, and prosecution under the relevant laws for clearing vegetation;
- The Project owner shall provide training to staffs and workers on applicable rules, regulations and information concerning restrictions related to unauthorised clearing of vegetation and/or illegal hunting or poaching activities or capturing/ collecting fauna and flora, as well as the sanctions that may be imposed if any staff or worker or other person associated with the Project violates these rules and regulations;
- Land rehabilitation will be undertaken using native species if natural habitats in Project's proximity is lost due to the presence of the Project. It is important to state that modified habitats currently dominates the Project area;

- Where flora is identified during inspections, this will have to be confiscated and photographed for a physical evidence for the recordkeeping. Wherever possible, the flora is to be relocated into their place of origin.
- In areas of natural habitat, native species will be used for reinstatement; and
- The introduction of invasive none native species (INNS) will be controlled by the development and application of an INNS policy.

10.10.3.1.5 Monitoring and Audit Program

The following program is proposed to ensure the impact is maintained at Negligible level:

- Regular (weekly) checks during construction are to occur along area where work is occurring to ensure compliance with clearing within marked boundaries;
- Records are to be kept and regularly reviewed (3 monthly) for implementation of the workforce training program for fauna/flora awareness;
- Monitoring of rehabilitation success/failure is to occur on all replanting sites. Monitoring is to consist of regular inspections (3 monthly) to determine plant establishment. Where plant establishment is determined to have failed, reestablishment is to occur; and
- Records of inspections (monthly during construction) are to be kept and regularly reviewed (3 monthly basis) during operation.

10.10.3.1.6 Significance of Residual Impact

The application of the mitigation measures will potentially reduce the significance of habitat loss effect to be Negligible.

10.10.3.2 Degradation

10.10.3.2.1 Potential Impacts

In general the impacts may result in: dust; release of domestic wastewater, waste; and introduction or spread of invasive species.

10.10.3.2.2 Existing Controls

The mitigation measures identified in the locally approved regulatory ESIA related to:

- Air pollution (detail in section 10.1.2.5 in this ESIA) ;
- Noise reduction (detail in section 10.3.3 in this ESIA);
- Water pollution (detail in section 10.2.2.5 in this ESIA);
- Wastewater (detail in section 10.2.2.5 in this ESIA).

10.10.3.2.3 Significance of Impacts

A range of Project activities have the potential to lead to degradation of flora and fauna habitats including excavation, construction, land clearing, movement of vehicles, refuelling, hazardous materials storage and maintenance. Construction activities have been assessed for degradation, including: construction of the access roads, erection of transmission towers, erection of wind turbines and installation of cables/wires and installation of associated infrastructure (such as the substation and laydown area). These impacts will be introduced during the construction phase and operation phase. The degraded areas may take time to recover. Overall, no natural habitats are subjected to possible degradation caused by the Project activities. Only modified habitats will be affected, thus receptor sensitivity is Low.

The impact magnitude is considered to be Small as the influence area is small without the loss of viability/function of the habitat. Consequently, the impact significance is projected to be Negligible.

Dust

During construction, movement of vehicles, clearing and excavation activities have the potential to generate dust which may settle on vegetation adjacent to the construction area (including access roads). Excessive dust deposition on flora may act to suppress growth through limiting photosynthesis and the dusted foliage may also become unpalatable to foraging fauna. The construction activities will be temporary and dust generation is likely to be localised to active work areas. Rainfall will generally remove dust from foliage. Effects on fauna are negligible as effects are temporary, localised, and unlikely to affect rare or sensitive species.

Given Nui Chua National Park is approximately 5km from the Project, the heavy particulates are unlikely to be deposited in this area. Hence, native flora and fauna will not to be affected.

Domestic wastewater and rainwater runoff

Domestic sewage contains dissolved or suspended pollutants including organic matters (mainly food waste), chemicals (e.g. detergents, soap) and disease-causing bacteria (e.g. from human/animal feacal matter), while rainwater runoff picks up solid waste, pesticides, oil and grease and other pollutants as it flows. These types of disturbances, if being discharged into the surrounding environments untreated, may trigger significant ecosystem degradation (especially in aquatic habitats).

However, the Project's has designed appropriate controls for wastewater and rainwater runoff which will likely reduce the negative effects to Negligible.

Waste

Likewise, solid domestic waste have the same potentiality to pollute the surrounding ecosystems if disposed into the environment improperly. The Project's waste management measures include bins placed at strategic positions within the project footprint, a dedicated storeroom in compliance with applicable regulations, contracting authorized waste treatment vendors for transport and disposal . The magnitude of the effect is considered Negligible.

Illegal forest resource possession

The temporary increase in labour force during the construction stage enhance the amount of people to access the forest for local communities and loggers are subjects for increase risk of illegal forest resource possession. Wood extractions are able to degrade plantation that currently has reasonable-ecological functions. Additionally, accessing the forest may cause greater domestic wastes which can result in habitat degradation.

Invasive species (INNS)

Invasive species surveys were not be conducted within the Project area. However, the Project area is dominated by modified habitats containing low biodiversity values which are agricultural lands with an abundance of human activities. A total of 22 flora species which are mainly associated with agricultural operations were recorded but only one native species. Invasive non-native species have not been identified as a significant threat, however control measure to prevent the spread of INNS will be implemented.

Table 10.48 IA of Degradation

Impact Type	**Direct**	Indirect		Induced
Impact Duration	Temporary	Short-term	**Long-term**	Permanent
Impact Extent	**Local**	Regional		International

Impact Frequency	The impacts are continous and can extend from construction to operation phase.				
Impact Magnitude	Positive	Negligible	**Small**	Medium	Large
Receptor Sensitivity	**Low**		Medium	High	
Impact Significance	**Negligible**	Minor	Moderate	Major	

10.10.3.2.4 Additional Mitigation Measures

Control measures during operation phase can be adopted from the construction phase. Additional measures are proposed for both phases as follows:

- All disturbed lands by construction activities, that will not be occupied by wind turbines are to be rehabilitated in the best way possible through native species, which are to be planted within areas under the Project's control;
- Erosion control measures are to be used in all areas of construction to minimise soil contaminated runoff entering waterways. These measures are outlined within the *Erosion Control Plan* under Biodiversity Management Plan (BMP);
- Invasive species are to be managed within the Project area so that any introduction or proliferation does not impact natural habitats in the proximity areas. These measures are well described within the *Invasive Species Management Plan* under Biodiversity Management Plan (BMP);
- To mitigate the impacts causes by dust and other contaminant emissions, these measures need to be conducted:
  - Mitigation measures to control dust are to be used to reduce dust generation and hence its deposition into surrounding vegetation as applying covers to loading trucks and the use of water spray in dry conditions to suppress dust disturbance on roads.
  - Develop and implement appropriate emergency spill response procedures to avoid spills and to manage accidental spills of fuels, oils, and other hazardous chemicals used during construction activities.
  - Ensure spill prevention equipment is readily available on site to clean any possible spills, clean these up as soon as possible.
- Hours of operation on the construction site are to be limited to the hours of 6.00am to 10.00pm Monday to Sunday; if activities are to be occurred during the night time, prior notification will have to be made to surrounding communities, and
- Light spillage outside of the construction area will be controlled by the use of appropriate cowling and positioning of luminaries to direct light onto the construction area and away from natural habitat in order to avoid the effect from lights on the habitat supporting threatened species (e.g Nui Chua National Park, Song Trau Protection Forest).

10.10.3.2.5 Monitoring and Audit Program

- Records are to be kept and regularly reviewed (3 monthly basis) on the survival rate of the native flora individuals planted on disturbed areas;
- Records are to be kept and regularly reviewed (3 monthly basis) during construction on the application on the implementation of the *Erosion Control Plan.* Results from water quality monitoring are to be reviewed and available for audit process to identify elevated (Total suspended solids) TSS from construction areas;
- Records are to be kept and regularly reviewed (3 monthly basis) during construction on the application on the implementation of the *Invasive Species Management Plan.* Monitoring is to include inspections of the site on a monthly basis during construction in areas of natural habitat to identify and eradicate any invasive species;

- Regular inspections (weekly during construction) during the dry season to determine the level of dust deposition on vegetation surrounding the Project Area. Where excessive dust on vegetation is identified, and rain is not forecast within the next 5 days, vegetation should be washed using a water truck;
- Monitoring of hours of operation of the construction site; and
- Inspection of light sources following erection of wind turbines.

10.10.3.2.6 Significance of Residual Impact

With the application of mitigation measures, the significance of impacts are likely to be maintained negligible.

10.10.3.3 Disturbances or Displacement of Fauna

10.10.3.3.1 Potential Impacts

The disturbance and displacement of resident fauna species within the footprint will primarily be caused by noise, vibration and light impacts for terrestrial habitats. The immediate displacement of fauna will occur during construction, however, the impact to fauna by these physical agents will continue throughout the life of the Project but will be considerably less in extent. Noise, vibration and light disturbances have the potential to influence the breeding, roosting or foraging behaviour of fauna.

10.10.3.3.2 Existing Controls

The mitigation measures are explained in detail within the approved regulatory EIA related to noise reduction (section 10.3 – Noise Impact Assessment).

10.10.3.3.3 Significance of Impacts

Direct impacts are predicted to occur within the EAAA1 for birds and bats, the EAAA2 for non-volant mammal, herpetofauna while indirect impacts occur within the adjacent area including Song Trau Protection Forest and Nui Chua National Park. These impacts are associated with both the construction (temporary) and operation (long-term) phases. These impacts to terrestrial environments are localised and limited to where clearing, land disturbance and transport of heavy machinery will be performed.

In addition, the magnitude of impact is expected to be small during the construction phase. During the operation phase, the impact magnitude is predicted to be small for the species traversing the Project area and negligible for species within Nui Chua National Park.

Given the species traversing/ within the Project area are common with the presence of one Data Deficient species, the sensitivity of receptors are likely to be medium. Due to the presence of Black-shanked douc langur in Nui Chua National Park, the receptor sensitivity is high.

Consequently, the significance of direct impacts on species found in the Project area is Minor whilst the indirect impacts on Black-shanked douc langur in Nui Chua National Park is Moderate. Furthermore, the impact significance is considered to be Minor during operation phase.

Noise

Anthropogenic noise will be the primary disturbance caused by vegetation clearing, excavation, movement of materials, transportations and general construction activities. These activities will introduce noise to areas not currently exposed to these disturbances. Excessive noise can impede fauna communication and deter the use of habitats nearby. Biological responses to different noise-source categories by terrestrial taxa is presented in Table 10.49. Generally, the literature review suggested that fauna responses to noise can be triggered at noise intensity as low as 45 dBA (Shannon et al. 2016). According to Shannon, multiple birds are likely to change in song characteristics, reproduction, abundance, stress hormone levels, and species richness at levels ≥45 dBA SPL.

Terrestrial mammals exhibited increased stress levels and decreased reproductive efficiency at noise levels between 52 and 68 dBA SPL (re 20 µPa). Traffic noise exceeding 60 dBA SPL (re 20 µPa) impacted the vocal behaviour of male anurans and traffic noise exceeding 80 dBA SPL (re 20 µPa) reduced the foraging efficiency of gleaning bats (Shannon et al. 2016). In terms of herpetofauna, artificial noise potentially affects the amphibians' behaviour such as the calling behaviour, especially mating call. For instance, amphibians' movement could be directed towards the noisy area and lead to accidents (Tennessen, et al., 2018). However, the noise during night-time may be not considerable so that the effect on amphibian is insignificant.

Construction phase

The construction phase of a wind energy facility entails increased traffic, earthwork, in some cases logging, and other human activity in the area, which may affect animal behaviour and spatial distribution. The duration of construction activities is expected to be short-term (12 months). As a result, the noise, light and vibration disturbances will not be continuous for the construction period, they are unlikely to occur at all locations simultaneously and will be localized. The noise levels during the construction period are considered to be medium-high that may lead to a small magnitude effect on species (Table 10.49). There are no species of conservation significance present within the project footprint and indirect ares of influence and that the highly modified habitats mean that effects on species will be local and negligible.

Black-shanked Douc Langur (*Pygathrix nigripes*) [IUCN CR; VNRB EN] is unlikely to occur within the Project area. However, Nui Chua National Park which is approximately 5 km to the Project area is the home range of 500- 700 individuals Black-shanked Douc Langur (Tran Van Bang[17] pers.comm.). The Project activities result in noise, light and vibration that can affect the vocalisations of Black-shanked Douc Langur during the construction phase. According to US Federal Highway Administration 2017, Generator (<25KVA) alone may cause noise at approximately 73 dBA. Hence, the noise level during the construction phase is the cumulative noise of multiple machines and activities simultaneously which is expected to be higher than 52 dBA. Increasing stress levels, therefore, may be exhibited but the effect is predicted insignificantly. Additionally, anthropogenic noise may affect this species more substantially in the construction phase compared with the operation phase.

Operation phase

During the operation phase, vocal communication of the animals or animals' ability to hear can be affected by noise from turbines. However, wind turbine noise does not pose an immediate risk as the animals are able to habituate to the sound (Helldin, et al., 2012). This is because wind turbine noise can also be masked by other sounds in the environment (Brumm 2004; Francis, Ortega & Cruz 2011; Parris, Velik-Lord & North 2009; Zhao et al. 2018), such as traffic or the wind in the vegetation, and at times appear less annoying[18]. The impact of noise on animal well-being and health therefore can be considered to be negligible.

Based on noise modelling results in the operation phase (section 10.3), the noise levels in Song Trau Protection Forest and Nui Chua National Park are predicted to be less than 40 dBA (Leq-1hr) which is lower than the threshold that triggers the change of the species' behaviour. Therefore, the magnitude of impact on species within Nui Chua National Park during the operation phase is considered to be negligible. Noise levels within 2 km of the Project area are predicted to be 40-99 dBA that may adversely affect some species traversing the Project area.

The baseline indicates that a range of both bat and bird species use the site, either for foraging and/or during migration. No collision risk modelling was done for birds but the numbers observed during the

[17] Tran Van Bang is a primate expert with more 14-year experience. Additionally, he has been a member of IUCN Primate Specialist Group – SE Asia since 2017.

[18] Naturvårdsverket 2010. Ljud från vindkraftverk; reviderad utgåva av rapport 6241 [Sound from wind power turbines; revised issue of report 6241]. Report no. 5933, Swedish Environmental Protection Agency, Stockholm, Sweden.

baseline (40 species and 36 species were recorded during transect surveys and vantage point surveys), and the data from the mortality study of Phu Lac Wind Farm which is roughly 60 km to the Project indicated small numbers linked to mortality (a total of 31) of widespread and common birds with huge population were found, indicating a low likelihood of risk to birds.

The data for bats from Phu Lac indicates a higher level of mortality than for birds, with an estimated 39 bats per turbine per year found killed. As consultation with bat expert, Loi Hai is regarded as a better habitat for bats than Phu Lac, where according to the bats monitoring results from Loi Hai identified at least 25 species present including one IUCN NT species and one VNRB VU species.

Given the poor local knowledge linked to bat populations, the potential of a high mortality rate, and the possibility of cumulative impacts with the operation of other windfarms located in the area, effects on bats may be high, therefore it is quite important to perform monitoring campaigns once the operation commences, twice a year for at least three to four years to have a better understanding of populations present in the area along with their behaviour. Although the populations affected may be local, the connectivity in terms of likely foraging ranges would extend effects to populations within at least 10 km, including those in the two protected areas. The sensitivity of the population, based on the presence of IUCN NT is medium. Impacts are therefore likely to be minor to moderate based on the assessment matrix.

The uncertainty around impacts on birds and bats requires conclusions that can be made once post-construction monitoring is concluded, and then developer will design an adaptive management plan in accordance with the results as well as including the adequate mitigation measures as part of the biodiversity management plan.

Table 10.49 Biological Responses to Different Noise-source Categories by Different Taxa

	Environmental*	Transportation**	Industrial***
Birds	■ Changes in call rate and duration ■ Increase in amplitude of vocalisations ■ Shifts in timing of vocalisations ■ Changes in frequency components of vocalisations ■ Decreases in acoustic complexity of songbird community ■ Decline in species diversity ■ Decline in reproductive success ■ Avoidance of noisy environment	■ Changes in frequency components of vocalisations ■ Increase in amplitude of vocalisations ■ Shifts in timing of vocalisations ■ Effects on physiology and development of species ■ Changes in abundance, species richness, distribution and occupancy ■ Reduction in reproductive success in presence of road noise ■ Preference for roosting in quieter areas	■ Changes in song frequency and length ■ Changes in community and species interactions ■ Increase in physiological stress levels ■ Reduced breeding success ■ Decline in occupancy and abundance
Mammals	Shifts in call frequency and amplitude for echolocating bats	Disruption of foraging in gleaning bats	■ Increase in physiological stress from construction noise ■ Reduced reproductive efficiency of laboratory mammals exposed to construction noise
Reptiles and amphibians	Shifts in energy distribution of cicadas songs towards higher frequency	■ Reduction in chorus tenure and duration by male anurans exposed to traffic noise ■ Difficulty locating mates ■ Increased minimum frequency of vocalisations ■ Change in calling time	
Invertebrates		Higher frequency components in courtship signal of grasshoppers	

	Environmental*	Transportation**	Industrial***

Note: Noise source from:

Environmental: General background noise (urban and developed areas, no specific source identified)

Transportation: Commercial (maritime shipping, commercial aircraft, train, bus) and private (general traffic, automobile, motorcycle, small boat) transport noise

Industrial: General construction, machinery, energy (wind, oil and gas) development and operation, pile driving, seismic survey (air-guns), echo sounder, and underwater communication network noise

Source: Shannon et al. 2016

Vibrations during Construction phase

Large ground-borne vibrations can be emitted through earthworks during the construction phase, while smaller vibrations can be produced by the operation of wind turbines. The consequences of these influences are dependent on the extent of disturbance but in extreme cases, these factors can influence local populations. For instance, breeding and communication can be reduced or individuals displaced from noisy areas. Species that are sensitive to vibrations such as snakes (Christensen et al. 2012) and ground-dwelling species might be frightened and experience increased stress. However, the turbines are located in modified habitats which suggests very low occurrences of, if any, snakes and ground-dwelling mammals. Additionally, considering that the vibration disturbances might only have significant biological effects within small areas around the turbines and the construction sites, and the potential avoidance of fauna, the effect is considered to be Negligible.

Lights during Operation phase

Artificial lights disrupt nocturnal activities, interfering with reproduction that can result in reduction in population. Introducing light sources has the potential to deter foraging and dispersal activities of nocturnal species. In addition, anthropogenic lights can trigger the orientation and immobility in amphibians (Tennessen, et al., 2018). There may be some temporary local displacement of bats during construction but there are alternative opportunities for foraging and commuting within the landscape. Consequently the impact is negligible to minor depending on the conservation status of the bat species concerned.

Table 10.50 IA of Disturbance or Displacement of Fauna during the Construction Phase

Impact Type	**Direct**		**Indirect**		Induced
Impact Duration	**Temporary**	Short-term		Long-term	Permanent
Impact Extent	**Local**		Regional		International
Impact Frequency	The impact frequency is expected to be continuous as the likelihood of threatened species being in the areas.				
Impact Magnitude	Positive	Negligible	**Small**	Medium	Large
Receptor Sensitivity	Low		**Medium (EAAA1 & EAAA2)**		**High (Nui Chua National Park)**
Impact Significance	Negligible	**Minor (EAAA1 & EAAA2)**		**Moderate (Nui Chua National Park)**	Major

Table 10.51 IA of Disturbance or Displacement of Fauna during the Operation phase

Impact Type	**Direct**		**Indirect**		Induced
Impact Duration	**Temporary**	Short-term		**Long-term**	Permanent
Impact Extent	**Local**		Regional		International
Impact Frequency	The impact frequency is expected to be continuous as the likelihood of threatened species being in the areas.				
Impact Magnitude	Positive	**Negligible (Nui Chua National Park)**	**Small (EAAA1&EAAA2)**	Medium	Large
Receptor Sensitivity	Low		**Medium (EAAA1&EAAA2)**		**High (Nui Chua National Park)**

Impact Significance	**Negligible (Nui Chua National Park)**	**Minor (EAAA1 & EAAA2)**	Moderate	Major

10.10.3.3.4 Additional Mitigation Measures

The additional measures are proposed as followed:

- Implement the mitigation measures regarding noise reduction in this ESIA (section 10.3);
- Light spillage outside of the construction area will be controlled by the use of appropriate cowling and positioning of direct light onto the construction area and away from natural habitats (Nui Chua National Park and Song Trau Protection Forest);
- A *Wildlife Shepherding Protocol* under Biodiversity Management Plan is to be used in the project area to ensure that any flora and fauna have vacated the area prior to any clearance work;
- Ecological connectivity across the site will be maintained. Fencing will be restricted to those discrete project components where it is necessary to prevent ingress by wildlife for safety and animal welfare reasons;
- Implement noise mitigation measures to minimise disturbance and displacement including:
  - Use of appropriate noise suppression techniques (such as silencer, noise barrier) where applicable; and
  - Limit the number of machines operated simultaneously.

10.10.3.3.5 Monitoring and Audit Program

- Monitoring the implementation of the mitigation measures regarding noise reduction in this ESIA (section 10.3);
- Lighting reports are to be kept and regularly reviewed (3 monthly basis) during operation;
- Records are to be kept and regularly reviewed (3 monthly basis) during construction on the application of the *Wildlife Shepherding Protocol.* Species records are maintained;
- Records are to be kept and regularly reviewed (3 monthly basis) during operation on the application of the fencing. Access records and Fencing integrity are maintained; and
- Records of noise monitoring are to be kept and regularly reviewed weekly during construction and every three months during operation.

10.10.3.3.6 Significance of Residual Impact

With the application of mitigation measures, the significance of impacts are likely to be reduced to the minor/ negligible.

10.10.3.4 Barrier Creations, Fragmentation and Edge Effects

10.10.3.4.1 Potential Impacts

- Barrier creations due to the existing project components that disturbs the movement of fauna;
- Fragmentation causes the connective habitat between habitat that affects the movement and reduce the opportunities to breeding and foraging sites; and
- Edge effects due to the introduction and spreading of invasive species which possibly degrades the adjacent habitat.

10.10.3.4.2 Existing Controls

There are no existing controls outlined in the local regulatory ESIA.

10.10.3.4.3 Significance of Impacts

These impacts are indirect impacts resulted from habitat loss due to land clearance that may last throughout the lifespan of the Project. Species that are affected include Least Concern, Near Threatened, Data Deficient species, thus the sensitivity of receptor is Medium. Additionally, it is projected that the barrier creation, fragmentation and edge effects cause Negligible magnitude during the construction phase and Small magnitude during the operation phase. General impact significance, therefore, is minor but barrier creation impacting on birds and bats should be noticed.

Construction phase

Construction activities relating to infrastructure have the potential to create a barrier to fauna movement (for some fauna groups). This includes widening internal roads, construction of the 110 kV transmission line and other infrastructure. Most other Project components are discrete areas that may be navigated around by fauna that may be moving through the area. The construction of the Project will primarily be within the modified habitat. Barrier impacts cannot be generalised, as each species responds differently, which is due to different requirements for food, shelter, space, suitable climatic conditions and interspecific interactions (competition, predation and mutualisms). Small mammals and herpetofauna will likely be impacted at a local scale whilst larger fauna is unlikely to be impacted given that barriers will be localised within close proximity of the turbine layout.

Fragmentation of habitats can occur where currently linked habitats are disconnected through the construction of Project components. Fragmentation reduces the continuity of habitat and hence the ability for fauna to move within and between habitats patches. The resulting impact can cause reductions in access to foraging and breeding habitats. Fragmentation of existing habitats is not considered to be a significant impact as the infrastructure design does not lead to the isolation of habitat patches and is primarily within modified habitat. This comprises impacts as a result of strung wires of the transmission line, which also include bird/bat collision risks (see impact assessment for mortality in section 10.10.3.5 and 10.10.3.6). Fences will be placed to ensure proper safety for personnel, as well as proper security to prevent access of non-Project personnel and fauna. The Project is expected to have permanent impacts throughout the operation phase.

Edge effects may be generated when vegetation clearing or land disturbance occurs in a current unmodified environment. The creation of new edges in a landscape potentially cause areas of habitat to become vulnerable to impacts such as weed invasion (section 10.10.3.2.3 – Invasive species), opportunistic predation and changes in neighbouring vegetation communities. Changes to climatic conditions in vegetation communities and an increase in predation and weeds could significantly degrade habitat values within the EAAA. These aspects have the potential to reduce the value of habitat for native flora and fauna.

Considering the project area is located in modified habitat with low-value biodiversity, barrier creation, fragmentation and edge effects are expected to have a minor effect on the high mobility species such as birds and bats. This is a large open landscape with the turbine locations being placed next to existing infrastructure that already fragments the landscape such as roads. Therefore the barrier effects arising during construction are insignificant.

Operation phase

In operation phase, the barrier effect means that an obstacle such as wind turbines and overhead transmission line acts as a barrier to flying birds, thus they avoid the vicinity of the obstacle and take another flight course. During the operation period, there may well be a barrier effect created for birds in particular, as these show avoidance in relation to turbines and therefore may divert around or be deterred from passing such structures. Generally, there is very little evidence that such macro or micro

avoidance generates significant additional biological demands. Bats appear to have several responses to wind turbines, but to data there is no evidence that bats perceive them as a barrier. Barrier effects are therefore likely to be negligible. This potentially facilitates the longer routes, then potentially increases the energy consumption during transports between feeding, breeding and resting areas. This may cause a small magnitude impact in a single project level.

Table 10.52 IA of Terrestrial Barrier Creation, Fragmentation and Edge Effects during the Construction Phase

Impact Type	Direct	**Indirect**	Induced		
Impact Duration	Temporary	**Short-term**	Long-term	Permanent	
Impact Extent	**Local**	Regional	International		
Impact Frequency	The impact can be continuous.				
Impact Magnitude	Positive	**Negligible**	Small	Medium	Large
Receptor Sensitivity	Low	**Medium**	High		
Impact Significance	**Negligible**	Minor	Moderate	Major	

Table 10.53 IA of Terrestrial Barrier Creation, Fragmentation and Edge Effects during the Operation Phase

Impact Type	Direct	**Indirect**	Induced		
Impact Duration	Temporary	Short-term	**Long-term**	Permanent	
Impact Extent	**Local**	Regional	International		
Impact Frequency	The impact can be continuous.				
Impact Magnitude	Positive	Negligible	**Small**	Medium	Large
Receptor Sensitivity	Low	**Medium**	High		
Impact Significance	Negligible	**Minor**	Moderate	Major	

10.10.3.4.4 Additional Mitigation Measures

Additional measures are proposed for both phases as follows:

- Fencing and hoarding to only be used where necessary to protect wildlife from accessing active work areas;
- Appropriate rehabilitation of disturbed areas using native vegetation to encourage returning the habitat for fauna to its natural stage.

10.10.3.4.5 Monitoring and Audit Program

The following measures are proposed:

- Records are to be kept and regularly reviewed (3 monthly basis) during construction on the application of the fencing and hoarding implementation; and
- Monitoring if rehabilitation success/failure is to occur on all replanting sites. Monitoring is to consist of regular inspections (yearly) to determine plant establishment. Where plant establishment is determined to have failed, reestablishment is to occur.

10.10.3.4.6 Significance of Residual Impact

With the application of mitigation measures, as well as monitoring and audit programs, the significance of impacts are more likely to be negligible.

10.10.3.5 Direct Mortality of Birds

10.10.3.5.1 Potential Impacts

Direct fatalities occur by vehicle collisions, hunting and poaching during the construction phase; and wind turbine collision, transmission line strikes and electrocutions during the operational phase.

10.10.3.5.2 Existing Controls

There are no existing controls described in the local regulatory ESIA.

10.10.3.5.3 Significance of Impacts

The direct mortality of birds are on-going throughout the Projects' operation and construction phase. Impacts are restricted to the location of the Project area and transportation routes. The recorded species comprises Least Concern (LC) and Near Threatened (NT) species in the IUCN Red List. Additionally, the EAAA1 does not support restricted-range species and globally significant concentration of migratory species and/or congregatory species.

During construction

Project activities may lead to direct mortality of fauna species that are different between the construction and operation phase. During construction, vehicle or machine strikes, falling debris, cutting down of trees that have juveniles nesting in them, and increased hunting or poaching conducted by workers pose risks to wildlife survival. The effects are considered to be Negligible as species within the proximity of the construction site are likely to be displaced by multiple anthropogenic disturbances before construction starts; thus numbers killed would be trivial (no differences to the natural mortality background).

During operation

Heightened risk of mortality for avifauna during operation of the wind farm may be a risk to birds within the Project area. The risks of death are higher during the operation phase due to potential collision with Project's facilities, mostly with turbine blades and transmission lines. Transmission line risks include both collisions with wires and accidental electrocution associated with perching on pylons. Raptors and heron species are more prone to electrocution on transmission lines due to their large body size that can span the distance between two energized or grounded components (such as two wires, or between a wire and a non-insulated pole or pole equipment such as conductors).

Collision risk with turbines may be affected by the species present, numbers present, flight behaviour, location of the project in the landscape, local topography and habitat within and surrounding the site. This may include areas of aggregation and congregation, even where these may be kilometres away from the wind farm.

A total of 54 species were recorded during field surveys with most species are Least Concern (LC) except for two Near Threatened species namely Red-necked Stint (*Calidris ruficollis*) and Bar-tailed Godwit (*Limosa lapponica*). Baseline surveys identified that of the species recorded, 22 species (including both Red-necked Stint and Bar-tailed Godwit) flew through the rotor swept zone (27m-177m), and were therefore at collision risk height..

In terms of migratory raptors, the survey did not record the presence of these species. Some large-body species such as heron were observed that may collide with either wind turbines or transmission lines. In addition, seven migratory birds were recorded, which are widespread species with large Extent of Occurrence (EOO). Dam Vua salt-pans is approximately 11 km to the south of the project which is the most important area supporting the resting site for birds compared with Song Trau and Ba Rau reservoirs. Presence of similar species observed between the EAAA1 and the salt-pans/ reservoirs may indicate possible connectivity between these two areas (e.g Red-necked Stint, Little Egret). The presence of project components possibly affects the species foraging in these areas. However, the

surveys indicate that species occurring in the Dam Vua salt-pans, Song Trau and Ba Rau reservoirs are common (Least Concern and Near Threatened species) with high populations (Birds baseline report, 2017).

Overall, the baseline surveys indicate low numbers of mostly common and widespread species passing through the area, with the exception of two NT species. The Phu Lac 1 post-construction monitoring study indicate low rates of bird mortality. On this basis mortality from turbine collisions is unlikely to cause to population level effects in any species. The receptor sensitivity is medium and magnitude of the impact is predicted to be negligible.

Table 10.54 Birds Considered being Prone to Collision

No.	English Name	Scientific name	Flight height band	IUCN Red List	Extent of Occurrence (EOO) (km^2)	Found during transect/ vantage point survey	Relative Abundance
1	Yellow Bittern	*Ixobrychus sinensis*	B, I	LC	51,500,000	TR, VP	5%
2	Cinnamon Bittern	*Ixobrychus cinnamomeus*	I, I	LC	25,400,000	TR, VP	16%
3	Grey Heron	*Ardea cinerea*	I, O	LC	136,000,000	TR, VP	14%
4	Purple Heron	*Ardea purpurea*	I	LC	131,000,000	TR, VP	3%
5	Great Egret	*Ardea alba*	B, I	LC	36,800,000	VP	
6	Intermediate Egret	*Mesophoyx intermedia*	B, I	LC	unknow	TR, VP	11%
7	Little Egret	*Egretta garzetta*	B, I, O	LC	151,000,000	TR, VP	35%
8	Cattle Egret	*Bubulcus ibis*	B, I	LC	349,000,000	TR, VP	41%
9	Chinese Pond Heron	*Ardeola bacchus*	B, I	LC	9,030,000	VP	
10	Black-crowned Night heron	*Nycticorax nycticorax*	I, O	LC	296,000,000	VP	
11	Greater Coucal	*Centropus sinensis*	B	LC	19,600,000	TR, VP	11%
12	White-browed Crake	*Porzana cinerea*	B	LC	32,500,000	VP	
13	Red-wattled Lapwing	*Vanellus indicus*	B, I	LC	15,100,000	TR, VP	8%
14	Little Ringed Plover	*Charadrius dubius*	B, I	LC	55,900,000	VP	
15	Common Greenshank	*Tringa nebularia*	I	LC	18,700,000	VP	
16	Wood Sandpiper	*Tringa glareola*	I, O	LC	23,000,000	VP	
17	Red-necked Stint	*Calidris ruficollis*	I	NT	3,360,000	VP	
18	Black-winged Stilt	*Himantopus himantopus*	B, I	LC	302,000,000	VP	
19	Bar-tailed Godwit	*Limosa lapponica*	I	NT	9,050,000	VP	
20	Oriental Pratincole	*Glareola maldivarum*	B, O	LC	25,400,000	TR, VP	3%
21	Red Collared-Dove	*Streptopelia tranquebarica*	B, I, O	LC	18,300,000	TR, VP	32%
22	Spotted Dove	*Streptopelia chinensis*	B, I, O	LC	unknow	TR, VP	51%

No.	English Name	Scientific name	Flight height band	IUCN Red List	Extent of Occurrence (EOO) (km^2)	Found during transect/ vantage point survey	Relative Abundance
23	Zebbra Dove	*Geopelia striata*	B	LC	6,960,000	TR, VP	49%
24	German's Swiftlet	*Aerodramus germani*	B, I, O	LC	unknow	TR, VP	57%
25	Blue-tailed Bee-eater	*Merops philippinus*	B, I	LC	22,800,000	TR, VP	14%
26	Black Drongo	*Dicrurus macrocercus*	B, I	LC	17,900,000	VP	
27	Barn Swallow	*Hirundo rustica*	B, I, O	LC	251,000,000	TR, VP	19%
28	Streak-eared Bulbul	*Pycnonotus blanfordi*	I	LC	1,910,000	TR, VP	5%
29	Common Myna	*Acridotheres tristis*	B, I, O	LC	18,000,000	VP	
30	Vinous-breasted Starling	*Acridotheres burmannicus*	B, I, O	LC	420,000	TR, VP	5%
31	White-shouldered Starling	*Sturnia sinensis*	B, I, O	LC	1,070,000	TR, VP	5%
32	Zitting Cisticola	*Cisticola juncidis*	B	LC	134,000,000	TR, VP	43%
33	Eurasian Tree Sparrow	*Passer montanus*	I	LC	98,800,000	TR, VP	65%
34	Oriental Skylark	*Alauda gulgula*	B, I	LC	24,000,000	VP	
35	Paddyfield Pipit	*Anthus rufulus*	B	LC	19,500,000	VP	
36	Plaintive Cuckoo	*Cacomantis merulinus*				TR	11%
37	White-throated Kingfisher	*Halcyon smyrnensis*				TR	24%
38	Green Bee-eater	*Merops orientalis*				TR	11%
39	Eurasian Hoopoe	*Upupa epops*				TR	8%
40	Lineated Barbet	*Megalaima lineata*				TR	5%
41	Ashy Woodswallow	*Artamus fuscus*				TR	24%
42	Common Iora	*Aegithina tiphia*				TR	22%
43	Burmese Shrike	*Lanius collurioides*				TR	8%
44	Racket-tailed Treepie	*Crypsirina temia*				TR	8%
45	Indochinese Bushlark	*Mirafra erythrocephala*				TR	54%
46	Oriental Skylark	*Alauda gulgula*				TR	11%

No.	English Name	Scientific name	Flight height band	IUCN Red List	Extent of Occurrence (EOO) (km^2)	Found during transect/ vantage point survey	Relative Abundance
47	Red-rumped Swallow	*Cecropis daurica*				TR	14%
48	Common Tailorbird					TR	3%
49	Pied Bushchat	*Saxicola caprata*				TR	3%
50	Oriental Pipit	*Anthus rufulus*				TR	32%
51	House Sparrow	*Passer domesticus*				TR	8%
52	White-rumped Munia	*Lonchura striata*				TR	30%
53	Nutmeg Mannikin	*Lonchura punctulata*				TR	5%

Note:
Flight Height band: (O) Above the height of RSZ; (I) transverse RSZ; (B) Below the height of RSZ
TR: Found in transect surveys
VP: Found in vantage point surveys

Table 10.55 IA of Bird Mortality

Impact Type	**Direct**	Indirect	Induced	
Impact Duration	Temporary	Short-term	**Long-term**	Permanent
Impact Extent	**Local**	Regional	International	
Impact Frequency	The transmission line and turbines will be operational 24 hours of the day. Impact frequency is expected to be intermittent over the operation phase.			
Impact Magnitude	Positive	**Negligible**	Small	Medium	Large
Receptor Sensitivity	Low	**Medium**	High	
Impact Significance	**Negligible**	Minor	Moderate	Major

10.10.3.5.4 Additional Mitigation Measures

Additional measures are proposed for both phases as follows:

Transmission Line

- Use of flight diverters through out the power line. The deflectors will increase line visibility by thickening the appearance of the line for easier detection by avifauna. The diverters are suggested to be placed with a 5-10m spacing. The detail regarding design features is presented in BMP;

- Flight diverter maintenance should be part of the normal overhead transmission line inspection and maintenance regime (e.g two yearly);
- Insulators are recommended not to be attached to crossarms with metal pins or similar conductive material as this can result in a circuit grounding for birds when perching on insulators. The replacement of steel on power poles is also suggested to be an effective mitigation measure, especially of cross-arm braces. Intermediate structures with horizontal configuration of lines large enough to accommodate the wingspan (or 'wrist-towrist') of the largest perching bird species present in the area of interest if all three phases are above the cross-arm. Alternatively two outer conductors should be suspended below cross-arm (Convention on the Conservation of Migratory Species of Wild Animals (CMS), Agreement on the Conservation of African-Eurasian Migratory Waterbirds (AEWA) and Memorandum of Understanding on the Conservation of Migratory Birds of Prey in Africa and Eurasia (Raptors MOU), 2012);

- If three conductors are positioned above cross-arm, centre conductor can be insulated to achieve necessary clearance between two outer conductors (Convention on the Conservation of Migratory Species of Wild Animals (CMS), Agreement on the Conservation of African-Eurasian Migratory Waterbirds (AEWA) and Memorandum of Understanding on the Conservation of Migratory Birds of Prey in Africa and Eurasia (Raptors MOU), 2012);

- Decrease vertical laying of power lines as having lines in a horizontal plane minimise collision risk;

Tower Designs

- Ensure that power towers and transmission lines meet safety standards such as Avian Power Line Interaction Committee (APLIC) standard[19] to minimise birds and bats electric shock risk. It should be note the current tower designs complies with aforementioned mitigation measures;
- Framing structures so that there is adequate separation between phases or phases and grounds to accommodate large perching birds. Based on the dimensions of eagles, APLIC recommends 60 inches of horizontal separation and 40 inches of vertical separation;
- Applying covers on phases or grounds where adequate separation is not feasible. Examples of covers include insulator/conductor covers, bushing covers, arrester covers, cut-out covers, and jumper wire covers. Cover designs should be evaluated and approved by company engineers prior to use. (Note: bird/animal protection covers are not intended for human protection);
- Images below illustrates the Typical avian safe structures: single phase (left), three-phase with lowered 8-foot crossarm (right). On three phase structures, a vertical clearance of at least 43 inches (1.05m) between un-insulated conductors, ground wires and grounded hardware on poles with 8-foot crossarms will provide the 60-inch (1.96m) required clearance;

- It should be note the current tower designs complies with aforementioned mitigation measures;

Operation of turbines

- Limit the operation of turbines when there are low winds avoid “free-wheeling” (free spinning of rotors under low wind conditions when turbines are not generating power).

Birds and Bats Management Plan

- The airspace of the project is considered to be natural habitat as defined in IFC PS6 relating to impacts on avifauna. The assessment of no-net-loss and a Bird and Bat Adaptive Management Plan (BBAMP) will be prepared for to demonstrate this requirement prior to commencement of windfarm operation.

10.10.3.5.5 Monitoring and Audit Program

All mitigations must be installed prior to the completion of the transmission line.

Post construction monitoring involving carcass searching will be required as part of the Bird and Bat Adaptive Management Plan (BBAMP), and details of the monitoring regime in terms of methods, timing and frequency required will form part of the BBAMP.

Records are to be kept on site and regularly reviewed during operation on the application of the Birds and Bats Management Plan.

10.10.3.5.6 Significance of Residual Impact

With the implementation of existing controls and additional mitigation measures, the impact significance is expected to be Negligible. However, this will need to be validated by post-construction monitoring results that will be described in more detail in the separate Birds and Bats Management Plan. If needed after monitoring results are obtained, mitigation measure could well need to be redesigned.

[19] APLIC offers a variety of training resources and guidance documents that identify causes and minimization methods for bird electrocutions and collisions with power lines. These resources include:
Avian Protection Plan (APP) Guidelines
Suggested Practices for Avian Protection on Power Lines document
Reducing Avian Collisions with Power Lines: State of the Art in 2012
Sage-grouse BMPs: Best Management Practices for Electric Utilities in Sage-grouse Habitat and Click here to view the Press Release

10.10.3.6 Direct Mortality of Bats

10.10.3.6.1 Potential Impacts

Potential impacts may comprise:

- Loss of roosting sites during the construction phase; and
- The Project components collision and barotrauma during the operation phase.

10.10.3.6.2 Existing Controls

Reviews of mitigation studies (e.g., Arnett et al. 2013) indicate the following approaches can substantially reduce bat fatalities at wind farms:

- Altering turbine operations to eliminate blade movement by feathering blades (blades pitched 90° and parallel to the wind) at or below normal cut-in speeds can significantly reduce bat fatalities when turbines are not producing electricity into the power grid; and
- Increasing normal turbine cut-in speed (wind speed at which turbines begin producing electricity into the power grid) by 1.5–3.0 m/s above the manufacturer's cut-in speed (studies have consistently shown this reduces bat fatalities by at least 50%).

Bat baseline report (ESIA, 2017) also recommended:

- Should the Loi Hai project proceed as proposed, given the likelihood of significant bat fatalities and reality that only operational mitigation has demonstrated effective reductions in bat fatalities at wind facilities to date, establishment of an operational curtailment program is highly recommended to minimize bat fatalities and reduce the probability of long term population-level impacts on bat;
- At a minimum, this should eliminate blade movement by feathering blades (blades pitched 90° and parallel to the wind) at and below manufacturer cut-in speeds when turbines are not producing electricity into the power grid. In addition, increases to the turbine cut-in speed by 1.5–3.0 m/s above the manufacturer's cut-in speed should also be considered;
- If a curtailment program is adopted, fine-tuning of its operational parameters through the identification of the high-risk periods when bats are most active and the abiotic conditions defining these periods is recommended. This would minimize bat fatalities while significantly improving the economic efficiency of the curtailment program and would require a dedicated study involving the use of passive acoustic equipment and dataloggers for abiotic variables; and
- A minimum set back of 100 metres from areas of natural vegetation/forest is recommended for all turbines. This boundary represents the distance from the blade tips as opposed to the turbine towers;
- Habitat modification measures are recommended to introduce deterrents and reduce bat roosting and foraging opportunities within the 100-metre set-back zone and all areas within the blade radius of turbines as follows;
    - Removing fruit and nectar producing plants (to reduce food availability for frugivorous and nectivorous bats), particularly including banana, mango, sapodilla, custard apple, guava, papaya and other plants with similarly fleshy fruit;
    - Ensuring that any all-night lighting on turbine towers and blades consists of LED lights (as these deter certain bat species) that have low ultraviolet wavelengths (as these are less attractive to insects that bats forage on) (Rowse et al. 2015); and
    - Removing dense woody or other vegetation that could potentially provide roosting habitat for foliage-dwelling bat species. Advice from a bat ecologist is recommended when designing and implementing these measures.

Once bat monitoring programs are performed, mitigation measures will be tailored in accordance with the monitoring results. Among the mitigation measures imposed to wind farms above, nevertheless these will be reviewed after the monitoring results are evaluated, and if needed, developer will redesign these.

10.10.3.6.3 Significance of Impacts

Impacts are restricted to the EAAA1. The affected species comprises the IUCN Red List of Threatened Species as Near Threatened (NT), Least Concern (LC),Data Deficient (DD) and one VNRB VU species thus the receptor sensitivity is Medium.

During construction

Threats to bats during the construction phase are largely related to incidental death from the clearing of vegetation when bats may be roosting in trees and buildings, or disruption of flight lines by lighting and construction disturbance.. Interviews with residents and extensive daytime searches did not reveal the existence of any significant diurnal roosts within the Project Area. Impacts arising from the loss of roosting sites during construction are therefore likely to be Negligible.

During operation

The risk of turbine collisions' impact on bats has been assessed using a species-based risk assessment informed by species ecology and biology. Based on available information on the desktop review, at least 25 bat species including four fruit bat taxa and 21 insectivorous species occur in the Project area. Most species are listed as Least Concern, although there is one Near Threatened species namely Griffin's Leaf-nosed Bat (*Hipposideros griffini)* and one Data Deficient species particularly Walston's tube-nosed bat (*Murina walstoni*).

Following the Risk Classification Guide of Furey and Racey (2016)[20], the collision risks are categorized based on their foraging behaviour. Based on field survey results and the Risk Classification, at least seven bat phonic species were recorded in the Project Area classified as at high risk of collision, including two that could not be defined, on the basis of the echolocation calls, to species level.

Foraging preferences of bat species were inferred using wing morphology and observations of foraging behaviour in the literature. Because the foraging classification of McKenzie et al. (1995) reflects the differential risks of collision at wind farms and propensities for migration of bat species, all species registered during the screening were categorized using Furey & Racey (2016) and associated publications as follows (Table 10.56).

All bat species to be identified upon the surveys could be categorized based on their foraging preferences, and therefore collision risks, as shown in Table 10.57 (Furey & Racey, 2016)[20].

Table 10.56 Risk Classification Guide of Bat Species[20]

Category	Description	Risk Classification
I	Insectivorous species that forage in the highly cluttered airspace within the forest interior (or forest interior specialists).	Low
II	Insectivorous species that forage in partially cluttered spaces such as clearings, streams or other tunnels within the forest or just above the canopy (edge and gap foragers).	Medium
III	Insectivorous bats that forage in unobstructed airspaces found in large clearings or high above the forest canopy (open-space foragers).	High

[20] Furey, N. M., & Racey, P. A. (2016). Can wing morphology inform conservation priorities for Southeast Asian cave bats?. Biotropica, 48(4), 545-556.

IV	Fruit and nectar-eating bats that fly into the partially cluttered air-spaces between tree canopies, roost in small numbers and forage locally.	Medium
V	Fruit and nectar-eating bats that fly in unobstructed airspaces, roost in large colonies and forage over large areas.	High

Table 10.57 Collision Risks of Bat Species Recorded in Loi Hai 2 Wind Farm

No.	Scientific name	English name	IUCN[1]	Roosting Preference	Foraging Strategy[2]	Collision Risk
	Pteropodidae	Old World fruit bats				
1	*Cynopterus sphinx*	Greater short-nosed fruit bat	LC	Foliage / Cave	IV	Medium
2	*Eonycteris spelaea*	Cave nectar Bat	LC	Cave	V	High
3	*Megaerops niphanae*	Ratanaworabhan's fruit bat	LC	Foliage	IV	Medium
4	*Rousettus* sp.	Leschenault's Rousette	LC	Cave	V	High
	Megadermatidae	False vampire Bats				
5	*Megaderma lyra*	Greater False vampire	LC	Cave / Hollow tree	II	Medium
6	*Megaderma spasma*	Lesser False vampire	LC	Cave / Hollow tree	II	Medium
	Rhinolophidae	Horseshoe bats				
7	*Rhinolophus chaseni*	Chasen's horseshoe bat	NA	Cave / Hollow tree	I	Low
8	*Rhinolophus microglobosus*	Lesser brown horseshoe bat	NA	Cave / Hollow tree	I	Low
9	*Rhinolophus lepidus*	Blyth's Horseshoe bat	LC	Cave / Hollow tree	I	Low
10	*Rhinolophus pearsonii*	Pearson's horseshoe bat	LC	Cave / Hollow tree	I	Low
11	*Rhinolophus marshalli*	Marshall's horseshoe bat	LC	Cave / Hollow tree	I	Low
12	*Rhinolophus thomasi*	Thomas's horseshoe bat	LC	Cave / Hollow tree	I	Low
	Hipposideridae	Leaf-nosed bats				
13	*Hipposideros cineraceus*	Least Leaf-nosed bat	LC	Cave / Hollow tree	I	Low
14	*Hipposideros galeritus*	Cantor's Leaf-nosed bat	LC	Cave / Hollow tree	I	Low
15	*Hipposideros grandis*	Grand Leaf-nosed bat	LC	Cave / Hollow tree	II	Medium
16	*Hipposideros griffini*	Griffin's Leaf-nosed bat	NT	Cave / Hollow tree	II	Medium
17	*Hipposideros pomona*	Andersen's Leaf-nosed bat	LC	Cave / Hollow tree	I	Low
	Vespertilionidae	Evening bats				

No.	Scientific name	English name	IUCN[1]	Roosting Preference	Foraging Strategy[2]	Collision Risk
18	*Murina walstoni*	Walston's tube-nosed Bat	DD	Foliage	I	Low
19	*Myotis muricola*	Nepalese whiskered Myotis	LC	Crevices in buildings	II	Medium
20	*Pipistrellus javanicus*	Javan Pipistrelle	LC	Crevices in buildings	III	High
21	*Scotophilus heathi*	Greater Asian yellow house bat	LC	Crevices in buildings	III	High
22	*Scotophilus kuhlii*	Lesser Asian yellow house bat	LC	Crevices in buildings	III	High
23	*Kerivoula picta*	Painted woolly bat	LC	Foliage	I	Low
24	Phonic type 1 (FM ≈66 kHz)				III	
25	Phonic type 2 (FM <30kHz)				III	

Griffin's Leaf-nosed bat (*Hipposideros griffini*) is one of the largest species of the family *Hipposiderodae*. Griffin's leaf-nosed bat has only been recorded from three national parks, namely limestone karst of Cat Ba National Park, secondary forest in a mountain area in Chu Mom Ray and lowland forest in Cat Tien. The live trapping and acoustic survey recorded the presence of this species within the Project area and Nui Chua National Park which is 2 km to the east of the Project. To meet basic nutritional requirements, leaf-nosed bats that primarily feed on fruit and nectar must also ensure sufficient protein and fat intake by consuming insects or leaves[21]. It is predicted that the species is likely to fly at a low height (tree height) which is lower than the RSZ (27-177m).

Walston's tube-nosed Bat (*Murina walstoni*) were recorded in semi-evergreen forest, heavily disturbed lowland forest. These and other records all suggest *M. walstoni* uses more open, drier and can tolerate more disturbed habitats than most other Southeast Asian *Murina* species (Francis and Eger 2012, Csorba, pers. comm.). A number of tube-nosed bat have been observed flying low over forest stream[22]. Consultation with bat expert Mr. Vuong Tuan Tu, Walston's tube-nosed Bat is forest-dwelling bat that is likely to forage under canopies (<30m) and rarely traverse the RSZ (27-177m).

Besides, there is no roosting habitat which was detected during the field survey. Based on consultation with bat expert, Phu Lac Wind Farm mortality study indicated an average of 39 bat fatalities per turbine per year, study points out that Loi Hai was likely to support more bats and a more diverse assemblage. Although the effects on populations are local, considering the potential connectivity with other areas based on foraging range, the effects are likely to occur in a wider area than simply the project itself. Additionally, though the impact assessment matrix indicates the effects are low, given the uncertainties population levels and potential for cumulative effects validation of this assessment is required. This will be undertaken as part of the Bird and Bat Adaptive Management Plan as a part of the BMP. As a result, the bat collision likelihood within the Project area at the time of this report is expected to be low. It may affect a small proportion of the populations, but does not substantially affect other species dependent on it, or the populations of the species themselves. The impact magnitude, therefore, is considered Small. Significance of impact is therefore considered to be Minor.

[21] Elangovan, V., Marimuthu, G., Kunz, T.H. Temporal patterns of resource use by the short-nosed fruit bat, Cynopterus sphinx (Megachiroptera: Pteropodidae) (2001) Journal of Mammalogy, 82 (1), pp. 161-165.

[22] Available at: https://www.ecologyasia.com/verts/bats/tube-nosed-bats.htm Access date: 04 February 2021.

Table 10.58 Bat Mortality Impact Assessment

Impact Type	**Direct**		Indirect		Induced
Impact Duration	Temporary	Short-term		**Long-term**	Permanent
Impact Extent	**Local**		Regional		International
Impact Frequency	The transmission line and turbines will be operational 24 hours of the day. Impact frequency is expected to be intermittent over the operation phase.				
Impact Magnitude	Positive	Negligible	**Small**	Medium	Large
Receptor Sensitivity	Low		**Medium**		High
Impact Significance	Negligible	**Minor**		Moderate	Major

10.10.3.6.4 Additional Mitigation Measures

Apply the mitigation measures in section 10.10.3.5.4

10.10.3.6.5 Monitoring and Audit Program

Apply the mitigation measures in section 10.10.3.5.5. Post construction monitoring involving carcass searching will be required as part of the Bird and Bat Adaptive Management Plan (BBAMP), and details of the monitoring regime in terms of methods, timing and frequency required will form part of the BBAMP.

10.10.3.6.6 Significance of Residual Impact

With the implementation of existing controls and additional mitigation measures, the impact significance is expected to be Minor. However, this may be subjective to change according to the results of Birds and Bats Management Plan.

10.10.3.7 Mortality – Non-volant Mammals, Herpetofauna

10.10.3.7.1 Potential Impact

Induced impacts due to hunting and poaching species in Nui Chua National Park by the Project workforces.

10.10.3.7.2 Existing Controls

No existing controls were identified to mitigate this impact in the locally approved regulatory ESIA.

10.10.3.7.3 Significance of Impact

Mortality risks of other fauna as a result of the Project are mainly present in the construction phase. During the construction phase, mortality of other fauna may occur due to vehicle/machinery strike, or as a result of worker influx and hunting/poaching during construction and operation phases. Regarding the vehicle/machinery strike, during the construction phase land clearing, excavation and levelling activities will potentially cause mortality of less mobile fauna (such as reptiles and amphibians). However, given the low biodiversity value in the Project activities, the fatalities due to vehicle/machinery collision is forecasted to be negligible magnitude.

The influx of workers during the construction phase may lead to increased hunting, poaching, or trapping activities for Black-shanked douc langur as well as numerous other species within Nui Chua National Park. There may also be attempted by the Project staffs, workers, and/or subcontractors to trap reptiles for subsistence or for economic value during the operation phase.

Hunting and poaching Black-shanked Douc Langur is prohibited complying with Decree no.06/2019/ND-CP dated 22 January 2019. This species has been hunted and poached in many places

in Vietnam, not particularly Ninh Thuan province. Hunting is currently the major threat to this species (Nadler et al. 2003). Additionally, the species is hunted rampantly for food and 'medicine', and live caught for the pet trade. The measures to avoid the adverse influence on this species require to consider seriously the awareness of labour forces and extend to local people if possible.

However, the duration of construction activities is expected to be short-term (12 months). The risk of mortality during the construction of the Project is considered low, due to adherence to established driving rules, limiting night-time driving, and the large area of general habitat is unlikely to be affected by the proposed development. As a result, the impact magnitude is expected to be Small.

The impact type is likely to be induced as it is relevant to the Project in the form of worker influx and possible poaching. The magnitude of the impact is expected to be Small as the impacts may affect a small proportion of a population, but does not substantially affect other species dependent on it, or the populations of the species itself. The sensitivity of the receptor is considered to be High, as the Nui Chua National Park contains a habitat of importance to globally CR species (e.g Black-shanked Douc Langur). The overall impact significance is therefore considered to be Moderate**.**

Table 10.59 Other Fauna Mortality Impact Assessment

Impact Type	Direct	Indirect	**Induced**		
Impact Duration	Temporary	**Short-term**	**Long-term**	Permanent	
Impact Extent	**Local**	Regional	International		
Impact Frequency	The impact frequency is expected to be hunting/poaching.				
Impact Magnitude	Positive	Negligible	**Small**	Medium	Large
Receptor Sensitivity	Low	Medium	**High**		
Impact Significance	Negligible	Minor	**Moderate**	Major	

10.10.3.7.4 Additional Mitigation Measures

Additional measures are proposed for both phases as follows:

- A *Wildlife Shepherding Protocol* under BMP is to be used within the Project Area to ensure that any resident species have vacated the area to be impacted prior commencing clearance work;
- Prior to starting any type of works in the area, personnel will checked for presence of fauna along the tracks, routes or other working areas, to minimize the likelihood of vehicle collision with these species, specially the slow motion ones. Wildlife will be encouraged to leave the site by the use of sound and visual disturbance e.g. air horns, flags. This subject will be provided for labour in training courses;
- All vehicles are to maintain a speed of a maximum of 10-20kph[23] within work sites to reduce fauna collision risk;
- Ecological connectivity across the site will be maintained. Fencing will be restricted to those discrete project components where it is necessary to prevent ingress by wildlife for safety and animal welfare reasons;
- The Project owner shall provide training to staff and workers on all applicable rules, regulations and information concerning restrictions related to hunting and poaching, as well as sanctions that may be imposed if any staff or worker or other person associated with the Project violates these rules and regulations;
- Hunting and poaching will be prohibited for Project staff, workers, all contractors and personnel engaged in or associated with the Project, with penalties levied, including fines and dismissal, and

[23] kilometres per hour

prosecution under the relevant applicable laws for clearing vegetation. Staff identified to have participated in the possession, purchase, trade or collection of wildlife or forest resources will be dismissed from employment and not re-employed at any later date. The staff will be made aware that such illegal activity will lead to dismissal and potentially reporting to the authorities for further legal action;

- Collaborate with Management Board of Nui Chua National Park and Song Trau Protection Forest to avoid the illegal hunting, poaching and wood extraction in these areas. Regular inspections are to occur at least monthly during construction basis to identify any illegal actions linked with the flora and fauna;
- As workforce may illegally possess fauna and flora from the project area, random inspections within the Project area will be performed to identify this possession. Inspections within the Project boundary and workers' camp which will be made of labour forces. Where fauna is identified during regular inspections (monthly during construction phase), this is to be confiscated and photographed for recordkeeping. *Injured Wildlife Management Protocol* under BMP is to be applied when injured individuals are found. Wherever possible, fauna are to be relocated to their point of origin or similar natural adjacent areas;
- Publication and signage should be placed at biodiversity controlled properties stating the Biodiversity and Ecosystem Service policy, outlining the prohibition of species poaching/hunting; and
- *Community Engagement Procedure* aligned to *Stakeholder Engagement Plan* (SEP) is used to raise awareness of local people and collaborate with community to achieve zero tolerance policy including appropriate labels and signs. Encourage local people to avoid illegal hunting/poaching activities and discuss alternatives through proactive community engagement.

10.10.3.7.5 Monitoring and Auditing Program

The following measures are proposed:

- Records are to be kept and regularly reviewed (3 monthly) on the application of site check before starting works;
- Regular checks of speed limits within the Project Area;
- Records are to be kept and regularly reviewed (3 monthly basis) during construction on the application of the fencing and hoarding implementation;
- Four workforce trainings during construction phase and one workforce training per year during operation. Records are to be kept and regularly reviewed (3 monthly) for implementation of the workforce training program for fauna/flora awareness;
- Ongoing inspection during construction (daily) and operation (weekly);
- Formal records of meetings with these bodies should be generated, and should be available for audit as required;;
- Records are to be kept and regularly reviewed (3 monthly basis) during construction on the application of the *Injured Wildlife Management Protocol*;
- Publication and signage in place;
- Records are to be kept and regularly reviewed (3 monthly basis) during construction on the application of the *Wildlife Shepherding Protocol*; and
- Records are to be kept and regularly reviewed (3 monthly) on the application of the *Community Engagement Procedure*.

10.10.3.7.6 Significance of Residual Impact

The residual impact significance is likely to be Minor/ Negligible**.**

10.10.4 Next Steps

Based on the findings of these biodiversity impact assessments, the recommended next steps for the Project should involve:

- A Biodiversity Management Plan (BMP) to bring together all the mitigation and monitoring requirements; and
- A Bird and Bat Adaptive Management Plan (BBAMP) will be prepared. This will define carcass monitoring requirements and link finding to agreed levels of acceptable change (action triggers). Adaptive management actions will be defined (e.g. curtailment regimes) together with roles and responsibilities for initiating and maintaining such actions

11. SOCIAL IMPACT ASSESSMENT

11.1 Introduction

This chapter analyses the potential socio-economic impacts that may result from the pre-construction, construction, and operation of the Loi Hai 2 Wind Power Project. The assessment has been conducted based on the impact assessment methodology detailed in Chapter 4 and social data gathered (via secondary and primary means). Baseline data covering categories such as demographics and governance of the impacted villages, income and livelihoods, land use and ownership, community health, access and quality of local services, and infrastructure has been gathered from recent secondary information and a socio-economic baseline survey conducted in September and November 2020. The baseline survey focus group discussions, key interviews with local authorities, and surveys were conducted with those households identified as having lost agricultural land, relocating due for health and safety reasons, or experiencing restricted land activities due to the Project development. The baseline data has been analysed and is presented in Chapter 8 of this Environmental and Social Impact Assessment (ESIA) report.

This chapter aims to:

- Define the scope of the social impact assessment, including the area of influence and receptors considered;
- Identify the potential/existing social impacts associated with the pre-construction, construction, and operation activities of the Project. Issues concerning the perceptions and values of local residents are also put into consideration;
- Present existing controls to the impacts, which the Project Owner has already developed and implemented;
- Propose meaningful and effective mitigation measures and, where possible, enhance Project benefits; and
- Recommend an appropriate monitoring and auditing schedule.

11.2 Scope of Social Impact Assessment

The social receptors are defined as communities currently residing in the Area of Influence (AoI) that the Project may impact as a result of their proximity to the Project site and/or associated facilities. Based on the scoping outcomes from Chapter 5, the Area of Influence for social impacts to the community is defined in Figure 11.1.

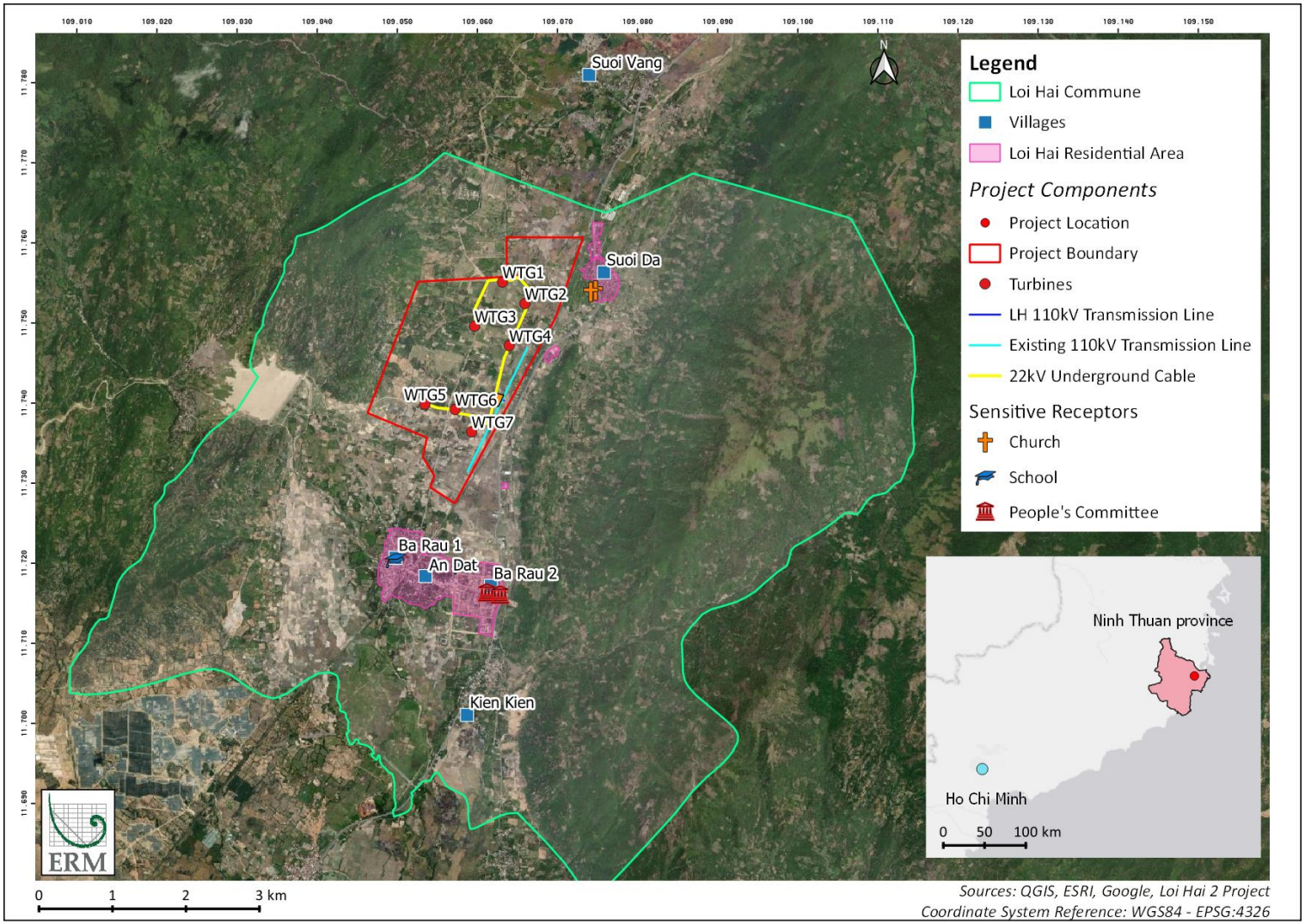


Figure 11.1 Area of Influence of Social Impacts

11.3 Approach for Assessing Social Impacts

The assessment is based on the impact assessment methodology explained in Chapter 4 and the social baseline data presented in Chapter 8 of this ESIA report. When undertaking a social and health impact assessment, several important criteria must be considered: the magnitude of impact, vulnerability of receptor, stakeholder perceptions, and Project planning and development objectives, as illustrated in Figure 11.2. The first three criteria are explained in detail in the next sections, while the latter Project planning and development activities are explained in detail in Chapter 1 of this report.

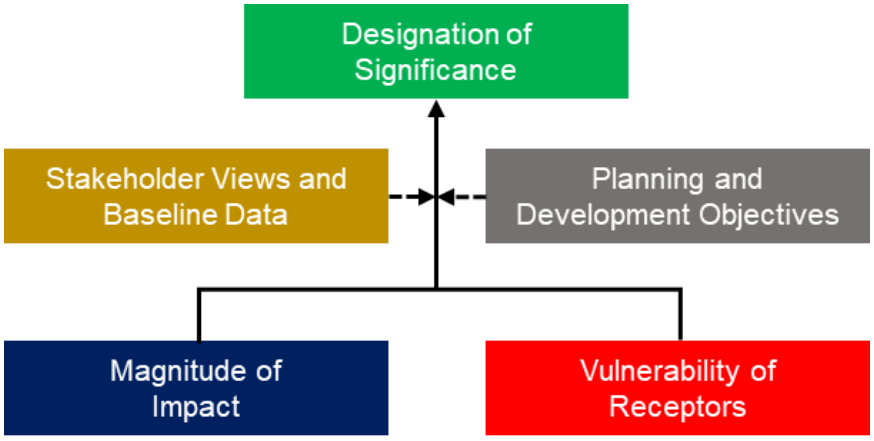


Figure 11.2 Evaluation of Social Impact Significance

11.3.1 Magnitude of Social Impact

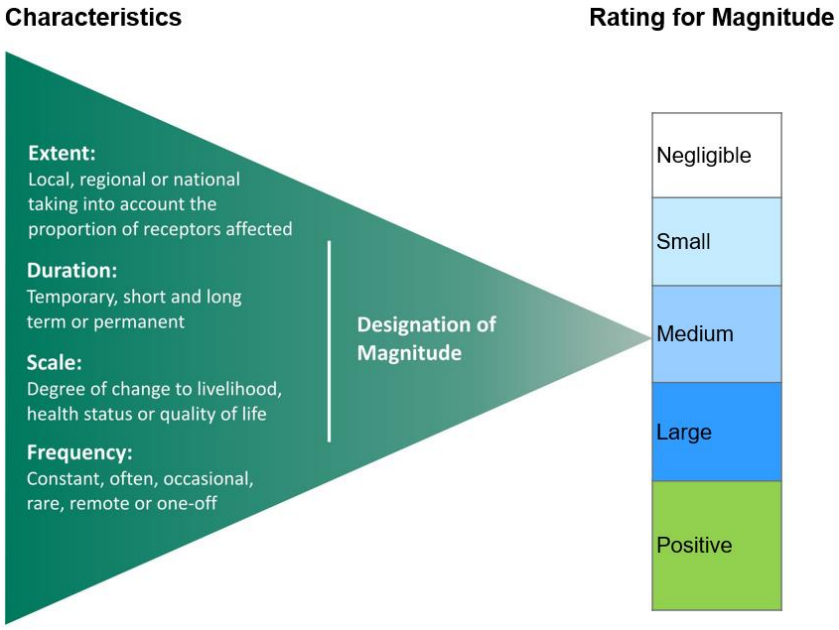


Figure 11.3 Characteristics of Social Impact Magnitude

The magnitude of social and health impacts is understood as a reflection of the “size” or degree of change caused by social and community impacts. Figure 11.2 depicts the characteristics that need to be taken into account when defining impact magnitude. A description of the social magnitude rating is provided in Table 11.1.

Table 11.1 Designation of Social Impact Magnitude

Designation of Magnitude	Description
Negligible	Change remains within the range commonly experienced within the household or community.
Small	Perceptible difference from baseline conditions. Tendency is that impact is local, rare, affects a small proportion of households, and is of a short duration.
Medium	Clear evident difference from baseline conditions. Tendency is that impact affects a substantial area or number of people and/or is of medium duration. Frequency may be occasional, and impact may be regional in scale.
Large	Change dominates baseline conditions. Affects the majority of the area or population in the area of influence and/or persists for many years. The impact may be experienced over a regional or national area.
Positive	In the case of positive impacts, it is generally recommended that no magnitude be assigned, unless there is ample data to support a more robust characterisation. It is usually sufficient to indicate that the Project will result in a positive impact, without characterising the exact degree of positive change likely to occur.

11.3.2 Vulnerability of Receptor

In the social and community health context, vulnerability is the accepted term for describing the social receptor's sensitivity that will experience the impact. Vulnerable receptors are defined as stakeholders who:

- are less resilient than others within their socio-cultural context;
- have a reduced ability to respond to, cope with, and manage change and ‘shocks’; and
- are less able to access resources and development opportunities.

It is important to understand the vulnerability context as it will affect the social receptor's ability to adapt to any changes brought about by the Project in a direct, indirect or induced manner. A higher level of vulnerability can result in increased susceptibility to negative impacts or a limited ability to take advantage of positive impacts. A Project may also exacerbate existing vulnerabilities if individuals and communities' status and their coping mechanisms are not adequately understood or considered. Evaluation is made based on the pre-existing status of receptors, as well as their proximity to the Project components, to define the receptor’s level of vulnerability, as presented in Table 11.2.

Table 11.2 Level of Vulnerability of Social Receptor

Ranking	Definition
Low	Minimal vulnerability; consequently, with a high ability to adapt to changes brought on by the Project and opportunities associated with it.
Medium	Some, but few areas of vulnerability; still retaining an ability to, at least in part, adapt to change brought on by the Project and opportunities associated with it.
High	Profound or multiple levels of vulnerability that undermine the ability to adapt to changes brought on by the Project and opportunities associated with it.

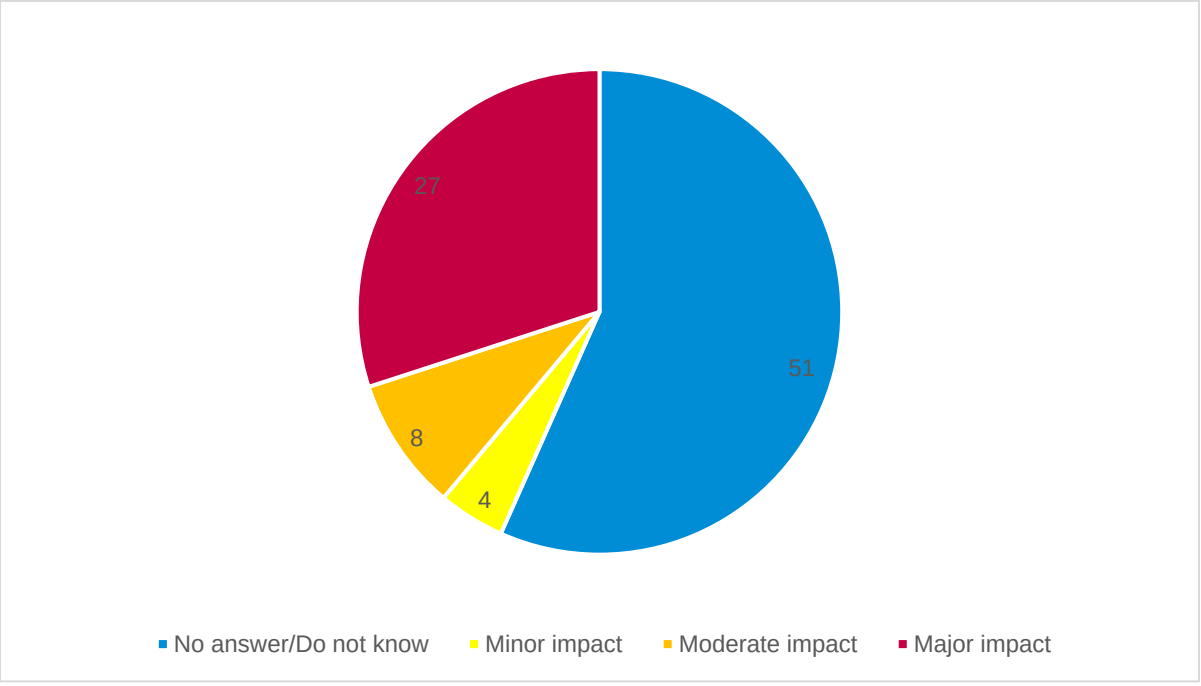
11.3.3 Integration of Stakeholder Perceptions into the Assessment Process

It is common that Project affected people have the perception that Project impacts are more significant than may actually be the case. This is referred to as perceived impacts (as opposed to actual impacts). Regardless of whether an impact is considered negligible by the Project or ESIA team, if it has been identified as significant by a stakeholder, it must be factored into the evaluation process. This may result in the development of focused mitigation and management measures that address these perceptions (such as technical health and safety briefings with the communities). It should be noted that perceived impacts are no less important than actual impacts with respect to addressing community acceptance for a Project and that failure to adequately assess such impacts and develop supporting mitigation may result in Project delays as in the case of actual impacts.

The major concerns and suggestions of the surveyed households, general public, and local authorities based on the performed interviews and observations during the site visit are presented in the next sections. The below mentioned issues are recognised as critical concerns and therefore have been taken into account within the ESIA.

11.3.3.1 Perception of Surveyed Households

Figure 11.4 provides information about the impact levels of the Loi Hai 2 Project perceived by households who participated in the socio-economic baseline survey in November 2020. Among the 90 respondents, four believed the Project would have a minor impact on their families, and eight other households perceived the Project's impact as moderate, while 27 households were afraid that the Project would profoundly impact them.

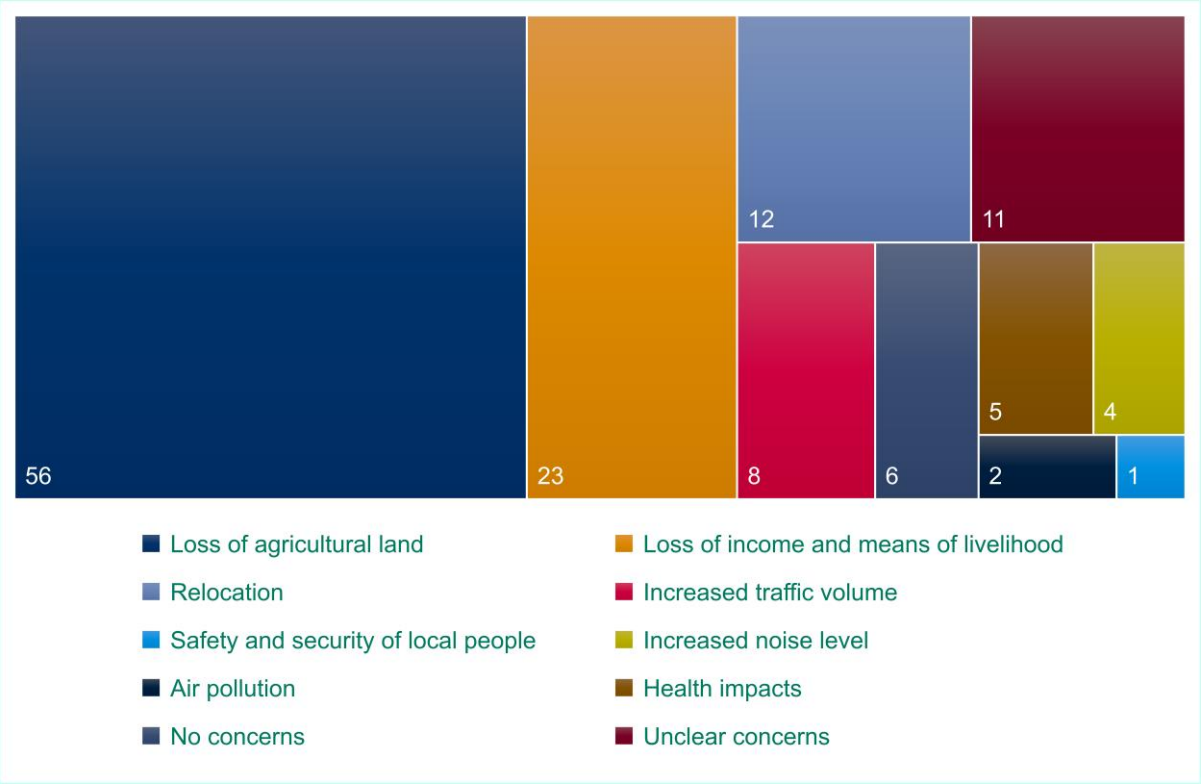


Source: Socio-economic survey conducted by ERM, 2020

Figure 11.4 Project Impact Level Perceived by Surveyed Households

Concerns shared by participating households are presented in Figure 11.5. The top three potential impacts perceived include:

- Loss of agricultural land leading to loss of production;
- Loss of income and means of livelihood; and
- Relocation due to safety reasons.



Source: Socio-economic survey conducted by ERM, 2020

Figure 11.5 Specific Concerns from Surveyed Households

11.3.3.2 Perception of General Public from Focus Group Discussion (FGD)

The perception of local people collected via focus group discussion is also presented in Table 11.3.

Table 11.3 Specific Concerns from General Public

Concerns from Focus Group Discussion during ESIA Engagement
Environment
■ Concerns regarding impacts of the Project on the environment
■ Concerns regarding land status after land clearance
■ Noise pollution caused by wind turbines
Security and traffic safety
■ Concerns regarding the disturbance caused by workers in the construction phase
■ Concerns regarding traffic safety along the access road that will be used by local community and Project vehicles during the construction phase
Social, economic, cultural issues
■ Concerns regarding the loss of cultivation land, impacts on cultivation activities, crop yield and production
■ Concerns regarding the land-based livelihoods if their land is acquired by the Project
■ Concerns about appropriate compensation

Concerns from Focus Group Discussion during ESIA Engagement
■ Concerns regarding how their worship traditions on land use can best be communicated to the Project Owner. Raglai people will need to do a ceremony to respect their ancestors when they allow the Project Owner (outsider) to use their land. In this ceremony, the Raglai people will also need to ask for the Project Owner to pay for conducting the ancestor worshiping ceremony.
■ Concerns regarding understanding information related to the Project
Technical issues
■ Concerns regarding blade throw, electric issues from underground cable
■ Concerns whether the presence of turbine leads to more thunder in the area

11.3.3.3 Perception of Local Authorities

During consultation with local authorities at different levels they noted general support for the Project as it is expected to benefit the province's socio-economic development, having low impacts on the environment, and creating more employment opportunities for local people. However, some concerns related to the Project implementation were raised and are recorded in Table 11.4.

Table 11.4 Concerns from Local Authorities during ESIA Engagement

Concerns from Local Authorities during ESIA Engagement
Environment
■ Concerns on impacts of the Project on the environment
■ Concerns regarding land status after land clearance
■ Air pollution during construction of wind turbines
■ Noise pollution caused by wind turbines
Social, economic, cultural issues
■ Loss of agricultural land and impacts on agricultural production (cultivation and husbandry)
■ Land acquisition and compensation process
■ Local recruitment

11.3.4 Evaluation of Impacts

The impacts are evaluated based on the Project-specific considerations, assumptions, and social-economic/cultural data. These parameters are then used to inform the significance of the impact across the Project phase cycle (i.e. pre-construction, construction, and operation). The social impact evaluation by ERM includes the following components:

- Consideration of the interaction of Project activities with the social receptors based on data provided by Project Owner and/or presented in the Feasibility Study (FS) report as well as the regulatory Environmental Impact Assessment (EIA) report;
- Identification of the receptors, sensitivity/vulnerability and perceptions (if any) based on social-economic baseline data and consultations;
- Identification of potential impacts and benefits based on the method described above;
- Documentation of existing controls based on data provided by the Project Owner and/or presented in the Project FS and EIA reports;

- Evaluation of impact significance taking into account the vulnerability of the receptor and the magnitude of the impact;
- Development of additional mitigation/management (or enhancement) measures determined by understanding the impact and significance based on best practice; and
- Assessment of residual impact following an assumption that the mitigation and or management measures proposed are implemented effectively. In some cases, further discussion may be required to reassess Project design and/or how monitoring can play a part in the management process.

Each social impact was identified as part of the Project scoping process set out in the scoping methodology. These impacts have been selected based on a robust understanding of the proposed activities in the Project description (set out in the Project FS and EIA reports) and primary and secondary data gathered in the affected villages and by public consultation.

The significance of social and health impacts is then evaluated, taking into account the magnitude of the impact and the vulnerability of the affected receptors. The matrix provided in Chapter 5 is used to assign social and health impact significance for both negative and positive impacts. Table 11.5 shows how the different designations of significance may be interpreted from a social perspective. These are highlighted to reflect the Project context and setting, specifically reflected in planning and stakeholder views as appropriate.

While the default is not to rate the significance of positive impacts, as it is not possible to gather exact data to measure the positive impact accurately, it is important to describe how the impact may differentially benefit vulnerable groups.

Table 11.5 Description of Social and Health Impact Assessment Significance Rankings

Significance	Social Impact	Health Impact
Negligible	■ Inconvenience caused, but with no consequences to livelihoods, culture, or quality of life.	■ Receptors may experience annoyance, minor irritation, or stress associated with change with minimal impact to perceived quality of life. Does not require treatment. No long-term consequences for the health of individuals and the community.
Minor	■ Impacts are short term and temporary and do not result in long term reductions in livelihood or quality of life.	■ Temporary reduction to health status of certain individuals that can be easily treated and does not result in long term consequences for community health. Impacts may lead to greater health inequalities in the Project area.
Moderate	■ Adverse impacts that notably affect livelihood or quality of life at the household and community level. Impacts can mainly be reversed but some households may suffer long term effects.	■ High risk of diseases or injuries as well as exposure to Project operational risks to the local community. May result in long term but reversible community health impacts.
Major	■ Diverse primary and secondary impacts that will be impossible to reverse or compensate for, possibly leading to long term impoverishment, or societal breakdown.	■ Loss of life, severe injuries or chronic illness requiring hospitalisation. Exposure to and incidence of diseases not commonly seen previously in the area. Likely to have long-term consequences for community health.

Initially, the significance of the impact has been evaluated for the "general" population. The evaluation has then taken into account whether the identified vulnerable groups will be impacted differently. When this is the case, the impact on these vulnerable groups has been differentially stated in the assessment (i.e. an impact may receive an overall significance rating of moderate, but a high rating when considered in relation to a particular group of vulnerable receptors).

The change brought by the Project has been reflected in the frame of reference of the local setting with stakeholder views on impacts integrated into the evaluation. It is common that the Project affected people may have the perception that an impact is different (either lower or higher) than is actually likely be the case. Perceived impacts have been captured and differentiated to 'actual' impacts; however, they are no less important than actual impacts with respect to addressing community acceptance for the Project. In some cases, failure to adequately assess such impacts and develop supporting mitigation is likely to result in Project delays as in the case of actual impacts.

The assessment of impacts has considered not only the magnitude of impact and vulnerability ratings but also the perceptions or sensitivities of stakeholders as well as any planning and development objectives laid out for the administrative area in which the Project is located. The impact significance has been discussed pre- and post-mitigation implementation, with the residual impact being as low as practicable. If the residual rating is still not acceptable, the impact and Project activities will require further discussion with the Project Owner to agree on a more appropriate design or technology that will result in a lower impact significance.

Impacts and benefits have been considered across the Project lifecycle (i.e. pre-construction, construction, and an operation phase of approximately 20 years).

11.3.5 Management Measures and Residual Impacts

The impacts identified during the social impact assessment will be mitigated and/or managed, aiming to reduce them to acceptable residual levels. Ideally, the Project Owner will adopt the proposed measures and implement them effectively throughout the appropriate Project phase. Often, in reality, however, the measures cannot be implemented as suggested and alternative actions are required; these are to be identified through monitoring. As such, the residual impact in some cases cannot always be determined as an acceptable level.

11.4 Potential Social Impacts, Receptors, and Areas of Influence

Project development activities causing potential impacts to stakeholders who are identified as receptors are summarised in Table 11.6. In each section, the Project's area of influence for a specific resource or receptor is described in the context of the identified impacts.

Table 11.6 Summary of Potential Impacts, Receptors and Area of Influence

Project Activities	Potential Impacts	Receptors	Areas of Influence
Pre-construction Phase			
■ Land acquisition process	*Economic displacement to an ethnic minority:* ■ Loss of land and access to land owned by local people ■ Loss or relocation of assets on land ■ Change of land use ■ Loss of/impact on livelihood associated with loss of land resulting in full or partial loss of income	■ Raglai People as the land users of Agricultural land	■ Project footprint includes turbine foundations, internal access roads, substations, laydown areas and Right Of Way (ROW) of transmission line
Construction Phase			
■ Land clearance, lay down area usage during construction of wind turbine pole, and construction for Project components (wind turbine pole, transmission line, substation, access road) ■ Employee recruitment during construction activities ■ Higher risk activities include working at height, lifting operations, live electrical work, and	*Local employment and business* ■ Increased local employment and income ■ Temporary direct employment for the Project and induced employment opportunities by local suppliers ■ Opportunities for small and medium local businesses ■ Community discontent due to high expectation to be hired as unskilled workers ■ Reduction of economic opportunities to local business due to employee demobilization at the end of the construction phase	■ Opportunity seeker and business owners ■ Raglai People and the general community in the project location	■ Thuan Bac district ■ Loi Hai commune
	Recruitment and employment of construction workers ■ Impacts to rights of contracted workers engaged by contractors ■ Employment of children or other minors, forced or bonded labour ■ Potential for discriminatory practices to occur in the hiring process	■ Project worker	■ Construction sites ■ Worker's accommodation (their houses or hostels, camps) ■ Loi Hai commune

Project Activities	Potential Impacts	Receptors	Areas of Influence
use of vehicles/heavy equipment ■ Presence of influx and operation of worker's accommodation ■ Equipment and material transport and supply ■ Construction of turbine foundations, transmission line pylons, internal road, auxiliary works, and turbine installation ■ Wastes, emissions, and discharges generation, handling, and disposal ■ Operation of associated facilities such as concrete batching plant ■ Project vehicular movement (movement of trucks and lorries, transport of large-heavy equipment)	■ Potential for discrimination against workers that join unions (or other similar organisations) or take part in collective bargaining ■ Inappropriate or delayed payments to workers ■ Lack of clarity information on workers' rights ■ Gender inequality during contractual processes ■ Unjustified dismissals ■ Non-payment of overtime *Working conditions* ■ Accidents, injuries, fatalities or other health and safety risks, which can arise from inappropriate working or unsafe conditions, such as excessive working hours, lack of appropriate training, insufficient lock-out/tag-out practices as well as equipment failure ■ Higher risk activities include working at height, lifting operations, live electrical work, use of vehicles/heavy equipment *Operation of worker's accommodation* ■ Impacts on worker's health and safety due to poor management of worker's accommodation		
	Community way of life, health, safety and security due to construction activities ■ Impacts on mental health and wellbeing of people residing in the Project footprint and adjacent areas (i.e. Ba Rau 2 village) due to induced noise vibration, dust and gas emissions from vehicles ■ Risk of disease to the local population via contamination of groundwater (from borehole) and surface water (from ponds) ■ Risk of disease to the local population due to lack of proper hazardous and non-hazardous waste management Risk of injury to local persons gaining unauthorised access to the construction or restricted sites	■ Raglai People and the general community in the project location	■ Construction sites ■ Thuan Bac district

Project Activities	Potential Impacts	Receptors	Areas of Influence
	Community way of life, health, safety and security due to the presence of influx ■ Risk of communicable disease spread (such as sexually transmitted infections, dengue, malaria, influenza, diarrheal) ■ Increased pressure on local health facilities/capacities ■ Increased pressure on local governance ■ Tension with local communities due to issues of cultural conflict ■ Security-related impacts or concerns (such as drinking, drugs consumption, gambling, theft) ■ Risk posed by Project security arrangements to those within and outside the Project site ■ Risk of gender-based violence, violence against children, sexual harassment/abuse due to the increase in number of non-local male workers ■ Risk to vulnerable groups as prostitution and/or child labour	■ Project worker & Affected Communities	■ Loi Hai commune
	Traffic safety due to increase traffic volume ■ Increased risk of traffic accidents and interaction between Project vehicles and local communities	■ Project worker & Affected Communities	■ Access roads ■ Local roads in and near Ba Rau 1, Ba Rau 2 and An Dat villages ■ National Highway 1A from Cam Ranh port to Loi Hai commune
Operation phase			
■ Employee recruitment and supply demand	*Project positive impacts and benefit sharing* ■ Direct employment for the Project ■ Opportunities for small and medium local businesses	■ Project worker & Affected Communities ■ Business owner	■ Loi Hai commune

Project Activities	Potential Impacts	Receptors	Areas of Influence
■ General operation activities	*Community health, safety and security* ■ Relocation of houses used to watch farms due to health and safety reasons ■ Impacts on mental health and wellbeing of people residing in the Project footprint and adjacent areas (i.e. Ba Rau 2 village) due to induced noise vibration and shadow flicker due to the presence of turbines ■ Visual impact due to the presence of turbines	■ Project worker & Affected Communities	■ Loi Hai commune
	Physical displacement ■ Physical displacement due to health and safety reason	■ Affected people living within the 300 m safety zone	■ Loi Hai commune
Project lifecycle			
■ Project land acquisition, construction and operation activities	*Impact on ethnic minority groups* ■ Disruption of ethnic minority way of life	■ Raglai People as the land users of Agricultural land	■ Ethnic minority settlement and agricultural area in Loi Hai commune

11.5 Pre-construction – Economic Displacement Impact due to Land Acquisition for Ethnic Minority

11.5.1 Summary of Project's Land Use

The land acquisition process is being conducted in the Ninh Thuan province, Thuan Bac district, Loi Hai commune. According to the preliminary land measurement result by the Project Owner as of December 2020, the Project will acquire approximately 7.53 ha of land to serve the construction of Project components, including seven turbine grounds, construction site, laydown area, construction road and 22kV underground cable, 110kV transmission line, operation house and 22/110kV substation. The land acquisition process is expected to impact ethnic minority people as affected people. Before the 2020 land acquisition process, resettlement and ethnic minority development plan were issued to understand the impact and ensure the benefit for the ethnic minority.

The land acquisition process is being conducted using two types of process, i.e. one for permanent land occupation and the other for temporary land occupation. Permanent land occupation process will acquire the land permanently from affected households. The temporary land occupation will temporarily acquire the land during construction and return the land to the affected household. From the record per December 2020, 35% land will be acquired permanently while the rest will be used temporarily. Both processes will give the affected people cash compensation of fixed-term land.

Table 11.7 Required Land for the Loi Hai 2 Wind Project

Project Components	Permanent land occupation (m^2)	Temporary land occupation (m^2)	Total (m^2)
Turbine foundations	8,796		8,796
Construction site (Crane installation area)	5,427		5,427
Laydown area (blades and towers)		18,827	18,827
Construction roads and 22kV underground cable		29,530	29,530
Operation house and 22/110kV substation	12,662		12,662
Transmission line 110kV footings	100		100
Total	**26,986**	**48,357**	**75,343**

Source: TBW Project Description December, 2020.

Land acquisition for the Loi Hai 2 Project follows the government-led process and includes two stages of acquisition. The land acquisition for the operation house and 22/110kV substation (about 1.26 ha) was reportedly completed in Jan 2019. The Thuan Bac district People's Committee undertaken the land acquisition process and acquired agricultural land from seven households and one organization (public land plots under Loi Hai Commune People's Committee management) for the operation house and substation.

Land acquisition for the other Project components, including turbine area, transmission line, and underground cable started in mid-December 2020 and is expected to finish early February 2021. The Project Owner will tentatively acquire agricultural land from 32 households and one organization. This is the estimated number from the preliminary land measurement result by the Project Owner as of early December 2020, and the final number of displaced households will be confirmed once the final Compensation, Support and Resettlement (CSR) Plans from the Thuan Bac district People's Committee are issued.

The Land Use Right Certificate (LURC) status of affected households will be determined during the government-led land acquisition process. However, according to the Loi Hai Commune PC during the

consultation meetings, this area mainly belongs to individual households' legal usage in Ba Rau 1 and Ba Rau 2 villages of Loi Hai commune. As such, informal land users have not yet been identified in the Project area.

Table 11.8 Types of Acquired Land for Loi Hai 2 Project

Types of Land	Main site (including T-line footing) (m^2)	Operation house and 22/110kV substation (m^2)	Total (m^2)	Percentage
Rice land	12,588	6,082	18,670	24.8%
Other annual crops land	16,934	5,743	22,677	30.1%
Perennial land	6,698	-	6,698	8.9%
Public land	26,460	838	27,297	36.2%
Total land area	**62,681**	**12,663**	**75,343**	**100%**
Number of Displaced Households	**32**	**7**	**35*** *(04 households are affected by both components)*	

(*) Note: the final number of displaced households is to be confirmed upon the finalisation of the final CSR Plans by Thuan Bac District People's Committee.

Source: TBW Project Description December, 2020.

It was observed during the site visit and confirmed via the census baseline survey that the Project area is occupied by local people for growing rice, annual crops, perennial trees (cashew) and grass land for cattle breeding. There are no residential houses, but there are a few temporary agriculture huts of used by the local farmers to watch over their agriculture fields and livestock. Therefore, the Project's land acquisition will result in no physical displacement but economic displacement for 35 households in Loi Hai Commune. The loss of agricultural land will consequently result in loss of income from land-based livelihood and food insecurity in the affected households. The affected people have mentioned their concern that they will lose income and are not well informed about the land acquisition process compensation package. As such, they do not have specific concerns regarding the size of the compensation package. They only expect that the compensation can be used to invest in agriculture activities, and the Project can assist their livelihood after the land acquisition process.

Additionally, in pursuance of Decree No. 14/2014/ND-CP which stipulates the implementation of Electricity Law regarding electricity safety, the land area situated under the 110kV transmission line will be subject to crop height restriction due to safety reasons[24]. Only one household was identified as having rice land in this area; therefore, the 100kV transmission line will only cause the disturbance during the construction of the transmission line and not the restriction of height.

11.5.2 Potential Impacts

The assessment of potential impacts associated with the land acquisition process in the Project area takes into consideration the following information:

[24] Decree No. 14/2014/ND-CP on stipulating in detail the implementation of Electricity Law regarding electricity safety requires a safety distance of three metres from the lowest point of 100kV transmission line to the highest point of the tree in the rural area.

Table 11.9 Summary of Potential Impact, Receptor, and Vulnerability

Potential Social Impact Triggered	Receptor	Vulnerability
■ Loss of income due to the project will acquire affected households' agricultural land. ■ Loss of land assets as the government chooses to compensate affected household with cash, not with similar size land	■ Raglai people as land users of agricultural land acquired by the Project. ■ Affected people as land users of Agricultural land acquired by the Project	Within 35 affected households, there are: ■ 35 ethnic minority (Raglai) households ■ Seven poor/near poor with certification (as certificated by the Government); ■ Two women-headed households that also the main breadwinner ■ 15 households having illiterate breadwinners ■ One household having members with a disability

Agriculture activities have become the main income source among the affected people along with other types of day labour jobs in the construction or service industry. Raglai people in the Project area are known to do agriculture activities without other income or skill source from entrepreneurs or formal jobs. The survey data showed that most surveyed households had agricultural production land with an average area of 9,095 m^2. The majority of Raglai people still pursued traditional upland cultivation, which depends solely on rainwater and without the use of fertilizer, the productivity was usually very low.

Table 11.10 Summary of Key Livelihood Indicators of Affected Household

Key Economic Baseline for Affected Household	Key Information
Family size (people)	5.6
Household head's age (years old)	51.6
Monthly average household income (VND)	6,309,000
Monthly average household expenditure (VND)	5,042,000

The average income per capital recorded 2,167,000 VND, and the monthly average income per household is 6,309,000 VND. This is much higher than the poverty threshold of Vietnam's multi-dimensional poverty standard[25]. This income level is slightly lower than the average income per capita of the Ninh Thuan province in 2019 (2.8 million VND) but higher than that of Thuan Bac District and Loi

[25] According to Government Decision 59/2015/QD-TTg (2015) regarding multidimensional poverty for the period 2016-2020, the poverty certificate will be given yearly to households with low income and accessibility to basic social services.
Income norms:
(a) Having a monthly per capita income of VND 700,000 or lower for rural areas and VND 900,000 or lower for urban areas; or
(b) Having a monthly per capita income of between VND 700,000 and VND 1,000,000 for rural areas and between VND 900,000 and VND 1,300,000 for urban areas, and deprived of at least 3 indicators measuring deprivation of access to basic social services.
Norms on deprivation of accessing to basic social services:
(c) Basic social services (5 services): health; education; housing; clean water and sanitation; and information;
(d) Indicators measuring the level of deprivation of access to basic social services (10 indicators): accessibility to health care services; health insurance; adult education; child school attendance; housing quality; housing area per capita; drinking water supply; hygienic toilet/latrine; use of telecommunication services; and assets for information accessibility..

Hai Commune in 2019 (1.93 million VND and 1.83 million VND, respectively). This income mostly comes from agriculture activities and day labour. By the end of the CSR process in February 2021, the Project Owner will need to update the amount of income loss due to the land acquisition process.

Losing access to the agricultural land also means that the community needs to replace it from elsewhere. The community can still obtain the food source, herbs, and plants for consumption from the nearby market. On other uses of agricultural land in the community, there was no mention of communities' dependency on firewood collected in the Project area. Some affected people mentioned that they sometimes gather herbs for domestic consumption, but they can also access these in the local market. Their animals like buffalo, cows, sheep, and goats were observed grazing in farmland, and at the end of the day, when local people take them back to the yard. As such, land-use change due to the construction and operation of Project components may reduce the agriculture production quantity and result in changes in animal grazing location. When the community buys these commodities, they need to spend some money for a service that was free to them before.

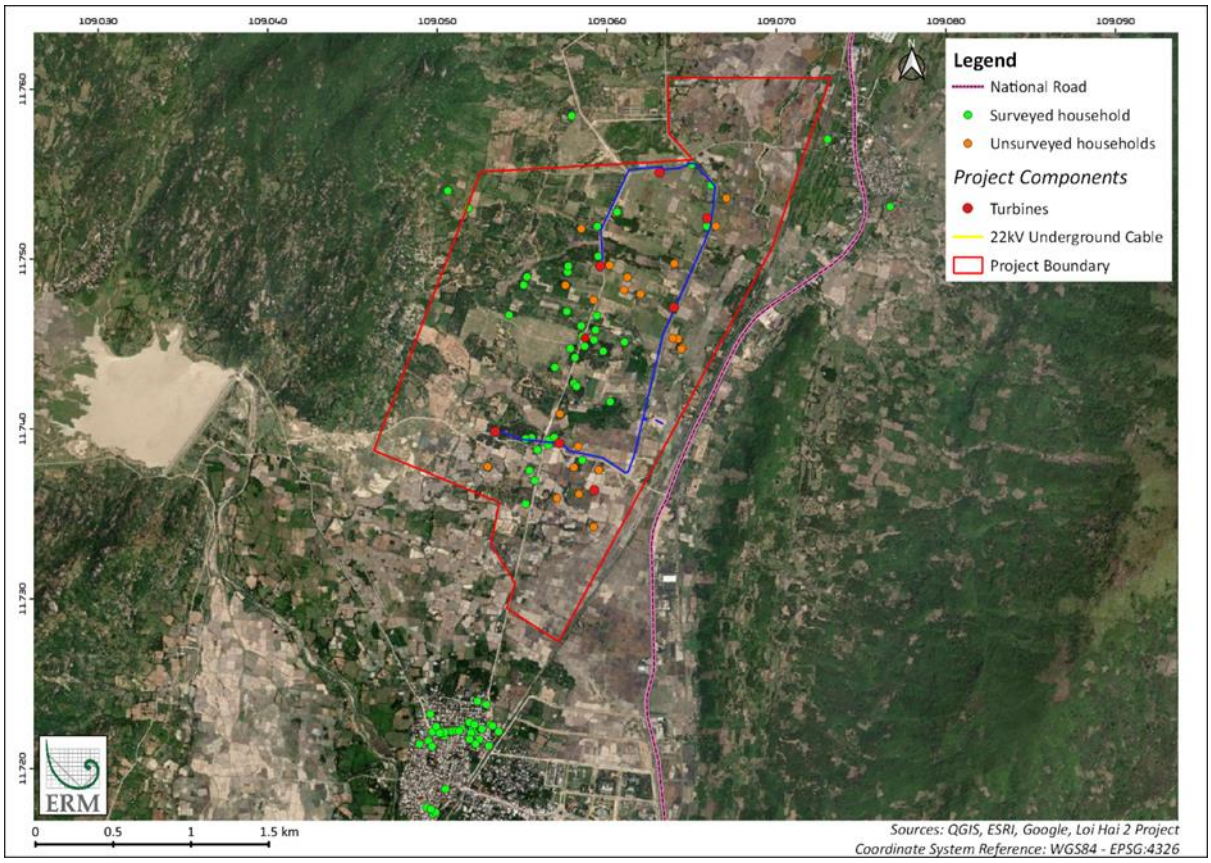


Figure 11.6 Map of Surveyed Households in November 2020

11.5.3 Existing Controls

As suggested by Circular No. 37/2014/TT-BTNMT dated June 30, 2014 of MoNRE and mentioned in the local regulatory EIA: the implementation of CSR will be conducted by the local authority. Other support for resettlement process of affected households will be needed to stabilize their livelihood.

11.5.4 Significance of Impacts

Land acquisition impact nature is considered a negative impact as it will directly take away the people's source of livelihood. The land acquisition process will result in either temporary or permanent loss. Most of the affected people will be impacted on a temporary basis as 64% of the land will only be used temporarily during 12-month-construction phase as showed in Table 11.7. The Project will impact a small proportion of their total agricultural land (approximately 8.5% of their land will be acquired both

permanently and temporarily) and with only a small number of affected households compared to the total population at the commune level (1.12%). Therefore, the land acquisition impact magnitude is predicted as small.

The vulnerability profile among affected households is considered high as they are ethnic minority and many have illiterate breadwinners with limited skills to change their job but still manage to gain enough income to pass the poverty income rate. Losing their land to land acquisition can be perceived as high impact to them as it might not be their intention to sell their land as it is the source of their livelihood as a farmer. However, with the small magnitude of the impact, the overall impact significant is found moderate.

Table 11.11 Economic Displacement and Loss of Livelihood

Impact Description	Economic Displacement and Loss of Livelihood				
Impact Nature	**Negative**	Positive	Neutral		
Impact Type	**Direct**	Indirect	Induced		
Impact Duration	**Temporary**	Short-term	Long-term	**Permanent**	
Impact Extent	**Local**	Regional	International		
Impact Magnitude	Positive	Negligible	**Small**	Medium	Large
Receptor Sensitivity	Low	Medium	**High**		
Impact Significance	Negligible	Minor	**Moderate**	Major	

11.5.5 Additional Mitigation and Management Measures

In addition to the mitigation and management measures required under the government-led land acquisition process, the following measures are recommended in order to meet international standards:

- Monitor the land acquisition process to ensure it complies with Vietnamese regulations and IFC standards. This activity should be supported by documentation recording the land acquisition process. This will be required for internal and external audits.
- Based on the CSR completion report, identify the gaps between national and IFC PS 5 requirements regarding land acquisition and resettlement, and then formulate a Corrective Action Plan to close the gaps found.
- Prepare a SEP within ESIA which includes a Grievance Management Plan (GMP). GMP should be disclosed to the affected communities prior to the Project's construction. As such, the affected community is aware of communications grievance lines and understand how to submit a grievance.
- Continuously coordinate with commune PC to solve any submitted grievance relevant to land acquisition activities.
- Implement the Resettlement and Ethnic Minorities Development Plan (REMDP) for those identified as Project affected households. The REMDP will be designed to ensure sustainable restoration and enhancement of income for impacted land users. The REMDP should take into account the women and other vulnerable groups to ensure they are not overlooked during Project implementation and left worse off.

11.5.6 Residual Impacts

With mitigation measures in place, the Project may reduce the impact to minor significance by the year of Project operation.

11.5.7 Monitoring and Audit

The following monitoring and audit programs are required:

- Preparation of a completion report for the land acquisition process.
- Monitoring of the REMDP in a quarterly term.
- Preparation of a completion report for the REMDP.
- Creation and maintenance of a Consultation and Grievance record in relation to land acquisition.

11.6 Construction – Local Employment and Business during the Project Construction

11.6.1 Potential Impacts

The potential impacts on local employment and business during the Project's construction phase are considered as follow:

a. Increase local employment and income;

b. Provide temporary direct employment for the Project and induced employment opportunities by local suppliers;

c. Provide opportunities for small and medium local businesses; and

d. Community discontent due to high expectation in business and worker recruitment.

Baseline information showed that 64.7% equivalent to 339 people of 524 respondents in the socio-economic survey are working-age. However, approximately 45% of them are illiterate. The socio-economic survey shows that the Raglai affected people mainly have primary (30.7%) and secondary (22.3%) school education. the proportion of people achieved higher education level is less than 1%. As such, it can be assumed the education level in the Project area is low, which qualifies people for unskilled work only.

The construction is expected to employ approximately 84 workers during peak times through direct hire and subcontractor recruitment. The Project Owner is committed to hiring 80 local people within Thuan Bac district, two Vietnamese from other provinces and two foreigners for the Project construction process. Within the construction workforce, 50% are unskilled and 31% are semi-skilled positions. It is foreseen that without training, local people could meet 50% of the required number of local employment, and the increase the employment opportunities for local people, training should be considered by the Project Owner.

With the high percentage of local workers, the demand for services (e.g. groceries, restaurants, hairdressers, transport) and induced jobs are predicted small.

By the end of the construction phase, worker demobilization will occur and only 18 local workers (85% of total workers) will be eligible to stay on. The significant reduction in workforce, as a result, will reduce the local community's income, but the skills and experience gained during the construction could remain and increase the job opportunities in other industries nearby for such local workers.

11.6.2 Significance of Impacts

Given the Project Owner's commitment to optimize local employment and procurement, the Project would likely bring a positive impact to local communities. However, the positive impact cannot be achieved without enhancing measures and could create community discontent due to high expectations to be employed and benefit from Project activities. The Project can give direct benefit to the local economy via tax to the local government. The impact during construction time is categorized as short-term impact as it is 12 months duration. Given the number of opportunities possibly created in relation to the scale of local population, the impact magnitude is considered small. The sensitivity to economic

changes of local people surrounding the Project location is considered medium as they have experience with other nearby industries such as Trung Nam wind power plant, Dam Nai wind power plant and Du Long industrial park, but they might not have education level required for semi-skilled (secondary education) or skilled worker (higher education).

Table 11.12 Local Employment and Business during the Project Construction

Impact Description	Local Employment and Business during the Project Construction				
Impact Nature	Negative	**Positive**	Neutral		
Impact Type	**Direct**	Indirect	Induced		
Impact Duration	Temporary	**Short-term**	Long-term	Permanent	
Impact Extent	**Local**	Regional	International		
Impact Magnitude	Positive	Negligible	**Small**	Medium	Large
Receptor Sensitivity	Low	**Medium**	High		
Impact Significance	Negligible	**Minor**	Moderate	Major	

11.6.3 Enhancement Measures

Based on the above analysis, the Project is expected to have a positive impact in terms of employment, procurement, and induced job opportunities and increase the economic conditions of the local people. In order to enhance positive impacts, the following measures are recommended:

- Facilitate employment for local workers (e.g. un-skilled workers and provide adequate training for the tasks to be performed);
- Encourage contractors to hire local labour by the provision of a clear stipulation/commitment of using local labour, particularly in regards to economically displaced households, in the EPC contract and instruct the EPC contractors to prioritise qualified local people as construction workers in accordance with the needs of the Project;
- Communicate clear information about Project-related employment and business opportunities and prioritize local people wherever feasible. Such communication should be conducted at least two weeks before recruitment so that local people have enough time to prepare for the recruitment process (for example, preparing administration documentation for job application.);
- As locals are more likely to qualify for low-skilled jobs, the Project Owner should negotiate with Contractors to provide detailed requirements on educational qualifications and skills for each job opportunity;
- Work closely with local/relevant authorities to synchronize the Project's needs in terms of local labour as well as locals' capacity; and
- Provide grievance mechanism process from the beginning of Project construction process to manage community complaints and expectation on job hiring and purchasing process.

11.6.4 Residual Impacts

With mitigation measures in place, the impact may be reduced to negligible significance during the year of Project construction.

11.6.5 Monitoring and Audit

The following records are required to be kept:

- Number of workers hired local and non-local
- Type and frequency of information disclosure to community and government on workforce hiring
- Number of grievances received regarding workforce recruitment

11.7 Construction – Impacts on Worker Rights, Occupational Health and Safety

11.7.1 Potential Impacts

Worker's rights, either directly by the Project or within its supply chain

Approximately 84 workers are anticipated to be employed at the peak time of the Project construction phase. According to the Project Owner, around 80 people of the construction workforce (mostly unskilled workers) will be hired from the local community (i.e. Ninh Thuan province) while the remaining four (including skilled workers and management staff) will be resourced from elsewhere in Vietnam and overseas. Without appropriate safeguards, there is potential for workers' rights to be impacted, including workers directly employed by Project Owner and the contractors engaged in delivering the Project. Increasingly there is an expectation by stakeholders that a company has not only oversight of its workers but also its contractors and those involved in its supply chain. If safeguards are not in place, a range of potential impacts can arise, including:

- Lack of awareness on worker's rights;
- Violation of worker's rights encountered by contractors;
- Potential employment of children, forced or bonded labour. This risk is often higher for vulnerable groups (e.g. migrant labour);
- Potential for discriminatory practices to occur in the hiring process;
- Potential for discrimination against workers that join unions (or other similar organisations) or take part in collective bargaining;
- Inappropriate or delayed payments to workers;
- Unjustified dismissals; and
- Risk of association with contractors (e.g. service contracts) or third parties (e.g. recruitment agents) adhering to relevant laws and international standards and guidance.

Worker's health and safety

Besides the potential impacts to worker's rights, the nature of the Project and its construction activities presents a range of health and safety risks for the workforce, including those employed by the Project Owner and their EPC Contractors. Potential workforce health and safety risks include:

- Accidents and injuries: which may occur as a result of construction activities if safe work practices are not followed. Examples include:
  - Injury/fatality risks associated with working at heights (e.g. excavation, foundation construction, pylon, scaffolding, cranes);
  - Injury/fatality in a collision due to the movement of the vehicle and large mobile plant equipment such as backhoes, bulldozers, graders and mobile cranes present health and safety risks if not handled appropriately;
  - Non-compliance with health and safety programs, poor safety culture, and inappropriate use of worker personal protective equipment (PPE) may place workers at risk of accidents and injuries;
  - A surge in vehicle usage increases the potential for an accident or injury to occur; and

- Manual handling associated with day to day construction activities can result in injuries.

The above is not an exhaustive list of potential risks and hazards but presents examples of the types of activities that could contribute to an accident or injury during construction.

- Occupational diseases: that are caused or aggravated by exposure to workplace hazards and are often categorised into the following groups - musculoskeletal disorders, mental disorders, noise-induced hearing loss, infectious and parasitic disease, respiratory diseases, contact dermatitis, cardiovascular diseases, and occupational cancer. These diseases often develop as a result of poor working conditions and poor hygiene.

  Some occupational diseases manifest shortly after exposure, while others take longer to manifest after exposure. Examples include:

  - Hearing impairment due to exposure to high noise levels during equipment transport and use of large machinery;
  - Respiratory disease due to exposure to dust and reduced ambient air quality;
  - Repetitive work movements which may cause lateral epicondylitis (i.e. tennis elbow);
- Infectious diseases are illnesses caused by a diverse range of pathogens that can be transmitted through means such as:
  - Disease vectors (e.g. mosquitos), which may result in diseases such as dengue fever or malaria;
  - Ingestion of unsanitary food and water, which may result in a parasitic infection or diseases such as salmonella, E.coli, and listeria; and
  - Human or pest contact, which may result in diseases such as sexually transmitted infections (STIs), tuberculosis, influenza and rabies.
- Workers' may contract infectious diseases via a number of pathways. Examples include:
  - Interactions with local community members, which can expose workers to a range of communicable diseases (e.g. STIs, influenza.);
  - Un-hygienic and unsanitary facilities; and
  - Stagnant bodies of water created during the land clearing process, which can create disease vector habitat.
- The global COVID-19 situation is fluid and the duration of the crisis is yet unknown. Potential risks of spreading virus workers, especially from migrant workers from other provinces and countries, are still expected.

Health and safety risks can impact workers in a range of ways – e.g. temporary illness to long-term health impacts. The worst-case scenario would be a fatality, or multiple fatalities, which has occurred on other large scale developments in Vietnam during the construction phase. It appears that workplace fatalities in Vietnam, particularly in the construction sector, are on the rise. In most cases, the accidents were caused by low awareness and ignorance about occupational safety regulations by employers and employees.

It should be noted that occupational health and safety hazards during the operation of wind energy facilities are generally similar to those of most large industrial facilities and infrastructure projects. They may include physical hazards, such as working at heights, lone working, working in confined spaces, working with rotating machinery, and falling objects. Prevention and control of these and other physical, chemical, biological, and radiological hazards are similar to those discussed in the assessment for construction phase.

11.7.2 Existing Controls

Besides existing measures for air quality, noise and water usage control as mentioned in Chapter 10, several mitigation measures were included in the local regulatory EIA regarding the management of labour and working conditions:

- EPC Contractors shall provide the required PPE to workers as per regulations;
- EPC Contractors shall ensure all workers are provided with proper training on health and safety role prior to commencing work;
- Project Owner and their EPC Contractors shall arrange bi-annual health checks for all workers in compliance with Decree 45/2013/ND-CP dated 10 May 2013 and Decision 959/2018/QD-EVN dated 9 August 2018 to ensure workers are fit for work;
- Project Owner and their EPC Contractor shall ensure the inspection of critical equipment is conducted periodically;
- Project Owner and their EPC Contractor shall not encourage working under unfavourable weather conditions such as rain, typhoon, or high heat; and
- EPC Contractors shall ensure and maintain labour contracts which clearly mention all employee wage and benefits for all workers.

11.7.3 Significance of Impacts

In addition to general accidents, injuries, and infectious diseases, construction sites often involve activities that generate large amounts of noise and dust, repetitive activities, and interactions with hazardous substances. Such activities can present potential occupational diseases. Although practices in Vietnam are improving, there continues to be allegations of violations of worker rights in the construction industry. A large number of workforce in the industry are low-skilled with limited awareness of their rights; therefore, poor working conditions, long working hours, and delayed payment of wages violations frequently remain unreported. As such, the vulnerability of AoI was considered Medium. As the number of worker is considered as not more than 84 workers, the magnitude of impacts on worker's rights and working conditions was ranked as Small. Therefore, the overall impact significance of human rights, health, and safety risks to workers during the construction phase was assessed as Minor.

Table 11.13 Impacts on Worker's Rights, Occupational Health and Safety

Impact Description	Impacts on Worker's Rights, Occupational Health and Safety				
Impact Nature	**Negative**	Positive	Neutral		
Impact Type	**Direct**	Indirect	Induced		
Impact Duration	Temporary	**Short-term**	Long-term	Permanent	
Impact Extent	**Local**	Regional	International		
Frequency	Frequent over 12 months of the construction period.				
Impact Magnitude	Positive	Negligible	**Small**	Medium	Large
Receptor Vulnerability	Low	**Medium**	High		
Impact Significance	Negligible	**Minor**	Moderate	Major	

11.7.4 Additional Mitigation and Management Measures

In addition to the mitigation and management measures required under the regulation, the following measures are recommended in order to meet international standards:

Worker's rights

- EPC Contractors shall establish employment practices that ensure workers are paid appropriately in accordance with working hours and in a timely manner, informed by national standards and industry benchmarks;
- Project Owner and their EPC Contractors shall comply with Vietnam Labour Code requirements related to the hiring of labour and with applicable requirements from the EHS international guidelines;
- Special attention shall be given to establishing clear contractual agreements through the inclusion of particular clauses between Project Owner and all of their subcontractors to avoid child labour, forced labour, and human trafficking and other violations of human rights;
- EPC Contractors shall establish employment practices to check legal worker's age in identification document upon recruitment to ensure no child labour or forced labour and avoidance of unjustified dismissals;
- EPC Contractors shall establish employment practices that ensure workers are not discriminated against on the grounds of ethnicity, sex, religion, political opinion, social origin, age, marital or relationship status, sexual orientation, or trade union activity. As part of the hiring process, age checks will be conducted;
- EPC Contractors shall ensure workers are made aware of their rights as part of the induction process;
- EPC Contractors should implement a "zero tolerance" policy towards inappropriate behaviour from and amongst the workforce;
- EPC Contractors Ensure workers have a right to join unions;
- Project Owner and EPC Contractors shall establish a grievance mechanism for workers. This should include an option for grievances to be lodged anonymously. All workers, including those employed through the Project's supply chain, should have access to a grievance mechanism to ensure that their issues and concerns are identified and addressed. Contractors should be required to inform the Project about grievances raised;

Occupational health and safety

- EPC Contractors shall regularly inspect all critical components of the involved equipment and machinery;
- EPC Contractors shall establish operation and safety procedure for each equipment and make available for the workers involved;
- EPC Contractors shall ensure that only appropriately skilled and trained employees are assigned to the operation and maintenance of the corresponding equipment and machinery;
- EPC Contractors shall perform audits of different subcontractors involved in terms of health and safety topics to ensure these companies comply with the findings and remedial action follow-up;
- EPC Contractors shall establish health and safety internal rules and ensure worker's awareness of these rules;
- EPC Contractors shall ensure day to day compliance with the health and safety requirements (i.e. procedures, equipment usage, PPE usage, demonstration of safe behaviours, competent personnel, compliance with work permit system);

- EPC Contractors shall ensure safety measures are in place before workers perform high-risk tasks, such as working-at-height, loading and unloading of equipment, hot work, electrical works, use of scaffolds and heavy machinery;
- EPC Contractors shall monitor and report health and safety performance through site inspections to all involved subcontractors, using appropriate health and safety metrics, operations auditing as well as senior management review and follow-up;
- EPC Contractors shall monitor and report high-risk sites to restrict entry and prevent near misses, injuries and fatalities;
- EPC Contractors shall ensure training programs to adequately include the usage of appropriate PPE, good hygiene practices, awareness of infectious diseases, and the management of risks and hazards;
- EPC Contractors shall provide first aid box and competent first-aider at all construction sites and worker's accommodation facilities;
- Project Owner and their EPC Contractors shall conduct medical assessments of workers before they are mobilized to the site, including screening for infectious diseases and other health issues. This is to ensure workers are fit for work;
- Project Owner shall implement a system for selection and management of contractors/subcontractors/suppliers with clear criteria on required environmental and safety management capabilities;
- Project Owner and their EPC Contractors shall develop and implement a Worker Accommodation Management Plan in accordance with local regulations and IFC requirements to ensure the well-being of the workforce as well as the health, safety and security of local communities;
- EPC Contractors shall ensure the worker accommodation is constructed/leased and managed in accordance with Vietnam requirements and Worker's Accommodation: Processes and Standards developed by WBG, IFC and EBRD;
- Minimum requirements for the worker's accommodation facilities shall include:
  - Free of charge to workers, meaning that workers do not have to pay if they choose to stay in workers' camp built or owned by the Project Owner or the contractors;
  - Adequate living space for each worker;
  - At least one toilet shall be arranged for every 15 workers;
  - At least one shower/bathroom is provided for each 15 persons;
  - Wastewater, sewage, food and other waste materials shall be adequately discharged in compliance which Vietnam standard;
  - Male and female toilet/shower/bathroom shall be separated;
  - Sanitary, laundry and cooking facilities and potable water;
  - Adequate health, fire safety measures, including first aid and medical facilities;
  - Adequate heating and ventilation; and
  - Non-restrictive to workers' freedom of movement to and from the accommodation.
- Project Owner shall conduct regular audits of workers´ accommodation sites of all involved subcontractors.

11.7.5 Residual Impacts

While Project mitigation measures will help prevent impacts on workers' health and safety, there is the potential for accidents to occur as a result of human error, occupational diseases to occur as a result

of work activities/conditions, and diseases to spread. To reduce the impact significance to Negligible, it will be important that the Project Owner's existing policies and procedures (which are designed to protect the health and safety of workers) are implemented and regularly monitored to ensure that the policies and procedures are being effectively implemented.

11.7.6 Monitoring and Audit

Ongoing monitoring of the health and safety practices as well as labour contracts and management will be required. This can be conducted through regular audits, particularly of all the involved contractors, to ensure the Project Owner's expectations regarding health and safety practices are being implemented.

11.8 Construction – Impact on Community Way of Life, Health, and Safety and Security due to Construction Activities (Non-influx Issues)

11.8.1 Potential Impacts

General construction activities of an onshore wind project include land clearance, land preparation and civil work, transportation of materials and workers, construction and installation of turbines, and construction of associated facilities including the access road, and transmission line. These activities are likely to generate noise, dust, and risk to the community's health and traffic safety. Without proper management of noise, waste and dust from construction activities, local residents may experience a nuisance. This includes residents living near the construction sites and along the main routes that the Project workforce utilises. It was observed during the site visit and confirmed via the census baseline survey that there were 38 temporarily scattered agriculture huts of the local farmers within the 300 m radius of the turbine construction sites. Most farmers in their middle and late ages prefer staying in these watch huts during both day and night to look after their agriculture field and livestock. Improper management of the dust, waste and wastewater, noise, and vibration generated during construction activities may cause disturbances or certain health impacts to these families – the main receptors. Potential impacts and consequences of noise, vibration, waste and waste water as well as dust are also discussed in detail in Section 10.1, Section 10.2, Section 10.3 and Section 10.5.

Health issues as a result of noise, dust, and waste

The main sources of noise and vibration in the construction phase are transportation, mobilisation of construction material and operation of heavy machineries during the construction process (main site and transmission line), include piling activities. However, these construction activities do not represent a constant source of noise that will occur on a day-to-day basis for the duration of the construction schedule. These activities are expected to occur for only portions of the work, and will not occur for entire daytime periods. According to the noise modelling results conducted by ERM, the local people who are commonly stayed at a distance of 15 m from the construction site (among the 38 agriculture huts) will be exposed to exceeded noise level of 85 dBA in the case Project equipment are placed near each other and operated concurrently. This value is higher than the permitted noise level of IFC (55 dBA) and (60 dBA) standards and exceeds the noise level guided by WHO for community health protection. According to the Guideline for Community Noise of WHO 1999, the noise level at receptors should be within the following threshold values to not harm the community health:

- ≤ 70 dBA to prevent noise-induced hearing impairment;
- ≤ 55 dBA to prevent noise annoyance; and
- ≤ 45 dBA to prevent sleep disturbance.

Waste and wastewater from construction are also an impact source on community health if not managed properly. During the construction phase, the domestic waste will be generated from up to 84 workers, non-hazardous and hazardous industrial wastes from construction activities. Improper management of waste and wastewater from construction would result in potential contamination of soil,

groundwater and surface water as well as community health risks. The construction impact levels on surface and groundwater (due to rainwater runoff and wastewater discharge) of Loi Hai commune were assessed as low in ERM's water quality and waste impact assessment.

Meanwhile, dust may be generated during the earthworks and due to the mobilisation of construction materials to and from the Project site. Construction activities (such as soil disturbing activities, storage of materials such as concrete, and transportation of materials) without proper controls in place are likely to result in dust generation expected during the dry season. Based on the air quality impact assessment results, small-scale and centralized impacts were predicted for the exhaust emissions (from earthworks, construction activities and transportation).

Transportation of hazardous materials and hazardous waste from the construction site to the authorised treatment locations may also cause health risks to residents living by the transportation route or commuters travelling on the same road. The hazardous materials and waste, including engine/transformer oil, solvents, paints, used batteries, discarded lubricant, and fabric, electrical waste, medical waste, etc. may be released to the environment due to inadequate containment or traffic accidents, and consequently cause risks of fire, explosion and contamination of the environment to the community. During the implementation of construction activities, flammable gas, liquid or chemicals will be stored and used. As such, an emergency, such as fire, explosion or oil spill, may occur during the construction phase and may affect the nearby communes. These will be discussed in detail in the Unplanned Event Chapter.

Unauthorized access to the Project site

Unauthorized access of people nearby, especially children or vulnerable people, to the Project site is also likely to increase the risks of injuries and fatalities of public safety. It is the Project Owner and their contractors' responsibility to take necessary steps to ensure that local people and all workers are safe from activities on construction sites.

11.8.2 Existing Controls

Refer to Chapter 10 for existing controls proposed for dust, noise, water quality, solid waste and air quality impacts. Regarding the risk of injury to local persons gaining unauthorised access to the construction or restricted sites, the regulatory EIA also proposed the following measures to be implemented:

- EPC Contractors shall implement proper fencing, use of signage and site patrolling; and
- EPC Contractors shall disclose to information regarding the restricted area and potential risks to local communities.

11.8.3 Significance of Impacts

From the assessment of dust, noise, water quality, solid waste and air quality in Chapter 9, given the short construction period (12 months), this magnitude of impacts on local residents were predicted to be small as it would likely intermittently affect a few agriculture huts among more than 3,000 households of Loi Hai commune. The local community's sensitivity was ranked as Medium, taking into consideration that the local communities had experienced the developments of other industrial projects in the area and several concerns on noise and air pollution were raised during the social baseline interviews with Loi Hai people. Therefore, the significant impact of the community health and safety risk was assessed as Minor.

Table 11.14 Impacts on Community Health, Safety and Security due to Construction Activities

Impact Description	Impacts on Community Health, Safety and Security due to Construction Activities

Impact Nature	**Negative**	Positive	Neutral	
Impact Type	**Direct**	Indirect	Induced	
Impact Duration	Temporary	**Short-term**	Long-term	Permanent
Impact Extent	**Local**	Regional	International	
Frequency	Frequent over 12 months of the construction period.			
Impact Magnitude	Positive	Negligible	**Small**	**Medium**	Large
Receptor Vulnerability	Low	**Medium**	High	
Impact Significance	Negligible	**Minor**	Moderate	Major

11.8.4 Additional Mitigation and Management Measures

The Project Owner should implement the following additional mitigation measures to manage the potential negative impacts associated with construction activities:

- Project Owner and their EPC Contractors shall implement the imitation measures proposed in Chapter 10 for dust, noise, water quality, solid waste and air quality impacts to control the construction impacts; and
- Project Owner shall disclose the proposed grievance mechanism to make it accessible for all villagers to report concerns associated with health and safety issues. An immediate investigation shall be undertaken when complaints on accidents or near misses are submitted.

11.8.5 Residual Impacts

As a result of implementing the proposed management measures, the impact on community health, safety and security associated with construction activities will reduce to Negligible.

11.8.6 Monitoring and Audit

The following monitoring activities are recommended:

- On-going monitoring and periodical audit are required to check if the above mitigation measures are implemented at all levels of the Project supply chain; and
- Monitoring and audits are also required to be conducted in accordance with the schedule proposed in the management plans relating to dust, noise, water quality, solid waste, and air quality impacts management.

11.9 Construction – Impact on Community Way of Life, Health, Safety and Security due to the Presence of Influx

11.9.1 Potential Impacts

The Project will employ approximately 84 workers (peak number of workers per shift) during the construction phase of 12 months. The Project proponents will endeavour to source employees from the local area, subject to the availability of candidates with the required skills and experience. The proportion of the local workforce is 95% of the total construction workers. During construction, the EPC Contractors and subcontractors may arrange for workers to live in purpose-built accommodations.

These facilities are expected to be sited, designed, and managed according to the standards specified in the IFC/WBG/EBRD guidance document.

The potential interaction between the workforce and local communities still poses the following risks:

- COVID-19 related risks;
- Increased risks of infectious diseases;
- General disturbance and tension between migrant workers and local communities; and
- Pressure on public service and infrastructure.

COVID-19 related risks

The global COVID-19 situation is fluid and the duration of the crisis is yet unknown. Potential risks of spreading the virus among the community, especially from migrant workers from other provinces and countries, are still expected.

Increased risks of infectious diseases

Results from the social baseline survey indicated that the common infectious diseases in Loi Hai commune were influenza, dengue and hepatitis. Local people in Loi Hai utilize different water sources, including pipe water, well water and river water for domestic use and drinking. It was also noted that one surveyed household reported using river water for drinking, which is not classified as a clean water source and likely to transmit diseases such diarrhoea, cholera, dysentery, typhoid, and polio when not being well treated before drinking. There was also a common practice of local people that 41.1% of surveyed households did not have a separate toilet in their house. As such, hygiene and associated infectious disease had been a real concern in Loi Hai commune. During the construction phase, the presence of non-local workers in the area may exacerbate the existing health issues in the commune and might lead to an increased risk of diseases, including:

- Water-borne disease associated with poor sanitation of construction site and worker accommodation facilities;
- Sexually transmitted infections (STIs) and HIV/AIDS; and
- Gastro-intestinal diseases and other food borne diseases such as Hepatitis A due to poor standards of food hygiene in site catering facilities including facilities provided in workers' accommodation.

General disturbance and tension between migrant workers and local communities

The EPC Contractors and subcontractors may arrange on-site accommodation facilities for non-local workers. As such, interaction between migrant workers and the local residents will not pose a significant risk. However, the presence of a non-local workforce from other Vietnamese provinces may result in the presence of behavioural traits, habits and lifestyle in the community, which may be alien to the local community, especially when the majority of local people are Raglai. These behavioural traits may cause discomfort/ inconvenience to the Raglai ethnic minority group resulting in disagreement and conflicts. The potential impacts on the local community include:

- Risk of prostitution: Most non-local workers employed by EPC Contractors and subcontractors are males, living away from home, and most of them will be without families. Therefore, increased demand of sexual services could be possible. Poverty could be an incentive for women to get involved in sex work as an alternative livelihood option for a quick income source. Female-headed/single-mom households seem to be the most vulnerable to this risk. Furthermore, the vulnerability of these women will be increased if these women have babies as a corollary of the unsafe prostitution. In particular, given the temporary nature of contract work, it is possible that both the women and children will be abandoned when the construction phase ends and the contractors move on, leaving a new group of single female-headed households often dependent upon their extended family support networks.

- Increased tension: Conflicts among Project workers and locals can ensue from the use and treatment of local resources, establishment of settlements and difference in treatment of new construction workers and local people. Conflicts may also arise between the local people when the local people's recruitment policy is not transparent and non-equal access to opportunities between affected villages.
- Increased alcohol and drug abuse: The presence of contractual workers may also increase alcohol and drug abuse in the area as the contractor workforce may originate from urban areas where exposure to alcohol and drugs is much more prevalent, which could then be introduced into the local area.

Pressure on public service and infrastructure

The surveyed data indicated that overall, local communities in Loi Hai commune were satisfied with the availability and accessibility of existing public services, including piped water, electricity, health care, market, schools and road network. Several concerns were raised on the high water tariff, limited waste collection service and occasional flood in the commune. Given the small number of migrant workers to be employed during the construction phase, it is not anticipated to be a pressure on these infrastructures and services.

Security force

At the time of writing, it was unclear whether the Project will directly employ security staff or contract a private security force to protect their Project site, workers, and assets. The number of security guards to be deployed on-site was also not available. In both cases, the Project's security arrangements might posed threats to local communities in terms of potentially inappropriate use of force, unlawful detention, sexual violence/harassment against women.

11.9.2 Existing Controls

The mitigation measures required by the local regulatory EIA include:

- Project Owner and EPC Contractors should prioritize local employment for the unskilled job to minimize the number of migrant workers;
- Project Owner shall collaborate with local authorities and relevant authorities to organise awareness-raising and educational programs for workers. The purpose of these programs is to promote the collaborative relationship among local communities and migrant workers.
- Project Owner and their EPC Contractors shall establish labour regulations and penalties for all workers;
- Project Owner and their EPC Contractors shall comply with all site regulations on hygiene and safety; and
- EPC Contractors shall coordinate with local authorities to manage temporary resident registration for migrant workers and monitor social security in the area where migrant workers will be accommodated.

11.9.3 Significance of Impacts

Given the proportion of migrant workers (4) compared to the total population of the Project's footprint area (14,139 people) and their relatively short presence in the area (12 months of construction phase), the impact magnitude of the influx-induced risks was assessed as Negligible. Given the significant number of Raglai ethnic minority group in the Project area, especially those who stay in the agriculture huts nearby the turbines' locations, the existing health conditions of local people, and reliable availability of local infrastructure (see further the socio-economic baseline on local evaluation public facilities and services including local health stations, schools, water and electricity supply, waste collection, local markets and roads), the vulnerability of the community was deemed Medium, resulting in the impact significance of the influx worker issues as Negligible.

Table 11.15 Impacts on Community Health, Safety and Security due to the Presence of Influx

Impact Description	Impacts on Community Health, Safety and Security due to the Presence of Influx				
Impact Nature	**Negative**	Positive	Neutral		
Impact Type	**Direct**	Indirect	Induced		
Impact Duration	Temporary	**Short-term**	Long-term	Permanent	
Impact Extent	**Local**	Regional	International		
Frequency	Frequent over 12 months of the construction period.				
Impact Magnitude	Positive	**Negligible**	Small	Medium	Large
Receptor Vulnerability	Low	**Medium**	High		
Impact Significance	**Negligible**	Minor	Moderate	Major	

11.9.4 Additional Mitigation and Management Measures

The Project Owner should implement the following additional measures to maintain the impact level associated with the presence of migrant workers:

- Project Owner and their EPC Contractors shall strictly follow the Government's instructions on COVID-19, including compulsory COVID-19 tests and quarantine for migrant workers as well as wearing of face masks;
- Project Owner should develop a COVID-19 monitoring and response team, who are tasked with outbreak tracking and protocols and procedures developments as appropriate in line with local and national requirements and guidelines;
- Project Owner and their EPC Contractors shall conduct compulsory medical examinations (i.e. bi-annual health check-ups) for Project workers, including contractors, as required by national regulations, to ensure they are fit for work and to monitor the prevalence of communicable diseases
- Project Owner and their EPC Contractors shall ensure the health and safety of all workers and local communities by complying with relevant regulatory national requirements and international best practices on medical safety and food hygiene on the construction sites if there will be installed canteens among the working areas and in the workers´ accommodation areas that are equipped with canteens;
- The Project Environmental and Social Focal Point should assign and deliver induction training to guide requirements for culturally appropriate behaviours, and an overview of the risks to migrant staff and workers. The training will include key cultural sensitivity awareness topics/programs to ensure workers, including security staff, do not unintentionally offend the local community;
- Project Owner and their EPC Contractors shall regularly engage with local authorities relevant to crime (i.e. local police) or other social problems (e.g. village leaders) for prevention of issues and for mitigation purposes when Project influx-related issues arise;
- A Code of Conduct, including requirements on social interaction with the local community, gender awareness, vulnerable groups and environmental protection obligations, shall be developed for all

involved staff and workers within the construction site (including all subcontractors). An appropriate mechanism to address non-compliance shall also be included as part of the labour contract. All staff and workers within the construction site shall be trained and made aware of the Code of Conduct;

- Project Owner should establish and implement regulatory requirements and good practices in relation to a background check, hiring, rules of conduct, training, equipping of security personnel;
- Project Owner shall ensure that training to security force will include adequate and clear requirements in using force and appropriate conduct toward workers and affected communities. Project Owner shall not sanction any use of force except when used for preventive and defensive purposes in proportion to the nature and extent of the threat; and
- Project Owner shall implement the Stakeholder Engagement Plan and disclose a grievance mechanism for workers and affected communities to express concerns about the Project-related issues as well as security arrangements and acts of security personnel.

11.9.5 Residual Impacts

As a result of the implementation of the proposed management measures, the impact on community health, safety and security associated with a non-local presence is expected to remain Negligible throughout the Project construction period.

11.9.6 Monitoring and Audit

The following monitoring activities are recommended:

- Ongoing monitoring and periodical audit are required to check if the above mitigation measures are in implementation.

11.10 Construction – Impact on Traffic Safety due to Increased Transportation Volume

11.10.1 Potential Impacts

The traffic safety assessment considers the potential effects of construction traffic on the road network within the vicinity of Loi Hai 2 Wind Farm on the following aspects of traffic and transportation:

- The capacity of the existing road network to accommodate the traffic volumes generated by the Project; and
- Transportation safety on public roads due to Project-related traffic.

The key activities that are likely to have negative impacts on the local infrastructure and traffic safety include:

- Transport of equipment (turbines and transmission line components and material) from Cam Ranh port to the Project site; and
- Daily movement of construction workers.

According to the regulatory EIA, the principal components (i.e. the oversized pieces, which were defined as heavier than five tons and as larger than the standard size would be transported, such as piles, nacelles, rotor blades, wind turbine generator towers and other oversized equipment) will be imported by ship from overseas specialist manufacturers. Upon arrival in Vietnam, the equipment would be imported via waterway route to Cam Ranh port in Khanh Hoa province. The components will be temporarily stored at Khanh Hoa port and then transported directly to the site location via National Highway 1A with a travel distance of approximately 22 km. Figure 11.7 shows the proposed transportation route from Cam Ranh port to the Project site.

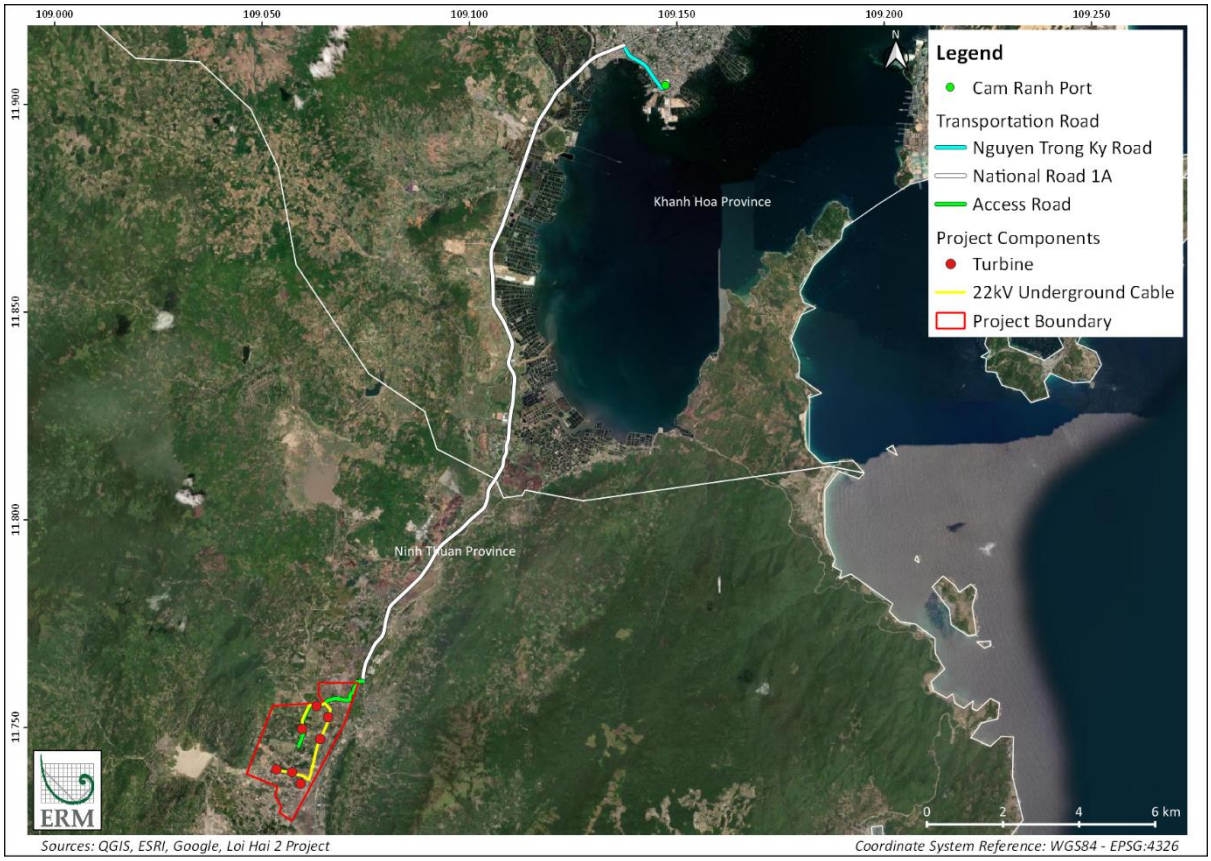


Figure 11.7 Equipment Transport Route

Materials/equipment, including transmission tower parts, would be delivered to the onshore construction sites by truck, using the National Highway 1A and the Project-specific access roads. Routing would be selected to avoid passing through villages where practicable. Currently, the Project land use, including the substation and transmission line, is mainly agricultural land. The area is sparsely populated, with arterial roads passing through and connected to National Highway 1A. It was expected that, on average, twenty-seven trips of 10-tonne trucks would occur in the Project site during the construction period.

In 2019, there were 13 traffic accidents in Thuan Bac district, causing six deaths and 21 injuries. In 2018, 13 traffic accidents occurred in the area causing eight deaths and 12 injuries, which was an increase from 2017 (5 cases with 5 deaths and 4 injuries).

As such, a cumulative increase of heavy trucks presence is likely to pose potential impacts to Loi Hai commune in terms of:

- Degradation of the public road infrastructure and network due to heavy load vehicle movement;
- Traffic congestion due to an increase of traffic movement; and
- Increase of local traffic incidents.

11.10.2 Existing Controls

Mitigation measures proposed in the regulatory EIA are as follows:

- EPC Contractors shall avoid vehicle movement during peak hours (6am to 8am and 4pm to 6pm);
- EPC Contractors should enhance the education of traffic safety awareness for drivers; and
- Project Owner and EPC Contractors should ensure traffic safety in the process of transporting equipment by super-heavy vehicles: Coordinate with relevant agencies (the Department of Transport, the Provincial Traffic Police Department) to survey the topographic location of loading

and unloading places, parking spots, driving itineraries, travel speed, travel time) to ensure safety for people, goods and traffic works.

11.10.3 Significance of Impacts

The transportation period is to occur over a 12 month period. According to the EIA report, the Project will need approximately 3,270 movements of a 10-tonne truck to transport all the required materials and equipment for the construction, equivalent to 9 truck movements per day. The construction peak will last approximately three months, where the transportation can be considered most intensive. It is estimated that during the construction peak, the number of truck movements will triple the average movement required for the entire construction period (i.e. 27 truck movements per day), which is considered small in terms of impact magnitude. Additionally, the number of the worker in the construction phase is about 84 workers at the peak period, an increase of daily movement of project workers compared to ordinary traffic movement is considered significant.

Regarding road infrastructure, the wind turbine equipment, cranes, and accompanying parts are normally transported by super-length and super-heavy trucks, which cause potential damages of road and bridge deterioration along the transportation routes. The source of traffic congestion and delays will be the movement of oversized turbine components. Heavy trucks will likely move slower than a typical vehicle, particularly at bends or intersections. Based on the observation from the site survey, it is noted that the Project area is connected with the National Highway 1A, which are completely asphalted and the widths of those roads are quite large. Given that there are currently construction activities going on for nearby industrial projects, the traffic volume in Loi Hai commune and Thuan Bac district is high. Any additional traffic movement will contribute to existing traffic congestion.

Also, during the transportation process, if many super-heavy trucks used that exceeding the roadbed capacity can cause degradation of road infrastructure, pavement and underground works such as sewage system, communication system. This may be especially so for the inter-communal roads accessing the Project site which are quite small and narrow; load capacity of the roads are low, overload trucks may cause road degradation and affect the daily movements of local community.

As such, Project impacts to traffic density and road infrastructure as a result of increased vehicle movement during the construction phase were assessed as Moderate significance. Impact duration was considered a Short-term effect to users of this road during the turbines and material transportation period. The magnitude was assessed as Medium considering that the National Highway 1A and inter-communal roads have already experienced heavy truck traffic. Sensitivity of the Receptor was assessed as Medium given some parts of the public roads might be damaged, particularly small and narrow roads near the Project location, affecting the daily movements of local community.

Table 11.16 Impacts on Traffic Safety due to Increased Transportation Volume

Impact Description	Impacts on Traffic Safety due to Increased Transportation Volume				
Impact Nature	**Negative**		Positive		Neutral
Impact Type	**Direct**		Indirect		Induced
Impact Duration	Temporary	**Short-term**		Long-term	Permanent
Impact Extent	**Local**		Regional		International
Frequency	Frequent over 12 months of the construction period.				
Impact Magnitude	Positive	Negligible	Small	**Medium**	Large

Receptor Vulnerability	Low		**Medium**	High
Impact Significance	Negligible	Minor	**Moderate**	Major

11.10.4 Additional Mitigation and Management Measures

The Project Owner should implement the following additional measures to manage the potential negative impacts associated with increased traffic volume from construction activities:

- EPC Contractors shall schedule deliveries to the site so that disruption to local amenities and traffic is minimized;
- EPC Contractors shall ensure all trucks are inspected regularly and carefully to ensure safety;
- EPC Contractors should train drivers on traffic safety and regulations. Driving under influence (DUI) is strictly prohibited;
- EPC Contractors shall install speed limit signs within the Project area and the external routes;
- EPC Contractors shall provide warning lights during movement at night;
- EPC Contractors shall plan a drive-through site to eliminate the need for vehicles to back up and ensure that mobile equipment backup alarms are audible above ambient noise levels;
- EPC Contractors shall establish designated pedestrian routes through worksites and use signs to indicate them;
- EPC Contractors shall prevent unauthorized workers or bystanders from entering a danger zone; when appropriate, install barricades and signs around the danger zone;
- EPC Contractors shall assign a flagman at the conjunction between the National Highway 1A and the access roads to coordinate trucks entering the Project site;
- Project Owner shall inspect transport routes before movement, avoid roads with high risk of erosion;
- Project Owner and their EPC Contractors shall coordinate with Loi Hai commune Peoples Committee to organise the traffic in and near Project site when necessary;
- Project Owner and their EPC Contractors shall develop and implement a Safety Transportation Management Plan and Traffic Management Plan.

11.10.5 Residual Impacts

As a result of implementation of proposed additional measures, the residual impact is expected to be Minor.

11.10.6 Monitoring and Audit

- Monitoring and audits are also required to be conducted in accordance to the schedule proposed in the Safety Transportation Management Plan and Traffic Management Plan.

11.11 Operation – Positive Impact on Local Employment and Community Development

11.11.1 Potential Impacts

During the operational phase, the local economy will be positively influenced by an increase in taxation revenue of the Province, and demand for materials and services. It is expected that the Project will employ 21 employees for the wind farm, of which 18 employees will be recruited from Thuan Bac district.

Most of the labourers during the operation phase will be skilled labourers and thus, to satisfy the local employment expectation, the Project Owner should consider training local people.

With the presence of an industry in the locality, in addition to local employment, the Project would benefit the local community with its corporate social responsibility activities such as charity, education and healthcare support.

11.11.2 Significance of Impacts

Given the Project Owner's commitment to optimise local employment and procurement, and community development, it is therefore very likely that the Project would positively impact local communities. Although the number of labour required for operation is low, the Project's contribution to the community is expected medium during the Project's lifetime of 20 years. Overall, the Project would bring a moderate benefit to the local community and economy.

Table 11.17 Local Employment and Community Development during the Project Construction

Impact Description	Local Employment and Business during the Project Construction				
Impact Nature	Negative	**Positive**	Neutral		
Impact Type	**Direct**	Indirect	Induced		
Impact Duration	Temporary	Short-term	**Long-term**	Permanent	
Impact Extent	**Local**	Regional	International		
Impact Magnitude	Positive	Negligible	Small	**Medium**	Large
Receptor Sensitivity	Low	**Medium**	High		
Impact Significance	Negligible	Minor	**Moderate**	Major	

11.11.3 Enhancement Measures

In order to further enhance positive impacts associated with the Project, the following additional measures are recommended:

- Facilitate employment for local workers (e.g. un-skilled workers and provide adequate training for the tasks to be performed).
- Communicate clear information about Project-related employment and business opportunities and prioritize local people wherever feasible. Such communication should be conducted at least two weeks before recruitment so that local people have enough time to prepare for the recruitment process (for example, preparing administration documentation for job application.)
- Via the REMDP, provide vocational training to maximise the job opportunities for local people in other projects and the local employment rate for the Project;
- Implement the REMDP to contribute to community development, especially for the ethnic minority community.

11.12 Operation – Health and Safety Impacts and General Disturbance to Local Community

11.12.1 Potential Impacts

During the operation phase (about 20 years), disturbance to the local communities mostly comes from the impacts from workers' presence, operation and maintenance of the turbines and substations. The

number of workers will be reduced to 21 staff/workers (of which three are non-local) for the operation phase. Hence, community health issues associated with migrant workers' presence such as the transmission of communicable diseases or conflict between workforce and local communities, include littering and noise, fighting due to heavy drinking, and gambling, are expected to be minimal. Potential cultural conflict and tension due to the difference in culture and living style between the migrant and local people are also not expected during this phase. The risk from blade throw will be assessed in the unplanned events chapter. Operational traffic impacts will be associated with emissions from a limited number of vehicles accessing the site for maintenance or security purposes. The potential impacts on traffic from operation activities (e.g. wind turbine generator operations, inspection and maintenance) are considered negligible, so no further assessment is needed.

Noise from the Project's substation and transformers is identified as another potential factor, despite being a minor impact, it may cause nuisance and disturbance to the surrounding community. The impact of operation noise on the health of the local community is discussed in detail in Section 11.13.

11.12.2 Existing Controls

Refer to Chapter 9 for existing controls proposed for dust, noise, water quality, solid waste and air quality impacts during operation phase.

11.12.3 Significance of Impacts

The magnitude of the aforementioned impacts was predicted to be Negligible during operation as a result of related impact assessments above. Although the local community will have already had experience with the disturbance from construction, the impacts from the operation are expected to be different in nature and impact sources such as noise from the operation of turbines and transformers and the physical presence of turbine. The receptor sensitivity was considered as Medium, resulting in the impact significance being Negligible.

Table 11.18 Health and Safety Impacts and General Disturbance to Local Community

Impact Description	Health and Safety Impacts and General Disturbance to Local Community				
Impact Nature	**Negative**	Positive	Neutral		
Impact Type	**Direct**	Indirect	Induced		
Impact Duration	Temporary	Short-term	**Long-term**	Permanent	
Impact Extent	**Local**	Regional	International		
Impact Magnitude	Positive	**Negligible**	Small	Medium	Large
Receptor Sensitivity	Low	**Medium**	High		
Impact Significance	**Negligible**	Minor	Moderate	Major	

11.12.4 Additional Mitigation and Management Measures

To ensure the significance of the impact remains as Negligible, the Project Owner is required to implement the additional measures as proposed in Noise Impact Assessment, Visual Impact Assessment and Shadow Flicker Impact Assessment and other measures as below:

- As part of the Project SEP implementation, Project Owner should conduct close communication with local communities on Project environmental and social risks. Future risk-communication efforts will be undertaken in the context of continuing, intense social distrust and will have to be designed in a culturally appropriate way;

- Project Owner shall implement community grievance mechanism is implemented to obtain and resolve community's feedback and concerns in a timely manner;
- Project Owner shall ensure the implementation of community health and safety management and emergency preparedness and response measures are effectively maintained;
- Project Owner shall conduct regular compliance assessments; undertake site visits as required, identify any environment-related and social-related issues; and
- Project Owner shall document issues, propose necessary corrective actions, and prepare these in a corrective action plan.

11.12.5 Residual Impacts

Following the implementation of proposed additional measures, the residual impact is expected to remain Negligible during its operation phase.

11.12.6 Monitoring and Audit

The following monitoring activities are recommended:

- Ongoing monitoring and periodical audit as proposed in the ESMP to ensure the above mitigation measures are being effectively implemented; and
- Monitoring and audit are also required to be conducted in accordance with the schedule proposed in Sections for Noise Impact Assessment, Visual Impact Assessment and Shadow Flicker Impact Assessment.

11.13 Operation – Relocation Impact Due to Health and Safety Reason

11.13.1 Potential Impacts

As mentioned in Section 11.8, the noise modelling based on Project's wind turbine specification has concluded that households residing within a radius of 250 m from the turbine ground may be exposed to significant noise impacts from the turbine operation.

Additionally, according to Article 11 of Circular No. 02/2019/TT-BCT dated 15/1/2019 by the Ministry of Industry and Trade on wind power project development, the wind power work must be 300 m away the residential area. Although the huts/houses nearby the wind turbine built on the cultivation area and not considered a residential area, living in the farm watching huts/houses is part of the Raglai ethnic minority people's customary practice in the area, and many of them live all day long in the huts/houses.

The huts/houses structure is formed from simple construction material like a tin roof, brown bricks or clay (Table 11.8). About 38 houses were identified within the total 300 m zone of the noise and safety impact, as shown in Figure 11.9. Six of them are among the economically displaced households due to the land acquisition discussed above. All of these houses are subject to the relocation from the 300 m area of influence. However, the necessity for relocation and the exact number of affected structures and people should be determined upon the finalization of detailed measurement surveys (DMS) and consultations with affected households that are recommended to be conducted by the Project Owner.

Figure 11.8 Non-permanent Houses in the Agricultural Land in Loi Hai Commune

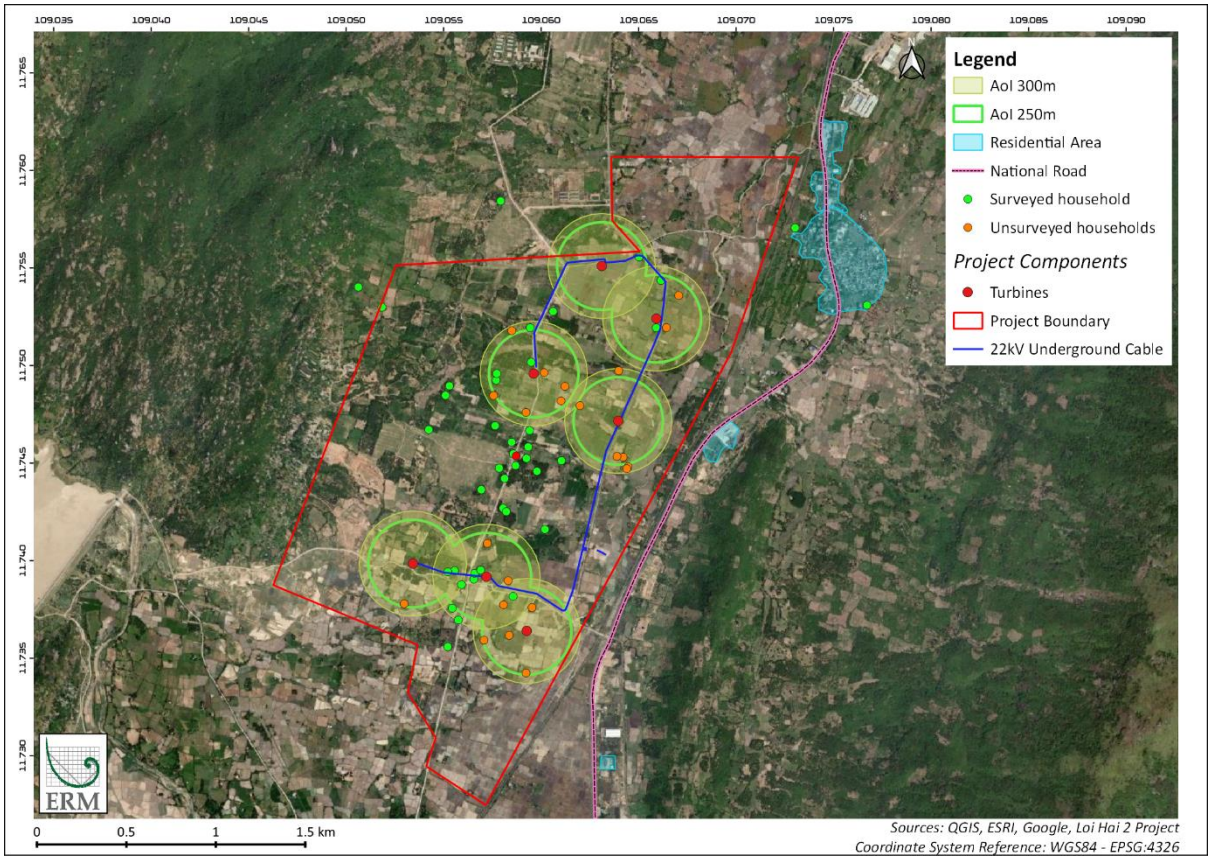


Figure 11.9 Area of Influence of Significant Noise Impact and Safety Impact

11.13.2 Existing Controls

No existing control in place.

11.13.3 Significance of Impacts

Farm watching house relocation impact nature is considered as negative impact as it will take away some of the affected people's access directly. The relocation would cause permanent agricultural land loss and physical displacement to affected people who stay in the house and most of them will experience access restriction to their land during construction and operation.

The vulnerability profile among affected households can be said to be high as they are an ethnic minority and many of them have illiterate breadwinners with limited skills to change their job but still manage to gain enough income to pass the poverty income rate. Losing their land to land acquisition process can be perceived as high impact to them as it might not be their intention to sell their land as it is the source of their livelihood as a farmer.

However, the Project will only impact a small area with 38 affected households compared to the total population in the commune level (3,102 households), and the affected houses are expected to move out of the area of influence but still within their agricultural area. Therefore, the physical displacement impact is considered minor.

Table 11.19 Physical Displacement Impact from Land Acquisition Due to Safety Zone

Impact Description	Physical Displacement Impact from Land Acquisition Due to Safety Zone				
Impact Nature	**Negative**	Positive	Neutral		
Impact Type	**Direct**	Indirect	Induced		
Impact Duration	Temporary	Short-term	Long-term	**Permanent**	
Impact Extent	**Local**	Regional	International		
Impact Magnitude	Positive	Negligible	**Small**	Medium	Large
Receptor Sensitivity	Low	Medium	**High**		
Impact Significance	Negligible	Minor	**Moderate**	Major	

11.13.4 Additional Mitigation and Management Measures

The following additional mitigation and management measures are recommended in order to meet international standards:

- Monitor the land acquisition process to ensure it complies with Vietnamese regulations and IFC standards. This activity should be supported by documentation recording the land acquisition process. This will be required for internal and external audits.
- Based on the CSR completion report, identify the gap between national and IFC PS 5 requirements on land acquisition and resettlement. Then formulate a Corrective Action Plan to close the gaps found.
- Prepare and include a SEP within the ESIA which covers Grievance Management Plan (GMP). GMP should be disclosed to the affected communities prior to the Project's construction implementation. As such, the affected community is aware of communication's grievance lines and understand how to submit a grievance.
- Continuously coordinate with commune PC to solve any submitted grievance relevant to land acquisition activities.
- Implement the Resettlement and Ethnic Minorities Development Plan (REMDP) for those identified as Project affected households. The REMDP will be designed to ensure sustainable restoration and enhancement of income for impacted land users. The Project Owner should priority the relocation before the turbine construction occurs to also minimise the disturbance impacts cause by the construction activities to the local people staying in the huts/houses.
- The REMDP should take into account the women and other vulnerable groups to ensure they are not overlooked during Project implementation and left worse off.

11.13.5 Residual Impacts

With mitigation measures in place, the project may reduce the impact to the negligible significance along the year of project operation.

11.13.6 Monitoring and Audit

The following monitoring and audit actions are recommended:

- Prepare the Completion report for the land acquisition process.
- Monitor implementation of the REMDP on a quarterly basis.
- Prepare the Completion report for the REMDP.
- Maintain Consultation and Grievance records in relation to land acquisition.

11.14 Impact on Indigenous Peoples Way of Life

11.14.1 Potential Impacts

Communication Issues

Construction and operation of the Project will take place within the Raglai people's farmland. The Raglai people are found mostly live in the mountainous areas of the Central Highlands of Vietnam. The Raglai have their own language, which belongs to the Malayo - Polynesian language group (of the Austronesian language family). As a result of their contacts with mainly Kinh people, the Raglai are bilingual or multi-lingual. However, elderly people are still recognised as not able to communicate in Vietnamese (Kinh language). Construction and operation of the Project may bring more people to the Project location from other locations in the district or even from other provinces. However, the total number of onsite workers during both phase is not expected to exceed 105. This is considered small compared to the number of Raglai people in Loi Hai commune which recorded as many as 13,580 people. Interaction misunderstanding between EPC workers and Raglai people may be expected.

Culture differences

The value and daily culture of Raglai people may also experience acculturation to new culture brought by the migrant workers from other locations. It is expected that construction and operation, including establishment of a worker camp will provide the opportunity for interactions between people from outside the Loi Hai Commune and Raglai people. Both non-local people and Raglai People may have high expectations of having a job from Project, but only a limited number of people may secure employment. The interaction process may bring changes and conflicts between Raglai people and workers themselves. As such, social conflict/project opposition may be triggered due to social jealousies.

The traditional practice of Raglai people, which has a more matriarchal culture, might be different from the majority culture, which has a patriarchal culture. It is expected that the worker will come from patriarchal culture. It means that more women will interact in the consultation or discussion with the project. Other practices like marriage ceremony, religious, and medication treatment might be different from other majority culture in Vietnam. So other Vietnamese workers from other provinces might need to learn to respect Raglai People's culture in the project location.

Land acquisition of Raglai's Cultivated Land is expected to affect natural resources

Currently, the local government offers vocational training programs for the poor and ethnic minorities for free especially for youth and farmers. The program focuses on agriculture and livestock techniques occupations such as cattle raising, fattening goats, techniques of growing asparagus, grapefruit. Other manual occupations like welding and sewing are also in the program. Regarding wage-based labour, some young people in the working-age get job opportunities at nearby Industrial Park as workers, and a few people are involved in labour export. The majority of ethnic minority people who are still working as seasonal workers, mainly find employment in simple or manual labour jobs in the communes.

Language barriers and low educational attainment are factors inhibiting these ethnic minorities from attaining more skilled job opportunities, reducing access to better employment or productive opportunities, resulting in their low earnings and high risk-taking.

As mentioned in the economic displacement impact, the cultivated lands have been used by Raglai people for generations. The Loi Hai commune is categorized as a poor, near-poor commune with an 80% population of Raglai people. Raglai are identified nationally as an ethnic minority group which entitles them to receive government assistance such as loan support, vocational training, residential land, and production land and welfare policies. The land use conversion from agriculture to project components might remove some food sources of the affected Raglai people and reduce their income.

Positive Impacts on Raglai People

The Raglai community in the Project area will likely benefit from the upgrade of infrastructure and job opportunities as well as ethnic minority development activities during the Project construction and operation.

11.14.2 Existing Controls

To date, there are no specific controls in EIA.

11.14.3 Significance of Impacts

The Project is likely to cause a short-term impact to affected people during construction and long term impact during operation locally. The vulnerability profile among affected households can be said to be high as many of them are ethnic minority with limited language skills. The Project will only impact a small number of affected people surrounding the Project footprint that can be said to have a minor impact on Raglai people's way of life.

Table 11.20 Impact on Indigenous People Way of Life

Impact Description	Impact on Indigenous People Way of Life				
Impact Nature	**Negative**	Positive	Neutral		
Impact Type	**Direct**	Indirect	Induced		
Impact Duration	Temporary	**Short-term**	**Long-term**	Permanent	
Impact Extent	**Local**	Regional	International		
Impact Magnitude	Positive	Negligible	**Small**	Medium	Large
Receptor Sensitivity	Low	Medium	**High**		
Impact Significance	Negligible	Minor	**Moderate**	Major	

11.14.4 Additional Mitigation and Management Measures

The following additional mitigation and management measures are recommended in order for the Project to meet international standards:

- As part of REMDP, the training for workers about Raglai people's culture is suggested to reduce misunderstanding among workers and Raglai people.
- A grievance redress mechanism should be established during construction and operation to capture any issues between the Project and local people. The Project owner will establish a grievance mechanism that is explained to and accessible for, all villagers including Raglai people. The mechanism will be simple and easy for Raglai people to access.

- Community consultation should be designed to accommodate the Raglai people's communication necessity and those who speak the general Vietnamese language to reduce miscommunication and be inclusive.
- Job or business opportunity disclosure should be disclosed as clear as possible about hiring priorities and selection criteria. So that, community discontent due to high recruitment expectations can be reduced.

11.14.5 Residual Impacts

After successfully implement all of the mitigation measures above, it is expected that the impact significance can be reduced to minor.

11.14.6 Monitoring and Audit

- Number of disclosure and coordination record report during construction and operation;
- Evidence on education/awareness program for EPC workers to interact with Raglai People;
- Every 3 months report on grievance mechanism on community – worker conflicts if any exist.

12. UNPLANNED EVENTS

12.1 Overview

This chapter presents the probable impacts of unplanned events associated with construction and operation of the Project. The unplanned events are those that potentially arise from a technical failure, human error, or as a result of unexpected natural phenomena.

The assessment of potential impacts arising from unplanned events are based on the environmental baseline data, consultation with Thuan Binh Wind JSC and judgements based on ERM's professional knowledge and previous experience on similar projects. The assessment of unplanned impacts considers the happening probability and an estimation of the consequences severity. The assessment of the severity of impacts due to fire and explosion is based on the worst case scenario, where it is assumed that safety devices and associated measures fail to operate properly resulting in the incidents.

Probable unplanned events relevant to the Project, in the order of potential occurrence, which are assessed in this chapter include but not limited to:

- Fire and explosion, including bushfire and Unexploded Ordnance (UXO);
- Spillage of fuel, oil, chemicals and hazardous materials;
- Traffic accidents;
- Occupational accidents;
- Blade throw; and
- Transmission line snapping, and transmission pylon/tower collapse.

This chapter covers impact assessment of the listed events examining potential and significance of the impacts. Mitigation measures are proposed based on international good practice (as recommended under the IFC EHS Guidelines) and relevant national regulatory requirements. Afterwards, a qualitative classification is resolved for each impact with regards to its significance following the implementation of the proposed mitigation measures. Finally, a protocol for monitoring and auditing is recommended when applicable.

12.2 Relevant Guidelines and Regulatory Requirements

12.2.1 Local Regulations

- Law on Fire Prevention and Fighting No. 27/2001/QH10;
- Law No. 40/2013/QH13 Amendment and Supplement a Number of Articles in the Law on Fire Prevention and Fighting No. 27/2001/QH10;
- Decree 136/2020/NĐ-CP on guidelines for the Law on Fire safety and firefighting and the Law on amendments to the Law on Fire safety and firefighting;
- Government Decree No. 113/2017/ND-CP dated October 9, 2017 specifying and providing guidelines for implementation of certain articles of the Law on Chemicals; and
- Circular No. 32/2017/TT-BCT dated December 28, 2017 specifying and providing guidelines for implementation of certain articles of the Law on Chemicals and Decree 113/2017/ND-CP specifying and providing guidelines for implementation of certain articles of the Law on Chemicals;
- Decree No. 02/2019/TT-BCT Regulating Wind Power Development; and
- Decision No. 02/2013/QD-TTG dated 14th January 2013 promulgating the regulation on oil spill response.

12.2.2 International Standards and Requirements

The IFC Performance Standards applicable to the Project in term of unplanned events are provided in Table 12.1.

Table 12.1 Applicable IFC Performance Standards

Performance Standard	Requirements
PS1: Assessment and Management of Environmental and Social Risks and Impacts	Emergency Preparedness and Response Where the project involves specifically identified physical elements, aspects and facilities that are likely to generate impacts, the ESMS will establish and maintain an emergency preparedness and response system so that the Client, in collaboration with appropriate and relevant third parties, will be prepared to respond to accidental and emergency situations to prevent and mitigate any harm to people and/or the environment. The preparation will include the identification of area where accidents and emergency situations may occur, communities and individuals that may be impacted, response procedures, provision of equipment and resources, designation of responsibilities, communication, including that with potentially affected communities and periodic training to ensure effective response. The emergency preparedness and response activities will be periodically reviewed and revised, as necessary, to reflect changing conditions.
PS4: Community Health, Safety, and Security	Emergency Preparedness and Response The Client will also assist and collaborate with the affected communities, local government agencies, and other relevant parties, in their preparations to respond effectively to emergency situations especially when their participation and collaboration are necessary to respond to such emergency situations. If local government agencies have little or no capacity to respond effectively, the Client will play an active role in preparing for and responding to emergencies associated with the Project. The Client will document its emergency preparedness and response activities, resources, and responsibilities, and will disclose appropriate information to affected communities, relevant government agencies, or other relevant parties.

12.3 Impact Assessment Methodology

For impact assessment of the unplanned events, the consequence of impact is considered together with its likelihood of occurrence. The impact consequence is evaluated based on duration (short-term, medium-term, long-term), scale (localized, medium, or widespread), and magnitude (minor, moderate, major) of the impact. Table 12.2 presents the indicative levels of consequence from unplanned events in terms of their impacts to the physical, biological and social environments.

Table 12.2 Classification of Level of Consequence

	Incidental (A)	Minor (B)	Moderate (C)	Major (D)	Severe (E)
Physical Environment	Localized or short-term impacts on environmental media; meeting	Widespread, short-term impacts on environmental media; meeting	Widespread, long-term impacts on environmental media; meeting	Significant, widespread and persistent changes in environmental media;	Exceeding the environmental standards; Fine / prosecution

	all environmental standards	all environmental standards	all environmental standards	Exceeding the environmental standards.	
Biological Environment	Localized or short-term impacts on habitat or species	Localized, long-term degradation of sensitive habitat or widespread, short-term impacts on habitat or species	Localized but irreversible impacts on habitat or widespread, long-term impacts on habitat or species	Significant, widespread and persistent changes in habitat or species	Persistent reduction in ecosystem function on a landscape scale or significant disruption of a sensitive species.
Social Environment	Slight, temporary, adverse impact on a few individuals	Temporary (<1 year), adverse impacts on community but still within the international health standards	Adverse specific impacts on multiple individuals that can be restored in <1 year; or One or more non-severe injuries.	Adverse, long-term, multiple impacts at a community level, but possibly restorable; or One or more severe injuries to members of the public including permanent disability.	Adverse, long-term, varied and diverse impacts at a community level or higher, unlikely restorable; or

In addition, given the irregular and unpredictable nature of the unplanned events, the likelihood of occurrence is weighted for each impact following the scale in Table 12.3 below.

Table 12.3 Classification of Likelihood of Occurrence

Level	Description
Remote (1)	Not known in the industry
Very unlikely (2)	Known but unlikely to happen
Unlikely (3)	May occur one or more time in the Project's lifetime
Likely (4)	May occur once or twice per year
Expected (5)	May occur more than twice per year

Once the level of potential consequence and likelihood of occurrence have been identified, the overall significance of impact will be assessed using the risk matrix shown in Table 12.4.

Table 12.4 Matrix for the Risk Assessment of Potential Unplanned Events

		Likelihood of Occurrence				
		Remote (1)	Very unlikely (2)	Unlikely (3)	Likely (4)	Expected (5)
Consequence	Incidental (A)	Negligible	Negligible	Negligible	Negligible	Negligible
	Minor (B)	Negligible	Minor	Minor	Minor	Moderate
	Moderate (C)	Minor	Minor	Moderate	Moderate	Major
	Major (D)	Moderate	Moderate	Major	Major	Major
	Severe (E)	Major	Major	Major	Major	Major

12.4 Impact Assessment

12.4.1 Combustion and Explosion Including Unexploded Ordnance (UXO) Explosion

12.4.1.1 Potential Impacts

The potential source of impacts associated with fire and explosion would occur as a result of the following events:

- Damage of the WTGs, transmission lines, insulators or other supporting parts;
- Electrical arcs or flashovers;
- Lightning strike;
- Bushfire;
- Facility and equipment failure;
- Storage of combustible materials; and
- Uncleared UXOs.

The potential impacts from large scale fires include the release of smoke and fumes in the broader area generating health issues associated with inhalation of toxic substances and uncontrollable wildfire that would contribute to a loss of houses, crops, natural habitats and impact on the economics of the area (e.g. community and workers' jobs and incomes). In more severe cases, combustion and explosion can lead to major injuries and possible fatality of human receptors, i.e. construction workers and nearby residents, especially in cases involving bushfires or UXO explosion.

12.4.1.2 Existing Controls

The EIA report has proposed a range of mitigation measures to prepare for the potential impacts from unplanned combustion and explosion during construction and operation phases, as follows:

- During construction phase:
  - Developing and circulating fire protection rules;
  - Putting warning signs at areas with high combustion risks;
  - Prohibiting smoking and sparking activities near combustion prone areas;
  - Arranging firefighting equipment including fire extinguishers, sand, shovels, etc. in several places convenient for use in case of emergency; and

- Installing fire alarm to promptly detect fires.

- During operation phase:
  - Establishing an emergency response team to take charge of responses against combustion and explosion emergency;
  - Performing regular fire drills in collaboration with the local firefighting police force;
  - Performing regular inspection and maintenance of firefighting equipment;
  - Improving awareness of operation staffs on fire risks;
  - Setting on-off switch for all the transmission line to switch off in case of fire incident;

12.4.1.3 Significance of Impacts

The wind farm and its transmission line are to be designed in accordance with the national regulations; of these safety is the first priority so the likelihood of fire is Unlikely (class 2). Similarly, the likelihood of an UXO activation during the construction and operation phase is considered Very Unlikely (class 2) following the completed UXO clearance. A low possibility of bushfire occurrence at the area of interest as the nearest forest area is distributed at the high mountains which are located approximately 5 km away from the project site.

As the project area is located relatively close to local residential and cropping areas, the combustion and explosion hazards, upon occurrence, might have direct or indirect effects on these receptors.. The consequence could range from incidental (class A) with only slight impacts to Major (class D) in case of serious injuries. Moreover, the impact is generally localized and short-term until the fire is extinguished.

Overall, the impact significance is considered Moderate (2D) as in Table 12.5.

Table 12.5 Impact Assessment for Combustion and Explosion.

Unplanned Event	Cause	Consequence	Risk Ranking
Combustion and explosion	**Construction phase**: Storage of combustible materials and fuels; Construction activities (welding, machinery operating); Workers' activities (smoking, cooking); Electrical incidents; Uncleared UXO. **Operation phase**: Fuel storage; Workers' living activities (smoking, cooking); Electrical incidents. **Natural cause:** Lightning.	Affect health and wellbeing of plants' workers, staffs, and local residents; Affect local houses, crops and vegetation; Affect plants' operation.	2D (Moderate)

12.4.1.4 Additional Mitigation Measures

The following additional measures are proposed for preventing occurrence of, mitigating and minimizing impacts from unplanned combustion and explosion events during the project construction and operation:

- During construction phase:

- Contacting relevant authority contingency bodies to conduct UXO clearance for the construction areas;
- Following strictly all electrical safety standards in the construction phase;
- Storing separately combustible solvents and fuels, away from sources of electric spark and flame;
- Inspecting fire protection activities at worker camps;
- Providing training to raise awareness of construction workers on fire protection and electrical safety; and
- Developing an emergency response and management plan and monitoring contractors to ensure consistent implementation.

■ During operation phase:

- Establishing an emergency response and evacuation plan, which provides guidance on internal and external actions to take and the responsible personnel in case of combustion and explosion.
- Installing smoke alarms and heat detectors in the control house;
- Arranging fire extinguishers in control house and transformer station; and
- Covering tops of turbine generators with a fire-retardant layer to prevent small fires.

12.4.1.5 Residual Impacts

With the implementation of the mitigation measures, residual impacts of fire and explosion are considered Minor (2C) for both the construction and operation phases.

12.4.1.6 Monitoring and Auditing

An audit program shall be established to check the implementation of emergency response and evacuation plan, staff training, equipment inspection, and firefighting drills.

12.4.2 Spillage of Fuel, Oil, Chemicals and Hazardous Materials

12.4.2.1 Potential Impact

The project will use a large amount of hazardous materials including fuel, oil and chemicals (paints, solvents, etc.) throughout its development. As a result, there is a risk that small volumes of these substances could be spilled on-site.

In construction phase, the Project uses large equipment powered by diesel oil and would contain relatively small reservoirs of lube oil and hydraulic oil, including cranes, excavators, heavy goods vehicles, fork-lift trucks, fuel trucks, etc. Therefore, there might be bulk storage of fuel such as diesel oil at the construction site. Meanwhile, in operation phase, chemicals including hydrocarbons will be used for operation & maintenance (O&M) services. Consequently, spillage risks are relatively high in both phases.

12.4.2.2 Existing Controls

The EIA report has proposed the following measures to mitigate the impacts from unplanned oil spills at substation area during operation phase. In which, a concrete oil collecting tank will be constructed at the substation area to store spilled oil. The tank can store up to 40 m^3 (L × W × H = 4.4 m × 4.4 m × 2.1 m) spilled oil. The tank will be equipped with walls to separate oil from water. Floating oil will be collected manually and will be treated as hazardous waste. The water at the bottom will also be treated as hazardous waste by specialized entities.

No mitigation measures have been proposed to deal with unexpected spillage of fuel, oil, chemical, and hazardous waste at other area of the project site.

12.4.2.3 Significance of Impact

Upon normal construction and operation activities, fuels, solvents and liquid spill materials such as paints and lubricants is Likely to happen (class 4), especially during the construction phase. The impact severity will depend on a variety of factors, such as the spilled volume and the chemical characteristics of it. At worst, the spillage can damage the terrestrial environment, soil, groundwater and surrounding communities. However, given the small scale of the fuel use during the project's development, the consequence of spillage risk is more likely of Incidental nature (class A) which involves localized, short-terms impacts on the physical, ecological and social receptors.

Table 12.6 Impact Assessment for Spillage of Fuel, Oil, Chemicals and Hazardous Materials

Unplanned Event	Cause	Consequence	Risk Ranking
Spillage of fuel, oil, chemicals and hazardous materials	**Construction phase**: Storage of fuels, oils, solvents, hazardous materials etc.; Usage of machinery and transport vehicles; Construction activities like painting, building; **Operation phase**: Operation and maintenance activities; Usage of chemicals, oils at transformer area.	Affecting soil and groundwater quality; Affecting terrestrial ecosystems (fauna and flora); Affect community health and safety.	4A (Negligible)

12.4.2.4 Additional Mitigation Measures

The following additional mitigation measures are proposed to reduce the likelihood of occurrence of a spillage event of fuel, oil, chemicals, and hazardous wastes, which can be applied to both construction and operation phase:

- Maintaining an inventory of the use of hazardous substances on site during construction and operation;
- Maintaining spill kits in relevant locations where hazardous substances are used within the Project area;
- Storing hazardous materials securely in closed containers, inside a roofed, impermeable dedicated storage area equipped with a secondary containment system for spills, in compliance with applicable regulations;
- Setting up protective barriers as applicable;
- Developing procedures for loading/ unloading hazardous chemicals to minimise the risk of incidents during operations;
- Conducting routine inspections of the areas that involve the use and storage of hazardous materials and preventive maintenance for all vehicles and equipment on a regular basis to detect possible spills, leaks and the potential for such occurrences.
- Train the involved personnel in the use (management and storage) of hazardous chemicals on site.

12.4.2.5 Residual Impacts

Proper implementation of the mitigation measures might maintain the impacts from spillage of fuel, oil, chemicals and hazardous materials at Negligible (3A) by reducing the likelihood of occurrence to Unlikely.

12.4.2.6 Monitoring and Auditing

The residual impacts after implementing the mitigation measures are expected to be Negligible, so no monitoring or audit program is needed to manage this unplanned event.

12.4.3 Traffic Accidents

12.4.3.1 Potential Impacts

The traffic accidents have more potential to happen during the construction rather than during the operation stage due to heavy and long-distanced transportation of wind turbines, auxiliary equipment and construction materials. The wind turbine will be transported from the Cam Ranh port, which is approximately 22.2 km away, through the National Highway 1A, to the project site. Regarding the construction materials, only short distance travel is required. According to information provided by TBW, rocks from Ong Ngai rock mine within the Loi Hai commune will be used along with concrete batching from the nearby existing Thap Cham station. As a result, the number of traffic vehicles moving in and out of the Project WTG's layout will be increased during the construction stage, and hence, the risk of traffic collision or accident will also increase. Key receptors of concerns with regards to the impacts from traffic accidents are local residents found along the external transport routes.

12.4.3.2 Existing Controls

The EIA report has proposed the following measures to mitigate the impacts from unplanned traffic accidents during construction phase:

- Avoiding transportation during rush hours;
- Training construction workers and drivers on road safety to comply with regular laws and regulations on road safety;
- All drivers may need to be aware of the traffic control management plan;
- Ensuring to use only the designated roads;
- Drivers should respect speed limits at all times and avoid using roads that crosses communities.
- Investigating and improving road conditions prior to the heavy transports; and
- Assign workers to guide the traffic when vehicles have to stop to load or unload materials.

12.4.3.3 Significance of Impact

Traffic accidents can happen during the whole project's lifecycle if rigorous management measures are not in place, with especially high occurrence potential during peak construction time. However, owing to the dispersion of the construction layout along with the arrangement of transport routes outside of the residential area, the potential for traffic accidents to happen during the construction phase is largely reduced. The amount of transportation during operation phase is negligible, thus, negligible potential of traffic accidents.

Overall, following the definition shown in Table 12.3, the likelihood of occurrence is considered unlikely (class 3 – can happen once or twice during the project's lifetime). Upon occurrence, traffic accidents can lead to a wide range of consequences, from property damage to personnel injuries and fatalities,

depending on various factors including the type and size of vehicles and the moving speed at the time of collision. The consequence could thus be ranked up to Severe (class E).

In the worst case scenario, a traffic accident happening during the project's lifetime can be ranked Major (3E) with regards to the impact significance and mitigation measures are strongly required.

Table 12.7 Impact Assessment for Traffic Accidents

Unplanned Event	Cause	Consequence	Risk Ranking
Traffic accidents	**Construction phase**: Transportation of wind turbines, heavy equipment and construction materials.	Property damage; Injuries; Fatality.	**3E (Major)**

12.4.3.4 Additional Mitigation Measures

The following additional mitigation measures are proposed to further control the impacts from unplanned traffic accidents:

- Developing and implementing a Traffic Management Plan which set out plan for transport activities, personnel in charge, actions to be taken in case of emergency, vehicle inspection timeline, etc. All drivers must be aware of this.
- Installing signs, signals, and sufficient lighting specially during construction, to support vehicle operation at night;
- Ensure speed limits are always respected by all drivers;
- Planning the transport routes carefully to avoid potential of collision and roads crossing housing areas;
- Coordinating with the People's Committees at provincial levels (Khanh Hoa and Ninh Thuan provinces) for support for the transportation of turbine foundations and blades from the Cam Ranh port to the project site;
- Coordinating with Communal People's Committee to organize the traffic in and near project site when necessary;
- Building the internal access road system to support the transportation of equipment and materials in construction phase, as well as to support the operation and maintenance activities in operation phase;
- The straight road will be built to connect the main gate and the control house and the transformer station. The road will be asphalted and designed for expected types of vehicle;
- Inspecting vehicles regularly for quality and safety aspects; and
- In case the transportation activities of the project cause the damage to the local roads, the Project Owner shall make compensation and restore the road condition to its original state.

12.4.3.5 Residual Impacts

The mitigation measures, if implemented effectively, can reduce both the likelihood of occurrence of traffic accidents and the severity of consequence in case of actual happening. On that basis, the impact significance can be reduced to Minor (2C).

12.4.3.6 Monitoring and Auditing

No monitoring programme is required.

12.4.4 Occupational Accidents

12.4.4.1 Potential Impacts

The nature of the Project presents occupational health and safety risks, which can result in direct impacts on worker's health and safety. Construction will involve a range of activities that could contribute to or present an occupational health and safety risk, resulting in an accident, injury, of even fatality, including:

- The use of large mobile equipment, such as backhoes, bulldozers, graders and mobile cranes, which could, if not managed correctly, lead to an accident or injury;
- Manual handling associated with day to day construction activities; and
- Working with heavy equipment, working at height, and working under high temperature.

12.4.4.2 Existing Controls

The EIA report has proposed the following measures to mitigate the impacts from unplanned occupational accidents during construction phase:

- Inspecting equipment / machinery regularly to ensure proper operation;
- Preparing technical safety procedure for all equipment and machinery;
- Providing workers with proper personal protective equipment while working on site and corresponding training to operate and perform high risk equipment/activities, to raise their awareness on health, safety and hygiene;
- Supervising and regulating workers to wear and maintain personal protective equipment as required;
- Implementing sufficient protection measures while working at height, hot work activities, operation, maintenance and transport of heavy vehicles and electrical equipment, doing heavy lifting and carrying, among other high risk activities.

12.4.4.3 Significance of Impact

Occupational accidents are considered Likely to happen (class 4, may happen once or twice a year). However, the consequence can range widely from Incidental (class A) to Severe (class E) in case of major injury and fatality of construction workers. Therefore, the overall significance is considered Major (4E) and strategic management and mitigation measures are strongly required.

Table 12.8 Impact Assessment for Traffic Accidents

Unplanned Event	Cause	Consequence	Risk Ranking
Occupational accidents	**Construction phase**: Working with heavy equipment; Heavy handling; Working at height.	Impact on workers' health and safety; Injuries; Fatality.	**4E (Major)**

12.4.4.4 Additonal Mitigation Measures

The following additional mitigation measures are proposed to further control the impacts from unplanned occupational accidents:

- Providing training to workers involved in high risk work positions/activities as needed (e.g. hot work, work at heights, operation-maintenance of heavy equipment, etc).

- Providing training on lockout/ tagout to all employees involved in high risk activities (operation and maintenance).
- Keeping track of the vehicle / equipment inspection records, planned inspections, etc.;
- Prohibiting using old, unqualified vehicle / equipment;
- Preparing measures to prevent and respond to unplanned occurrence of occupational accidents, and when happening, perform immediate root cause analyses;
- Assigning supervisors to supervise the activities on site to ensure all safety regulations and practices are followed and the risks will be minimised;
- Ensure all subcontractors are aware of the high risk activities to be performed on site, and ensure all workers involved have been properly trained;
- Providing first aid kits at different places on site, where needed;
- Ensuring that workers (including contractors) complete a Job Hazard Analysis (JHA) prior to undertaking construction activities, and also conduct daily toolbox discussions to ensure hazards are identified and management measures are implemented; and
- Ensuring sufficient lighting at working areas, especially during night time.
- Ensuring high risk signals are placed in the working areas where required.

12.4.4.5 Additional Mitigation Measures

The mitigation measures, if implemented effectively, can reduce both the likelihood of occurrence of traffic accidents and the severity of consequence in case of actual happening. On that basis, the impact significance can be reduced to Minor (2C).

12.4.4.6 Monitoring and Audit

Random audits to the areas with high risk activities will be conducted on a monthly basis to ensure proper implementation of the mitigation measures and other internal safety procedures. Any found deviations will be followed up until resolved.

12.4.5 Blade Throw

12.4.5.1 Potential Impacts

Blade throw events that have been reported worldwide occur as a result of the failure of the rotor blade which thereby results in the ejection or throwing of the rotor blade which can endanger people living/working close to the wind farm. Assessment of reports and case studies in the open domain have revealed an increasing trend to locate them in proximity of build-up areas which can endanger people living/working close to the wind farm. Therefore, it becomes strictly necessary to define setback distances and/or buffer zones to minimize the risk of damage or injury from components failure. Research has been conducted to assess the root cause of blade throw incidents and is currently ongoing [26] [27] [28] [29].

[26] Eggwertz S, Carlsson I, Gustafsson A, Linde M, Lundemo C, Montgomerie B, Thor S. Safety of wind energy conversion systems with horizontal axis. Technical Note HU-2229, Flygtekniska Försöksanstalten (FFA—The Aeronautical Research Institute of Sweden), Stockholm, 1981

[27] Eggers AJ, Holley WE, Digumarthi R, Chaney K. Exploratory study of HAWT blade throw risk to nearby people and property. Proceedings of the 2001 ASME Wind Energy Symposium, Reno, Nevada, 2001; 355–367

[28] Montgomerie B. Horizontal axis wind turbine blade failure, blade fragment six degrees of freedom trajectory, site risk level prediction. Fourth International Symposium on Wind Energy Systems, Stockholm, Sweden, HRA Fluid Engineering, 1982; 389–401

[29] Turner D. A Monte Carlo method for determining the risk presented by wind turbine blade failures. Wind Engineering 1986; 11: 1–20

12.4.5.2 Considerations and Assumptions

The blade throw/ ejection incidents have been classified into the following based on photographic evidence over the years, modelling studies by various research groups and blade test practices based on the International Electro-technical Commissions (IEC) specifications (IEC 61400-23). Their origin has been classified as:

(a) root connection failure;

(b) catastrophic structural buckling or separation;

(c) leading edge, trailing edge, or other bond separation;

(d) lightening damage;

(e) erosion;

(f) failure at outboard aerodynamic device;

(g) reduction in stiffness of blades (up to 10%);

(h) superficial structural or delamination/ laminate wrinkling that eventually become permanent leading to damage; and

(h) over speeding due to failure of supervisory control and data acquisition (SCADA) to rectify the failure or high wind/ cyclonic/ meteorological conditions [30].

Considering all of the above points, it is difficult to attribute blade throw failure to a single attribute or a combination of attributes, thus leading to these incidents. Therefore, host country regulations in some countries and recommendations to define setback distances and/or buffer zones are currently being framed to minimize the risk of damage or injury from components failure.

12.4.5.3 Existing Standards for Blade Ejection / Blade Throw

In Vietnam, the level of setback distance identified to ensure safety of settlements is not defined. However, the IFC EHS Guidelines for Wind Energy [31] has recommended that "*the minimum setback distance is 1.5 x turbine height (tower + rotor radius), although modelling suggests that the theoretical blade throw distance can vary with the size, shape, weight, and speed of the blades, and the height of the turbine. It is therefore recommended that the minimum setback distances required to required to meet noise and shadow flicker limits be maintained with respect to sensitive residential receptors to provide further protection*."

The IFC also recommends minimising the probability of a blade failure:

- By selecting wind turbines that have been subject to independent design verification/certification (e.g. IEC 61400-1);
- Surveillance of manufacturing quality; and
- Ensuring that lightning protection systems are properly installed and maintained.

Recommendations also include carrying out periodic blade inspections and repair any defects that could affect blade integrity and equipping wind turbines with vibration sensors which can react to any imbalance in the rotor blades and shut down the turbine, if necessary.

[30] Robinson et al. Study and development of a methodology for the estimation of the risk and harm to persons from wind turbines. 2013. Prepared by MMI Engineering Ltd for the Health and Safety Executive 2013

(7) IFC EHS guidelines for wind energy, IFC, August 7, 2015. [Online] Available at: https://www.ifc.org/wps/wcm/connect/b82d0563-b39a-42a7-b94e-0b926b4a82f9/FINAL_Aug%2B2015_Wind%2BEnergy_EHS%2BGuideline.pdf?MOD=AJPERES&CVID=mpusVXy.

12.4.5.4 Qualitative Blade Throw Assessment Methodology

The qualitative blade throw assessment encompasses the rationale that has been proposed by the IFC pertaining to setback distances which is 1.5 x turbine height (tower + rotor radius).

The Project comprises 7 wind turbines. The blade throw/blade ejection (BT/BE) assessment was carried out considering Vestas wind turbine specifications (proposed to be used in this Project). Technical specifications of wind turbine considered in BT/BE assessment are provided in Table 12.9:

Table 12.9 Technical Specifications of Wind Turbines.

Description	Unit	Design Data
Wind Turbine Model	-	Vestas V150-4.0/4.2
Type	-	3-bladed, horizontal axis
Rated Power	kW	4,000/4,200
Hub Height	m	105
Rotor Diameter	m	150
No. of Blades	-	3
Swept area	m^2	17,671
Cut-in Wind Speed	m/s	3
Cut-out Wind Speed	m/s	22.5

Source: Performance Specification of V150-4.0/4.2 MW, Vestas 2020.

The theoretical setback distances of the WTGs as per IFC guidelines is presented in Table 12.10. This information was utilised to independently assess the setback distances of the receptors that were identified using the latest satellite imagery of the Project Area.

Table 12.10 Setback Distances for the Project

WTG Model	Hub Height	Rotor Radius	Minimum setback distance
Vestas V150-4.0/4.2	105 m	75 m	= 1.5 × (hub height + rotor radius) = 1.5 × (105 + 75) = 270 m

Source: EHS guidelines for wind energy, IFC, August 7, 2015.

12.4.5.5 Receptors

Following recommendation from the noise impact assessment, all 38 households located within the 300 m safety zone from each of the turbine foundation will be relocated (Section 10.3 – noise impact assessment). Therefore, no human receptors will reside within the impact zone of theoretical blade throw (distance of 270 m from the turbine foundations) during the project operation.

12.4.5.6 Existing Controls

Technically, the blade safety has been considered in the project technical design, wherein the cut-out mode will be activated (the blades will change direction and be parallel to the wind direction, the turbines stop rotating) if wind speed exceeds the designed cut-out wind speed, especially in extreme weather conditions such as typhoon, cyclone, etc.

The EIA report does not consider the blade throw risk, hence has not proposed any additional mitigation measures.

12.4.5.7 Impact Assessment

Blade throw failure could result in rapid spread of fire and projectile spread of debris given the heights of wind turbines. This could result in injuries at surrounding communities, or in the worst-case fatalities, and damage to local flora and fauna. However, as no human receptors will be located within the expected impact zone, the blade throw will more likely land on vacant land which will result in Moderate consequence and affect cropping property at worst. Therefore, the overall impact of blade throw is considered Minor (2C) with worst-cast consequence of Moderate (class C) and likelihood of Very Unlikely (class 2).

The blade throw impact significance is illustrated in Table 12.11.

Table 12.11 Impact Assessment for Blade Throw.

Unplanned Event	Cause	Consequence	Risk Ranking
Blade throw	**Operation phase**: Failure of the rotor blades.	Affect people living and working nearby;	**2C (Minor)**

12.4.5.8 Mitigation / Management Measures

The blade throw impact can be avoided if there is option of altering the micro siting of the WTGs. Therefore, in order to avoid any incident in future, it is important to adopt following mitigation measures:

- Strengthening the foundation of all WTGs;
- Providing anchors to all WTGs to delay the immediate impacts;
- Carrying out periodic blade inspections, maintenance and repair any defects that could affect the blade integrity;
- Ensuring that lightning protection systems are properly installed and maintained;
- Equipping wind turbines with vibration sensors that can react to any imbalance in the rotor blades and shut down the turbine, if necessary;
- Creating awareness amongst the residents if any about any potential impacts and bringing to immediate notice of the client any abnormal sound/changes noticed by the residents regarding operations of the turbines;
- Communicating risks in the proximity of wind turbines to the neighbouring community; and
- Monitoring any development close to the turbines within the impact zone.

12.4.5.9 Residual Impacts

The mitigation measures, if implemented effectively, can maintain the impact significance at Minor (2C).

12.4.5.10 Monitoring and auditing

A quarterly audit program shall be established to check the implementation of regular technical inspection of the WTGs and blades' safety. Any identify gaps or areas of opportunity will be followed up after the inspection until resolved. The auditing records will be kept onsite for future review and supervision.

12.4.6 Transmission Line Snapping and Transmission Pylon/Tower Collapse

12.4.6.1 Potential Impacts

During operation, there is a possibility of lines or transmission towers/parts snapping/swaying due to the tower failing and resulting in injuries and/or fatalities. Additionally, any contacts (both intentional and unintentional) with the exposing snapped transmission line can result in electrocution. The causes are mainly poor foundation quality, tower member theft, material corrosion due to poor coating and poor quality or damaged fittings exposing the system to failure. Other natural hazards can also result in snapping incidents of transmission line such as strong wind, flash flood, land slide, etc.

The receptor sensitivity was considered high as there were households and livelihood activities within the transmission line RoWs in the Project area. Impacts on community health and wellbeing could lead in injuries and fatalities.

12.4.6.2 Significance of Impacts

The collapse of the transmission pylon / tower and failure of transmission lines might happen at relatively high frequency due to technical and natural reasons. The likelihood of occurrence is therefore considered Likely (class 4). In case of actual occurrence, the event can lead to injury of human receptors, loss / reduction of ecological receptors and loss / reduction of community likelihood during a short-term period. Therefore, the consequence level is considered Moderate (class C). Overall, the impact is of Moderate significance (4C).

Table 12.12 Impact Assessment for Transmission Line Snapping and Transmission Pylon/tower Collapse

Unplanned Event	Cause	Consequence	Risk Ranking
Impact assessment for transmission line snapping and transmission pylon/tower collapse	**Operation phase**: Foundation failure; Theft; Damaged fittings; Natural hazards.	Affect community health and safety; Affect cropping activity and productivity; Loss/reduction of community livelihood.	**4C (Moderate)**

12.4.6.3 Mitigation Measures

- Conducting sufficient geological surface prior to the construction;
- Aligning the turbine foundations and towers design with the geological conditions of the area;
- Supervising closely the construction of the turbine foundation and towers to make sure the foundation / tower structure follow the technical design;
- Inspecting quality of the structure regularly to promptly detect and respond to issues;
- Installing on-off switch to automatically cut off electrical connection in case of transmission line failure;
- Preparing an action plan to set out the actions to take in case of transmission line failure;
- Conducting training to operation staffs of the action plan.

12.4.6.4 Residual Impacts

Upon effective implementation of the mitigation measures, the likelihood of occurrence of the transmission line / tower / pylon failure can be reduced to Unlikely (class 3), the consequence level reduced to Minor (class B), and the overall impact significance can become Minor (3B).

12.4.6.5 Monitoring and Auditing

An audit program shall be established to check the implementation of regular technical inspection of the transmission lines and transmission pylons' safety.

12.5 Summary

In summary, a range of unplanned events can create minor to detrimental unexpected impacts during the projects' lifetime. This chapter examines the potential impacts of those events, proposes additional mitigation measures and evaluates the impact significant prior to and after implementing the mitigation measures. Table 12.13 summarizes the key findings of this chapter.

Table 12.13 Summarized Impact Ranking of the Potential Unplanned Events.

No	Unplanned event	Consequence	Likelihood	Impact significance	
				Pre-mitigation	Post-mitigation
1.	Combustion and explosion, including UXO explosion	Major (D)	Very unlikely (2)	Moderate (2D)	Minor (2C)
2.	Spillage of fuel, oil, chemicals and hazardous materials	Incidental (A)	Likely (4)	Negligible (4A)	Negligible (3A)
3.	Traffic accidents	Severe (E)	Likely (4)	Major (4E)	Minor (2C)
4.	Occupational accidents	Severe (E)	Likely (4)	Major (4E)	Minor (2C)
5.	Blade throw	Moderate (C)	Very Unlikely (2)	Minor (2C)	Minor (2C)
6.	Transmission line snapping, and transmission pylon/tower collapse	Moderate (C)	Likely (4)	Moderate (4C)	Minor (3B)

13. CUMULATIVE IMPACT ASSESSMENT

According to IFC's Guidance Note 1, cumulative impacts are formed by combining individual potential impacts from the proposed Project, together with those of other existing projects and anticipated future projects. Cumulative impacts can become either increasingly adverse or beneficial when considered in combination with the current Project. This Chapter evaluates the significance of cumulative impacts based on the methodology described in Chapter 4.

The overall objective of this CIA is to identify and assess the contribution of the Project's impacts to existing or proposed developments within this Project's Area of Influence (AoI). It is based on information included in the regulatory EIA for other developments, information presented throughout this ESIA, information provided by the Client, and information available in the public domain. The specific objectives are to:

- Identify Valued Ecosystem Components (VECs) that could be impacted cumulatively in areas potentially affected by the Project, considering input from stakeholders through the consultation process and the scientific community;
- Identify other existing and planned projects and external environmental and social drivers that could cumulatively impact VECs;
- Undertake a high-level assessment of potential cumulative impacts on VECs, considering the Project and the other identified existing and planned projects and external drivers in the area; and
- Recommend a management framework for the integrated management of potential cumulative impacts.

13.1 Relevant Guidelines and Criteria

To achieve these objectives and gain an understanding of the complexities of cumulative impacts, this Chapter is prepared with reference to international best practice guidance documents, such as:

- The European Union's "Guidelines for the Assessment of Indirect and Cumulative Impacts as well as Impact Interactions" (1999);
- The Canadian Environmental Assessment Agency's "Assessing Cumulative Environmental Effects under the Canadian Environmental Assessment Act" (2012);
- The IFC's "Good Practice Handbook: Cumulative Impact Assessment and Management Guidance for the Private Sector in Emerging Markets" (2013); and
- The USA NEPA Council on Environmental Quality's "Considering Cumulative Effects under the National Environmental Policy Act" (1997).

13.2 Scoping Assessment

13.2.1 Identification of VECs

According to the Decision No. 460/QD-UBND dated December 26th, 2018 of People's Committee of Binh Thuan province on the Adjustment of Land use planning of Thuan Bac district until 2020, the majority of land of the district will be agriculture land, accounting for 86% (27,826 ha). Non-agriculture land account for 13.06%, including 577 ha planned for power development (1.81% of total land). In a larger scale, according to the Development planning of Ninh Thuan province to 2020 with vision towards 2030[32], Ninh Thuan is planned to be one of the economic centre of the central Vietnam, with the focus

[32] Decision 292/QD-UBND of People's Committee of Ninh Thuan province, dated September 04th 2018. Summary available at http://www.ninhthuan.gov.vn/chinhquyen/soxd/Pages/phe-duyet-Quy-hoach-xay-dung-vung-tinh-Ninh-Thuan-den-nam-2020-tam-nhin-den-nam-2030.aspx

on the development of 1) Hi-tech agriculture; 2) Tourism; and 3) Renewable energy. Therefore, it is expected that the upcoming projects in the future will generally fall into those categories.

These developments will generate various impacts that may interact with impacts to be generated by the Project causing cumulative effects on the same VECs (Figure 13.1).

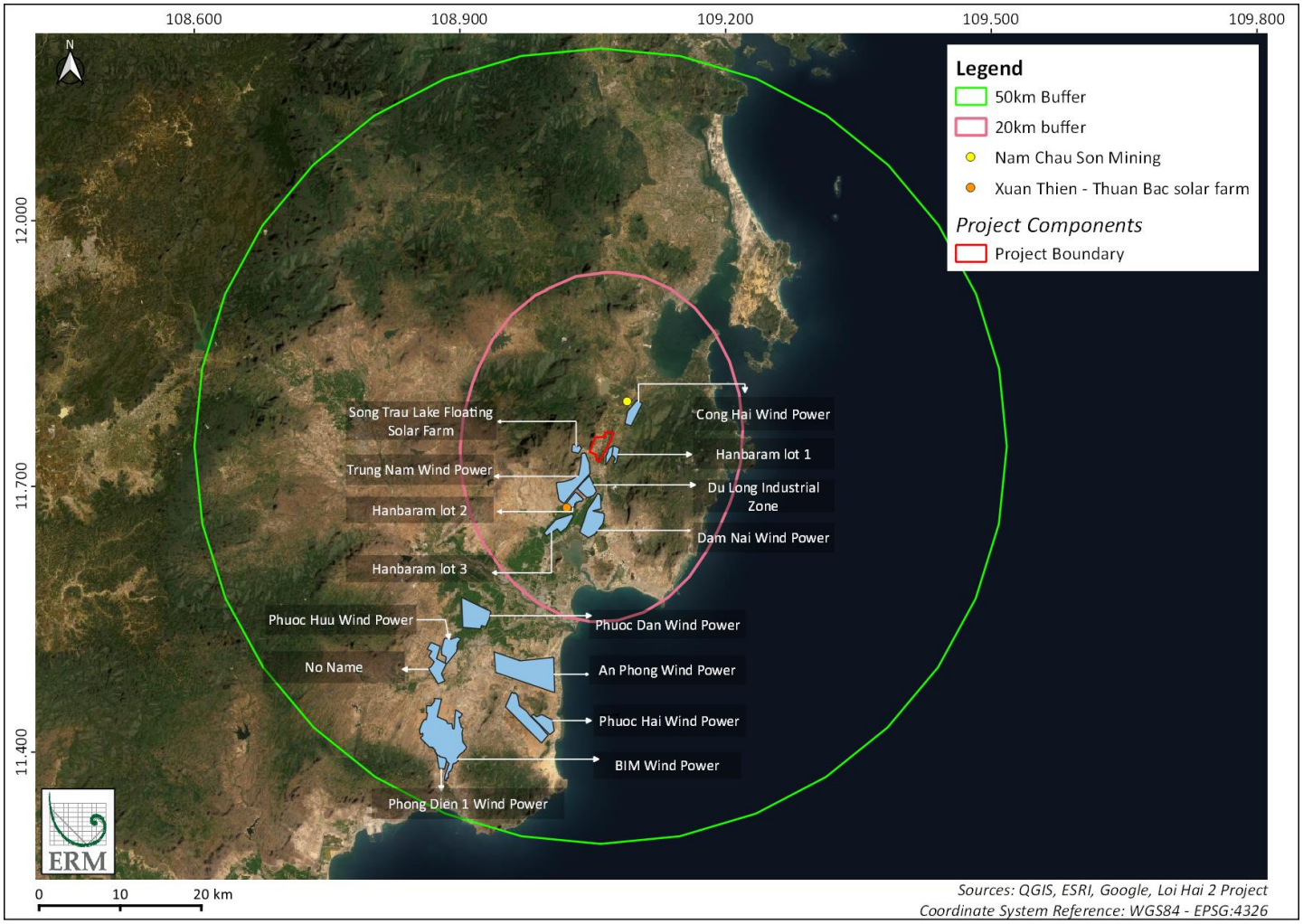


Figure 13.1 Major developments and key VECs in the Project region

The following VECs have been identified to be important in assessing risks caused by the Project:

- Physical features: noise emissions and visual quality;
- Wildlife populations: including avifauna and chiropteran at risk of collision with the turbines; and
- Biodiversity: terrestrial habitat loss and particular interest in flying fauna.

13.2.2 Scope of Assessment

Identification of key cumulative impacts needs to be in alignment with those assessed throughout the main body of this ESIA, and needs to include those which are recognised as important on the basis of genuine scientific concerns and the views of affected communities and other stakeholders. This allows for impacts to be appropriately grouped and added to impacts identified as likely to occur from other projects. In this regard, a largely qualitative approach was taken for the CIA. This is to enable a focus to be placed upon identification of trends across the various projects in the area, as well as their temporal and spatial interactions. Whilst impacts arising from the Project have been defined and assessed in isolation, it can be difficult to accurately quantify cumulative impacts as there can be a high degree of uncertainty in interactions with other projects and activities that may be occurring in the area as well as a lack of confirmed project information.

A cumulative screening assessment was carried out to consider the interactions of impacts from various key developers on the relevant VECs, including:

- Terrestrial habitats;
- Avifauna and bats; and
- Noise.

Cumulative impacts that do not have major impact on the VECs or are not contributed significantly by the Project's development were scoped-out. Results of the impact screening on VECs are presented in Appendix H.

13.2.3 Spatial Boundaries

The main layout of the Project area will be located at the onshore area in the vicinity of Cho Lau Town. The AoI was guided by information taken from similar projects in Vietnam and abroad (Table 13.1). This allows for a decision to be made as to whether there is the potential for overlap with the Project and other developments' impacts.

Table 13.1 Area of Influence (AoI)

VECs	Potential Impact	ZOI (km)
Physical features	Elevated noise from wind farm	4[33]
Ecology system	Collision of birds and bats with the turbines	50 (IFC PS6)

Key to this spatial and temporal assessment are the following elements:

- Identification of appropriate geographical boundaries. Where potentially interacting projects are not located close enough or sufficiently linked through various ecological and social processes for relevant impacts to overlap, cumulative impacts are less likely;
- Identification of temporal boundaries. Where the schedules of various components of projects do not overlap in time, particularly with regards to the construction phase of large projects, cumulative

[33] Estimated from modelling output for similar Project

impacts are less likely. Additionally, where projects are going to be short-term, cumulative impacts will generally be of limited duration.

13.2.4 Existing and Planned Developments

According to the approved Wind power development plan of Ninh Thuan province which was issued in 2013 by MOIT[34], 21,432 ha of land will be reserved for future wind power projects with total expected capacity of 1,429 MW.

On June 25th 2020, the Government issued the Announcement No. 795/TTg-CN, which approves the addition of 92 wind power projects to the existing plan. Among them, nine projects are located in Ninh Thuan province with the total capacity of 336.2 MW.

Recently, the Department of Industry and Trade of Ninh Thuan province has informed that, as of October 10th 2020, there are three operational wind farms with total capacity of 181 MW[35]. In addition to that, 14 wind power projects are currently under development phase with total capacity of 660 MW.

On the other hand, three solar power projects and five micro hydropower projects are being developed, adding to the existing 31 operational solar power projects.

The major development projects in Thuan Bac district, Ninh Thuan province and their status are presented in table

Table 13.2 Industrial, energy and infrastructure development project in Thuan Bac district, Ninh Thuan province

Code	Project name	Type - Capacity	Status	Distance from Loi Hai wind farm's (boundary-to-boundary)
1	Thong Thuan	Mining	No info	3.8 km
2	Nam Chau Son	Mining	No info	2.8 km
3	An Hung	Mining	No info	2.5 km
4	Trung Viet	Mining	No info	2.5 km
5	Kim Dinh Cement plant	Cement production	Operational	2.3 km
6	Son Hai factory	Sea moss production	Operational	1.8 km
7	Bau troi xanh	Mining	No info	1.8 km
8	Son Long Thuan	Stone quarry	No info	1.8 km
9	Phuong Hai	Mining	No info	1.8 km
10	Truong Quang	Mining	No info	1.8 km

[34] Decision No. 2574/QĐ-BCT of Ministry of Industry and Trade, dated April 23rd, 2013 on the Approval of Wind power development of Ninh Thuan province for the period 2011 to 2020, with vision towards 2030.

[35] Ninh Thuan province: 03 solar projects, 14 wind power projects under development. Available at https://ictnews.vietnamnet.vn/kham-pha/tiet-kiem-nang-luong/ninh-thuan-3-du-an-dien-mat-troi-14-du-an-dien-gio-dang-trien-khai-268213.html. Accessed on November 30, 2020.

Code	Project name	Type - Capacity	Status	Distance from Loi Hai wind farm's (boundary-to-boundary)
12	Cong Hai 1 wind farm	Onshore wind farm, 3 MW	Construction started in 2014, but currently on-hold	1.8 km
13	Cong Hai 2 wind farm	Onshore wind farm, 41 MW	Land acquisition in progress	2.0 km
14	Hanbaram wind farm - Lot 1	Onshore wind farm, 254 ha	Construction to start in 2021 (Phase 1)	0.4 km
15	Hanbaram wind farm - Lot 2	Onshore wind farm, 194 ha	Construction to start in 2021 (Phase 1)	4.9 km
16	Hanbaram wind farm - Lot 3	Onshore wind farm, 402 ha	Construction to start in 2021 (Phase 1)	7.5 km
17	**Loi Hai 2 wind farm (*this project*)**	**Onshore wind farm**	**Construction to start in December 2020**	**-**
18	Mining project	Mining	No info	0.5 km
19	Trung Nam wind farm	Onshore wind farm, 45 turbines, 106 MW	Partially operational	0.8 km
20	Trung Nam - Thuan Bac solar farm	Onshore solar farm, 264 ha, 241 MW	Operational	3.5 km
21	Xuan Thien - Thuan Bac solar farm	Onshore solar farm, 264 ha, 250 MW	Operational	3.5 km
22	Song Trau lake floating solar farm	Floating solar farm, 60 ha of surface area	No info	2.1 km
23	Du Long industrial zone	Centralised industrial zone, 407 ha	Operational but largely vacant	3.0 km
24	Dam Nai wind farm	Onshore wind farm, 16 turbines, 40 MW	Operational	4.5 km
25	North - South expressway	Expressway, 22 km passing Thuan Bac district	Land clearance almost completed. 4,452 ha to be acquired, 1,299 households to be	0.9 km (nearest section)

Code	Project name	Type - Capacity	Status	Distance from Loi Hai wind farm's (boundary-to-boundary)
			affected. Construction to start in 2021[36].	

Source: ERM, summarised from Decision 509/QD-UBND dated December 31st 2019 of Ninh Thuan Province People's Committee on the Approval of Land use planning of Thuan Bac district in 2020 and Resolution No. 07/NQ-HDND dated May 13th 2019 of Ninh Thuan Province People's Council on the Adjustment of Land use for energy development until 2020 and other public sources of information.

13.3 Cumulative Impacts on Noise Levels

As presented in Table 13.2, the construction of several projects are expected to begin in 2021, as a result, the cumulative effects of noise will likely increase in short term. Major sources of noise impact in the construction phase is from pile-driving work, transportation and installation activities. Thuan Bac town, the administrative centre of Thuan Bac district, will be affected by the cumulative noise effects from construction activities due to its close proximity to the transportation routes, such as National Highway 1A and access roads to project sites of three wind farm projects (project codes 14, 17, 19). The construction activities of the North-South Expressway, section passing through Thuan Bac district will significantly contribute to the elevated noise levels at Ba Rau 1 and Ba Rau 2 village. While visiting the town in November 2020, ERM staff already saw some noise mitigation measures in place, such as heavy trucks are not allowed to go through the town. Instead, they have to go around the town to reach to the construction sites. Nevertheless, noise concern of this area during construction phase is evaluated to be moderate.

Within the windfarms, at operation phase, major noise impact is generated from the movement of WTGs. The wind farm projects No. 14, 17, 19 with total 64 turbines were assessed for the potential to contribute to cumulative noise effect at the residential areas at Thuan Bac town of Loi Hai commune. Projects No. 19 (Trung Nam, 45 turbines) will likely bring minor impacts to Ba Rau 1 village of the town due to their close proximity (approximately 600m from the nearest turbine). Project No. 14 (Hanbaram Lot 1, 12 turbines) and Project No. 17 (Loi Hai 2, 7 turbines) are about 1 km and 1.8 km from the nearest dense residential area respectively, therefore, the noise impact significance of these projects is assessed as negligible. On the other hand, the North-South Expressway section passing through Ninh Thuan province is expected to be open for traffic in 2023 or 2024, however, with the distance of 900 m from the edge of the expressway to the nearest residential area (Ba Rau 1 village), the impact of noise will be insignificant.

Overall, the significance of cumulative noise impact of the projects surrounding Loi Hai 2 wind farm, including the project itself, is assessed as minor. Therefore, no further mitigation measures is required.

13.4 Cumulative Impact on Loss of Terrestrial Habitat

Based on remote sensing, the Project and other projects such as Hanbaram, Trung Nam wind farms appear to locate in the same landscape, which is mainly occupied by agricultural activities, and therefore considered to be modified ecosystems. Subsequently, any CIA from projects to be located would be linked to impacts in modified habitats. Additional any of the modified habitats located in the area of interest are recognized in the IUCN Ecosystem Red List and neither do represent an area that needs conservation priority in the Southern Vietnam Lowland and Dry Forest ecoregion. In addition, the

[36] Ninh Thuan to speed up the handover of land to the construction of North - South expressway project. Available at https://vov.vn/kinh-te/ninh-thuan-day-nhanh-tien-do-giao-mat-bang-cho-du-an-cao-toc-bac-nam-819701.vov. Accessed on December 1st, 2020.

biodiversity baseline of Loi Hai 2 suggests a low biodiversity linked to the landscape. The cumulative effects loss of terrestrial habitats are, therefore, likely to be insignificant.

13.5 Cumulative Impact on Birds and Bats

The main issue when multiple wind farms operate simultaneously is the effect on avian fauna and bats. Accordingly, this cumulative impact assessment focused on eight wind farms within a 10 km radius from the project area (Table 13.3). Given a lack of sufficient information from the other wind farms at the time of this report, the assessment will base on the available data from Loi Hai itself, Phu Lac Wind Farm is approximately 60 km from the same developer and literature review.

Table 13.3 Wind Farm Projects within 10 km radius from the Project

S/N	Project name	Type - Capacity	Status	Distance from Loi Hai wind farm's (boundary-to-boundary)
1	**Loi Hai 2 wind farm (*project of interest*)**	**Onshore wind farm**	**Construction to start in December 2020**	**-**
2	Cong Hai 1 wind farm	Onshore wind farm, 3 MW	Construction started in 2014, but currently on-hold	1.8 km
3	Cong Hai 2 wind farm	Onshore wind farm, 41 MW	Land acquisition in progress	2.0 km
4	Hanbaram wind farm - Lot 1	Onshore wind farm, 254 ha	Construction to start in 2021 (Phase 1)	0.4 km
5	Hanbaram wind farm - Lot 2	Onshore wind farm, 194 ha	Construction to start in 2021 (Phase 1)	4.9 km
6	Hanbaram wind farm - Lot 3	Onshore wind farm, 402 ha	Construction to start in 2021 (Phase 1)	7.5 km
7	Trung Nam wind farm	Onshore wind farm, 45 turbines, 106 MW	Partially operational	0.8 km
8	Dam Nai wind farm	Onshore wind farm, 16 turbines, 40 MW	Operational	4.5 km

13.5.1 Cumulative Impacts on Birds

Collision with turbine towers, blades and/or associated infrastructure

There is limited information about mortality studies or even the biodiversity baseline of other nearby wind farms, so a detailed assessment of how these wind farms may bring effects at population levels is unachievable. However, the cumulative mortalities are likely to bring significant impacts, especially in the case threatened species are present. According to Assessing the Cumulative Impacts of onshore wind farms on birds guidance by Scottish Natural Heritage (2018), Collision Risk Modelling (CRM) is recommended so as to produces indicative figures for annual losses (individuals per annum) or a total sum over the lifetime of the wind farms. CRM may be not available at the time of this report but can be applied once more information from CIA projects is available.

Within a 50 km radius, there is one Important Bird Area (IBA) particularly Phuoc Binh IBA. The area is known to contain habitat supporting Pale-capped Pigeon (*Columba punicea)* [IUCN VU, VNRB EN][37], Collared Laughingthrush (*Trochalopteron yersini)* [IUCN EN][38], Crested Argus (*Rheinardia ocellata)* [IUCN EN]. These three species are resident in Vietnam and not migratory species. Additionally, no evidence indicated that these species have been found in the Project area. Accordingly, it is a low possibility that the aforementioned species leave the area with abundant food sources and transverse the Project.

The data from the mortality study of Phu Lac Wind Farm which is roughly 60 km to the Project indicated small numbers (a total of 31) of widespread and common birds (e.g Red-collared Dove, Spotted Dove, Cook's Swift) were found, indicating a low likelihood of risk to birds.

Though individual wind farms appear to have minor effects, the underlying data to inform that is relatively poor, especially when applied to other wind farms where data on collision risk may not be available. Therefore, there is a need to undertake post-construction monitoring ASAP to validate such predictions and develop adaptive management plans in accordance with the monitoring results, that is, if the impacts on populations are greater than those that have already been predicted.

Creating a barrier to dispersal, regular movement or migration

Multiple windfarms aligning on the flyways of birds may create cumulative barrier effects that cause birds to adjust their migratory trajectories, resulted in increased energy expenditures to avoid the windfarms. Although effects of extra distances taken to detour around the barriers are poorly-understood, the cumulative effects are likely to be insignificant. A study by Masden et al. (2009) suggested an equivalence to 100 Nysted wind farms[39] to bring about a reduction in 1% mass of the bird. Obviously, the extra cost of avoiding one wing farm is negligible, but the cumulative effect of avoidance behavior at many wind farms along the way could potentially increase the risk for more important and long-term consequences (Masden et al. 2009)[40].

East Asian-Australian Flyway (EAAF) extends from within the Arctic Circle, through East and South-east Asia, to Australia and New Zealand, stretching across 22 countries including Vietnam. Shorebirds such as Spoon-billed Sandpiper (*Calidris pygmaea)* [IUCN CR] occurs within this EAAF and its presence was recorded in salt pans on the coast of La Gi district, Binh Thuan province recently[41]. Notwithstanding, the area is unlikely to play an important role in providing resting or foraging sites for Spoon-billed Sandpiper, the CIA projects may occupy its flyways.

Other migratory birds including two Near Threatened species namely Red-necked Stint and Bar-tailed Godwit were recorded within the Project area and Dam Vua salt-pans which are widespread with a global population. Therefore, the barrier creation may affect these species but insignificantly.

Displacement of birds due to loss of suitable feeding and/or breeding/wintering habitat

Dam Vua salt-pans is the most important area supporting the resting site for birds in the Project's proximity (refer to Biodiversity Baseline –section 8). A total of 15 migratory species were recorded

[37] BirdLife International. 2020. Columba punicea. The IUCN Red List of Threatened Species 2020: e.T22690191A180939007. https://dx.doi.org/10.2305/IUCN.UK.2020-3.RLTS.T22690191A180939007.en. Downloaded on 20 January 2021.

[38] BirdLife International. 2017. Trochalopteron yersini (amended version of 2016 assessment). The IUCN Red List of Threatened Species 2017: e.T22715758A110435138. https://dx.doi.org/10.2305/IUCN.UK.2017-1.RLTS.T22715758A110435138.en.

[39] Nysted windfarm is a Danish offshore windfarm built in 2003, with 72 turbines and a total capacity of 166 MW, and was the largest in the world until 2007. In 2010, a 207 MW extension for the windfarm was conducted and finished in end of 2011.

[40] Masden, E. A., D. T. Hayden, A. D. Fox, R. W. Furness, R. Bullman & M. Desholm 2009. Barriers to movement: impacts of wind farms on migrating birds. Journal of Marine Science 66, 746-753

[41] Available at: https://www.m-h-s.org/media/sbs_newsletter_may_2020_web.pdf Access date: 05 February 2021

during the field surveys in 2017 indicates that some migratory species may utilise this area. In addition, there is Dam Nai lake which is approximately 10km to the south of the project may be a potential resting place from birds.

The closest distance between wind farms are around 400 meters while birds are displaced by wind farms is around from 200 m and possible extended to 4 m for small birds such as plover[42]. A cluster of multiple windfarms locating close to each other may result in access reductions of avifauna populations in the resting site due to avoidance. However, the effects of functional loss are insignificant as not all species avoid wind farms and there are many alternatives that can provide the same ecosystem services other than birds and bats.

13.5.2 Cumulative Impacts on Bats

No existence of significant diurnal roosts for bat was found within the Project area. Nonetheless, the roosting sites are potentially located within proximal areas and may be identified in further surveys. There is little evidence of bats responding to transmission lines or turbines as barriers, largely because they are ill equipped to detect turbines as a barrier, which is why they suffer higher mortality. Despite these, the magnitude of the cumulative impacts is predicted to not reduce the population, further endangering bat populations.

Due to the overlapping of operations of wind farm projects, the collision risks and barotrauma increase as a result of increasing of a number of wind turbines operating in the area simultaneously. It was anticipated that 90% of bat fatalities involved internal haemorrhaging consistent with barotrauma and that direct contact with turbine blades only accounted for about half of the fatalities (Baerwald, Baerwald, D'Amours, & Barclay, 2008). Air pressure change at turbine blades is an undetectable hazard and helps explain high bat fatality rates. The data for bats from Phu Lac indicates a higher level of mortality than for birds, with an estimated 39 bats per turbine per year killed. Loi Hai is regarded as better habitat for bats than Phu Lac, something that was demonstrated from the bat surveys undertaken at Loi Hai that identified at least 25 species present including one IUCN NT species and one VNRB VU species.

As bats have naturally low reproductive rates, populations may be less able to recover from this additional mortality**.**

13.5.3 Mitigation Measures

To reduce cumulative avifauna impacts from the Project and other developments in the region, the following mitigation measures are suggested to be implemented:

- The projects are recommended to adopt a BBAMP and that the effect of the uncertainty is that triggers for adaptive management will need to take into account the potential for cumulative effects;
- Project is recommended to facilitate a Cumulative Impact Assessment (CIA) committee with project and government representation (such as Ninh Thuan Provincial People Committee) to govern a system for managing cumulative impacts. This system however should be compliant with Vietnam regulations and should seek guidance from these to strengthen their mandate (such as justification of presence of VN Red data book and protected species and consequences of cumulative impacts on these, VN commitments to international treaties such as Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES));
- Establish reporting system with the compliance status of each mitigation measure and results of monitoring and evaluations to be performed in conjunction with other windfarms so the involved projects in the area of interest are also aware of any possible cumulative impacts that may be generated in the area, if any. If additional impacts are detected, then work together as a group in conjunction to other windfarms in the mitigation measures. ;

[42] Pearce-Higgins, J.W., Stephen, L., Langston, R.H.W., Bainbridge, I.P. and Bulman, R. 2009. The distribution of breeding birds around upland wind farms. Journal of Applied Ecology 46, 1323-1331

- Sharing best practices available in mitigations for transmission line designs and bird diverter deployment (designs for diverters, spacing and location along sensitive areas) between CIA projects; and
- Implementing *Wildlife Shepherding Protocol* and *Injured Wildlife Management Protocol*.

13.5.4 Monitoring and Auditing Program

The following measures are proposed:

- Records of Cumulative Impact Assessment (CIA) committee meeting are to be kept and regularly reviewed (yearly) for implementation by CIA committee in order to track the process and keep the communication between the involved projects;
- Records of reporting and best practise sharing are to be kept and regularly reviewed (twice a year in the first year and then annually hence) for implementation so that the best practise are ensured to be shared timely and successfully between the CIA projects; and
- Records are to be kept and annually reviewed on the application of the *Wildlife Shepherding Protocol* and *Injured Wildlife Management Protocol*.

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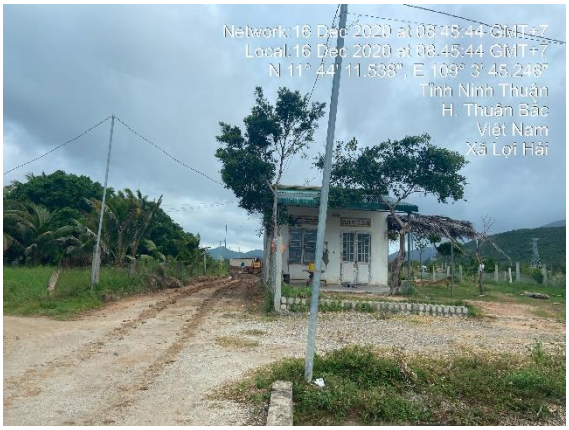
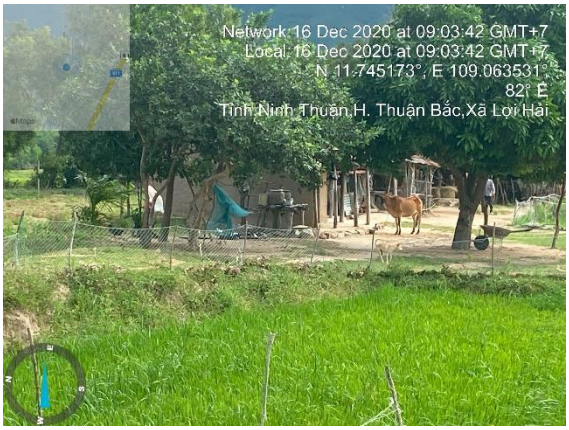
APPENDIX A PHOTOS OF IMPACTED RECEPTORS

Receptor no. 356



Receptor no. 357



Receptor no. 362

Receptor no. 365

Receptor no. 367

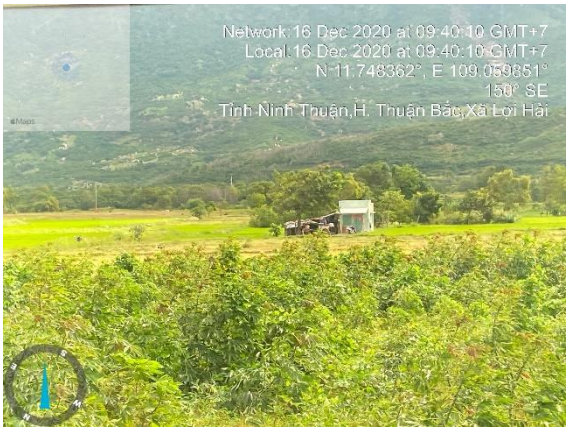
Receptor no. 368

Receptor no. 369

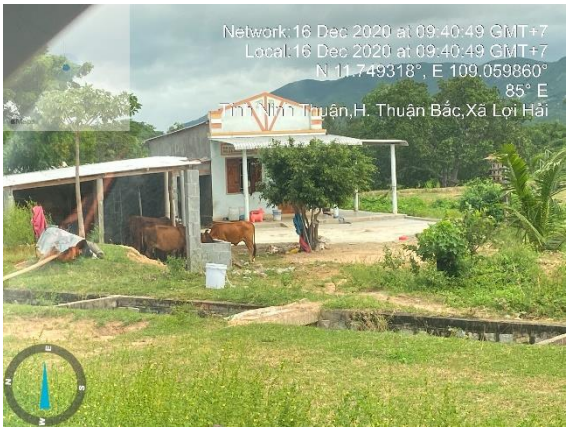
Receptor no. 370

Receptor no. 371

Receptor no. 384



Receptor no. 385



Receptor no. 386

Receptor no. 387

Receptor no. 393

APPENDIX B SHADOW FLICKER MAIN RESULT

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ERM
Level 3, 09 Dinh Tien Hoang St
VN-DAKAO WARD, District 1

Phat Tran / phat.tran@erm.com
Calculated:
2/7/2021 9:01 PM/3.4.388

SHADOW - Main Result

Calculation: 0575014 - Loi Hai Worst Case - Green Mode

Assumptions for shadow calculations

Maximum distance for influence
Calculate only when more than 20 % of sun is covered by the blade
Please look in WTG table

Minimum sun height over horizon for influence	3 °
Day step for calculation	1 days
Time step for calculation	1 minutes

Sunshine probability S (Average daily sunshine hours) []

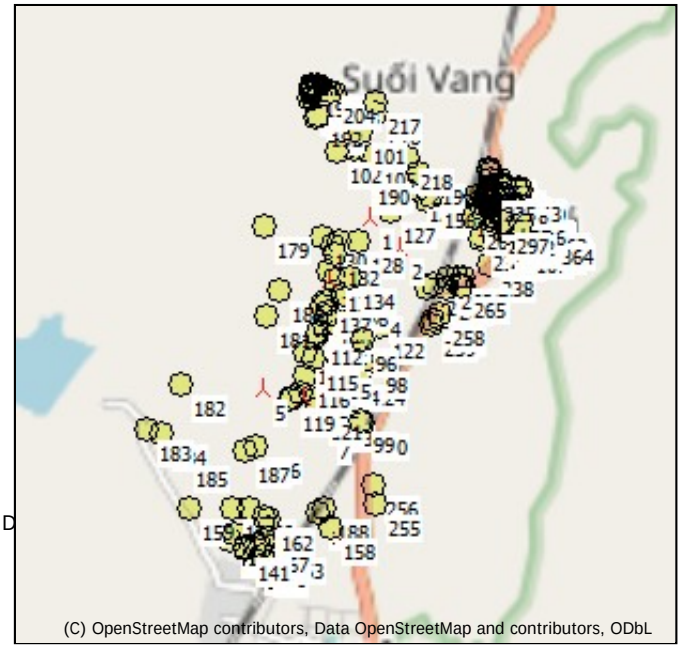
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
6.94	7.86	6.61	6.50	5.65	5.33	4.03	4.19	3.33	4.68	5.67	6.13

Operational time

N	NNE	ENE	E	ESE	SSE	S	SSW	WSW	W	WNW	NNW	Sum
4,347	1,305	385	237	166	149	140	105	105	96	96	1,629	8,760

A ZVI (Zones of Visual Influence) calculation is performed before flicker calculation so non visible WTG do not contribute to calculated flicker values. A WTG will be visible if it is visible from any part of the receiver window. The ZVI calculation is based on the following assumptions:
Height contours used: Project Wizard Elevation Data Grid (SRTM: Shuttle D
Obstacles not used in calculation
Eye height for map: 1.5 m
Grid resolution: 1.0 m

All coordinates are in
UTM (north)-WGS84 Zone: 48



Scale 1:75,000
New WTG Shadow receptor

WTGs

	Easting	Northing	Z	Row data/Description	WTG type Valid	Manufact.	Type-generator	Power, rated	Rotor diameter	Hub height	Shadow data Calculation distance	RPM
			[m]					[kW]	[m]	[m]	[m]	[RPM]
1	943,045	1,302,678	33.8	WTG1	Yes	VESTAS	V150-4.2-4,200	4,200	150.0	125.0	1,904	10.4
2	943,355	1,302,384	30.8	WTG2	Yes	VESTAS	V150-4.2-4,200	4,200	150.0	125.0	1,904	10.4
3	942,673	1,302,062	38.1	WTG3	Yes	VESTAS	V150-4.2-4,200	4,200	150.0	125.0	1,904	10.4
4	943,150	1,301,800	28.3	WTG4	Yes	VESTAS	V150-4.2-4,200	4,200	150.0	125.0	1,904	10.4
5	942,011	1,300,973	36.3	WTG5	Yes	VESTAS	V150-4.2-4,200	4,200	150.0	125.0	1,904	10.4
6	942,425	1,300,904	33.9	WTG6	Yes	VESTAS	V150-4.2-4,200	4,200	150.0	125.0	1,904	10.4
7	942,655	1,300,600	28.0	WTG7	Yes	VESTAS	V150-4.2-4,200	4,200	150.0	125.0	1,904	10.4

Shadow receptor-Input

No.	Easting	Northing	Z	Width	Height	Elevation a.g.l.	Degrees from south cw	Slope of window	Direction mode	Eye height (ZVI) a.g.l.
			[m]	[m]	[m]	[m]	[°]	[°]		[m]
1	944,496	1,302,753	29.0	1.0	1.0	1.5		90.0	"Green house mode"	2.5
10	944,436	1,302,773	26.8	1.0	1.0	1.5		90.0	"Green house mode"	2.5
100	943,017	1,300,641	27.5	1.0	1.0	1.5		90.0	"Green house mode"	2.5
101	942,966	1,303,519	33.0	1.0	1.0	1.5		90.0	"Green house mode"	2.5
102	942,727	1,303,333	33.0	1.0	1.0	1.5		90.0	"Green house mode"	2.5
103	942,870	1,303,388	29.7	1.0	1.0	1.5		90.0	"Green house mode"	2.5
104	942,891	1,303,349	28.4	1.0	1.0	1.5		90.0	"Green house mode"	2.5
105	943,054	1,303,292	23.3	1.0	1.0	1.5		90.0	"Green house mode"	2.5
106	944,634	1,302,468	24.9	1.0	1.0	1.5		90.0	"Green house mode"	2.5
107	944,601	1,302,460	26.5	1.0	1.0	1.5		90.0	"Green house mode"	2.5
108	944,592	1,302,474	27.8	1.0	1.0	1.5		90.0	"Green house mode"	2.5
109	942,610	1,301,613	38.7	1.0	1.0	1.5		90.0	"Green house mode"	2.5
11	944,435	1,302,781	27.1	1.0	1.0	1.5		90.0	"Green house mode"	2.5
110	942,563	1,301,604	40.4	1.0	1.0	1.5		90.0	"Green house mode"	2.5
111	942,549	1,301,538	39.7	1.0	1.0	1.5		90.0	"Green house mode"	2.5
112	942,565	1,301,531	36.7	1.0	1.0	1.5		90.0	"Green house mode"	2.5
113	942,519	1,301,470	37.5	1.0	1.0	1.5		90.0	"Green house mode"	2.5
114	942,429	1,301,321	35.1	1.0	1.0	1.5		90.0	"Green house mode"	2.5
115	942,534	1,301,279	33.6	1.0	1.0	1.5		90.0	"Green house mode"	2.5
116	942,430	1,301,101	34.8	1.0	1.0	1.5		90.0	"Green house mode"	2.5

To be continued on next page...

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VN-DAKAO WARD, District 1

Phat Tran / phat.tran@erm.com

SHADOW - Main Result

Calculation: 0575014 - Loi Hai Worst Case - Green Mode

...continued from previous page

No.	Easting	Northing	Z	Width	Height	Elevation a.g.l.	Degrees from south cw	Slope of window	Direction mode	Eye height (ZVI) a.g.l.
			[m]	[m]	[m]	[m]	[°]	[°]		[m]
117	942,392	1,300,941	32.5	1.0	1.0	1.5		90.0	"Green house mode"	2.5
118	942,316	1,300,899	35.4	1.0	1.0	1.5		90.0	"Green house mode"	2.5
119	942,288	1,300,865	34.6	1.0	1.0	1.5		90.0	"Green house mode"	2.5
12	944,420	1,302,771	26.5	1.0	1.0	1.5		90.0	"Green house mode"	2.5
120	942,554	1,300,866	34.3	1.0	1.0	1.5		90.0	"Green house mode"	2.5
121	942,565	1,300,796	30.5	1.0	1.0	1.5		90.0	"Green house mode"	2.5
122	943,187	1,301,596	29.3	1.0	1.0	1.5		90.0	"Green house mode"	2.5
123	942,687	1,300,731	30.4	1.0	1.0	1.5		90.0	"Green house mode"	2.5
124	942,993	1,301,132	30.3	1.0	1.0	1.5		90.0	"Green house mode"	2.5
125	943,628	1,302,857	18.6	1.0	1.0	1.5		90.0	"Green house mode"	2.5
126	943,519	1,302,947	22.3	1.0	1.0	1.5		90.0	"Green house mode"	2.5
127	943,252	1,302,737	29.6	1.0	1.0	1.5		90.0	"Green house mode"	2.5
128	942,944	1,302,426	31.7	1.0	1.0	1.5		90.0	"Green house mode"	2.5
129	942,757	1,302,437	39.7	1.0	1.0	1.5		90.0	"Green house mode"	2.5
13	944,548	1,302,719	29.0	1.0	1.0	1.5		90.0	"Green house mode"	2.5
130	942,579	1,302,482	44.2	1.0	1.0	1.5		90.0	"Green house mode"	2.5
131	942,697	1,302,386	37.4	1.0	1.0	1.5		90.0	"Green house mode"	2.5
132	942,710	1,302,309	37.4	1.0	1.0	1.5		90.0	"Green house mode"	2.5
133	942,658	1,302,141	34.7	1.0	1.0	1.5		90.0	"Green house mode"	2.5
134	942,872	1,302,086	33.5	1.0	1.0	1.5		90.0	"Green house mode"	2.5
135	942,730	1,302,066	36.3	1.0	1.0	1.5		90.0	"Green house mode"	2.5
136	942,827	1,301,910	36.9	1.0	1.0	1.5		90.0	"Green house mode"	2.5
137	942,632	1,301,849	42.5	1.0	1.0	1.5		90.0	"Green house mode"	2.5
138	942,596	1,301,801	43.1	1.0	1.0	1.5		90.0	"Green house mode"	2.5
139	942,647	1,301,744	40.4	1.0	1.0	1.5		90.0	"Green house mode"	2.5
14	944,543	1,302,715	29.0	1.0	1.0	1.5		90.0	"Green house mode"	2.5
140	942,627	1,301,699	39.6	1.0	1.0	1.5		90.0	"Green house mode"	2.5
141	941,867	1,299,379	33.8	1.0	1.0	1.5		90.0	"Green house mode"	2.5
142	941,869	1,299,406	32.6	1.0	1.0	1.5		90.0	"Green house mode"	2.5
143	941,761	1,299,522	38.7	1.0	1.0	1.5		90.0	"Green house mode"	2.5
144	941,705	1,299,469	37.8	1.0	1.0	1.5		90.0	"Green house mode"	2.5
145	944,194	1,302,503	26.3	1.0	1.0	1.5		90.0	"Green house mode"	2.5
146	944,118	1,302,895	23.4	1.0	1.0	1.5		90.0	"Green house mode"	2.5
147	944,159	1,302,845	27.5	1.0	1.0	1.5		90.0	"Green house mode"	2.5
148	944,195	1,302,819	29.5	1.0	1.0	1.5		90.0	"Green house mode"	2.5
149	944,512	1,302,701	28.0	1.0	1.0	1.5		90.0	"Green house mode"	2.5
15	944,540	1,302,724	29.0	1.0	1.0	1.5		90.0	"Green house mode"	2.5
150	944,622	1,302,780	28.3	1.0	1.0	1.5		90.0	"Green house mode"	2.5
151	944,625	1,302,754	28.9	1.0	1.0	1.5		90.0	"Green house mode"	2.5
152	944,636	1,302,761	28.9	1.0	1.0	1.5		90.0	"Green house mode"	2.5
154	941,735	1,299,777	33.5	1.0	1.0	1.5		90.0	"Green house mode"	2.5
155	943,984	1,302,825	20.5	1.0	1.0	1.5		90.0	"Green house mode"	2.5
156	943,675	1,302,890	19.0	1.0	1.0	1.5		90.0	"Green house mode"	2.5
157	942,582	1,299,740	30.5	1.0	1.0	1.5		90.0	"Green house mode"	2.5
158	942,713	1,299,609	33.7	1.0	1.0	1.5		90.0	"Green house mode"	2.5
159	941,310	1,299,762	37.4	1.0	1.0	1.5		90.0	"Green house mode"	2.5
16	944,547	1,302,704	29.2	1.0	1.0	1.5		90.0	"Green house mode"	2.5
160	941,915	1,299,774	35.2	1.0	1.0	1.5		90.0	"Green house mode"	2.5
161	942,067	1,299,693	31.4	1.0	1.0	1.5		90.0	"Green house mode"	2.5
162	942,096	1,299,680	34.2	1.0	1.0	1.5		90.0	"Green house mode"	2.5
163	942,202	1,299,403	32.0	1.0	1.0	1.5		90.0	"Green house mode"	2.5
164	942,104	1,299,598	35.6	1.0	1.0	1.5		90.0	"Green house mode"	2.5
165	942,110	1,299,567	34.6	1.0	1.0	1.5		90.0	"Green house mode"	2.5
166	942,064	1,299,476	31.9	1.0	1.0	1.5		90.0	"Green house mode"	2.5
167	942,061	1,299,464	32.7	1.0	1.0	1.5		90.0	"Green house mode"	2.5
168	942,028	1,299,264	33.1	1.0	1.0	1.5		90.0	"Green house mode"	2.5
169	941,959	1,299,304	31.9	1.0	1.0	1.5		90.0	"Green house mode"	2.5
17	944,531	1,302,702	28.7	1.0	1.0	1.5		90.0	"Green house mode"	2.5
170	942,037	1,299,336	34.1	1.0	1.0	1.5		90.0	"Green house mode"	2.5
171	942,019	1,299,412	36.8	1.0	1.0	1.5		90.0	"Green house mode"	2.5
172	941,966	1,299,419	33.5	1.0	1.0	1.5		90.0	"Green house mode"	2.5
173	942,609	1,303,913	42.7	1.0	1.0	1.5		90.0	"Green house mode"	2.5

To be continued on next page...

SHADOW - Main Result

Calculation: 0575014 - Loi Hai Worst Case - Green Mode

...continued from previous page

No.	Easting	Northing	Z	Width	Height	Elevation a.g.l.	Degrees from south cw	Slope of window	Direction mode	Eye height (ZVI) a.g.l.
			[m]	[m]	[m]	[m]	[°]	[°]		[m]
174	942,442	1,303,843	46.0	1.0	1.0	1.5		90.0	"Green house mode"	2.5
175	942,549	1,303,907	44.1	1.0	1.0	1.5		90.0	"Green house mode"	2.5
176	942,600	1,303,869	42.3	1.0	1.0	1.5		90.0	"Green house mode"	2.5
177	942,641	1,303,852	42.0	1.0	1.0	1.5		90.0	"Green house mode"	2.5
178	942,498	1,303,838	43.9	1.0	1.0	1.5		90.0	"Green house mode"	2.5
179	942,020	1,302,569	51.6	1.0	1.0	1.5		90.0	"Green house mode"	2.5
18	944,546	1,302,694	29.3	1.0	1.0	1.5		90.0	"Green house mode"	2.5
180	942,174	1,301,932	46.3	1.0	1.0	1.5		90.0	"Green house mode"	2.5
181	942,044	1,301,696	52.2	1.0	1.0	1.5		90.0	"Green house mode"	2.5
182	941,195	1,300,991	53.9	1.0	1.0	1.5		90.0	"Green house mode"	2.5
183	940,864	1,300,537	44.0	1.0	1.0	1.5		90.0	"Green house mode"	2.5
184	941,015	1,300,510	39.8	1.0	1.0	1.5		90.0	"Green house mode"	2.5
185	941,254	1,300,311	40.9	1.0	1.0	1.5		90.0	"Green house mode"	2.5
186	941,959	1,300,395	35.8	1.0	1.0	1.5		90.0	"Green house mode"	2.5
187	941,845	1,300,358	35.6	1.0	1.0	1.5		90.0	"Green house mode"	2.5
188	942,635	1,299,804	31.9	1.0	1.0	1.5		90.0	"Green house mode"	2.5
189	943,030	1,303,095	31.2	1.0	1.0	1.5		90.0	"Green house mode"	2.5
19	944,553	1,302,688	29.8	1.0	1.0	1.5		90.0	"Green house mode"	2.5
190	943,000	1,303,099	32.9	1.0	1.0	1.5		90.0	"Green house mode"	2.5
191	942,960	1,303,073	31.9	1.0	1.0	1.5		90.0	"Green house mode"	2.5
192	942,529	1,303,670	44.8	1.0	1.0	1.5		90.0	"Green house mode"	2.5
193	942,504	1,303,667	44.8	1.0	1.0	1.5		90.0	"Green house mode"	2.5
194	942,521	1,303,976	42.7	1.0	1.0	1.5		90.0	"Green house mode"	2.5
195	942,476	1,303,979	44.0	1.0	1.0	1.5		90.0	"Green house mode"	2.5
196	942,465	1,303,963	45.0	1.0	1.0	1.5		90.0	"Green house mode"	2.5
197	942,523	1,303,955	43.5	1.0	1.0	1.5		90.0	"Green house mode"	2.5
198	942,510	1,303,933	44.3	1.0	1.0	1.5		90.0	"Green house mode"	2.5
199	942,461	1,303,941	45.9	1.0	1.0	1.5		90.0	"Green house mode"	2.5
2	944,487	1,302,762	28.7	1.0	1.0	1.5		90.0	"Green house mode"	2.5
20	944,546	1,302,690	29.3	1.0	1.0	1.5		90.0	"Green house mode"	2.5
200	942,455	1,303,896	47.6	1.0	1.0	1.5		90.0	"Green house mode"	2.5
201	942,447	1,303,917	47.8	1.0	1.0	1.5		90.0	"Green house mode"	2.5
202	942,516	1,303,910	45.2	1.0	1.0	1.5		90.0	"Green house mode"	2.5
203	942,693	1,303,898	42.9	1.0	1.0	1.5		90.0	"Green house mode"	2.5
204	942,660	1,303,924	41.1	1.0	1.0	1.5		90.0	"Green house mode"	2.5
205	944,286	1,302,730	28.8	1.0	1.0	1.5		90.0	"Green house mode"	2.5
206	944,302	1,302,723	27.7	1.0	1.0	1.5		90.0	"Green house mode"	2.5
207	944,307	1,302,705	27.5	1.0	1.0	1.5		90.0	"Green house mode"	2.5
208	944,303	1,302,694	27.8	1.0	1.0	1.5		90.0	"Green house mode"	2.5
209	944,096	1,302,699	31.1	1.0	1.0	1.5		90.0	"Green house mode"	2.5
21	944,552	1,302,666	29.2	1.0	1.0	1.5		90.0	"Green house mode"	2.5
210	944,112	1,302,739	32.2	1.0	1.0	1.5		90.0	"Green house mode"	2.5
211	944,176	1,302,769	31.9	1.0	1.0	1.5		90.0	"Green house mode"	2.5
212	944,180	1,302,785	30.9	1.0	1.0	1.5		90.0	"Green house mode"	2.5
213	944,185	1,302,804	30.1	1.0	1.0	1.5		90.0	"Green house mode"	2.5
214	944,227	1,302,788	29.6	1.0	1.0	1.5		90.0	"Green house mode"	2.5
215	944,228	1,302,780	29.9	1.0	1.0	1.5		90.0	"Green house mode"	2.5
216	943,111	1,303,701	29.6	1.0	1.0	1.5		90.0	"Green house mode"	2.5
217	943,099	1,303,823	27.6	1.0	1.0	1.5		90.0	"Green house mode"	2.5
218	943,425	1,303,284	19.6	1.0	1.0	1.5		90.0	"Green house mode"	2.5
219	943,524	1,303,124	20.1	1.0	1.0	1.5		90.0	"Green house mode"	2.5
22	944,545	1,302,666	29.1	1.0	1.0	1.5		90.0	"Green house mode"	2.5
220	943,768	1,302,972	17.7	1.0	1.0	1.5		90.0	"Green house mode"	2.5
221	944,221	1,303,162	23.0	1.0	1.0	1.5		90.0	"Green house mode"	2.5
222	944,267	1,303,127	23.1	1.0	1.0	1.5		90.0	"Green house mode"	2.5
223	944,260	1,303,068	25.7	1.0	1.0	1.5		90.0	"Green house mode"	2.5
224	944,259	1,302,989	24.5	1.0	1.0	1.5		90.0	"Green house mode"	2.5
225	944,269	1,302,969	25.4	1.0	1.0	1.5		90.0	"Green house mode"	2.5
226	944,271	1,303,015	24.8	1.0	1.0	1.5		90.0	"Green house mode"	2.5
227	944,215	1,302,942	25.6	1.0	1.0	1.5		90.0	"Green house mode"	2.5
228	944,218	1,302,879	27.7	1.0	1.0	1.5		90.0	"Green house mode"	2.5
229	944,218	1,302,897	27.1	1.0	1.0	1.5		90.0	"Green house mode"	2.5

To be continued on next page...

SHADOW - Main Result

Calculation: 0575014 - Loi Hai Worst Case - Green Mode

...continued from previous page

No.	Easting	Northing	Z [m]	Width [m]	Height [m]	Elevation a.g.l. [m]	Degrees from south cw [°]	Slope of window [°]	Direction mode	Eye height (ZVI) a.g.l. [m]
23	944,534	1,302,667	28.9	1.0	1.0	1.5		90.0	"Green house mode"	2.5
230	944,237	1,302,909	26.5	1.0	1.0	1.5		90.0	"Green house mode"	2.5
231	944,279	1,302,934	27.8	1.0	1.0	1.5		90.0	"Green house mode"	2.5
232	944,274	1,302,871	27.3	1.0	1.0	1.5		90.0	"Green house mode"	2.5
233	944,260	1,302,852	27.5	1.0	1.0	1.5		90.0	"Green house mode"	2.5
234	944,281	1,302,823	28.5	1.0	1.0	1.5		90.0	"Green house mode"	2.5
235	944,264	1,302,782	30.2	1.0	1.0	1.5		90.0	"Green house mode"	2.5
236	944,277	1,302,798	29.6	1.0	1.0	1.5		90.0	"Green house mode"	2.5
237	943,939	1,302,095	24.6	1.0	1.0	1.5		90.0	"Green house mode"	2.5
238	944,234	1,302,228	24.0	1.0	1.0	1.5		90.0	"Green house mode"	2.5
239	944,151	1,302,470	26.5	1.0	1.0	1.5		90.0	"Green house mode"	2.5
24	944,524	1,302,671	28.4	1.0	1.0	1.5		90.0	"Green house mode"	2.5
240	944,343	1,302,443	25.0	1.0	1.0	1.5		90.0	"Green house mode"	2.5
241	944,306	1,302,464	25.6	1.0	1.0	1.5		90.0	"Green house mode"	2.5
242	944,309	1,302,488	26.9	1.0	1.0	1.5		90.0	"Green house mode"	2.5
243	944,301	1,302,518	29.1	1.0	1.0	1.5		90.0	"Green house mode"	2.5
244	944,324	1,302,512	27.6	1.0	1.0	1.5		90.0	"Green house mode"	2.5
245	944,332	1,302,536	28.6	1.0	1.0	1.5		90.0	"Green house mode"	2.5
246	944,329	1,302,546	29.0	1.0	1.0	1.5		90.0	"Green house mode"	2.5
247	944,323	1,302,604	28.5	1.0	1.0	1.5		90.0	"Green house mode"	2.5
248	944,325	1,302,614	28.1	1.0	1.0	1.5		90.0	"Green house mode"	2.5
249	944,303	1,302,627	29.2	1.0	1.0	1.5		90.0	"Green house mode"	2.5
25	944,517	1,302,693	27.9	1.0	1.0	1.5		90.0	"Green house mode"	2.5
250	944,301	1,302,634	29.1	1.0	1.0	1.5		90.0	"Green house mode"	2.5
251	944,306	1,302,672	28.1	1.0	1.0	1.5		90.0	"Green house mode"	2.5
252	944,234	1,303,177	23.0	1.0	1.0	1.5		90.0	"Green house mode"	2.5
253	944,432	1,302,465	26.6	1.0	1.0	1.5		90.0	"Green house mode"	2.5
254	944,430	1,302,457	26.4	1.0	1.0	1.5		90.0	"Green house mode"	2.5
255	943,141	1,299,842	28.0	1.0	1.0	1.5		90.0	"Green house mode"	2.5
256	943,130	1,300,037	25.2	1.0	1.0	1.5		90.0	"Green house mode"	2.5
257	943,764	1,301,696	27.0	1.0	1.0	1.5		90.0	"Green house mode"	2.5
258	943,775	1,301,734	25.0	1.0	1.0	1.5		90.0	"Green house mode"	2.5
259	943,688	1,301,617	27.4	1.0	1.0	1.5		90.0	"Green house mode"	2.5
26	944,522	1,302,717	28.8	1.0	1.0	1.5		90.0	"Green house mode"	2.5
260	943,705	1,301,664	29.8	1.0	1.0	1.5		90.0	"Green house mode"	2.5
261	943,635	1,301,983	21.6	1.0	1.0	1.5		90.0	"Green house mode"	2.5
262	943,703	1,302,040	21.3	1.0	1.0	1.5		90.0	"Green house mode"	2.5
263	943,849	1,302,086	17.8	1.0	1.0	1.5		90.0	"Green house mode"	2.5
264	943,839	1,301,978	21.8	1.0	1.0	1.5		90.0	"Green house mode"	2.5
265	943,988	1,302,000	23.9	1.0	1.0	1.5		90.0	"Green house mode"	2.5
266	943,991	1,302,011	23.9	1.0	1.0	1.5		90.0	"Green house mode"	2.5
267	943,990	1,302,094	23.1	1.0	1.0	1.5		90.0	"Green house mode"	2.5
268	943,958	1,302,044	24.0	1.0	1.0	1.5		90.0	"Green house mode"	2.5
269	944,451	1,302,588	27.3	1.0	1.0	1.5		90.0	"Green house mode"	2.5
27	944,513	1,302,714	28.5	1.0	1.0	1.5		90.0	"Green house mode"	2.5
270	944,443	1,302,592	28.2	1.0	1.0	1.5		90.0	"Green house mode"	2.5
271	944,465	1,302,551	24.7	1.0	1.0	1.5		90.0	"Green house mode"	2.5
272	944,470	1,302,575	25.4	1.0	1.0	1.5		90.0	"Green house mode"	2.5
273	944,457	1,302,572	26.2	1.0	1.0	1.5		90.0	"Green house mode"	2.5
274	944,449	1,302,558	26.4	1.0	1.0	1.5		90.0	"Green house mode"	2.5
275	944,436	1,302,562	27.9	1.0	1.0	1.5		90.0	"Green house mode"	2.5
276	944,418	1,302,561	28.5	1.0	1.0	1.5		90.0	"Green house mode"	2.5
277	944,396	1,302,564	28.6	1.0	1.0	1.5		90.0	"Green house mode"	2.5
278	944,388	1,302,566	28.3	1.0	1.0	1.5		90.0	"Green house mode"	2.5
279	944,513	1,302,540	26.9	1.0	1.0	1.5		90.0	"Green house mode"	2.5
28	944,506	1,302,709	28.1	1.0	1.0	1.5		90.0	"Green house mode"	2.5
280	944,643	1,302,533	25.9	1.0	1.0	1.5		90.0	"Green house mode"	2.5
281	944,558	1,302,504	29.0	1.0	1.0	1.5		90.0	"Green house mode"	2.5
282	944,609	1,302,521	26.5	1.0	1.0	1.5		90.0	"Green house mode"	2.5
283	944,501	1,302,483	27.0	1.0	1.0	1.5		90.0	"Green house mode"	2.5
284	944,527	1,302,476	26.4	1.0	1.0	1.5		90.0	"Green house mode"	2.5
285	944,388	1,302,694	24.0	1.0	1.0	1.5		90.0	"Green house mode"	2.5

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SHADOW - Main Result

Calculation: 0575014 - Loi Hai Worst Case - Green Mode

...continued from previous page

No.	Easting	Northing	Z	Width	Height	Elevation a.g.l.	Degrees from south cw	Slope of window	Direction mode	Eye height (ZVI) a.g.l.
			[m]	[m]	[m]	[m]	[°]	[°]		[m]
286	944,393	1,302,706	23.8	1.0	1.0	1.5		90.0	"Green house mode"	2.5
287	944,377	1,302,704	24.4	1.0	1.0	1.5		90.0	"Green house mode"	2.5
288	944,359	1,302,713	25.4	1.0	1.0	1.5		90.0	"Green house mode"	2.5
289	944,350	1,302,712	25.7	1.0	1.0	1.5		90.0	"Green house mode"	2.5
29	944,584	1,302,675	29.1	1.0	1.0	1.5		90.0	"Green house mode"	2.5
290	944,390	1,302,681	24.3	1.0	1.0	1.5		90.0	"Green house mode"	2.5
291	944,371	1,302,688	24.2	1.0	1.0	1.5		90.0	"Green house mode"	2.5
292	944,373	1,302,680	24.2	1.0	1.0	1.5		90.0	"Green house mode"	2.5
293	944,408	1,302,660	25.6	1.0	1.0	1.5		90.0	"Green house mode"	2.5
294	944,396	1,302,670	24.9	1.0	1.0	1.5		90.0	"Green house mode"	2.5
295	944,407	1,302,648	26.2	1.0	1.0	1.5		90.0	"Green house mode"	2.5
296	944,386	1,302,642	25.8	1.0	1.0	1.5		90.0	"Green house mode"	2.5
297	944,379	1,302,646	25.5	1.0	1.0	1.5		90.0	"Green house mode"	2.5
298	944,374	1,302,605	26.6	1.0	1.0	1.5		90.0	"Green house mode"	2.5
299	944,405	1,302,618	27.2	1.0	1.0	1.5		90.0	"Green house mode"	2.5
3	944,468	1,302,804	28.3	1.0	1.0	1.5		90.0	"Green house mode"	2.5
30	944,579	1,302,680	29.5	1.0	1.0	1.5		90.0	"Green house mode"	2.5
300	944,424	1,302,588	28.6	1.0	1.0	1.5		90.0	"Green house mode"	2.5
301	944,410	1,302,807	25.6	1.0	1.0	1.5		90.0	"Green house mode"	2.5
302	944,407	1,302,800	25.8	1.0	1.0	1.5		90.0	"Green house mode"	2.5
303	944,401	1,302,790	26.2	1.0	1.0	1.5		90.0	"Green house mode"	2.5
304	944,400	1,302,797	25.7	1.0	1.0	1.5		90.0	"Green house mode"	2.5
305	944,385	1,302,805	24.1	1.0	1.0	1.5		90.0	"Green house mode"	2.5
306	944,364	1,302,754	25.3	1.0	1.0	1.5		90.0	"Green house mode"	2.5
307	944,352	1,302,778	25.7	1.0	1.0	1.5		90.0	"Green house mode"	2.5
308	944,371	1,302,783	24.7	1.0	1.0	1.5		90.0	"Green house mode"	2.5
309	944,386	1,302,779	25.9	1.0	1.0	1.5		90.0	"Green house mode"	2.5
31	944,588	1,302,701	30.0	1.0	1.0	1.5		90.0	"Green house mode"	2.5
310	944,385	1,302,763	25.4	1.0	1.0	1.5		90.0	"Green house mode"	2.5
311	944,390	1,302,752	25.2	1.0	1.0	1.5		90.0	"Green house mode"	2.5
312	944,373	1,302,733	25.0	1.0	1.0	1.5		90.0	"Green house mode"	2.5
313	944,365	1,302,734	25.3	1.0	1.0	1.5		90.0	"Green house mode"	2.5
314	944,365	1,302,727	25.3	1.0	1.0	1.5		90.0	"Green house mode"	2.5
315	944,345	1,302,734	25.9	1.0	1.0	1.5		90.0	"Green house mode"	2.5
316	944,344	1,302,726	26.0	1.0	1.0	1.5		90.0	"Green house mode"	2.5
317	944,434	1,302,951	27.8	1.0	1.0	1.5		90.0	"Green house mode"	2.5
318	944,416	1,302,996	28.5	1.0	1.0	1.5		90.0	"Green house mode"	2.5
319	944,396	1,303,018	27.9	1.0	1.0	1.5		90.0	"Green house mode"	2.5
32	944,586	1,302,709	30.0	1.0	1.0	1.5		90.0	"Green house mode"	2.5
320	944,368	1,303,022	27.1	1.0	1.0	1.5		90.0	"Green house mode"	2.5
321	944,345	1,303,071	29.1	1.0	1.0	1.5		90.0	"Green house mode"	2.5
322	944,340	1,303,041	28.5	1.0	1.0	1.5		90.0	"Green house mode"	2.5
323	944,327	1,302,826	26.9	1.0	1.0	1.5		90.0	"Green house mode"	2.5
324	944,328	1,302,921	35.2	1.0	1.0	1.5		90.0	"Green house mode"	2.5
325	944,329	1,303,019	28.2	1.0	1.0	1.5		90.0	"Green house mode"	2.5
326	944,391	1,302,923	33.5	1.0	1.0	1.5		90.0	"Green house mode"	2.5
327	944,378	1,302,915	34.9	1.0	1.0	1.5		90.0	"Green house mode"	2.5
328	944,381	1,302,879	30.5	1.0	1.0	1.5		90.0	"Green house mode"	2.5
329	944,426	1,302,801	26.7	1.0	1.0	1.5		90.0	"Green house mode"	2.5
33	944,597	1,302,713	29.9	1.0	1.0	1.5		90.0	"Green house mode"	2.5
330	944,424	1,302,812	26.3	1.0	1.0	1.5		90.0	"Green house mode"	2.5
331	944,417	1,302,814	25.8	1.0	1.0	1.5		90.0	"Green house mode"	2.5
332	944,420	1,302,801	26.4	1.0	1.0	1.5		90.0	"Green house mode"	2.5
333	944,405	1,302,730	23.9	1.0	1.0	1.5		90.0	"Green house mode"	2.5
334	944,426	1,302,724	24.0	1.0	1.0	1.5		90.0	"Green house mode"	2.5
335	944,443	1,302,702	24.4	1.0	1.0	1.5		90.0	"Green house mode"	2.5
336	944,434	1,302,702	24.0	1.0	1.0	1.5		90.0	"Green house mode"	2.5
337	944,421	1,302,700	23.8	1.0	1.0	1.5		90.0	"Green house mode"	2.5
338	944,566	1,302,856	25.7	1.0	1.0	1.5		90.0	"Green house mode"	2.5
339	944,572	1,302,936	27.1	1.0	1.0	1.5		90.0	"Green house mode"	2.5
34	944,586	1,302,786	28.7	1.0	1.0	1.5		90.0	"Green house mode"	2.5
340	944,560	1,302,976	29.2	1.0	1.0	1.5		90.0	"Green house mode"	2.5

To be continued on next page...

SHADOW - Main Result

Calculation: 0575014 - Loi Hai Worst Case - Green Mode

...continued from previous page

No.	Easting	Northing	Z	Width	Height	Elevation a.g.l.	Degrees from south cw	Slope of window	Direction mode	Eye height (ZVI) a.g.l.
			[m]	[m]	[m]	[m]	[°]	[°]		[m]
341	944,538	1,303,006	26.6	1.0	1.0	1.5		90.0	"Green house mode"	2.5
342	944,513	1,302,988	26.4	1.0	1.0	1.5		90.0	"Green house mode"	2.5
343	944,500	1,302,974	26.4	1.0	1.0	1.5		90.0	"Green house mode"	2.5
344	944,521	1,302,970	28.5	1.0	1.0	1.5		90.0	"Green house mode"	2.5
345	944,507	1,302,916	25.6	1.0	1.0	1.5		90.0	"Green house mode"	2.5
346	944,493	1,302,923	25.7	1.0	1.0	1.5		90.0	"Green house mode"	2.5
347	944,488	1,302,896	25.3	1.0	1.0	1.5		90.0	"Green house mode"	2.5
348	944,462	1,302,934	26.0	1.0	1.0	1.5		90.0	"Green house mode"	2.5
349	944,463	1,302,676	24.6	1.0	1.0	1.5		90.0	"Green house mode"	2.5
35	944,615	1,302,740	29.4	1.0	1.0	1.5		90.0	"Green house mode"	2.5
350	944,473	1,302,671	25.0	1.0	1.0	1.5		90.0	"Green house mode"	2.5
351	944,449	1,302,660	24.5	1.0	1.0	1.5		90.0	"Green house mode"	2.5
352	944,452	1,302,644	25.0	1.0	1.0	1.5		90.0	"Green house mode"	2.5
353	944,470	1,302,629	25.2	1.0	1.0	1.5		90.0	"Green house mode"	2.5
354	944,456	1,302,607	26.4	1.0	1.0	1.5		90.0	"Green house mode"	2.5
355	944,436	1,302,604	28.3	1.0	1.0	1.5		90.0	"Green house mode"	2.5
356	944,420	1,302,624	27.0	1.0	1.0	1.5	100.0	90.0	Fixed direction	2.5
356	944,509	1,302,587	26.6	1.0	1.0	1.5	100.0	90.0	Fixed direction	2.5
357	944,495	1,302,580	25.5	1.0	1.0	1.5	-100.0	90.0	Fixed direction	2.5
357	944,432	1,302,628	26.8	1.0	1.0	1.5	-100.0	90.0	Fixed direction	2.5
358	944,498	1,302,570	25.3	1.0	1.0	1.5	140.0	90.0	Fixed direction	2.5
358	944,445	1,302,627	26.3	1.0	1.0	1.5	140.0	90.0	Fixed direction	2.5
359	944,425	1,302,679	24.3	1.0	1.0	1.5	-15.0	90.0	Fixed direction	2.5
359	944,475	1,302,560	24.9	1.0	1.0	1.5	-15.0	90.0	Fixed direction	2.5
36	944,605	1,302,768	28.6	1.0	1.0	1.5		90.0	"Green house mode"	2.5
361	944,409	1,302,769	26.4	1.0	1.0	1.5	-15.0	90.0	Fixed direction	2.5
361	944,668	1,302,660	27.7	1.0	1.0	1.5	-15.0	90.0	Fixed direction	2.5
362	944,406	1,302,762	25.9	1.0	1.0	1.5	-15.0	90.0	Fixed direction	2.5
362	944,648	1,302,625	28.0	1.0	1.0	1.5	-15.0	90.0	Fixed direction	2.5
363	944,433	1,302,751	25.2	1.0	1.0	1.5	-100.0	90.0	Fixed direction	2.5
363	944,770	1,302,646	29.0	1.0	1.0	1.5	-100.0	90.0	Fixed direction	2.5
364	944,832	1,302,551	27.0	1.0	1.0	1.5	-20.0	90.0	Fixed direction	2.5
364	944,423	1,302,736	24.5	1.0	1.0	1.5	-20.0	90.0	Fixed direction	2.5
365	944,764	1,302,524	27.1	1.0	1.0	1.5	-150.0	90.0	Fixed direction	2.5
365	944,809	1,302,594	28.5	1.0	1.0	1.5	-150.0	90.0	Fixed direction	2.5
366	944,793	1,302,604	28.9	1.0	1.0	1.5	-20.0	90.0	Fixed direction	2.5
366	944,464	1,302,647	24.4	1.0	1.0	1.5	-20.0	90.0	Fixed direction	2.5
367	944,776	1,302,607	28.5	1.0	1.0	1.5	-140.0	90.0	Fixed direction	2.5
367	944,477	1,302,646	25.1	1.0	1.0	1.5	-140.0	90.0	Fixed direction	2.5
368	944,478	1,302,670	25.3	1.0	1.0	1.5	-50.0	90.0	Fixed direction	2.5
368	944,784	1,302,572	27.6	1.0	1.0	1.5	-50.0	90.0	Fixed direction	2.5
369	944,770	1,302,597	27.9	1.0	1.0	1.5	-20.0	90.0	Fixed direction	2.5
37	944,594	1,302,746	29.2	1.0	1.0	1.5		90.0	"Green house mode"	2.5
370	944,743	1,302,550	27.9	1.0	1.0	1.5	-100.0	90.0	Fixed direction	2.5
371	944,774	1,302,546	27.0	1.0	1.0	1.5	-10.0	90.0	Fixed direction	2.5
372	944,508	1,302,658	27.2	1.0	1.0	1.5	20.0	90.0	Fixed direction	2.5
373	944,498	1,302,660	26.3	1.0	1.0	1.5	20.0	90.0	Fixed direction	2.5
374	944,489	1,302,655	25.6	1.0	1.0	1.5	20.0	90.0	Fixed direction	2.5
375	944,491	1,302,632	26.5	1.0	1.0	1.5	10.0	90.0	Fixed direction	2.5
376	944,502	1,302,632	27.3	1.0	1.0	1.5	135.0	90.0	Fixed direction	2.5
377	944,516	1,302,614	27.9	1.0	1.0	1.5	10.0	90.0	Fixed direction	2.5
378	944,504	1,302,599	26.6	1.0	1.0	1.5	-50.0	90.0	Fixed direction	2.5
379	944,498	1,302,614	26.7	1.0	1.0	1.5	25.0	90.0	Fixed direction	2.5
38	944,576	1,302,721	29.7	1.0	1.0	1.5		90.0	"Green house mode"	2.5
380	944,480	1,302,607	26.0	1.0	1.0	1.5	30.0	90.0	Fixed direction	2.5
381	944,599	1,302,549	26.8	1.0	1.0	1.5	30.0	90.0	Fixed direction	2.5
382	944,562	1,302,571	28.6	1.0	1.0	1.5	25.0	90.0	Fixed direction	2.5
383	944,536	1,302,553	28.2	1.0	1.0	1.5	25.0	90.0	Fixed direction	2.5
384	944,547	1,302,573	28.2	1.0	1.0	1.5	105.0	90.0	Fixed direction	2.5
385	944,542	1,302,589	28.0	1.0	1.0	1.5	20.0	90.0	Fixed direction	2.5
386	944,528	1,302,589	27.8	1.0	1.0	1.5	30.0	90.0	Fixed direction	2.5
387	944,515	1,302,568	26.3	1.0	1.0	1.5	10.0	90.0	Fixed direction	2.5

To be continued on next page...

SHADOW - Main Result

Calculation: 0575014 - Loi Hai Worst Case - Green Mode

...continued from previous page

No.	Easting	Northing	Z	Width	Height	Elevation a.g.l.	Degrees from south cw	Slope of window	Direction mode	Eye height (ZVI) a.g.l.
			[m]	[m]	[m]	[m]	[°]	[°]		[m]
388	944,425	1,302,761	25.8	1.0	1.0	1.5	30.0	1.0	Fixed direction	1.5
389	944,470	1,302,748	27.4	1.0	1.0	1.5	10.0	1.0	Fixed direction	1.5
39	944,576	1,302,732	29.4	1.0	1.0	1.5		90.0	"Green house mode"	2.5
390	944,471	1,302,741	27.2	1.0	1.0	1.5	20.0	1.0	Fixed direction	1.5
391	944,471	1,302,735	27.0	1.0	1.0	1.5	20.0	1.0	Fixed direction	1.5
392	944,454	1,302,724	25.5	1.0	1.0	1.5	25.0	1.0	Fixed direction	1.5
393	944,467	1,302,720	26.3	1.0	1.0	1.5	135.0	1.0	Fixed direction	1.5
394	944,485	1,302,728	27.7	1.0	1.0	1.5	-65.0	1.0	Fixed direction	1.5
395	944,482	1,302,718	27.2	1.0	1.0	1.5	-65.0	1.0	Fixed direction	1.5
396	944,494	1,302,710	27.7	1.0	1.0	1.0	20.0	1.0	Fixed direction	1.0
397	944,480	1,302,701	26.5	1.0	1.0	1.0	80.0	1.0	Fixed direction	1.0
4	944,455	1,302,797	28.1	1.0	1.0	1.5		90.0	"Green house mode"	2.5
40	944,556	1,302,731	29.0	1.0	1.0	1.5		90.0	"Green house mode"	2.5
41	944,567	1,302,747	29.0	1.0	1.0	1.5		90.0	"Green house mode"	2.5
42	944,526	1,302,741	29.0	1.0	1.0	1.5		90.0	"Green house mode"	2.5
43	944,549	1,302,750	29.0	1.0	1.0	1.5		90.0	"Green house mode"	2.5
44	944,551	1,302,754	29.0	1.0	1.0	1.5		90.0	"Green house mode"	2.5
45	944,521	1,302,789	28.7	1.0	1.0	1.5		90.0	"Green house mode"	2.5
46	944,531	1,302,770	29.0	1.0	1.0	1.5		90.0	"Green house mode"	2.5
47	944,515	1,302,771	29.0	1.0	1.0	1.5		90.0	"Green house mode"	2.5
48	944,519	1,302,755	29.0	1.0	1.0	1.5		90.0	"Green house mode"	2.5
49	944,514	1,302,739	28.9	1.0	1.0	1.5		90.0	"Green house mode"	2.5
5	944,493	1,302,792	29.0	1.0	1.0	1.5		90.0	"Green house mode"	2.5
50	944,521	1,302,633	28.6	1.0	1.0	1.5		90.0	"Green house mode"	2.5
51	944,540	1,302,629	28.6	1.0	1.0	1.5		90.0	"Green house mode"	2.5
52	944,539	1,302,635	28.7	1.0	1.0	1.5		90.0	"Green house mode"	2.5
53	944,539	1,302,644	28.8	1.0	1.0	1.5		90.0	"Green house mode"	2.5
54	944,525	1,302,642	28.9	1.0	1.0	1.5		90.0	"Green house mode"	2.5
55	944,537	1,302,650	28.9	1.0	1.0	1.5		90.0	"Green house mode"	2.5
56	944,566	1,302,645	28.3	1.0	1.0	1.5		90.0	"Green house mode"	2.5
57	944,564	1,302,651	28.5	1.0	1.0	1.5		90.0	"Green house mode"	2.5
58	944,565	1,302,658	28.7	1.0	1.0	1.5		90.0	"Green house mode"	2.5
59	944,578	1,302,656	28.2	1.0	1.0	1.5		90.0	"Green house mode"	2.5
6	944,487	1,302,782	29.0	1.0	1.0	1.5		90.0	"Green house mode"	2.5
60	944,577	1,302,663	28.6	1.0	1.0	1.5		90.0	"Green house mode"	2.5
61	944,618	1,302,677	28.5	1.0	1.0	1.5		90.0	"Green house mode"	2.5
62	944,628	1,302,661	27.7	1.0	1.0	1.5		90.0	"Green house mode"	2.5
63	944,626	1,302,645	27.2	1.0	1.0	1.5		90.0	"Green house mode"	2.5
64	944,619	1,302,659	27.9	1.0	1.0	1.5		90.0	"Green house mode"	2.5
65	944,618	1,302,648	27.3	1.0	1.0	1.5		90.0	"Green house mode"	2.5
66	944,594	1,302,647	27.5	1.0	1.0	1.5		90.0	"Green house mode"	2.5
67	944,606	1,302,652	27.7	1.0	1.0	1.5		90.0	"Green house mode"	2.5
68	944,607	1,302,675	28.7	1.0	1.0	1.5		90.0	"Green house mode"	2.5
69	944,600	1,302,678	29.0	1.0	1.0	1.5		90.0	"Green house mode"	2.5
7	944,496	1,302,781	29.0	1.0	1.0	1.5		90.0	"Green house mode"	2.5
70	944,552	1,302,766	29.0	1.0	1.0	1.5		90.0	"Green house mode"	2.5
71	944,552	1,302,783	28.9	1.0	1.0	1.5		90.0	"Green house mode"	2.5
72	944,556	1,302,783	28.9	1.0	1.0	1.5		90.0	"Green house mode"	2.5
73	944,535	1,302,804	28.2	1.0	1.0	1.5		90.0	"Green house mode"	2.5
74	944,548	1,302,797	28.5	1.0	1.0	1.5		90.0	"Green house mode"	2.5
75	944,548	1,302,812	28.0	1.0	1.0	1.5		90.0	"Green house mode"	2.5
76	944,518	1,302,799	28.5	1.0	1.0	1.5		90.0	"Green house mode"	2.5
77	944,631	1,302,797	28.3	1.0	1.0	1.5		90.0	"Green house mode"	2.5
78	944,599	1,302,582	27.5	1.0	1.0	1.5		90.0	"Green house mode"	2.5
79	944,612	1,302,579	27.4	1.0	1.0	1.5		90.0	"Green house mode"	2.5
8	944,452	1,302,777	28.1	1.0	1.0	1.5		90.0	"Green house mode"	2.5
80	944,611	1,302,562	26.9	1.0	1.0	1.5		90.0	"Green house mode"	2.5
81	944,583	1,302,624	27.2	1.0	1.0	1.5		90.0	"Green house mode"	2.5
82	944,566	1,302,625	27.7	1.0	1.0	1.5		90.0	"Green house mode"	2.5
83	944,540	1,302,619	28.4	1.0	1.0	1.5		90.0	"Green house mode"	2.5
84	944,541	1,302,614	28.3	1.0	1.0	1.5		90.0	"Green house mode"	2.5
85	944,573	1,302,609	27.8	1.0	1.0	1.5		90.0	"Green house mode"	2.5

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SHADOW - Main Result

Calculation: 0575014 - Loi Hai Worst Case - Green Mode

...continued from previous page

No.	Easting	Northing	Z [m]	Width [m]	Height [m]	Elevation a.g.l. [m]	Degrees from south cw [°]	Slope of window [°]	Direction mode	Eye height (ZVI) a.g.l. [m]
86	944,566	1,302,595	28.0	1.0	1.0	1.5		90.0	"Green house mode"	2.5
87	944,580	1,302,601	27.9	1.0	1.0	1.5		90.0	"Green house mode"	2.5
88	944,603	1,302,595	27.9	1.0	1.0	1.5		90.0	"Green house mode"	2.5
89	944,609	1,302,613	27.1	1.0	1.0	1.5		90.0	"Green house mode"	2.5
9	944,443	1,302,776	27.4	1.0	1.0	1.5		90.0	"Green house mode"	2.5
90	944,610	1,302,623	26.5	1.0	1.0	1.5		90.0	"Green house mode"	2.5
91	944,603	1,302,706	29.7	1.0	1.0	1.5		90.0	"Green house mode"	2.5
92	944,603	1,302,685	29.2	1.0	1.0	1.5		90.0	"Green house mode"	2.5
93	942,981	1,301,132	29.5	1.0	1.0	1.5		90.0	"Green house mode"	2.5
94	942,844	1,301,123	28.7	1.0	1.0	1.5		90.0	"Green house mode"	2.5
95	942,754	1,301,182	31.9	1.0	1.0	1.5		90.0	"Green house mode"	2.5
96	943,008	1,301,472	30.9	1.0	1.0	1.5		90.0	"Green house mode"	2.5
97	942,928	1,301,476	27.8	1.0	1.0	1.5		90.0	"Green house mode"	2.5
98	943,118	1,301,272	30.4	1.0	1.0	1.5		90.0	"Green house mode"	2.5
99	942,977	1,300,658	26.8	1.0	1.0	1.5		90.0	"Green house mode"	2.5
BR12	944,464	1,302,707	25.6	1.0	1.0	1.5	-157.0	90.0	Fixed direction	2.5
BR5	944,462	1,302,697	25.2	1.0	1.0	1.5	96.0	90.0	Fixed direction	2.5
SD1	944,507	1,302,689	27.4	1.0	1.0	1.5	93.0	90.0	Fixed direction	2.5
SD2	944,495	1,302,688	27.0	1.0	1.0	1.5	-12.0	1.0	Fixed direction	1.5
SD3	944,505	1,302,671	27.1	1.0	1.0	1.5	26.0	90.0	Fixed direction	2.5
SD4	944,505	1,302,643	27.2	1.0	1.0	1.5	91.0	90.0	Fixed direction	2.5
SD5	944,507	1,302,728	28.6	1.0	1.0	1.5	102.0	90.0	Fixed direction	2.5
SD6	944,501	1,302,730	28.5	1.0	1.0	1.5	110.0	90.0	Fixed direction	2.5
SD7	944,488	1,302,740	28.3	1.0	1.0	1.5	63.0	90.0	Fixed direction	2.5
SD8	944,477	1,302,746	27.8	1.0	1.0	1.5		90.0	"Green house mode"	2.5

Calculation Results

Shadow receptor

No.	Shadow, worst case: Shadow hours per year [h/year]	Shadow, worst case: Shadow days per year [days/year]	Shadow, worst case: Max shadow hours per day [h/day]	Shadow, expected values: Shadow hours per year [h/year]
1	25:31	77	0:28	4:27
10	33:26	102	0:30	6:04
100	201:25	217	1:26	38:54
101	0:00	0	0:00	0:00
102	0:00	0	0:00	0:00
103	0:00	0	0:00	0:00
104	0:00	0	0:00	0:00
105	0:00	0	0:00	0:00
106	35:50	132	0:25	6:55
107	37:24	131	0:25	7:15
108	36:34	128	0:25	7:06
109	108:42	120	1:02	13:27
11	33:42	102	0:30	6:09
110	98:57	120	0:58	12:03
111	68:11	86	0:56	9:18
112	59:35	77	0:56	8:21
113	20:54	43	0:36	3:09
114	0:00	0	0:00	0:00
115	56:59	72	0:57	12:42
116	116:30	122	1:15	18:40
117	721:54	298	3:33	254:59
118	899:13	271	4:13	164:33
119	688:36	248	4:23	109:43
12	34:42	103	0:31	6:19
120	550:40	203	3:30	120:10
121	218:25	116	2:38	55:25
122	13:18	40	0:24	2:49
123	245:41	194	2:58	87:42

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SHADOW - Main Result

Calculation: 0575014 - Loi Hai Worst Case - Green Mode

...continued from previous page

No.	Shadow, worst case			Shadow, expected values
	Shadow hours per year [h/year]	Shadow days per year [days/year]	Max shadow hours per day [h/day]	Shadow hours per year [h/year]
124	113:16	167	0:57	21:03
125	62:00	87	0:56	10:06
126	81:11	88	1:06	17:50
127	360:17	237	2:04	53:21
128	107:21	107	1:18	23:01
129	53:55	73	0:56	11:24
13	22:14	72	0:26	3:47
130	135:05	158	1:11	21:01
131	44:53	68	0:51	8:04
132	49:30	73	0:52	7:46
133	636:10	337	3:34	263:33
134	346:44	215	2:06	58:34
135	724:35	321	3:26	129:20
136	218:26	167	1:35	67:58
137	71:25	87	1:04	15:20
138	62:50	80	1:00	11:20
139	80:54	95	1:06	12:47
14	22:18	71	0:26	3:48
140	83:30	102	1:04	11:42
141	0:00	0	0:00	0:00
142	0:00	0	0:00	0:00
143	0:00	0	0:00	0:00
144	0:00	0	0:00	0:00
145	52:48	129	0:40	9:45
146	17:41	43	0:32	3:03
147	37:58	84	0:40	7:35
148	51:37	102	0:40	10:18
149	23:48	73	0:27	4:05
15	22:34	72	0:26	3:49
150	19:55	69	0:24	3:26
151	19:19	68	0:24	3:15
152	19:07	68	0:23	3:14
154	0:00	0	0:00	0:00
155	22:20	48	0:36	3:52
156	56:57	85	0:52	9:49
157	0:00	0	0:00	0:00
158	0:00	0	0:00	0:00
159	0:00	0	0:00	0:00
16	21:58	71	0:26	3:46
160	0:00	0	0:00	0:00
161	0:00	0	0:00	0:00
162	0:00	0	0:00	0:00
163	0:00	0	0:00	0:00
164	0:00	0	0:00	0:00
165	0:00	0	0:00	0:00
166	0:00	0	0:00	0:00
167	0:00	0	0:00	0:00
168	0:00	0	0:00	0:00
169	0:00	0	0:00	0:00
17	22:43	71	0:27	3:54
170	0:00	0	0:00	0:00
171	0:00	0	0:00	0:00
172	0:00	0	0:00	0:00
173	0:00	0	0:00	0:00
174	0:00	0	0:00	0:00
175	0:00	0	0:00	0:00
176	0:00	0	0:00	0:00
177	0:00	0	0:00	0:00
178	0:00	0	0:00	0:00
179	26:22	80	0:29	4:49
18	21:51	71	0:26	3:46

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SHADOW - Main Result

Calculation: 0575014 - Loi Hai Worst Case - Green Mode

...continued from previous page

No.	Shadow, worst case			Shadow, expected values
	Shadow hours per year [h/year]	Shadow days per year [days/year]	Max shadow hours per day [h/day]	Shadow hours per year [h/year]
180	165:32	195	1:13	22:31
181	13:50	40	0:24	2:10
182	37:47	98	0:39	7:54
183	43:19	147	0:26	5:44
184	39:04	122	0:29	5:26
185	11:24	52	0:18	1:40
186	61:42	102	0:49	7:10
187	43:50	81	0:42	5:08
188	0:00	0	0:00	0:00
189	0:00	0	0:00	0:00
19	21:29	71	0:26	3:43
190	0:00	0	0:00	0:00
191	0:00	0	0:00	0:00
192	0:00	0	0:00	0:00
193	0:00	0	0:00	0:00
194	0:00	0	0:00	0:00
195	0:00	0	0:00	0:00
196	0:00	0	0:00	0:00
197	0:00	0	0:00	0:00
198	0:00	0	0:00	0:00
199	0:00	0	0:00	0:00
2	26:32	81	0:28	4:40
20	21:54	71	0:26	3:48
200	0:00	0	0:00	0:00
201	0:00	0	0:00	0:00
202	0:00	0	0:00	0:00
203	0:00	0	0:00	0:00
204	0:00	0	0:00	0:00
205	46:13	117	0:36	8:29
206	43:53	112	0:36	7:59
207	42:25	111	0:35	7:36
208	42:34	111	0:35	7:34
209	83:37	144	0:46	16:03
21	21:20	70	0:26	3:45
210	74:05	129	0:46	14:30
211	64:32	123	0:41	12:36
212	61:01	117	0:41	12:01
213	55:56	109	0:41	11:06
214	59:59	119	0:39	11:40
215	61:11	123	0:39	11:50
216	0:00	0	0:00	0:00
217	0:00	0	0:00	0:00
218	0:00	0	0:00	0:00
219	0:00	0	0:00	0:00
22	21:46	70	0:26	3:50
220	61:35	110	0:46	11:43
221	23:45	69	0:28	4:31
222	17:24	50	0:26	3:10
223	15:22	44	0:26	2:38
224	14:02	40	0:27	2:20
225	13:34	39	0:26	2:18
226	14:03	41	0:26	2:18
227	14:51	40	0:28	2:32
228	30:27	75	0:35	6:00
229	19:36	61	0:28	3:38
23	22:13	70	0:27	3:54
230	16:57	56	0:27	3:04
231	12:54	38	0:26	2:14
232	40:22	91	0:36	8:06
233	45:12	99	0:37	9:02
234	52:16	111	0:36	10:13

To be continued on next page...

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SHADOW - Main Result

Calculation: 0575014 - Loi Hai Worst Case - Green Mode

...continued from previous page

	Shadow, worst case			Shadow, expected values
No.	Shadow hours per year [h/year]	Shadow days per year [days/year]	Max shadow hours per day [h/day]	Shadow hours per year [h/year]
235	58:26	126	0:37	11:12
236	56:06	121	0:36	10:49
237	74:23	156	0:42	15:33
238	93:01	228	0:39	19:57
239	58:35	135	0:43	10:52
24	22:39	70	0:27	3:58
240	48:41	145	0:35	9:23
241	42:07	115	0:36	7:50
242	41:29	115	0:36	7:38
243	41:44	117	0:36	7:38
244	40:01	113	0:35	7:19
245	39:12	114	0:35	7:09
246	39:28	113	0:35	7:10
247	40:12	112	0:35	7:10
248	40:14	111	0:35	7:09
249	41:50	112	0:35	7:24
25	23:25	74	0:27	4:02
250	42:02	111	0:36	7:25
251	41:43	109	0:35	7:18
252	25:36	78	0:27	4:55
253	45:17	146	0:31	8:45
254	47:01	148	0:31	9:08
255	0:00	0	0:00	0:00
256	0:00	0	0:00	0:00
257	107:11	204	0:55	22:42
258	80:23	136	0:54	16:19
259	116:27	150	1:11	26:15
26	23:26	73	0:27	3:58
260	139:09	185	1:06	29:46
261	135:26	187	1:06	25:14
262	114:52	160	0:59	22:22
263	81:25	148	0:47	15:25
264	58:41	109	0:48	10:12
265	40:52	92	0:40	7:09
266	41:03	91	0:40	7:09
267	81:22	161	0:45	17:39
268	46:00	99	0:42	7:54
269	31:24	102	0:30	5:36
27	23:50	74	0:27	4:03
270	31:47	105	0:30	5:40
271	30:50	101	0:30	5:33
272	30:34	101	0:30	5:28
273	31:09	102	0:30	5:35
274	31:27	102	0:30	5:40
275	31:57	101	0:30	5:46
276	33:07	105	0:31	5:58
277	34:35	108	0:32	6:14
278	35:23	108	0:32	6:22
279	30:21	114	0:28	5:33
28	24:11	74	0:27	4:08
280	30:54	114	0:24	5:56
281	33:50	113	0:26	6:33
282	32:11	113	0:25	6:12
283	42:16	144	0:28	8:09
284	42:52	147	0:28	8:17
285	35:57	104	0:32	6:15
286	35:45	102	0:32	6:15
287	36:50	103	0:33	6:28
288	38:17	106	0:33	6:48
289	38:52	107	0:34	6:54
29	20:14	68	0:25	3:33

To be continued on next page...

SHADOW - Main Result

Calculation: 0575014 - Loi Hai Worst Case - Green Mode

...continued from previous page

No.	Shadow, worst case Shadow hours per year [h/year]	Shadow days per year [days/year]	Max shadow hours per day [h/day]	Shadow, expected values Shadow hours per year [h/year]
290	36:01	104	0:33	6:14
291	37:12	105	0:33	6:27
292	37:05	105	0:33	6:24
293	34:24	102	0:32	6:02
294	35:18	103	0:32	6:08
295	34:19	102	0:32	6:03
296	35:45	104	0:32	6:19
297	36:29	106	0:33	6:26
298	36:37	108	0:33	6:32
299	34:31	106	0:32	6:09
3	30:16	89	0:28	5:31
30	20:16	67	0:25	3:33
300	33:02	106	0:31	5:55
301	39:24	114	0:31	7:22
302	38:51	110	0:31	7:14
303	38:12	108	0:31	7:05
304	39:21	111	0:31	7:20
305	44:18	127	0:32	8:20
306	39:28	107	0:33	7:12
307	43:33	116	0:34	8:07
308	41:32	113	0:33	7:44
309	38:57	108	0:32	7:12
31	20:05	69	0:25	3:28
310	37:42	105	0:32	6:53
311	36:44	103	0:32	6:39
312	37:30	103	0:33	6:43
313	38:17	105	0:33	6:53
314	38:19	106	0:33	6:51
315	40:07	108	0:34	7:15
316	39:51	106	0:34	7:10
317	28:11	80	0:28	5:37
318	10:13	38	0:22	1:45
319	10:42	35	0:22	1:47
32	20:18	69	0:25	3:29
320	11:28	38	0:23	1:54
321	12:27	40	0:23	2:04
322	12:10	38	0:24	1:59
323	51:14	117	0:34	9:55
324	26:26	74	0:30	5:13
325	12:16	38	0:24	2:02
326	31:22	86	0:30	6:16
327	32:30	86	0:30	6:29
328	41:25	102	0:31	8:10
329	36:14	106	0:30	6:43
33	19:49	67	0:24	3:24
330	38:14	112	0:30	7:09
331	39:45	114	0:31	7:27
332	37:06	108	0:31	6:53
333	35:14	103	0:32	6:15
334	33:33	100	0:31	5:53
335	32:15	99	0:30	5:32
336	32:49	98	0:31	5:39
337	33:51	102	0:32	5:51
338	26:26	85	0:26	4:50
339	33:35	102	0:25	6:30
34	21:36	73	0:25	3:47
340	28:58	88	0:25	5:44
341	22:33	73	0:25	4:28
342	25:07	77	0:26	4:59
343	27:35	82	0:27	5:29
344	28:52	85	0:26	5:44

To be continued on next page...

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SHADOW - Main Result

Calculation: 0575014 - Loi Hai Worst Case - Green Mode

...continued from previous page

	Shadow, worst case			Shadow, expected values
No.	Shadow hours per year [h/year]	Shadow days per year [days/year]	Max shadow hours per day [h/day]	Shadow hours per year [h/year]
345	37:16	103	0:27	7:15
346	36:21	99	0:27	7:07
347	39:16	107	0:28	7:35
348	34:14	93	0:29	6:48
349	31:12	99	0:30	5:27
35	19:34	69	0:24	3:19
350	30:31	98	0:29	5:20
351	31:56	101	0:30	5:37
352	31:57	101	0:30	5:39
353	30:48	101	0:30	5:28
354	31:24	102	0:30	5:36
355	32:18	104	0:30	5:46
356	33:30	105	0:31	5:57
356	23:04	70	0:28	4:10
357	0:00	0	0:00	0:00
357	0:00	0	0:00	0:00
358	28:41	98	0:29	5:09
358	32:00	101	0:30	5:42
359	12:12	48	0:28	2:07
359	1:44	14	0:12	0:17
36	20:28	71	0:24	3:31
361	25:36	70	0:31	4:43
361	0:00	0	0:00	0:00
362	25:23	70	0:31	4:38
362	0:00	0	0:00	0:00
363	0:00	0	0:00	0:00
363	0:00	0	0:00	0:00
364	12:18	64	0:14	2:25
364	4:41	29	0:15	0:50
365	0:00	0	0:00	0:00
365	0:00	0	0:00	0:00
366	9:47	46	0:14	2:01
366	0:00	0	0:00	0:00
367	0:00	0	0:00	0:00
367	0:00	0	0:00	0:00
368	0:00	0	0:00	0:00
368	0:00	0	0:00	0:00
369	9:51	44	0:15	2:02
37	20:35	70	0:25	3:28
370	0:00	0	0:00	0:00
371	13:09	60	0:15	2:38
372	23:23	71	0:28	4:06
373	24:03	72	0:28	4:13
374	24:30	73	0:29	4:18
375	29:16	98	0:28	5:12
376	23:33	72	0:28	4:11
377	22:34	71	0:27	4:03
378	0:00	0	0:00	0:00
379	23:39	72	0:28	4:14
38	20:52	70	0:25	3:33
380	30:07	101	0:29	5:22
381	28:08	102	0:25	5:21
382	20:47	72	0:26	3:46
383	23:34	84	0:27	4:20
384	21:10	68	0:26	3:50
385	21:23	69	0:27	3:51
386	22:04	68	0:27	3:59
387	22:40	69	0:28	4:07
388	34:05	101	0:31	6:09
389	27:05	78	0:29	4:44
39	20:58	71	0:25	3:33

To be continued on next page...

SHADOW - Main Result

Calculation: 0575014 - Loi Hai Worst Case - Green Mode

...continued from previous page

No.	Shadow, worst case Shadow hours per year [h/year]	Shadow days per year [days/year]	Max shadow hours per day [h/day]	Shadow, expected values Shadow hours per year [h/year]
390	26:56	79	0:29	4:41
391	26:59	80	0:29	4:40
392	31:28	98	0:30	5:29
393	26:44	77	0:29	4:35
394	25:37	76	0:28	4:23
395	25:43	75	0:29	4:22
396	24:53	74	0:28	4:14
397	25:37	76	0:29	4:22
4	30:53	90	0:29	5:38
40	21:58	72	0:26	3:42
41	21:45	71	0:25	3:42
42	23:43	76	0:27	4:03
43	22:42	74	0:26	3:53
44	22:37	73	0:26	3:53
45	25:10	78	0:27	4:29
46	24:10	76	0:26	4:14
47	25:03	77	0:27	4:25
48	24:15	76	0:27	4:13
49	24:08	75	0:27	4:08
5	27:27	83	0:28	4:56
50	22:32	72	0:27	4:01
51	21:45	69	0:27	3:53
52	21:49	70	0:26	3:53
53	21:49	70	0:26	3:52
54	22:22	71	0:27	3:58
55	22:00	70	0:26	3:54
56	20:48	68	0:26	3:42
57	20:51	67	0:26	3:42
58	20:55	69	0:26	3:42
59	20:28	68	0:25	3:37
6	27:19	83	0:28	4:53
60	20:23	67	0:25	3:36
61	18:44	65	0:24	3:18
62	18:30	64	0:24	3:17
63	18:36	65	0:24	3:19
64	18:52	64	0:24	3:21
65	18:55	65	0:24	3:22
66	19:42	67	0:25	3:31
67	19:18	66	0:25	3:26
68	19:21	67	0:24	3:24
69	19:28	67	0:25	3:25
7	26:35	82	0:27	4:44
70	22:43	73	0:26	3:57
71	23:24	76	0:26	4:07
72	23:11	76	0:25	4:05
73	25:07	80	0:26	4:31
74	24:02	77	0:26	4:17
75	24:37	80	0:26	4:26
76	25:59	80	0:27	4:40
77	19:56	72	0:23	3:29
78	21:14	81	0:25	3:53
79	23:00	88	0:25	4:16
8	29:34	85	0:29	5:19
80	26:29	98	0:25	5:01
81	20:06	67	0:25	3:36
82	20:47	68	0:26	3:43
83	21:36	69	0:27	3:52
84	21:41	69	0:27	3:53
85	20:11	66	0:26	3:38
86	20:45	68	0:26	3:44
87	20:07	67	0:25	3:37

To be continued on next page...

SHADOW - Main Result

Calculation: 0575014 - Loi Hai Worst Case - Green Mode

...continued from previous page

No.	Shadow, worst case: Shadow hours per year [h/year]	Shadow, worst case: Shadow days per year [days/year]	Shadow, worst case: Max shadow hours per day [h/day]	Shadow, expected values: Shadow hours per year [h/year]
88	19:11	65	0:25	3:27
89	19:16	67	0:25	3:27
9	30:30	86	0:30	5:30
90	19:15	66	0:25	3:27
91	19:33	68	0:24	3:22
92	19:31	67	0:25	3:25
93	117:21	167	0:59	21:59
94	146:44	164	1:14	30:01
95	46:13	89	0:45	8:09
96	29:54	62	0:33	6:13
97	19:41	46	0:31	4:16
98	64:57	117	0:47	13:00
99	239:09	235	1:33	45:21
BR12	0:00	0	0:00	0:00
BR5	30:56	98	0:30	5:20
SD1	23:53	73	0:28	4:08
SD2	24:31	73	0:28	4:14
SD3	23:46	72	0:28	4:09
SD4	23:33	72	0:28	4:10
SD5	24:32	76	0:27	4:11
SD6	24:45	75	0:28	4:14
SD7	25:50	78	0:28	4:28
SD8	26:40	79	0:29	4:39

Total amount of flickering on the shadow receptors caused by each WTG

No.	Name	Worst case [h/year]	Expected [h/year]
1	WTG1	708:30	115:59
2	WTG2	451:32	84:13
3	WTG3	1744:43	471:16
4	WTG4	792:52	172:07
5	WTG5	621:25	122:26
6	WTG6	1936:02	485:09
7	WTG7	456:15	122:45

Total times in Receptor wise and WTG wise tables can differ, as a WTG can lead to flicker at 2 or more receptors simultaneously and/or receptors may receive flicker from 2 or more WTGs simultaneously.

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Calculated:
2/4/2021 1:12 PM/3.4.388

SHADOW - Calendar

Calculation: 0575014 - Loi Hai Real Case - Green Mode Shadow receptor: 355 - Shadow Receptor: 1.0 × 1.0 Azimuth: 0.0° Slope: 90.0° (1418)

Assumptions for shadow calculations

Sunshine probability S (Average daily sunshine hours) []

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
6.94	7.86	6.61	6.50	5.65	5.33	4.03	4.19	3.33	4.68	5.67	6.13

Operational time

N	NNE	ENE	E	ESE	SSE	S	SSW	WSW	W	WNW	NNW	Sum
4,347	1,305	385	237	166	149	140	105	105	96	96	1,629	8,760

	January	February	March	April	May	June	July	August	September	October	November	December
1	06:04	06:09	06:00	17:14 (2) 05:41	17:22 (1) 05:25	05:19	05:24	05:31	05:34	05:33	05:37	05:49
	17:31	17:47	17:54 23	17:37 (2) 17:55 16	17:38 (1) 17:58	18:05	18:12	18:10	17:55	17:35	17:19	17:18
2	06:05	06:09	05:59	17:14 (2) 05:40	17:22 (1) 05:25	05:19	05:24	05:32	05:34	05:33	05:37	05:49
	17:31	17:47	17:54 23	17:37 (2) 17:55 16	17:38 (1) 17:58	18:05	18:12	18:10	17:54	17:34	17:19	17:18
3	06:05	06:09	05:59	17:15 (2) 05:40	17:23 (1) 05:24	05:19	05:24	05:32	05:34	05:33	05:37	05:50
	17:32	17:47	17:54 22	17:37 (2) 17:55 16	17:39 (1) 17:58	18:05	18:12	18:09	17:54	17:34	17:19	17:18
4	06:05	06:09	05:58	17:15 (2) 05:39	17:24 (1) 05:24	05:19	05:25	05:32	05:34	05:33	05:37	05:50
	17:33	17:48	17:54 21	17:36 (2) 17:55 14	17:38 (1) 17:58	18:06	18:12	18:09	17:53	17:33	17:18	17:18
5	06:06	06:08	05:57	17:16 (2) 05:39	17:26 (1) 05:24	05:19	05:25	05:32	05:34	05:33	05:38	05:51
	17:33	17:48	17:54 19	17:35 (2) 17:56 9	17:35 (1) 17:58	18:06	18:12	18:09	17:52	17:33	17:18	17:19
6	06:06	06:08	05:57	17:17 (2) 05:38	05:23	05:19	05:25	05:32	05:34	05:33 16:59 (2)	05:38	05:51
	17:34	17:48	17:54 16	17:33 (2) 17:56	17:58	18:06	18:13	18:08	17:52	17:32 5 17:04 (2)	17:18	17:19
7	06:06	06:08	05:56	17:21 (2) 05:37	05:23	05:19	05:25	05:32	05:34 17:22 (1)	05:33 16:55 (2)	05:38	05:52
	17:34	17:49	17:54 10	17:31 (2) 17:56	17:59	18:07	18:13	18:08	17:51 8 17:30 (1)	17:31 13 17:08 (2)	17:18	17:19
8	06:07	06:08	05:56	05:37	05:23	05:19	05:26	05:32	05:34 17:19 (1)	05:33 16:52 (2)	05:39	05:52
	17:35	17:49	17:54	17:56	17:59	18:07	18:13	18:07	17:51 13 17:32 (1)	17:31 18 17:10 (2)	17:17	17:20
9	06:07	06:07	05:55	05:36	05:22	05:19	05:26	05:33	05:34 17:17 (1)	05:33 16:51 (2)	05:39	05:53
	17:35	17:49	17:54	17:56	17:59	18:07	18:13	18:07	17:50 16 17:33 (1)	17:30 20 17:11 (2)	17:17	17:20
10	06:07	06:07	05:55	05:36	05:22	05:20	05:26	05:33	05:34 17:16 (1)	05:33 16:49 (2)	05:39	05:53
	17:36	17:50	17:55	17:56	17:59	18:07	18:13	18:07	17:49 16 17:32 (1)	17:30 23 17:12 (2)	17:17	17:20
11	06:08	06:07	05:54	05:35	05:22	05:20	05:27	05:33	05:34 17:15 (1)	05:33 16:48 (2)	05:40	05:54
	17:36	17:50	17:55	17:56	17:59	18:08	18:13	18:06	17:49 17 17:32 (1)	17:29 23 17:11 (2)	17:17	17:21
12	06:08	06:07	05:53	05:34	05:21	05:20	05:27	05:33	05:34 17:14 (1)	05:34 16:47 (2)	05:40	05:54
	17:37	17:50	17:55	17:56	18:00	18:08	18:13	18:06	17:48 17 17:31 (1)	17:28 23 17:10 (2)	17:17	17:21
13	06:08	06:06	05:53	05:34	05:21	05:20	05:27	05:33	05:34 17:12 (1)	05:34 16:46 (2)	05:40	05:55
	17:38	17:51	17:55	17:56	18:00	18:08	18:13	18:05	17:47 17 17:29 (1)	17:28 24 17:10 (2)	17:17	17:21
14	06:08	06:06	05:52	05:33	05:21	05:20	05:27	05:33	05:34 17:12 (1)	05:34 16:46 (2)	05:41	05:55
	17:38	17:51	17:55	17:56	18:00	18:09	18:13	18:05	17:47 17 17:29 (1)	17:27 23 17:09 (2)	17:17	17:22
15	06:08	06:06	05:52	05:33	05:21	05:20	05:28	05:33	05:34 17:12 (1)	05:34 16:46 (2)	05:41	05:56
	17:39	17:51	17:55	17:56	18:00	18:09	18:13	18:04	17:46 16 17:28 (1)	17:27 22 17:08 (2)	17:16	17:22
16	06:09	06:05	05:51	05:32	05:20	05:20	05:28	05:33	05:34 17:12 (1)	05:34 16:45 (2)	05:42	05:57
	17:39	17:51	17:55	17:56	18:01	18:09	18:13	18:04	17:45 15 17:27 (1)	17:26 23 17:08 (2)	17:16	17:23
17	06:09	06:05	05:50	05:32	05:20	05:21	05:28	05:33	05:33 17:12 (1)	05:34 16:46 (2)	05:42	05:57
	17:40	17:52	17:55	17:56	18:01	18:09	18:13	18:03	17:44 15 17:27 (1)	17:26 22 17:08 (2)	17:16	17:23
18	06:09	06:05	05:50	05:31	05:20	05:21	05:28	05:33	05:33 17:13 (1)	05:34 16:47 (2)	05:42	05:58
	17:40	17:52	17:55	17:56	18:01	18:10	18:12	18:03	17:44 13 17:26 (1)	17:25 20 17:07 (2)	17:16	17:24
19	06:09	06:04 17:21 (2)	05:49	05:31	05:20	05:21	05:29	05:34	05:33 17:14 (1)	05:34 16:47 (2)	05:43	05:58
	17:41	17:52 12 17:33 (2)	17:55	17:56	18:01	18:10	18:12	18:02	17:43 11 17:25 (1)	17:25 20 17:07 (2)	17:16	17:24
20	06:09	06:04 17:19 (2)	05:49	05:30	05:20	05:21	05:29	05:34	05:33 17:17 (1)	05:34 16:48 (2)	05:43	05:59
	17:41	17:52 16 17:35 (2)	17:55	17:56	18:02	18:10	18:12	18:02	17:42 8 17:25 (1)	17:24 18 17:06 (2)	17:16	17:24
21	06:09	06:03 17:18 (2)	05:48	05:30	05:20	05:21	05:29	05:34	05:33	05:34 16:48 (2)	05:44	05:59
	17:42	17:52 18 17:36 (2)	17:55	17:56	18:02	18:10	18:12	18:01	17:42	17:24 18 17:06 (2)	17:16	17:25
22	06:09	06:03 17:16 (2)	05:47	05:29	05:19	05:22	05:29	05:34	05:33	05:35 16:50 (2)	05:44	06:00
	17:42	17:53 19 17:35 (2)	17:55	17:57	18:02	18:10	18:12	18:01	17:41	17:23 15 17:05 (2)	17:16	17:25
23	06:09	06:03 17:16 (2)	05:47 17:32 (1)	05:29	05:19	05:22	05:30	05:34	05:33	05:35 16:53 (2)	05:45	06:00
	17:43	17:53 20 17:36 (2)	17:55 6 17:38 (1)	17:57	18:02	18:11	18:12	18:00	17:40	17:23 10 17:03 (2)	17:16	17:26
24	06:09	06:02 17:14 (2)	05:46 17:28 (1)	05:28	05:19	05:22	05:30	05:34	05:33	05:35	05:45	06:01
	17:43	17:53 22 17:36 (2)	17:55 10 17:38 (1)	17:57	18:03	18:11	18:12	18:00	17:40	17:22	17:17	17:26
25	06:09	06:02 17:14 (2)	05:45 17:26 (1)	05:28	05:19	05:22	05:30	05:34	05:33	05:35	05:46	06:01
	17:44	17:53 22 17:36 (2)	17:55 13 17:39 (1)	17:57	18:03	18:11	18:11	17:59	17:39	17:22	17:17	17:27
26	06:09	06:01 17:13 (2)	05:45 17:25 (1)	05:27	05:19	05:23	05:30	05:34	05:33	05:35	05:46	06:02
	17:44	17:53 23 17:36 (2)	17:55 14 17:39 (1)	17:57	18:03	18:11	18:11	17:59	17:38	17:21	17:17	17:27
27	06:09	06:01 17:14 (2)	05:44 17:23 (1)	05:27	05:19	05:23	05:30	05:34	05:33	05:35	05:47	06:02
	17:44	17:53 23 17:37 (2)	17:55 15 17:38 (1)	17:57	18:03	18:11	18:11	17:58	17:38	17:21	17:17	17:28
28	06:09	06:00 17:13 (2)	05:44 17:23 (1)	05:26	05:19	05:23	05:31	05:34	05:33	05:36	05:47	06:02
	17:45	17:54 23 17:36 (2)	17:55 16 17:39 (1)	17:57	18:04	18:12	18:11	17:57	17:37	17:21	17:17	17:29
29	06:09		05:43 17:22 (1)	05:26	05:19	05:23	05:31	05:34	05:33	05:36	05:48	06:03
	17:45		17:55 17 17:39 (1)	17:57	18:04	18:12	18:11	17:57	17:36	17:20	17:17	17:29
30	06:09		05:42 17:21 (1)	05:25	05:19	05:24	05:31	05:34	05:33	05:36	05:48	06:03
	17:46		17:55 17 17:38 (1)	17:57	18:04	18:12	18:10	17:56	17:36	17:20	17:17	17:30
31	06:09		05:42 17:22 (1)		05:19		05:31	05:34		05:36		06:04
	17:46		17:55 17 17:39 (1)		18:05		18:10	17:56		17:20		17:30
Potential sun hours	357	329	374	372	393	384	395	388	366	368	348	355
Total, worst case		198	259	71					199	340		
Sun reduction		0.67	0.55	0.52					0.27	0.39		
Oper. time red.		1.00	1.00	1.00					1.00	1.00		
Wind dir. red.		0.35	0.39	0.45					0.45	0.35		
Total reduction		0.23	0.22	0.24					0.12	0.14		
Total, real		46	57	17					25	47		

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)		First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker	(WTG causing flicker last time)

SHADOW - Calendar

Calculation: 0575014 - Loi Hai Real Case - Green Mode Shadow receptor: 356 - Shadow Receptor: 1.0 × 1.0 Azimuth: 0.0° Slope: 90.0° (1288)

Assumptions for shadow calculations

Sunshine probability S (Average daily sunshine hours) []

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
6.94	7.86	6.61	6.50	5.65	5.33	4.03	4.19	3.33	4.68	5.67	6.13

Operational time

N	NNE	ENE	E	ESE	SSE	S	SSW	WSW	W	WNW	NNW	Sum
4,347	1,305	385	237	166	149	140	105	105	96	96	1,629	8,760

	January		February			March			April			May			June		
1	06:04		06:09			06:00		16:02 (7)	05:41		15:56 (7)	05:25			05:19		16:52 (6)
	17:31		17:47			17:54	74	17:16 (7)	17:55	71	17:07 (7)	17:58			18:05	51	17:43 (5)
2	06:05		06:09			05:59		16:01 (7)	05:40		15:57 (7)	05:25			05:19		16:51 (6)
	17:32		17:47			17:54	75	17:16 (7)	17:55	70	17:07 (7)	17:58			18:05	51	17:42 (5)
3	06:05		06:09			05:59		16:00 (7)	05:40		15:58 (7)	05:24			05:19		16:51 (6)
	17:32		17:47			17:54	77	17:17 (7)	17:55	67	17:05 (7)	17:58			18:05	51	17:42 (5)
4	06:05		06:09			05:58		15:59 (7)	05:39		15:58 (7)	05:24			05:19		16:51 (6)
	17:33		17:48			17:54	78	17:17 (7)	17:56	65	17:03 (7)	17:58			18:06	51	17:42 (5)
5	06:06		06:08			05:58		15:59 (7)	05:39		16:00 (7)	05:24		17:21 (5)	05:19		16:50 (6)
	17:33		17:48			17:54	79	17:18 (7)	17:56	62	17:02 (7)	17:58	11	17:32 (5)	18:06	52	17:42 (5)
6	06:06		06:08			05:57		15:58 (7)	05:38		16:00 (7)	05:23		17:17 (5)	05:19		16:50 (6)
	17:34		17:48			17:54	80	17:18 (7)	17:56	60	17:00 (7)	17:59	17	17:34 (5)	18:06	51	17:41 (5)
7	06:06		06:08			05:56		15:58 (7)	05:37		16:01 (7)	05:23		17:16 (5)	05:19		16:50 (6)
	17:34		17:49			17:54	81	17:19 (7)	17:56	57	16:58 (7)	17:59	20	17:36 (5)	18:07	51	17:41 (5)
8	06:07		06:08			05:56		15:57 (7)	05:37		16:02 (7)	05:23		17:15 (5)	05:19		16:50 (6)
	17:35		17:49			17:54	82	17:19 (7)	17:56	54	16:56 (7)	17:59	23	17:38 (5)	18:07	51	17:41 (5)
9	06:07		06:08			05:55		15:57 (7)	05:36		16:03 (7)	05:22		17:13 (5)	05:20		16:50 (6)
	17:35		17:49			17:55	83	17:20 (7)	17:56	51	16:54 (7)	17:59	25	17:38 (5)	18:07	51	17:41 (5)
10	06:07		06:07			05:55		15:56 (7)	05:36		16:05 (7)	05:22		17:12 (5)	05:20		16:50 (6)
	17:36		17:50			17:55	84	17:20 (7)	17:56	47	16:52 (7)	17:59	27	17:39 (5)	18:07	50	17:40 (5)
11	06:08		06:07			05:54		15:55 (7)	05:35		16:07 (7)	05:22		17:12 (5)	05:20		16:50 (6)
	17:37		17:50			17:55	84	17:19 (7)	17:56	42	16:49 (7)	17:59	28	17:40 (5)	18:08	50	17:40 (5)
12	06:08		06:07			05:54		15:55 (7)	05:34		16:09 (7)	05:21		17:11 (5)	05:20		16:50 (6)
	17:37		17:50			17:55	85	17:20 (7)	17:56	36	16:45 (7)	18:00	30	17:41 (5)	18:08	51	17:41 (5)
13	06:08		06:06			05:53		15:55 (7)	05:34		16:12 (7)	05:21		17:10 (5)	05:20		16:50 (6)
	17:38		17:51			17:55	85	17:20 (7)	17:56	31	16:43 (7)	18:00	31	17:41 (5)	18:08	51	17:41 (5)
14	06:08		06:06			05:52		15:55 (7)	05:33		16:15 (7)	05:21		17:10 (5)	05:20		16:50 (6)
	17:38		17:51			17:55	85	17:20 (7)	17:56	23	16:38 (7)	18:00	32	17:42 (5)	18:09	51	17:41 (6)
15	06:08		06:06		16:33 (7)	05:52		15:54 (7)	05:33		16:22 (7)	05:21		17:09 (5)	05:20		16:50 (6)
	17:39		17:51	12	16:45 (7)	17:55	86	17:20 (7)	17:56	9	16:31 (7)	18:00	33	17:42 (5)	18:09	51	17:41 (6)
16	06:09		06:05		16:26 (7)	05:51		15:54 (7)	05:32			05:21		17:09 (5)	05:21		16:50 (6)
	17:39		17:51	25	16:51 (7)	17:55	85	17:19 (7)	17:56			18:01	34	17:43 (5)	18:09	51	17:41 (6)
17	06:09		06:05		16:22 (7)	05:51		15:54 (7)	05:32			05:20		17:09 (5)	05:21		16:50 (6)
	17:40		17:52	33	16:55 (7)	17:55	85	17:19 (7)	17:56			18:01	34	17:43 (5)	18:09	51	17:41 (6)
18	06:09		06:05		16:19 (7)	05:50		15:54 (7)	05:31			05:20		17:08 (5)	05:21		16:51 (6)
	17:40		17:52	40	16:59 (7)	17:55	85	17:19 (7)	17:56			18:01	34	17:42 (5)	18:10	51	17:42 (6)
19	06:09		06:04		16:16 (7)	05:49		15:53 (7)	05:31			05:20		17:08 (6)	05:21		16:51 (6)
	17:41		17:52	45	17:01 (7)	17:55	85	17:18 (7)	17:56			18:01	35	17:43 (5)	18:10	51	17:42 (6)
20	06:09		06:04		16:14 (7)	05:49		15:54 (7)	05:30			05:20		17:03 (6)	05:21		16:51 (6)
	17:41		17:52	50	17:04 (7)	17:55	84	17:18 (7)	17:56			18:02	40	17:43 (5)	18:10	51	17:42 (6)
21	06:09		06:03		16:13 (7)	05:48		15:54 (7)	05:30			05:20		17:01 (6)	05:22		16:51 (6)
	17:42		17:52	53	17:06 (7)	17:55	83	17:17 (7)	17:56			18:02	42	17:43 (5)	18:10	51	17:42 (6)
22	06:09		06:03		16:10 (7)	05:47		15:54 (7)	05:29			05:20		16:59 (6)	05:22		16:51 (6)
	17:42		17:53	57	17:07 (7)	17:55	83	17:17 (7)	17:57			18:02	44	17:43 (5)	18:10	51	17:42 (6)
23	06:09		06:03		16:09 (7)	05:47		15:54 (7)	05:29			05:19		16:58 (6)	05:22		16:52 (6)
	17:43		17:53	60	17:09 (7)	17:55	82	17:16 (7)	17:57			18:02	45	17:43 (5)	18:11	51	17:43 (6)
24	06:09		06:02		16:07 (7)	05:46		15:54 (7)	05:28			05:19		16:57 (6)	05:22		16:52 (6)
	17:43		17:53	63	17:10 (7)	17:55	81	17:15 (7)	17:57			18:03	46	17:43 (5)	18:11	51	17:43 (6)
25	06:09		06:02		16:06 (7)	05:46		15:54 (7)	05:28			05:19		16:56 (6)	05:22		16:52 (6)
	17:44		17:53	66	17:12 (7)	17:55	81	17:15 (7)	17:57			18:03	47	17:43 (5)	18:11	51	17:43 (6)
26	06:09		06:01		16:05 (7)	05:45		15:54 (7)	05:27			05:19		16:55 (6)	05:23		16:52 (6)
	17:44		17:53	68	17:13 (7)	17:55	80	17:14 (7)	17:57			18:03	48	17:43 (5)	18:11	51	17:43 (6)
27	06:09		06:01		16:04 (7)	05:44		15:54 (7)	05:27			05:19		16:54 (6)	05:23		16:53 (6)
	17:45		17:53	70	17:14 (7)	17:55	79	17:13 (7)	17:57			18:03	49	17:43 (5)	18:11	51	17:44 (6)
28	06:09		06:00		16:02 (7)	05:44		15:55 (7)	05:26			05:19		16:53 (6)	05:23		16:53 (6)
	17:45		17:54	73	17:15 (7)	17:55	77	17:12 (7)	17:57			18:04	50	17:43 (5)	18:12	51	17:44 (6)
29	06:09					05:43		15:55 (7)	05:26			05:19		16:53 (6)	05:23		16:53 (6)
	17:45					17:55	76	17:11 (7)	17:57			18:04	50	17:43 (5)	18:12	51	17:44 (6)
30	06:09					05:42		15:55 (7)	05:25			05:19		16:52 (6)	05:24		16:53 (6)
	17:46					17:55	74	17:09 (7)	17:58			18:04	51	17:43 (5)	18:12	51	17:44 (5)
31	06:09					05:42		15:56 (7)				05:19		16:52 (6)			
	17:46					17:55	73	17:09 (7)				18:05	51	17:43 (5)			
Potential sun hours	357		329			374			372			393			384		
Total, worst case				715			2511			745			977			1529	
Sun reduction				0.67			0.55			0.52			0.45			0.42	
Oper. time red.				1.00			1.00			1.00			1.00			1.00	
Wind dir. red.				0.38			0.38			0.38			0.59			0.61	
Total reduction				0.26			0.21			0.20			0.27			0.26	
Total, real				185			531			151			260			394	

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm) Sun set (hh:mm)	Minutes with flicker	First time (hh:mm) with flicker Last time (hh:mm) with flicker	(WTG causing flicker first time) (WTG causing flicker last time)

SHADOW - Calendar

Calculation: 0575014 - Loi Hai Real Case - Green Mode Shadow receptor: 356 - Shadow Receptor: 1.0 × 1.0 Azimuth: 0.0° Slope: 90.0° (1288)

Assumptions for shadow calculations

Sunshine probability S (Average daily sunshine hours) []

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
6.94	7.86	6.61	6.50	5.65	5.33	4.03	4.19	3.33	4.68	5.67	6.13

Operational time

N	NNE	ENE	E	ESE	SSE	S	SSW	WSW	W	WNW	NNW	Sum
4,347	1,305	385	237	166	149	140	105	105	96	96	1,629	8,760

	July		August		September		October		November	December
1	05:24		16:55 (6)	05:31	17:21 (5)	05:34	16:06 (7)	05:33	15:35 (7)	05:37	05:49
	18:12	50	17:45 (5)	18:10	30	17:51 (5)	17:55	42	16:48 (7)	17:35	84	16:59 (7)	17:19	17:18
2	05:24		16:55 (6)	05:32	17:22 (5)	05:34	16:03 (7)	05:33	15:34 (7)	05:37	05:49
	18:12	50	17:45 (5)	18:10	28	17:50 (5)	17:54	47	16:50 (7)	17:35	85	16:59 (7)	17:19	17:18
3	05:24		16:55 (6)	05:32	17:22 (5)	05:34	16:01 (7)	05:33	15:34 (7)	05:37	05:50
	18:12	51	17:46 (5)	18:09	27	17:49 (5)	17:54	51	16:52 (7)	17:34	84	16:58 (7)	17:19	17:18
4	05:25		16:55 (6)	05:32	17:24 (5)	05:34	15:59 (7)	05:33	15:34 (7)	05:37	05:50
	18:12	51	17:46 (5)	18:09	25	17:49 (5)	17:53	54	16:53 (7)	17:33	83	16:57 (7)	17:18	17:18
5	05:25		16:56 (6)	05:32	17:25 (5)	05:34	15:58 (7)	05:33	15:34 (7)	05:38	05:51
	18:12	51	17:47 (5)	18:09	22	17:47 (5)	17:53	57	16:55 (7)	17:33	83	16:57 (7)	17:18	17:19
6	05:25		16:56 (6)	05:32	17:26 (5)	05:34	15:56 (7)	05:33	15:34 (7)	05:38	05:51
	18:13	51	17:47 (5)	18:08	20	17:46 (5)	17:52	60	16:56 (7)	17:32	82	16:56 (7)	17:18	17:19
7	05:26		16:56 (6)	05:32	17:28 (5)	05:34	15:55 (7)	05:33	15:34 (7)	05:38	05:52
	18:13	52	17:48 (5)	18:08	15	17:43 (5)	17:51	62	16:57 (7)	17:31	81	16:55 (7)	17:18	17:19
8	05:26		16:58 (6)	05:33	17:31 (5)	05:34	15:53 (7)	05:33	15:34 (7)	05:39	05:52
	18:13	51	17:49 (5)	18:07	9	17:40 (5)	17:51	65	16:58 (7)	17:31	80	16:54 (7)	17:18	17:20
9	05:26		16:58 (6)	05:33		05:34	15:52 (7)	05:33	15:34 (7)	05:39	05:53
	18:13	51	17:49 (5)	18:07		17:50	67	16:59 (7)	17:30	79	16:53 (7)	17:17	17:20
10	05:26		16:58 (6)	05:33		05:34	15:51 (7)	05:33	15:34 (7)	05:39	05:53
	18:13	51	17:49 (5)	18:07		17:49	68	16:59 (7)	17:30	78	16:52 (7)	17:17	17:20
11	05:27		16:58 (6)	05:33		05:34	15:49 (7)	05:34	15:34 (7)	05:40	05:54
	18:13	52	17:50 (5)	18:06		17:49	71	17:00 (7)	17:29	77	16:51 (7)	17:17	17:21
12	05:27		17:00 (6)	05:33		05:34	15:48 (7)	05:34	15:35 (7)	05:40	05:54
	18:13	51	17:51 (5)	18:06		17:48	73	17:01 (7)	17:28	75	16:50 (7)	17:17	17:21
13	05:27		17:00 (6)	05:33		05:34	15:47 (7)	05:34	15:35 (7)	05:40	05:55
	18:13	51	17:51 (5)	18:05		17:47	74	17:01 (7)	17:28	73	16:48 (7)	17:17	17:21
14	05:27		17:01 (6)	05:33		05:34	15:45 (7)	05:34	15:36 (7)	05:41	05:56
	18:13	50	17:51 (5)	18:05		17:47	76	17:01 (7)	17:27	71	16:47 (7)	17:17	17:22
15	05:28		17:01 (6)	05:33		05:34	15:44 (7)	05:34	15:36 (7)	05:41	05:56
	18:13	50	17:51 (5)	18:04		17:46	77	17:01 (7)	17:27	70	16:46 (7)	17:17	17:22
16	05:28		17:03 (6)	05:33		05:34	15:43 (7)	05:34	15:38 (7)	05:42	05:57
	18:13	49	17:52 (5)	18:04		17:45	78	17:01 (7)	17:26	67	16:45 (7)	17:16	17:23
17	05:28		17:03 (6)	05:33		05:34	15:42 (7)	05:34	15:39 (7)	05:42	05:57
	18:13	49	17:52 (5)	18:04		17:45	80	17:02 (7)	17:26	64	16:43 (7)	17:16	17:23
18	05:28		17:04 (6)	05:34		05:34	15:42 (7)	05:34	15:40 (7)	05:42	05:58
	18:12	48	17:52 (5)	18:03		17:44	80	17:02 (7)	17:25	62	16:42 (7)	17:16	17:24
19	05:29		17:05 (6)	05:34		05:33	15:41 (7)	05:34	15:41 (7)	05:43	05:58
	18:12	47	17:52 (5)	18:03		17:43	81	17:02 (7)	17:25	59	16:40 (7)	17:16	17:24
20	05:29		17:07 (6)	05:34		05:33	15:40 (7)	05:34	15:42 (7)	05:43	05:59
	18:12	46	17:53 (5)	18:02		17:42	82	17:02 (7)	17:24	56	16:38 (7)	17:16	17:25
21	05:29		17:08 (6)	05:34		05:33	15:39 (7)	05:34	15:43 (7)	05:44	05:59
	18:12	45	17:53 (5)	18:01		17:42	83	17:02 (7)	17:24	52	16:35 (7)	17:16	17:25
22	05:29		17:10 (6)	05:34		05:33	15:39 (7)	05:35	15:45 (7)	05:44	06:00
	18:12	43	17:53 (5)	18:01		17:41	83	17:02 (7)	17:23	48	16:33 (7)	17:16	17:26
23	05:30		17:12 (6)	05:34		05:33	15:38 (7)	05:35	15:48 (7)	05:45	06:00
	18:12	41	17:53 (5)	18:00		17:40	84	17:02 (7)	17:23	43	16:31 (7)	17:17	17:26
24	05:30		17:16 (6)	05:34		05:33	15:38 (7)	05:35	15:50 (7)	05:45	06:01
	18:12	38	17:54 (5)	18:00		17:40	84	17:02 (7)	17:22	38	16:28 (7)	17:17	17:27
25	05:30		17:19 (5)	05:34		05:33	15:37 (7)	05:35	15:53 (7)	05:46	06:01
	18:12	35	17:54 (5)	17:59		17:39	85	17:02 (7)	17:22	31	16:24 (7)	17:17	17:27
26	05:30		17:19 (5)	05:34		05:33	15:36 (7)	05:35	15:57 (7)	05:46	06:02
	18:11	34	17:53 (5)	17:59		17:38	85	17:01 (7)	17:22	23	16:20 (7)	17:17	17:28
27	05:31		17:19 (5)	05:34		05:33	15:36 (7)	05:35	16:04 (7)	05:47	06:02
	18:11	34	17:53 (5)	17:58		17:38	85	17:01 (7)	17:21	7	16:11 (7)	17:17	17:28
28	05:31		17:19 (5)	05:34	16:22 (7)	05:33	15:36 (7)	05:36		05:47	06:03
	18:11	33	17:52 (5)	17:58	11	16:33 (7)	17:37	85	17:01 (7)	17:21		17:17	17:29
29	05:31		17:21 (5)	05:34	16:16 (7)	05:33	15:35 (7)	05:36		05:48	06:03
	18:11	32	17:53 (5)	17:57	23	16:39 (7)	17:36	85	17:00 (7)	17:20		17:17	17:29
30	05:31		17:21 (5)	05:34	16:12 (7)	05:33	15:35 (7)	05:36		05:48	06:03
	18:10	31	17:52 (5)	17:56	31	16:43 (7)	17:36	85	17:00 (7)	17:20		17:18	17:30
31	05:31		17:21 (5)	05:34	16:08 (7)				05:36			06:04
	18:10	31	17:52 (5)	17:56	38	16:46 (7)				17:20			17:30
Potential sun hours	395		388		366		368		348	355
Total, worst case		1399		279		2189		1735		
Sun reduction		0.32		0.34		0.27		0.39		
Oper. time red.		1.00		1.00		1.00		1.00		
Wind dir. red.		0.60		0.50		0.38		0.38		
Total reduction		0.19		0.17		0.11		0.15		
Total, real		269		48		231		264		

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm) Sun set (hh:mm)	Minutes with flicker	First time (hh:mm) with flicker Last time (hh:mm) with flicker	(WTG causing flicker first time) (WTG causing flicker last time)

SHADOW - Calendar

Calculation: 0575014 - Loi Hai Real Case - Green Mode Shadow receptor: 356 - Shadow Receptor: 1.0 × 1.0 Azimuth: 0.0° Slope: 90.0° (1415)

Assumptions for shadow calculations

Sunshine probability S (Average daily sunshine hours) []

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
6.94	7.86	6.61	6.50	5.65	5.33	4.03	4.19	3.33	4.68	5.67	6.13

Operational time

N	NNE	ENE	E	ESE	SSE	S	SSW	WSW	W	WNW	NNW	Sum
4,347	1,305	385	237	166	149	140	105	105	96	96	1,629	8,760

	January			February			March			April			May	June
1	06:04			06:09		17:17 (3)	06:00		17:08 (2)	05:41		17:16 (1)	05:25	05:19
	17:31			17:47	11	17:28 (3)	17:54	24	17:32 (2)	17:55	22	17:38 (1)	17:58	18:05
2	06:05			06:09		17:17 (3)	05:59		17:09 (2)	05:40		17:16 (1)	05:25	05:19
	17:31			17:47	12	17:29 (3)	17:54	21	17:30 (2)	17:55	22	17:38 (1)	17:58	18:05
3	06:05			06:09		17:17 (3)	05:59		17:11 (2)	05:40		17:17 (1)	05:24	05:19
	17:32			17:47	13	17:30 (3)	17:54	17	17:28 (2)	17:55	22	17:39 (1)	17:58	18:05
4	06:05			06:09		17:16 (3)	05:58		17:13 (2)	05:39		17:17 (1)	05:24	05:19
	17:33			17:48	14	17:30 (3)	17:54	12	17:25 (2)	17:55	21	17:38 (1)	17:58	18:06
5	06:06			06:08		17:16 (3)	05:58			05:39		17:18 (1)	05:24	05:19
	17:33			17:48	14	17:30 (3)	17:54			17:56	20	17:38 (1)	17:58	18:06
6	06:06			06:08		17:16 (3)	05:57			05:38		17:19 (1)	05:23	05:19
	17:34			17:48	14	17:30 (3)	17:54			17:56	17	17:36 (1)	17:58	18:06
7	06:06			06:08		17:16 (3)	05:56			05:37		17:20 (1)	05:23	05:19
	17:34			17:49	15	17:31 (3)	17:54			17:56	13	17:33 (1)	17:59	18:07
8	06:07			06:08		17:17 (3)	05:56			05:37		17:24 (1)	05:23	05:19
	17:35			17:49	14	17:31 (3)	17:54			17:56	6	17:30 (1)	17:59	18:07
9	06:07			06:07		17:18 (3)	05:55			05:36			05:22	05:19
	17:35			17:49	14	17:32 (3)	17:55			17:56			17:59	18:07
10	06:07			06:07		17:18 (3)	05:55			05:36			05:22	05:20
	17:36			17:50	14	17:32 (3)	17:55			17:56			17:59	18:07
11	06:08			06:07		17:18 (2)	05:54			05:35			05:22	05:20
	17:36			17:50	14	17:32 (3)	17:55			17:56			17:59	18:08
12	06:08			06:07		17:14 (2)	05:54			05:34			05:21	05:20
	17:37			17:50	18	17:32 (3)	17:55			17:56			18:00	18:08
13	06:08			06:06		17:11 (2)	05:53			05:34			05:21	05:20
	17:38			17:51	19	17:30 (2)	17:55			17:56			18:00	18:08
14	06:08			06:06		17:10 (2)	05:52			05:33			05:21	05:20
	17:38			17:51	22	17:32 (2)	17:55			17:56			18:00	18:09
15	06:08			06:06		17:09 (2)	05:52			05:33			05:21	05:20
	17:39			17:51	25	17:34 (2)	17:55			17:56			18:00	18:09
16	06:09			06:05		17:07 (2)	05:51			05:32			05:20	05:20
	17:39			17:51	26	17:33 (2)	17:55			17:56			18:01	18:09
17	06:09			06:05		17:07 (2)	05:50			05:32			05:20	05:21
	17:40			17:52	27	17:34 (2)	17:55			17:56			18:01	18:09
18	06:09			06:05		17:07 (2)	05:50			05:31			05:20	05:21
	17:40			17:52	28	17:35 (2)	17:55			17:56			18:01	18:10
19	06:09			06:04		17:05 (2)	05:49			05:31			05:20	05:21
	17:41			17:52	29	17:34 (2)	17:55			17:56			18:01	18:10
20	06:09			06:04		17:05 (2)	05:49			05:30			05:20	05:21
	17:41			17:52	30	17:35 (2)	17:55			17:56			18:02	18:10
21	06:09			06:03		17:06 (2)	05:48			05:30			05:20	05:21
	17:42			17:52	30	17:36 (2)	17:55			17:56			18:02	18:10
22	06:09			06:03		17:05 (2)	05:47			05:29			05:19	05:22
	17:42			17:53	30	17:35 (2)	17:55			17:57			18:02	18:10
23	06:09			06:03		17:05 (2)	05:47		17:30 (1)	05:29			05:19	05:22
	17:43			17:53	31	17:36 (2)	17:55	4	17:34 (1)	17:57			18:02	18:11
24	06:09			06:02		17:05 (2)	05:46		17:25 (1)	05:28			05:19	05:22
	17:43			17:53	31	17:36 (2)	17:55	13	17:38 (1)	17:57			18:03	18:11
25	06:09			06:02		17:05 (2)	05:45		17:23 (1)	05:28			05:19	05:22
	17:44			17:53	31	17:36 (2)	17:55	16	17:39 (1)	17:57			18:03	18:11
26	06:09			06:01		17:05 (2)	05:45		17:21 (1)	05:27			05:19	05:23
	17:44			17:53	30	17:35 (2)	17:55	18	17:39 (1)	17:57			18:03	18:11
27	06:09			06:01		17:06 (2)	05:44		17:19 (1)	05:27			05:19	05:23
	17:44			17:53	29	17:35 (2)	17:55	19	17:38 (1)	17:57			18:03	18:11
28	06:09			06:00		17:07 (2)	05:44		17:19 (1)	05:26			05:19	05:23
	17:45			17:54	26	17:33 (2)	17:55	20	17:39 (1)	17:57			18:04	18:12
29	06:09		17:21 (3)				05:43		17:18 (1)	05:26			05:19	05:23
	17:45	6	17:27 (3)				17:55	21	17:39 (1)	17:57			18:04	18:12
30	06:09		17:19 (3)				05:42		17:17 (1)	05:25			05:19	05:24
	17:46	8	17:27 (3)				17:55	21	17:38 (1)	17:58			18:04	18:12
31	06:09		17:18 (3)				05:42		17:17 (1)				05:19	
	17:46	10	17:28 (3)				17:55	22	17:39 (1)				18:05	
Potential sun hours	357			329			374			372			393	384
Total, worst case		24			611			228			143			
Sun reduction		0.60			0.67			0.55			0.52			
Oper. time red.		1.00			1.00			1.00			1.00			
Wind dir. red.		0.31			0.32			0.41			0.45			
Total reduction		0.19			0.22			0.23			0.24			
Total, real		5			134			52			34			

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm) Sun set (hh:mm)	Minutes with flicker	First time (hh:mm) with flicker Last time (hh:mm) with flicker	(WTG causing flicker first time) (WTG causing flicker last time)

SHADOW - Calendar

Calculation: 0575014 - Loi Hai Real Case - Green Mode Shadow receptor: 356 - Shadow Receptor: 1.0 × 1.0 Azimuth: 0.0° Slope: 90.0° (1415)

Assumptions for shadow calculations

Sunshine probability S (Average daily sunshine hours) []

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
6.94	7.86	6.61	6.50	5.65	5.33	4.03	4.19	3.33	4.68	5.67	6.13

Operational time

N	NNE	ENE	E	ESE	SSE	S	SSW	WSW	W	WNW	NNW	Sum
4,347	1,305	385	237	166	149	140	105	105	96	96	1,629	8,760

	July	August	September		October		November		December
1	05:24	05:31	05:34		05:33		05:37	16:48 (3)	05:49
	18:12	18:10	17:55		17:35		17:19 14	17:02 (3)	17:18
2	05:24	05:32	05:34		05:33		05:37	16:47 (3)	05:49
	18:12	18:10	17:54		17:34		17:19 14	17:01 (3)	17:18
3	05:24	05:32	05:34		05:33		05:37	16:46 (3)	05:50
	18:12	18:09	17:54		17:34		17:19 14	17:00 (3)	17:18
4	05:25	05:32	05:34	17:21 (1)	05:33		05:37	16:46 (3)	05:50
	18:12	18:09	17:53 5	17:26 (1)	17:33		17:18 15	17:01 (3)	17:18
5	05:25	05:32	05:34	17:17 (1)	05:33		05:38	16:46 (3)	05:51
	18:12	18:09	17:52 13	17:30 (1)	17:33		17:18 14	17:00 (3)	17:19
6	05:25	05:32	05:34	17:15 (1)	05:33		05:38	16:46 (3)	05:51
	18:13	18:08	17:52 17	17:32 (1)	17:32		17:18 14	17:00 (3)	17:19
7	05:25	05:32	05:34	17:13 (1)	05:33		05:38	16:46 (3)	05:52
	18:13	18:08	17:51 20	17:33 (1)	17:31		17:18 14	17:00 (3)	17:19
8	05:26	05:33	05:34	17:12 (1)	05:33		05:39	16:47 (3)	05:52
	18:13	18:07	17:51 21	17:33 (1)	17:31		17:17 12	16:59 (3)	17:20
9	05:26	05:33	05:34	17:11 (1)	05:33	16:51 (2)	05:39	16:47 (3)	05:53
	18:13	18:07	17:50 22	17:33 (1)	17:30 6	16:57 (2)	17:17 12	16:59 (3)	17:20
10	05:26	05:33	05:34	17:10 (1)	05:33	16:47 (2)	05:39	16:48 (3)	05:53
	18:13	18:07	17:49 22	17:32 (1)	17:30 14	17:01 (2)	17:17 11	16:59 (3)	17:20
11	05:27	05:33	05:34	17:09 (1)	05:33	16:44 (2)	05:40	16:49 (3)	05:54
	18:13	18:06	17:49 23	17:32 (1)	17:29 19	17:03 (2)	17:17 10	16:59 (3)	17:21
12	05:27	05:33	05:34	17:09 (1)	05:34	16:42 (2)	05:40	16:51 (3)	05:54
	18:13	18:06	17:48 22	17:31 (1)	17:28 23	17:05 (2)	17:17 8	16:59 (3)	17:21
13	05:27	05:33	05:34	17:08 (1)	05:34	16:40 (2)	05:40	16:54 (3)	05:55
	18:13	18:05	17:47 21	17:29 (1)	17:28 26	17:06 (2)	17:17 5	16:59 (3)	17:21
14	05:27	05:33	05:34	17:08 (1)	05:34	16:39 (2)	05:41		05:56
	18:13	18:05	17:47 21	17:29 (1)	17:27 27	17:06 (2)	17:17		17:22
15	05:28	05:33	05:34	17:08 (1)	05:34	16:38 (2)	05:41		05:56
	18:13	18:04	17:46 20	17:28 (1)	17:27 29	17:07 (2)	17:16		17:22
16	05:28	05:33	05:34	17:08 (1)	05:34	16:37 (2)	05:42		05:57
	18:13	18:04	17:45 19	17:27 (1)	17:26 30	17:07 (2)	17:16		17:23
17	05:28	05:33	05:34	17:09 (1)	05:34	16:37 (2)	05:42		05:57
	18:13	18:03	17:44 18	17:27 (1)	17:26 31	17:08 (2)	17:16		17:23
18	05:28	05:33	05:33	17:10 (1)	05:34	16:37 (2)	05:42		05:58
	18:12	18:03	17:44 16	17:26 (1)	17:25 30	17:07 (2)	17:16		17:24
19	05:29	05:34	05:33	17:11 (1)	05:34	16:36 (2)	05:43		05:58
	18:12	18:02	17:43 14	17:25 (1)	17:25 31	17:07 (2)	17:16		17:24
20	05:29	05:34	05:33	17:14 (1)	05:34	16:36 (2)	05:43		05:59
	18:12	18:02	17:42 8	17:22 (1)	17:24 30	17:06 (2)	17:16		17:24
21	05:29	05:34	05:33		05:34	16:36 (2)	05:44		05:59
	18:12	18:01	17:42		17:24 30	17:06 (2)	17:16		17:25
22	05:29	05:34	05:33		05:35	16:35 (2)	05:44		06:00
	18:12	18:01	17:41		17:23 30	17:05 (2)	17:16		17:25
23	05:30	05:34	05:33		05:35	16:36 (2)	05:45		06:00
	18:12	18:00	17:40		17:23 29	17:05 (2)	17:16		17:26
24	05:30	05:34	05:33		05:35	16:37 (2)	05:45		06:01
	18:12	18:00	17:40		17:22 28	17:05 (2)	17:17		17:26
25	05:30	05:34	05:33		05:35	16:37 (2)	05:46		06:01
	18:11	17:59	17:39		17:22 27	17:04 (2)	17:17		17:27
26	05:30	05:34	05:33		05:35	16:38 (2)	05:46		06:02
	18:11	17:59	17:38		17:21 25	17:03 (2)	17:17		17:27
27	05:30	05:34	05:33		05:35	16:38 (2)	05:47		06:02
	18:11	17:58	17:38		17:21 24	17:02 (2)	17:17		17:28
28	05:31	05:34	05:33		05:36	16:40 (2)	05:47		06:02
	18:11	17:57	17:37		17:21 22	17:02 (2)	17:17		17:29
29	05:31	05:34	05:33		05:36	16:42 (2)	05:48		06:03
	18:11	17:57	17:36		17:20 18	17:00 (2)	17:17		17:29
30	05:31	05:34	05:33		05:36	16:44 (2)	05:48		06:03
	18:10	17:56	17:36		17:20 17	17:01 (3)	17:17		17:30
31	05:31	05:34			05:36	16:48 (3)			06:04
	18:10	17:56			17:20 13	17:01 (3)			17:30
Potential sun hours	395	388	366		368		348		355
Total, worst case				302		559		157	
Sun reduction				0.27		0.39		0.49	
Oper. time red.				1.00		1.00		1.00	
Wind dir. red.				0.45		0.33		0.31	
Total reduction				0.13		0.13		0.15	
Total, real				38		73		24	

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm) Sun set (hh:mm)	Minutes with flicker	First time (hh:mm) with flicker Last time (hh:mm) with flicker	(WTG causing flicker first time) (WTG causing flicker last time)

SHADOW - Calendar

Calculation: 0575014 - Loi Hai Real Case - Green Mode Shadow receptor: 357 - Shadow Receptor: 1.0 × 1.0 Azimuth: 0.0° Slope: 90.0° (1289)

Assumptions for shadow calculations

Sunshine probability S (Average daily sunshine hours) []

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
6.94	7.86	6.61	6.50	5.65	5.33	4.03	4.19	3.33	4.68	5.67	6.13

Operational time

N	NNE	ENE	E	ESE	SSE	S	SSW	WSW	W	WNW	NNW	Sum
4,347	1,305	385	237	166	149	140	105	105	96	96	1,629	8,760

	January		February			March			April			May			June		
1	06:04		06:09			06:00		15:43 (7)	05:41		15:49 (7)	05:25			05:19		16:46 (6)
	17:31		17:47			17:54	92	17:15 (7)	17:55	63	16:52 (7)	17:58			18:05	56	17:42 (5)
2	06:05		06:09		16:22 (7)	05:59		15:43 (7)	05:40		15:51 (7)	05:25			05:19		16:46 (6)
	17:32		17:47	8	16:30 (7)	17:54	91	17:14 (7)	17:55	60	16:51 (7)	17:58			18:05	55	17:41 (5)
3	06:05		06:09		16:15 (7)	05:59		15:43 (7)	05:40		15:52 (7)	05:24			05:19		16:46 (6)
	17:32		17:47	23	16:38 (7)	17:54	92	17:15 (7)	17:55	56	16:48 (7)	17:58			18:05	55	17:41 (5)
4	06:05		06:09		16:11 (7)	05:58		15:42 (7)	05:39		15:53 (7)	05:24		17:18 (5)	05:19		16:45 (6)
	17:33		17:48	32	16:43 (7)	17:54	93	17:15 (7)	17:56	53	16:46 (7)	17:58	13	17:31 (5)	18:06	56	17:41 (5)
5	06:06		06:08		16:07 (7)	05:58		15:42 (7)	05:39		15:55 (7)	05:24		17:16 (5)	05:19		16:45 (6)
	17:33		17:48	38	16:45 (7)	17:54	93	17:15 (7)	17:56	49	16:44 (7)	17:58	18	17:34 (5)	18:06	56	17:41 (5)
6	06:06		06:08		16:05 (7)	05:57		15:42 (7)	05:38		15:57 (7)	05:23		17:14 (5)	05:19		16:45 (6)
	17:34		17:48	44	16:49 (7)	17:54	93	17:15 (7)	17:56	43	16:40 (7)	17:59	21	17:35 (5)	18:06	55	17:40 (5)
7	06:06		06:08		16:03 (7)	05:56		15:42 (7)	05:37		15:58 (7)	05:23		17:12 (5)	05:19		16:45 (6)
	17:34		17:49	48	16:51 (7)	17:54	93	17:15 (7)	17:56	39	16:37 (7)	17:59	25	17:37 (5)	18:07	55	17:40 (5)
8	06:07		06:08		16:01 (7)	05:56		15:42 (7)	05:37		16:02 (7)	05:23		17:11 (5)	05:19		16:45 (6)
	17:35		17:49	53	16:54 (7)	17:54	92	17:14 (7)	17:56	32	16:34 (7)	17:59	27	17:38 (5)	18:07	55	17:40 (5)
9	06:07		06:08		16:00 (7)	05:55		15:42 (7)	05:36		16:05 (7)	05:22		17:10 (5)	05:20		16:44 (6)
	17:35		17:49	56	16:56 (7)	17:55	93	17:15 (7)	17:56	24	16:29 (7)	17:59	28	17:38 (5)	18:07	56	17:40 (5)
10	06:07		06:07		15:58 (7)	05:55		15:42 (7)	05:36		16:12 (7)	05:22		17:09 (5)	05:20		16:44 (6)
	17:36		17:50	59	16:57 (7)	17:55	92	17:14 (7)	17:56	10	16:22 (7)	17:59	30	17:39 (5)	18:07	55	17:39 (5)
11	06:08		06:07		15:56 (7)	05:54		15:41 (7)	05:35			05:22		17:09 (5)	05:20		16:44 (6)
	17:37		17:50	63	16:59 (7)	17:55	92	17:13 (7)	17:56			17:59	31	17:40 (5)	18:08	55	17:39 (5)
12	06:08		06:07		15:55 (7)	05:54		15:42 (7)	05:34			05:21		17:08 (5)	05:20		16:45 (6)
	17:37		17:50	66	17:01 (7)	17:55	92	17:14 (7)	17:56			18:00	33	17:41 (5)	18:08	55	17:40 (5)
13	06:08		06:06		15:53 (7)	05:53		15:41 (7)	05:34			05:21		17:07 (5)	05:20		16:45 (6)
	17:38		17:51	69	17:02 (7)	17:55	92	17:13 (7)	17:56			18:00	33	17:40 (5)	18:08	54	17:39 (5)
14	06:08		06:06		15:53 (7)	05:52		15:42 (7)	05:33			05:21		17:07 (5)	05:20		16:45 (6)
	17:38		17:51	71	17:04 (7)	17:55	91	17:13 (7)	17:56			18:00	34	17:41 (5)	18:09	54	17:39 (5)
15	06:08		06:06		15:52 (7)	05:52		15:42 (7)	05:33			05:21		17:07 (5)	05:20		16:45 (6)
	17:39		17:51	73	17:05 (7)	17:55	90	17:12 (7)	17:56			18:00	35	17:42 (5)	18:09	54	17:39 (5)
16	06:09		06:05		15:50 (7)	05:51		15:42 (7)	05:32			05:21		17:07 (5)	05:21		16:45 (6)
	17:39		17:51	76	17:06 (7)	17:55	89	17:11 (7)	17:56			18:01	35	17:42 (5)	18:09	54	17:39 (5)
17	06:09		06:05		15:50 (7)	05:51		15:42 (7)	05:32			05:20		17:07 (5)	05:21		16:45 (6)
	17:40		17:52	77	17:07 (7)	17:55	89	17:11 (7)	17:56			18:01	35	17:42 (5)	18:09	54	17:39 (5)
18	06:09		06:05		15:49 (7)	05:50		15:42 (7)	05:31			05:20		17:02 (6)	05:21		16:46 (6)
	17:40		17:52	80	17:09 (7)	17:55	88	17:10 (7)	17:56			18:01	40	17:42 (5)	18:10	54	17:40 (6)
19	06:09		06:04		15:48 (7)	05:49		15:42 (7)	05:31			05:20		16:58 (6)	05:21		16:46 (6)
	17:41		17:52	81	17:09 (7)	17:55	87	17:09 (7)	17:56			18:01	44	17:42 (5)	18:10	54	17:40 (6)
20	06:09		06:04		15:48 (7)	05:49		15:43 (7)	05:30			05:20		16:56 (6)	05:21		16:46 (6)
	17:41		17:52	82	17:10 (7)	17:55	85	17:08 (7)	17:56			18:02	46	17:42 (5)	18:10	54	17:40 (6)
21	06:09		06:03		15:47 (7)	05:48		15:43 (7)	05:30			05:20		16:54 (6)	05:22		16:46 (6)
	17:42		17:52	84	17:11 (7)	17:55	84	17:07 (7)	17:56			18:02	48	17:42 (5)	18:10	54	17:40 (6)
22	06:09		06:03		15:46 (7)	05:47		15:44 (7)	05:29			05:20		16:53 (6)	05:22		16:46 (6)
	17:42		17:53	85	17:11 (7)	17:55	83	17:07 (7)	17:57			18:02	49	17:42 (5)	18:10	54	17:40 (6)
23	06:09		06:03		15:46 (7)	05:47		15:44 (7)	05:29			05:19		16:52 (6)	05:22		16:47 (6)
	17:43		17:53	86	17:12 (7)	17:55	81	17:05 (7)	17:57			18:02	50	17:42 (5)	18:11	54	17:41 (6)
24	06:09		06:02		15:45 (7)	05:46		15:44 (7)	05:28			05:19		16:51 (6)	05:22		16:47 (6)
	17:43		17:53	87	17:12 (7)	17:55	80	17:04 (7)	17:57			18:03	52	17:43 (5)	18:11	54	17:41 (6)
25	06:09		06:02		15:45 (7)	05:46		15:45 (7)	05:28			05:19		16:50 (6)	05:22		16:47 (6)
	17:44		17:53	88	17:13 (7)	17:55	78	17:03 (7)	17:57			18:03	52	17:42 (5)	18:11	54	17:41 (5)
26	06:09		06:01		15:44 (7)	05:45		15:45 (7)	05:27			05:19		16:49 (6)	05:23		16:47 (6)
	17:44		17:53	89	17:13 (7)	17:55	77	17:02 (7)	17:57			18:03	53	17:42 (5)	18:11	54	17:41 (5)
27	06:09		06:01		15:44 (7)	05:44		15:45 (7)	05:27			05:19		16:48 (6)	05:23		16:48 (6)
	17:45		17:53	90	17:14 (7)	17:55	75	17:00 (7)	17:57			18:03	54	17:42 (5)	18:11	54	17:42 (5)
28	06:09		06:00		15:43 (7)	05:44		15:47 (7)	05:26			05:19		16:48 (6)	05:23		16:48 (6)
	17:45		17:54	91	17:14 (7)	17:55	72	16:59 (7)	17:57			18:04	54	17:42 (5)	18:12	54	17:42 (5)
29	06:09					05:43		15:47 (7)	05:26			05:19		16:47 (6)	05:23		16:48 (6)
	17:45					17:55	70	16:57 (7)	17:57			18:04	55	17:42 (5)	18:12	54	17:42 (5)
30	06:09					05:42		15:47 (7)	05:25			05:19		16:47 (6)	05:24		16:48 (6)
	17:46					17:55	68	16:55 (7)	17:58			18:04	55	17:42 (5)	18:12	55	17:43 (5)
31	06:09					05:42		15:49 (7)				05:19		16:46 (6)			
	17:46					17:55	65	16:54 (7)				18:05	56	17:42 (5)			
Potential sun hours	357		329			374			372			393			384		
Total, worst case				1799			2652			429			1106			1637	
Sun reduction				0.67			0.55			0.52			0.45			0.42	
Oper. time red.				1.00			1.00			1.00			1.00			1.00	
Wind dir. red.				0.35			0.35			0.35			0.59			0.61	
Total reduction				0.24			0.20			0.19			0.27			0.26	
Total, real				429			519			80			297			426	

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm) Sun set (hh:mm)	Minutes with flicker	First time (hh:mm) with flicker Last time (hh:mm) with flicker	(WTG causing flicker first time) (WTG causing flicker last time)

Licensed user:
ERM
Level 3, 09 Dinh Tien Hoang St
VN-DAKAO WARD, District 1

Phat Tran / phat.tran@erm.com
Calculated:
2/4/2021 1:12 PM/3.4.388

SHADOW - Calendar

Calculation: 0575014 - Loi Hai Real Case - Green Mode Shadow receptor: 357 - Shadow Receptor: 1.0 × 1.0 Azimuth: 0.0° Slope: 90.0° (1289)

Assumptions for shadow calculations

Sunshine probability S (Average daily sunshine hours) []

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
6.94	7.86	6.61	6.50	5.65	5.33	4.03	4.19	3.33	4.68	5.67	6.13

Operational time

N	NNE	ENE	E	ESE	SSE	S	SSW	WSW	W	WNW	NNW	Sum
4,347	1,305	385	237	166	149	140	105	105	96	96	1,629	8,760

	July		August		September		October		November		December
1	05:24		16:49 (6)	05:31		17:19 (5)	05:34		05:33		15:21 (7)	05:37		15:28 (7)	05:49
	18:12	55	17:44 (5)	18:10	31	17:50 (5)	17:55		17:35	92	16:53 (7)	17:19	59	16:27 (7)	17:18
2	05:24		16:49 (6)	05:32		17:19 (5)	05:34		16:10 (7)	05:33		15:20 (7)	05:37		15:29 (7)	05:49
	18:12	55	17:44 (5)	18:10	31	17:50 (5)	17:54	10	16:20 (7)	17:35	92	16:52 (7)	17:19	56	16:25 (7)	17:18
3	05:24		16:49 (6)	05:32		17:19 (5)	05:34		16:03 (7)	05:33		15:20 (7)	05:37		15:31 (7)	05:50
	18:12	55	17:44 (5)	18:09	30	17:49 (5)	17:54	24	16:27 (7)	17:34	92	16:52 (7)	17:19	51	16:22 (7)	17:18
4	05:25		16:49 (6)	05:32		17:21 (5)	05:34		15:59 (7)	05:33		15:19 (7)	05:37		15:33 (7)	05:50
	18:12	56	17:45 (5)	18:09	28	17:49 (5)	17:53	32	16:31 (7)	17:33	93	16:52 (7)	17:18	48	16:21 (7)	17:18
5	05:25		16:51 (6)	05:32		17:22 (5)	05:34		15:55 (7)	05:33		15:19 (7)	05:38		15:35 (7)	05:51
	18:12	55	17:46 (5)	18:09	25	17:47 (5)	17:53	39	16:34 (7)	17:33	93	16:52 (7)	17:18	43	16:18 (7)	17:19
6	05:25		16:51 (6)	05:32		17:23 (5)	05:34		15:53 (7)	05:33		15:18 (7)	05:38		15:38 (7)	05:51
	18:13	55	17:46 (5)	18:08	23	17:46 (5)	17:52	43	16:36 (7)	17:32	93	16:51 (7)	17:18	37	16:15 (7)	17:19
7	05:26		16:51 (6)	05:32		17:24 (5)	05:34		15:50 (7)	05:33		15:18 (7)	05:38		15:42 (7)	05:52
	18:13	56	17:47 (5)	18:08	20	17:44 (5)	17:51	48	16:38 (7)	17:31	93	16:51 (7)	17:18	30	16:12 (7)	17:19
8	05:26		16:52 (6)	05:33		17:26 (5)	05:34		15:48 (7)	05:33		15:18 (7)	05:39		15:46 (7)	05:52
	18:13	56	17:48 (5)	18:07	16	17:42 (5)	17:51	52	16:40 (7)	17:31	92	16:50 (7)	17:18	22	16:08 (7)	17:20
9	05:26		16:52 (6)	05:33		17:28 (5)	05:34		15:46 (7)	05:33		15:17 (7)	05:39		15:55 (7)	05:53
	18:13	56	17:48 (5)	18:07	11	17:39 (5)	17:50	56	16:42 (7)	17:30	93	16:50 (7)	17:17	5	16:00 (7)	17:20
10	05:26		16:53 (6)	05:33			05:34		15:44 (7)	05:33		15:17 (7)	05:39			05:53
	18:13	55	17:48 (5)	18:07			17:49	60	16:44 (7)	17:30	92	16:49 (7)	17:17			17:20
11	05:27		16:53 (6)	05:33			05:34		15:43 (7)	05:34		15:17 (7)	05:40			05:54
	18:13	56	17:49 (5)	18:06			17:49	62	16:45 (7)	17:29	92	16:49 (7)	17:17			17:21
12	05:27		16:54 (6)	05:33			05:34		15:41 (7)	05:34		15:16 (7)	05:40			05:54
	18:13	56	17:50 (5)	18:06			17:48	65	16:46 (7)	17:28	92	16:48 (7)	17:17			17:21
13	05:27		16:55 (6)	05:33			05:34		15:40 (7)	05:34		15:16 (7)	05:40			05:55
	18:13	55	17:50 (5)	18:05			17:47	67	16:47 (7)	17:28	91	16:47 (7)	17:17			17:21
14	05:27		16:55 (6)	05:33			05:34		15:37 (7)	05:34		15:16 (7)	05:41			05:56
	18:13	55	17:50 (5)	18:05			17:47	70	16:47 (7)	17:27	91	16:47 (7)	17:17			17:22
15	05:28		16:56 (6)	05:33			05:34		15:36 (7)	05:34		15:16 (7)	05:41			05:56
	18:13	54	17:50 (5)	18:04			17:46	72	16:48 (7)	17:27	90	16:46 (7)	17:17			17:22
16	05:28		16:57 (6)	05:33			05:34		15:35 (7)	05:34		15:17 (7)	05:42			05:57
	18:13	54	17:51 (5)	18:04			17:45	74	16:49 (7)	17:26	89	16:46 (7)	17:16			17:23
17	05:28		16:58 (6)	05:33			05:34		15:33 (7)	05:34		15:17 (7)	05:42			05:57
	18:13	53	17:51 (5)	18:04			17:45	76	16:49 (7)	17:26	88	16:45 (7)	17:16			17:23
18	05:28		16:58 (6)	05:34			05:34		15:32 (7)	05:34		15:17 (7)	05:42			05:58
	18:12	53	17:51 (5)	18:03			17:44	78	16:50 (7)	17:25	87	16:44 (7)	17:16			17:24
19	05:29		16:59 (6)	05:34			05:33		15:31 (7)	05:34		15:17 (7)	05:43			05:58
	18:12	53	17:52 (5)	18:03			17:43	80	16:51 (7)	17:25	86	16:43 (7)	17:16			17:24
20	05:29		17:01 (6)	05:34			05:33		15:30 (7)	05:34		15:17 (7)	05:43			05:59
	18:12	51	17:52 (5)	18:02			17:42	81	16:51 (7)	17:24	85	16:42 (7)	17:16			17:25
21	05:29		17:02 (6)	05:34			05:33		15:29 (7)	05:34		15:17 (7)	05:44			05:59
	18:12	50	17:52 (5)	18:01			17:42	83	16:52 (7)	17:24	84	16:41 (7)	17:16			17:25
22	05:29		17:03 (6)	05:34			05:33		15:28 (7)	05:35		15:18 (7)	05:44			06:00
	18:12	49	17:52 (5)	18:01			17:41	84	16:52 (7)	17:23	82	16:40 (7)	17:16			17:26
23	05:30		17:05 (6)	05:34			05:33		15:27 (7)	05:35		15:19 (7)	05:45			06:00
	18:12	47	17:52 (5)	18:00			17:40	85	16:52 (7)	17:23	80	16:39 (7)	17:17			17:26
24	05:30		17:08 (6)	05:34			05:33		15:26 (7)	05:35		15:19 (7)	05:45			06:01
	18:12	45	17:53 (5)	18:00			17:40	87	16:53 (7)	17:22	79	16:38 (7)	17:17			17:27
25	05:30		17:11 (6)	05:34			05:33		15:25 (7)	05:35		15:20 (7)	05:46			06:01
	18:12	42	17:53 (5)	17:59			17:39	88	16:53 (7)	17:22	77	16:37 (7)	17:17			17:27
26	05:30		17:16 (6)	05:34			05:33		15:25 (7)	05:35		15:20 (7)	05:46			06:02
	18:11	37	17:53 (5)	17:59			17:38	88	16:53 (7)	17:22	75	16:35 (7)	17:17			17:28
27	05:31		17:17 (5)	05:34			05:33		15:24 (7)	05:35		15:21 (7)	05:47			06:02
	18:11	35	17:52 (5)	17:58			17:38	89	16:53 (7)	17:21	73	16:34 (7)	17:17			17:28
28	05:31		17:17 (5)	05:34			05:33		15:23 (7)	05:36		15:23 (7)	05:47			06:03
	18:11	35	17:52 (5)	17:58			17:37	90	16:53 (7)	17:21	70	16:33 (7)	17:17			17:29
29	05:31		17:18 (5)	05:34			05:33		15:22 (7)	05:36		15:24 (7)	05:48			06:03
	18:11	34	17:52 (5)	17:57			17:36	91	16:53 (7)	17:20	68	16:32 (7)	17:17			17:29
30	05:31		17:18 (5)	05:34			05:33		15:22 (7)	05:36		15:25 (7)	05:48			06:03
	18:10	34	17:52 (5)	17:56			17:36	91	16:53 (7)	17:20	65	16:30 (7)	17:18			17:30
31	05:31		17:18 (5)	05:34						05:36		15:27 (7)				06:04
	18:10	33	17:51 (5)	17:56						17:20	62	16:29 (7)				17:30
Potential sun hours	395			388			366			368			348			355
Total, worst case		1535			215			1965			2631			351		
Sun reduction		0.32			0.34			0.27			0.39			0.49		
Oper. time red.		1.00			1.00			1.00			1.00			1.00		
Wind dir. red.		0.60			0.57			0.35			0.35			0.35		
Total reduction		0.19			0.20			0.10			0.14			0.17		
Total, real		298			42			191			370			61		

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm) Sun set (hh:mm)	Minutes with flicker	First time (hh:mm) with flicker Last time (hh:mm) with flicker	(WTG causing flicker first time) (WTG causing flicker last time)

SHADOW - Calendar

Calculation: 0575014 - Loi Hai Real Case - Green Mode Shadow receptor: 357 - Shadow Receptor: 1.0 × 1.0 Azimuth: 0.0° Slope: 90.0° (1373)

Assumptions for shadow calculations

Sunshine probability S (Average daily sunshine hours) []

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
6.94	7.86	6.61	6.50	5.65	5.33	4.03	4.19	3.33	4.68	5.67	6.13

Operational time

N	NNE	ENE	E	ESE	SSE	S	SSW	WSW	W	WNW	NNW	Sum
4,347	1,305	385	237	166	149	140	105	105	96	96	1,629	8,760

	January		February		March		April		May	June
1	06:04	16:57 (4)	06:09		06:00	17:16 (2)	05:41	17:23 (1)	05:25	05:19
	17:31	14 17:11 (4)	17:47		17:54	21 17:37 (2)	17:55	15 17:38 (1)	17:58	18:05
2	06:05	16:58 (4)	06:09		05:59	17:15 (2)	05:40	17:22 (1)	05:25	05:19
	17:31	13 17:11 (4)	17:47		17:54	22 17:37 (2)	17:55	16 17:38 (1)	17:58	18:05
3	06:05	16:58 (4)	06:09		05:59	17:14 (2)	05:40	17:22 (1)	05:24	05:19
	17:32	12 17:10 (4)	17:47		17:54	23 17:37 (2)	17:55	17 17:39 (1)	17:58	18:05
4	06:05	17:00 (4)	06:09		05:58	17:13 (2)	05:39	17:21 (1)	05:24	05:19
	17:33	11 17:11 (4)	17:48		17:54	24 17:37 (2)	17:55	17 17:38 (1)	17:58	18:06
5	06:06	17:01 (4)	06:08		05:58	17:14 (2)	05:39	17:21 (1)	05:24	05:19
	17:33	9 17:10 (4)	17:48		17:54	24 17:38 (2)	17:56	18 17:39 (1)	17:58	18:06
6	06:06	17:03 (4)	06:08		05:57	17:13 (2)	05:38	17:21 (1)	05:23	05:19
	17:34	5 17:08 (4)	17:48		17:54	24 17:37 (2)	17:56	18 17:39 (1)	17:58	18:06
7	06:06		06:08		05:56	17:13 (2)	05:37	17:20 (1)	05:23	05:19
	17:34		17:49		17:54	25 17:38 (2)	17:56	18 17:38 (1)	17:59	18:07
8	06:07		06:08		05:56	17:13 (2)	05:37	17:21 (1)	05:23	05:19
	17:35		17:49		17:54	25 17:38 (2)	17:56	18 17:39 (1)	17:59	18:07
9	06:07		06:07		05:55	17:13 (2)	05:36	17:22 (1)	05:22	05:19
	17:35		17:49		17:54	24 17:37 (2)	17:56	16 17:38 (1)	17:59	18:07
10	06:07		06:07		05:55	17:14 (2)	05:36	17:23 (1)	05:22	05:20
	17:36		17:50		17:55	24 17:38 (2)	17:56	15 17:38 (1)	17:59	18:07
11	06:08		06:07		05:54	17:15 (2)	05:35	17:24 (1)	05:22	05:20
	17:36		17:50		17:55	21 17:36 (2)	17:56	12 17:36 (1)	17:59	18:08
12	06:08		06:07		05:54	17:16 (2)	05:34	17:28 (1)	05:21	05:20
	17:37		17:50		17:55	19 17:35 (2)	17:56	2 17:30 (1)	18:00	18:08
13	06:08		06:06		05:53	17:18 (2)	05:34		05:21	05:20
	17:38		17:51		17:55	14 17:32 (2)	17:56		18:00	18:08
14	06:08		06:06		05:52	17:22 (2)	05:33		05:21	05:20
	17:38		17:51		17:55	6 17:28 (2)	17:56		18:00	18:09
15	06:08		06:06		05:52		05:33		05:21	05:20
	17:39		17:51		17:55		17:56		18:00	18:09
16	06:09		06:05		05:51		05:32		05:20	05:20
	17:39		17:51		17:55		17:56		18:01	18:09
17	06:09		06:05		05:50		05:32		05:20	05:21
	17:40		17:52		17:55		17:56		18:01	18:09
18	06:09		06:05		05:50		05:31		05:20	05:21
	17:40		17:52		17:55		17:56		18:01	18:10
19	06:09		06:04		05:49		05:31		05:20	05:21
	17:41		17:52		17:55		17:56		18:01	18:10
20	06:09		06:04		05:49		05:30		05:20	05:21
	17:41		17:52		17:55		17:56		18:02	18:10
21	06:09		06:03		05:48		05:30		05:20	05:21
	17:42		17:52		17:55		17:56		18:02	18:10
22	06:09		06:03		05:47		05:29		05:19	05:22
	17:42		17:53		17:55		17:57		18:02	18:10
23	06:09		06:03		05:47		05:29		05:19	05:22
	17:43		17:53		17:55		17:57		18:02	18:11
24	06:09		06:02		05:46		05:28		05:19	05:22
	17:43		17:53		17:55		17:57		18:03	18:11
25	06:09		06:02	17:24 (2)	05:45		05:28		05:19	05:22
	17:44		17:53	9 17:33 (2)	17:55		17:57		18:03	18:11
26	06:09		06:01	17:20 (2)	05:45		05:27		05:19	05:23
	17:44		17:53	15 17:35 (2)	17:55		17:57		18:03	18:11
27	06:09		06:01	17:19 (2)	05:44		05:27		05:19	05:23
	17:44		17:53	18 17:37 (2)	17:55		17:57		18:03	18:11
28	06:09		06:00	17:17 (2)	05:44		05:26		05:19	05:23
	17:45		17:54	19 17:36 (2)	17:55		17:57		18:04	18:12
29	06:09				05:43	17:30 (1)	05:26		05:19	05:23
	17:45				17:55	8 17:38 (1)	17:57		18:04	18:12
30	06:09				05:42	17:27 (1)	05:25		05:19	05:24
	17:46				17:55	11 17:38 (1)	17:57		18:04	18:12
31	06:09				05:42	17:25 (1)			05:19	
	17:46				17:55	14 17:39 (1)			18:05	
Potential sun hours	357		329		374		372		393	384
Total, worst case		64		61		329		182		
Sun reduction		0.60		0.67		0.55		0.52		
Oper. time red.		1.00		1.00		1.00		1.00		
Wind dir. red.		0.38		0.37		0.38		0.46		
Total reduction		0.23		0.25		0.21		0.25		
Total, real		15		15		69		45		

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm) Sun set (hh:mm)	Minutes with flicker	First time (hh:mm) with flicker Last time (hh:mm) with flicker	(WTG causing flicker first time) (WTG causing flicker last time)

SHADOW - Calendar

Calculation: 0575014 - Loi Hai Real Case - Green Mode Shadow receptor: 357 - Shadow Receptor: 1.0 × 1.0 Azimuth: 0.0° Slope: 90.0° (1373)

Assumptions for shadow calculations

Sunshine probability S (Average daily sunshine hours) []

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
6.94	7.86	6.61	6.50	5.65	5.33	4.03	4.19	3.33	4.68	5.67	6.13

Operational time

N	NNE	ENE	E	ESE	SSE	S	SSW	WSW	W	WNW	NNW	Sum
4,347	1,305	385	237	166	149	140	105	105	96	96	1,629	8,760

	July	August		September			October			November	December		
1	05:24	05:31		05:34		17:23 (1)	05:33		16:56 (2)	05:37	05:49		
	18:12	18:10		17:55	12	17:35 (1)	17:35	17	17:13 (2)	17:19	17:18		
2	05:24	05:32		05:34		17:21 (1)	05:33		16:54 (2)	05:37	05:49		
	18:12	18:10		17:54	15	17:36 (1)	17:34	20	17:14 (2)	17:19	17:18		
3	05:24	05:32		05:34		17:20 (1)	05:33		16:53 (2)	05:37	05:50		
	18:12	18:09		17:54	16	17:36 (1)	17:34	22	17:15 (2)	17:19	17:18		
4	05:25	05:32		05:34		17:18 (1)	05:33		16:52 (2)	05:37	05:50		
	18:12	18:09		17:53	18	17:36 (1)	17:33	24	17:16 (2)	17:18	17:18		
5	05:25	05:32		05:34		17:17 (1)	05:33		16:51 (2)	05:38	05:51		
	18:12	18:09		17:52	18	17:35 (1)	17:33	24	17:15 (2)	17:18	17:19		
6	05:25	05:32		05:34		17:17 (1)	05:33		16:50 (2)	05:38	05:51		16:49 (4)
	18:13	18:08		17:52	18	17:35 (1)	17:32	24	17:14 (2)	17:18	17:19	5	16:54 (4)
7	05:25	05:32		05:34		17:16 (1)	05:33		16:49 (2)	05:38	05:52		16:49 (4)
	18:13	18:08		17:51	18	17:34 (1)	17:31	25	17:14 (2)	17:18	17:19	8	16:57 (4)
8	05:26	05:32		05:34		17:16 (1)	05:33		16:49 (2)	05:39	05:52		16:47 (4)
	18:13	18:07		17:51	17	17:33 (1)	17:31	24	17:13 (2)	17:17	17:20	11	16:58 (4)
9	05:26	05:33		05:34		17:16 (1)	05:33		16:48 (2)	05:39	05:53		16:47 (4)
	18:13	18:07		17:50	17	17:33 (1)	17:30	24	17:12 (2)	17:17	17:20	12	16:59 (4)
10	05:26	05:33		05:34		17:16 (1)	05:33		16:48 (2)	05:39	05:53		16:48 (4)
	18:13	18:07		17:49	16	17:32 (1)	17:30	24	17:12 (2)	17:17	17:20	13	17:01 (4)
11	05:27	05:33		05:34		17:16 (1)	05:33		16:48 (2)	05:40	05:54		16:47 (4)
	18:13	18:06		17:49	16	17:32 (1)	17:29	23	17:11 (2)	17:17	17:21	14	17:01 (4)
12	05:27	05:33		05:34		17:17 (1)	05:34		16:49 (2)	05:40	05:54		16:48 (4)
	18:13	18:06		17:48	14	17:31 (1)	17:28	21	17:10 (2)	17:17	17:21	15	17:03 (4)
13	05:27	05:33		05:34		17:17 (1)	05:34		16:49 (2)	05:40	05:55		16:47 (4)
	18:13	18:05		17:47	12	17:29 (1)	17:28	21	17:10 (2)	17:17	17:21	16	17:03 (4)
14	05:27	05:33		05:34		17:19 (1)	05:34		16:50 (2)	05:41	05:55		16:48 (4)
	18:13	18:05		17:47	10	17:29 (1)	17:27	19	17:09 (2)	17:17	17:22	16	17:04 (4)
15	05:28	05:33		05:34			05:34		16:51 (2)	05:41	05:56		16:48 (4)
	18:13	18:04		17:46			17:27	17	17:08 (2)	17:16	17:22	16	17:04 (4)
16	05:28	05:33		05:34			05:34		16:53 (2)	05:42	05:57		16:48 (4)
	18:13	18:04		17:45			17:26	13	17:06 (2)	17:16	17:23	16	17:04 (4)
17	05:28	05:33		05:34			05:34		16:59 (2)	05:42	05:57		16:48 (4)
	18:13	18:03		17:44			17:26	3	17:02 (2)	17:16	17:23	16	17:04 (4)
18	05:28	05:33		05:33			05:34			05:42	05:58		16:49 (4)
	18:12	18:03		17:44			17:25			17:16	17:24	16	17:05 (4)
19	05:29	05:34		05:33			05:34			05:43	05:58		16:49 (4)
	18:12	18:02		17:43			17:25			17:16	17:24	16	17:05 (4)
20	05:29	05:34		05:33			05:34			05:43	05:59		16:50 (4)
	18:12	18:02		17:42			17:24			17:16	17:24	16	17:06 (4)
21	05:29	05:34		05:33			05:34			05:44	05:59		16:50 (4)
	18:12	18:01		17:42			17:24			17:16	17:25	16	17:06 (4)
22	05:29	05:34		05:33			05:35			05:44	06:00		16:51 (4)
	18:12	18:01		17:41			17:23			17:16	17:25	16	17:07 (4)
23	05:30	05:34		05:33			05:35			05:45	06:00		16:51 (4)
	18:12	18:00		17:40			17:23			17:16	17:26	16	17:07 (4)
24	05:30	05:34		05:33			05:35			05:45	06:01		16:51 (4)
	18:12	18:00		17:40			17:22			17:17	17:26	16	17:07 (4)
25	05:30	05:34		05:33			05:35			05:46	06:01		16:52 (4)
	18:11	17:59		17:39			17:22			17:17	17:27	16	17:08 (4)
26	05:30	05:34		05:33			05:35			05:46	06:02		16:52 (4)
	18:11	17:59		17:38			17:21			17:17	17:27	16	17:08 (4)
27	05:30	05:34		05:33			05:35			05:47	06:02		16:53 (4)
	18:11	17:58		17:38			17:21			17:17	17:28	16	17:09 (4)
28	05:31	05:34		05:33			05:36			05:47	06:02		16:53 (4)
	18:11	17:57		17:37			17:21			17:17	17:29	17	17:10 (4)
29	05:31	05:34		05:33			05:36			05:48	06:03		16:55 (4)
	18:11	17:57		17:36			17:20			17:17	17:29	16	17:11 (4)
30	05:31	05:34		05:33		16:59 (2)	05:36			05:48	06:03		16:55 (4)
	18:10	17:56		17:36	12	17:11 (2)	17:20			17:17	17:30	16	17:11 (4)
31	05:31	05:34	17:28 (1)				05:36				06:04		16:55 (4)
	18:10	17:56	3 17:31 (1)				17:20				17:30	16	17:11 (4)
Potential sun hours	395	388		366			368			348	355		
Total, worst case			3		229			345				383	
Sun reduction			0.34		0.27			0.39				0.54	
Oper. time red.			1.00		1.00			1.00				1.00	
Wind dir. red.			0.46		0.46			0.37				0.38	
Total reduction			0.16		0.13			0.15				0.21	
Total, real			0		29			50				80	

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm) Sun set (hh:mm)	Minutes with flicker	First time (hh:mm) with flicker Last time (hh:mm) with flicker	(WTG causing flicker first time) (WTG causing flicker last time)

Licensed user:
ERM
Level 3, 09 Dinh Tien Hoang St
VN-DAKAO WARD, District 1

Phat Tran / phat.tran@erm.com
Calculated:
2/4/2021 1:12 PM/3.4.388

SHADOW - Calendar

Calculation: 0575014 - Loi Hai Real Case - Green Mode Shadow receptor: 362 - Shadow Receptor: 1.0 × 1.0 Azimuth: 0.0° Slope: 90.0° (1298)

Assumptions for shadow calculations

Sunshine probability S (Average daily sunshine hours) []

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
6.94	7.86	6.61	6.50	5.65	5.33	4.03	4.19	3.33	4.68	5.67	6.13

Operational time

N	NNE	ENE	E	ESE	SSE	S	SSW	WSW	W	WNW	NNW	Sum
4,347	1,305	385	237	166	149	140	105	105	96	96	1,629	8,760

	January			February			March			April		May	June
1	06:04		15:43 (6)	06:09		16:00 (6)	06:00		16:54 (5)	05:41		05:25	05:19
	17:31	74	16:57 (6)	17:47	61	17:01 (6)	17:54	40	17:34 (5)	17:55		17:58	18:05
2	06:05		15:43 (6)	06:09		16:01 (6)	05:59		16:53 (5)	05:40		05:25	05:19
	17:32	74	16:57 (6)	17:47	59	17:00 (6)	17:54	40	17:33 (5)	17:55		17:58	18:05
3	06:05		15:44 (6)	06:09		16:03 (6)	05:59		16:54 (5)	05:40		05:24	05:19
	17:32	74	16:58 (6)	17:47	57	17:00 (6)	17:54	40	17:34 (5)	17:56		17:58	18:05
4	06:05		15:44 (6)	06:09		16:04 (6)	05:58		16:53 (5)	05:39		05:24	05:19
	17:33	74	16:58 (6)	17:48	55	16:59 (6)	17:54	40	17:33 (5)	17:56		17:58	18:06
5	06:06		15:44 (6)	06:08		16:04 (6)	05:58		16:54 (5)	05:39		05:24	05:19
	17:33	74	16:58 (6)	17:48	53	16:57 (6)	17:54	39	17:33 (5)	17:56		17:58	18:06
6	06:06		15:45 (6)	06:08		16:06 (6)	05:57		16:54 (5)	05:38		05:23	05:19
	17:34	73	16:58 (6)	17:48	50	16:56 (6)	17:54	38	17:32 (5)	17:56		17:59	18:06
7	06:06		15:46 (6)	06:08		16:07 (6)	05:56		16:55 (5)	05:37		05:23	05:19
	17:34	74	17:00 (6)	17:49	48	16:55 (6)	17:54	36	17:31 (5)	17:56		17:59	18:07
8	06:07		15:46 (6)	06:08		16:09 (6)	05:56		16:55 (5)	05:37		05:23	05:19
	17:35	74	17:00 (6)	17:49	45	16:54 (6)	17:54	35	17:30 (5)	17:56		17:59	18:07
9	06:07		15:46 (6)	06:08		16:11 (6)	05:55		16:56 (5)	05:36		05:22	05:20
	17:35	74	17:00 (6)	17:49	42	16:53 (6)	17:55	33	17:29 (5)	17:56		17:59	18:07
10	06:07		15:47 (6)	06:07		16:12 (6)	05:55		16:56 (5)	05:36		05:22	05:20
	17:36	74	17:01 (6)	17:50	38	16:50 (6)	17:55	32	17:28 (5)	17:56		17:59	18:07
11	06:08		15:48 (6)	06:07		16:14 (6)	05:54		16:57 (5)	05:35		05:22	05:20
	17:37	73	17:01 (6)	17:50	34	16:48 (6)	17:55	29	17:26 (5)	17:56		18:00	18:08
12	06:08		15:48 (6)	06:07		16:17 (6)	05:54		16:59 (5)	05:35		05:21	05:20
	17:37	73	17:01 (6)	17:50	29	16:46 (6)	17:55	25	17:24 (5)	17:56		18:00	18:08
13	06:08		15:48 (6)	06:06		16:20 (6)	05:53		17:01 (5)	05:34		05:21	05:20
	17:38	74	17:02 (6)	17:51	22	16:42 (6)	17:55	20	17:21 (5)	17:56		18:00	18:08
14	06:08		15:48 (6)	06:06		16:26 (6)	05:52		17:04 (5)	05:33		05:21	05:20
	17:38	74	17:02 (6)	17:51	10	16:36 (6)	17:55	14	17:18 (5)	17:56		18:00	18:09
15	06:08		15:50 (6)	06:06			05:52			05:33		05:21	05:20
	17:39	73	17:03 (6)	17:51			17:55			17:56		18:00	18:09
16	06:09		15:50 (6)	06:05		17:13 (5)	05:51			05:32		05:21	05:21
	17:39	73	17:03 (6)	17:51	3	17:16 (5)	17:55			17:56		18:01	18:09
17	06:09		15:50 (6)	06:05		17:07 (5)	05:51			05:32		05:20	05:21
	17:40	73	17:03 (6)	17:52	15	17:22 (5)	17:55			17:56		18:01	18:09
18	06:09		15:51 (6)	06:05		17:05 (5)	05:50			05:31		05:20	05:21
	17:40	72	17:03 (6)	17:52	21	17:26 (5)	17:55			17:56		18:01	18:10
19	06:09		15:51 (6)	06:04		17:02 (5)	05:49			05:31		05:20	05:21
	17:41	72	17:03 (6)	17:52	25	17:27 (5)	17:55			17:56		18:01	18:10
20	06:09		15:52 (6)	06:04		17:01 (5)	05:49			05:30		05:20	05:21
	17:41	71	17:03 (6)	17:52	28	17:29 (5)	17:55			17:56		18:02	18:10
21	06:09		15:52 (6)	06:03		17:00 (5)	05:48			05:30		05:20	05:22
	17:42	71	17:03 (6)	17:52	31	17:31 (5)	17:55			17:56		18:02	18:10
22	06:09		15:53 (6)	06:03		16:58 (5)	05:47			05:29		05:20	05:22
	17:42	70	17:03 (6)	17:53	33	17:31 (5)	17:55			17:57		18:02	18:10
23	06:09		15:53 (6)	06:03		16:57 (5)	05:47			05:29		05:19	05:22
	17:43	70	17:03 (6)	17:53	35	17:32 (5)	17:55			17:57		18:02	18:11
24	06:09		15:54 (6)	06:02		16:56 (5)	05:46			05:28		05:19	05:22
	17:43	69	17:03 (6)	17:53	37	17:33 (5)	17:55			17:57		18:03	18:11
25	06:09		15:55 (6)	06:02		16:56 (5)	05:46			05:28		05:19	05:22
	17:44	68	17:03 (6)	17:53	37	17:33 (5)	17:55			17:57		18:03	18:11
26	06:09		15:55 (6)	06:01		16:54 (5)	05:45			05:27		05:19	05:23
	17:44	68	17:03 (6)	17:53	39	17:33 (5)	17:55			17:57		18:03	18:11
27	06:09		15:56 (6)	06:01		16:54 (5)	05:44			05:27		05:19	05:23
	17:45	67	17:03 (6)	17:53	40	17:34 (5)	17:55			17:57		18:03	18:11
28	06:09		15:57 (6)	06:00		16:54 (5)	05:44			05:26		05:19	05:23
	17:45	65	17:02 (6)	17:54	40	17:34 (5)	17:55			17:57		18:04	18:12
29	06:09		15:58 (6)				05:43			05:26		05:19	05:23
	17:45	64	17:02 (6)				17:55			17:57		18:04	18:12
30	06:09		15:58 (6)				05:42			05:25		05:19	05:24
	17:46	64	17:02 (6)				17:55			17:58		18:04	18:12
31	06:09		15:59 (6)				05:42					05:19	
	17:46	62	17:01 (6)				17:55					18:05	
Potential sun hours	357			329			374			372		393	384
Total, worst case		2205			987			461					
Sun reduction		0.60			0.67			0.55					
Oper. time red.		1.00			1.00			1.00					
Wind dir. red.		0.38			0.37			0.35					
Total reduction		0.23			0.25			0.19					
Total, real		510			244			88					

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm) Sun set (hh:mm)	Minutes with flicker	First time (hh:mm) with flicker Last time (hh:mm) with flicker	(WTG causing flicker first time) (WTG causing flicker last time)

SHADOW - Calendar

Calculation: 0575014 - Loi Hai Real Case - Green Mode Shadow receptor: 362 - Shadow Receptor: 1.0 × 1.0 Azimuth: 0.0° Slope: 90.0° (1298)

Assumptions for shadow calculations

Sunshine probability S (Average daily sunshine hours) []

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
6.94	7.86	6.61	6.50	5.65	5.33	4.03	4.19	3.33	4.68	5.67	6.13

Operational time

N	NNE	ENE	E	ESE	SSE	S	SSW	WSW	W	WNW	NNW	Sum
4,347	1,305	385	237	166	149	140	105	105	96	96	1,629	8,760

	July	August	September			October			November			December		
1	05:24	05:31	05:34			05:33		16:39 (5)	05:37		15:42 (6)	05:49		15:30 (6)
	18:12	18:10	17:55			17:35	23	17:02 (5)	17:19	38	16:20 (6)	17:18	73	16:43 (6)
2	05:24	05:32	05:34			05:33		16:37 (5)	05:37		15:39 (6)	05:49		15:29 (6)
	18:12	18:10	17:54			17:35	27	17:04 (5)	17:19	43	16:22 (6)	17:18	74	16:43 (6)
3	05:24	05:32	05:34			05:33		16:35 (5)	05:37		15:38 (6)	05:50		15:30 (6)
	18:12	18:09	17:54			17:34	30	17:05 (5)	17:19	45	16:23 (6)	17:18	74	16:44 (6)
4	05:25	05:32	05:34			05:33		16:34 (5)	05:37		15:37 (6)	05:50		15:30 (6)
	18:12	18:09	17:53			17:33	32	17:06 (5)	17:18	49	16:26 (6)	17:18	74	16:44 (6)
5	05:25	05:32	05:34			05:33		16:32 (5)	05:38		15:35 (6)	05:51		15:31 (6)
	18:12	18:09	17:53			17:33	35	17:07 (5)	17:18	52	16:27 (6)	17:19	74	16:45 (6)
6	05:25	05:32	05:34			05:33		16:31 (5)	05:38		15:34 (6)	05:51		15:31 (6)
	18:13	18:08	17:52			17:32	36	17:07 (5)	17:18	53	16:27 (6)	17:19	73	16:44 (6)
7	05:26	05:32	05:34			05:33		16:30 (5)	05:38		15:34 (6)	05:52		15:31 (6)
	18:13	18:08	17:51			17:31	38	17:08 (5)	17:18	55	16:29 (6)	17:19	74	16:45 (6)
8	05:26	05:33	05:34			05:33		16:29 (5)	05:39		15:32 (6)	05:52		15:32 (6)
	18:13	18:08	17:51			17:31	39	17:08 (5)	17:18	58	16:30 (6)	17:20	74	16:46 (6)
9	05:26	05:33	05:34			05:33		16:29 (5)	05:39		15:32 (6)	05:53		15:32 (6)
	18:13	18:07	17:50			17:30	39	17:08 (5)	17:17	59	16:31 (6)	17:20	74	16:46 (6)
10	05:26	05:33	05:34			05:33		16:28 (5)	05:39		15:31 (6)	05:53		15:33 (6)
	18:13	18:07	17:49			17:30	40	17:08 (5)	17:17	61	16:32 (6)	17:20	74	16:47 (6)
11	05:27	05:33	05:34			05:34		16:27 (5)	05:40		15:30 (6)	05:54		15:33 (6)
	18:13	18:06	17:49			17:29	41	17:08 (5)	17:17	62	16:32 (6)	17:21	74	16:47 (6)
12	05:27	05:33	05:34			05:34		16:27 (5)	05:40		15:30 (6)	05:54		15:34 (6)
	18:13	18:06	17:48			17:28	40	17:07 (5)	17:17	64	16:34 (6)	17:21	74	16:48 (6)
13	05:27	05:33	05:34			05:34		16:27 (5)	05:40		15:29 (6)	05:55		15:34 (6)
	18:13	18:05	17:47			17:28	40	17:07 (5)	17:17	65	16:34 (6)	17:21	73	16:47 (6)
14	05:27	05:33	05:34			05:34		16:27 (5)	05:41		15:30 (6)	05:56		15:35 (6)
	18:13	18:05	17:47			17:27	39	17:06 (5)	17:17	65	16:35 (6)	17:22	73	16:48 (6)
15	05:28	05:33	05:34			05:34		16:26 (5)	05:41		15:29 (6)	05:56		15:35 (6)
	18:13	18:05	17:46			17:27	40	17:06 (5)	17:17	67	16:36 (6)	17:22	73	16:48 (6)
16	05:28	05:33	05:34			05:34		16:28 (5)	05:42		15:28 (6)	05:57		15:36 (6)
	18:13	18:04	17:45			17:26	38	17:06 (5)	17:16	68	16:36 (6)	17:23	73	16:49 (6)
17	05:28	05:33	05:34			05:34		16:28 (5)	05:42		15:28 (6)	05:57		15:36 (6)
	18:13	18:04	17:45			17:26	37	17:05 (5)	17:16	69	16:37 (6)	17:23	73	16:49 (6)
18	05:28	05:34	05:34			05:34		16:28 (5)	05:42		15:28 (6)	05:58		15:37 (6)
	18:13	18:03	17:44			17:25	36	17:04 (5)	17:16	69	16:37 (6)	17:24	73	16:50 (6)
19	05:29	05:34	05:33			05:34		16:28 (5)	05:43		15:28 (6)	05:58		15:37 (6)
	18:12	18:03	17:43			17:25	35	17:03 (5)	17:16	70	16:38 (6)	17:24	73	16:50 (6)
20	05:29	05:34	05:33			05:34		16:29 (5)	05:43		15:28 (6)	05:59		15:38 (6)
	18:12	18:02	17:42			17:24	33	17:02 (5)	17:16	70	16:38 (6)	17:25	73	16:51 (6)
21	05:29	05:34	05:33			05:34		16:30 (5)	05:44		15:28 (6)	05:59		15:38 (6)
	18:12	18:01	17:42			17:24	30	17:00 (5)	17:16	71	16:39 (6)	17:25	73	16:51 (6)
22	05:29	05:34	05:33			05:35		16:31 (5)	05:44		15:28 (6)	06:00		15:39 (6)
	18:12	18:01	17:41			17:23	27	16:58 (5)	17:16	71	16:39 (6)	17:26	73	16:52 (6)
23	05:30	05:34	05:33			05:35		16:33 (5)	05:45		15:28 (6)	06:00		15:39 (6)
	18:12	18:00	17:40			17:23	24	16:57 (5)	17:17	72	16:40 (6)	17:26	73	16:52 (6)
24	05:30	05:34	05:33			05:35		16:35 (5)	05:45		15:28 (6)	06:01		15:39 (6)
	18:12	18:00	17:40			17:22	20	16:55 (5)	17:17	72	16:40 (6)	17:27	73	16:52 (6)
25	05:30	05:34	05:33			05:35		16:38 (5)	05:46		15:28 (6)	06:01		15:40 (6)
	18:12	17:59	17:39			17:22	13	16:51 (5)	17:17	73	16:41 (6)	17:27	73	16:53 (6)
26	05:30	05:34	05:33			05:35			05:46		15:28 (6)	06:02		15:40 (6)
	18:11	17:59	17:38			17:22			17:17	73	16:41 (6)	17:28	73	16:53 (6)
27	05:31	05:34	05:33			05:35			05:47		15:29 (6)	06:02		15:41 (6)
	18:11	17:58	17:38			17:21			17:17	73	16:42 (6)	17:28	73	16:54 (6)
28	05:31	05:34	05:33			05:36		15:54 (6)	05:47		15:28 (6)	06:03		15:41 (6)
	18:11	17:58	17:37			17:21	14	16:08 (6)	17:17	74	16:42 (6)	17:29	73	16:54 (6)
29	05:31	05:34	05:33		16:46 (5)	05:36		15:49 (6)	05:48		15:29 (6)	06:03		15:42 (6)
	18:11	17:57	17:36	11	16:57 (5)	17:20	23	16:12 (6)	17:17	74	16:43 (6)	17:29	73	16:55 (6)
30	05:31	05:34	05:33		16:42 (5)	05:36		15:46 (6)	05:48		15:29 (6)	06:03		15:42 (6)
	18:10	17:56	17:36	18	17:00 (5)	17:20	29	16:15 (6)	17:18	73	16:42 (6)	17:30	73	16:55 (6)
31	05:31	05:34				05:36		15:44 (6)				06:04		15:42 (6)
	18:10	17:56				17:20	35	16:19 (6)				17:30	74	16:56 (6)
Potential sun hours	395	388	366			368			348			355		
Total, worst case				29			933			1908			2274	
Sun reduction				0.27			0.39			0.49			0.54	
Oper. time red.				1.00			1.00			1.00			1.00	
Wind dir. red.				0.35			0.35			0.38			0.38	
Total reduction				0.10			0.14			0.19			0.21	
Total, real				3			129			358			468	

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm) Sun set (hh:mm)	Minutes with flicker	First time (hh:mm) with flicker Last time (hh:mm) with flicker	(WTG causing flicker first time) (WTG causing flicker last time)

Licensed user:
ERM
Level 3, 09 Dinh Tien Hoang St
VN-DAKAO WARD, District 1

Phat Tran / phat.tran@erm.com
Calculated:
2/4/2021 1:12 PM/3.4.388

SHADOW - Calendar

Calculation: 0575014 - Loi Hai Real Case - Green Mode Shadow receptor: 362 - Shadow Receptor: 1.0 × 1.0 Azimuth: 0.0° Slope: 90.0° (1343)

Assumptions for shadow calculations

Sunshine probability S (Average daily sunshine hours) []

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
6.94	7.86	6.61	6.50	5.65	5.33	4.03	4.19	3.33	4.68	5.67	6.13

Operational time

N	NNE	ENE	E	ESE	SSE	S	SSW	WSW	W	WNW	NNW	Sum
4,347	1,305	385	237	166	149	140	105	105	96	96	1,629	8,760

	January			February		March			April			May		June	
1	06:04		16:56 (4)	06:09		06:00			05:41			05:25		05:19	
	17:31	16	17:12 (4)	17:47		17:54			17:55			17:58		18:05	
2	06:05		16:56 (4)	06:09		05:59			05:40			05:25		05:19	
	17:31	16	17:12 (4)	17:47		17:54			17:55			17:58		18:05	
3	06:05		16:56 (4)	06:09		05:59			05:40			05:24		05:19	
	17:32	17	17:13 (4)	17:47		17:54			17:55			17:58		18:05	
4	06:05		16:57 (4)	06:09		05:58			05:39			05:24		05:19	
	17:33	17	17:14 (4)	17:48		17:54			17:55			17:58		18:06	
5	06:06		16:57 (4)	06:08		05:58			05:39			05:24		05:19	
	17:33	17	17:14 (4)	17:48		17:54			17:56			17:58		18:06	
6	06:06		16:57 (4)	06:08		05:57			05:38			05:23		05:19	
	17:34	17	17:14 (4)	17:48		17:54			17:56			17:58		18:06	
7	06:06		16:58 (4)	06:08		05:56			05:37			05:23		05:19	
	17:34	18	17:16 (4)	17:49		17:54			17:56			17:59		18:07	
8	06:07		16:58 (4)	06:08		05:56			05:37		17:29 (1)	05:23		05:19	
	17:35	18	17:16 (4)	17:49		17:54			17:56	10	17:39 (1)	17:59		18:07	
9	06:07		16:58 (4)	06:07		05:55		17:23 (2)	05:36		17:26 (1)	05:22		05:19	
	17:35	18	17:16 (4)	17:49		17:54	12	17:35 (2)	17:56	12	17:38 (1)	17:59		18:07	
10	06:07		16:58 (4)	06:07		05:55		17:21 (2)	05:36		17:25 (1)	05:22		05:20	
	17:36	18	17:16 (4)	17:50		17:55	17	17:38 (2)	17:56	14	17:39 (1)	17:59		18:07	
11	06:08		17:00 (4)	06:07		05:54		17:18 (2)	05:35		17:23 (1)	05:22		05:20	
	17:36	18	17:18 (4)	17:50		17:55	20	17:38 (2)	17:56	16	17:39 (1)	17:59		18:08	
12	06:08		17:00 (4)	06:07		05:54		17:17 (2)	05:34		17:22 (1)	05:21		05:20	
	17:37	18	17:18 (4)	17:50		17:55	21	17:38 (2)	17:56	16	17:38 (1)	18:00		18:08	
13	06:08		17:00 (4)	06:06		05:53		17:16 (2)	05:34		17:22 (1)	05:21		05:20	
	17:38	18	17:18 (4)	17:51		17:55	22	17:38 (2)	17:56	17	17:39 (1)	18:00		18:08	
14	06:08		17:01 (4)	06:06		05:52		17:16 (2)	05:33		17:21 (1)	05:21		05:20	
	17:38	18	17:19 (4)	17:51		17:55	23	17:39 (2)	17:56	17	17:38 (1)	18:00		18:09	
15	06:08		17:01 (4)	06:06		05:52		17:14 (2)	05:33		17:21 (1)	05:21		05:20	
	17:39	18	17:19 (4)	17:51		17:55	24	17:38 (2)	17:56	18	17:39 (1)	18:00		18:09	
16	06:09		17:03 (4)	06:05		05:51		17:14 (2)	05:32		17:21 (1)	05:20		05:20	
	17:39	18	17:21 (4)	17:51		17:55	24	17:38 (2)	17:56	18	17:39 (1)	18:01		18:09	
17	06:09		17:03 (4)	06:05		05:50		17:14 (2)	05:32		17:21 (1)	05:20		05:21	
	17:40	18	17:21 (4)	17:52		17:55	25	17:39 (2)	17:56	18	17:39 (1)	18:01		18:09	
18	06:09		17:04 (4)	06:05		05:50		17:13 (2)	05:31		17:21 (1)	05:20		05:21	
	17:40	17	17:21 (4)	17:52		17:55	25	17:38 (2)	17:56	18	17:39 (1)	18:01		18:10	
19	06:09		17:05 (4)	06:04		05:49		17:13 (2)	05:31		17:22 (1)	05:20		05:21	
	17:41	17	17:22 (4)	17:52		17:55	25	17:38 (2)	17:56	17	17:39 (1)	18:01		18:10	
20	06:09		17:06 (4)	06:04		05:49		17:14 (2)	05:30		17:23 (1)	05:20		05:21	
	17:41	16	17:22 (4)	17:52		17:55	25	17:39 (2)	17:56	16	17:39 (1)	18:02		18:10	
21	06:09		17:07 (4)	06:03		05:48		17:14 (2)	05:30		17:23 (1)	05:20		05:21	
	17:42	14	17:21 (4)	17:52		17:55	24	17:38 (2)	17:56	13	17:36 (1)	18:02		18:10	
22	06:09		17:09 (4)	06:03		05:47		17:15 (2)	05:29		17:26 (1)	05:19		05:22	
	17:42	11	17:20 (4)	17:53		17:55	22	17:37 (2)	17:57	8	17:34 (1)	18:02		18:10	
23	06:09		17:11 (4)	06:03		05:47		17:16 (2)	05:29			05:19		05:22	
	17:43	7	17:18 (4)	17:53		17:55	20	17:36 (2)	17:57			18:02		18:11	
24	06:09			06:02		05:46		17:17 (2)	05:28			05:19		05:22	
	17:43			17:53		17:55	16	17:33 (2)	17:57			18:03		18:11	
25	06:09			06:02		05:45		17:20 (2)	05:28			05:19		05:22	
	17:44			17:53		17:55	11	17:31 (2)	17:57			18:03		18:11	
26	06:09			06:01		05:45			05:27			05:19		05:23	
	17:44			17:53		17:55			17:57			18:03		18:11	
27	06:09			06:01		05:44			05:27			05:19		05:23	
	17:44			17:53		17:55			17:57			18:03		18:11	
28	06:09			06:00		05:44			05:26			05:19		05:23	
	17:45			17:54		17:55			17:57			18:04		18:12	
29	06:09					05:43			05:26			05:19		05:23	
	17:45					17:55			17:57			18:04		18:12	
30	06:09					05:42			05:25			05:19		05:24	
	17:46					17:55			17:57			18:04		18:12	
31	06:09					05:42						05:19			
	17:46					17:55						18:05			
Potential sun hours	357			329		374			372			393		384	
Total, worst case		380					356			228					
Sun reduction		0.60					0.55			0.52					
Oper. time red.		1.00					1.00			1.00					
Wind dir. red.		0.36					0.41			0.49					
Total reduction		0.22					0.22			0.26					
Total, real		84					80			59					

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm) Sun set (hh:mm)	Minutes with flicker	First time (hh:mm) with flicker Last time (hh:mm) with flicker	(WTG causing flicker first time) (WTG causing flicker last time)

SHADOW - Calendar

Calculation: 0575014 - Loi Hai Real Case - Green Mode Shadow receptor: 362 - Shadow Receptor: 1.0 × 1.0 Azimuth: 0.0° Slope: 90.0° (1343)

Assumptions for shadow calculations

Sunshine probability S (Average daily sunshine hours) []

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
6.94	7.86	6.61	6.50	5.65	5.33	4.03	4.19	3.33	4.68	5.67	6.13

Operational time

N	NNE	ENE	E	ESE	SSE	S	SSW	WSW	W	WNW	NNW	Sum
4,347	1,305	385	237	166	149	140	105	105	96	96	1,629	8,760

	July	August			September			October			November			December		
1	05:24	05:31			05:34		17:22 (1)	05:33		16:56 (2)	05:37			05:49		16:42 (4)
	18:12	18:10			17:55	16	17:38 (1)	17:35	22	17:18 (2)	17:19			17:18	18	17:00 (4)
2	05:24	05:32			05:34		17:23 (1)	05:33		16:57 (2)	05:37			05:49		16:42 (4)
	18:12	18:10			17:54	14	17:37 (1)	17:34	20	17:17 (2)	17:19			17:18	17	16:59 (4)
3	05:24	05:32			05:34		17:24 (1)	05:33		16:58 (2)	05:37			05:50		16:42 (4)
	18:12	18:09			17:54	12	17:36 (1)	17:34	18	17:16 (2)	17:19			17:18	18	17:00 (4)
4	05:25	05:32			05:34		17:25 (1)	05:33		17:00 (2)	05:37			05:50		16:42 (4)
	18:12	18:09			17:53	11	17:36 (1)	17:33	14	17:14 (2)	17:18			17:18	18	17:00 (4)
5	05:25	05:32			05:34			05:33		17:03 (2)	05:38			05:51		16:43 (4)
	18:12	18:09			17:52			17:33	7	17:10 (2)	17:18			17:19	18	17:01 (4)
6	05:25	05:32			05:34			05:33			05:38			05:51		16:43 (4)
	18:13	18:08			17:52			17:32			17:18			17:19	17	17:00 (4)
7	05:25	05:32			05:34			05:33			05:38			05:52		16:44 (4)
	18:13	18:08			17:51			17:31			17:18			17:19	17	17:01 (4)
8	05:26	05:32			05:34			05:33			05:39			05:52		16:44 (4)
	18:13	18:07			17:51			17:31			17:17			17:20	17	17:01 (4)
9	05:26	05:33			05:34			05:33			05:39			05:53		16:45 (4)
	18:13	18:07			17:50			17:30			17:17			17:20	17	17:02 (4)
10	05:26	05:33			05:34			05:33			05:39			05:53		16:46 (4)
	18:13	18:07			17:49			17:30			17:17			17:20	16	17:02 (4)
11	05:27	05:33			05:34			05:33			05:40			05:54		16:46 (4)
	18:13	18:06			17:49			17:29			17:17			17:21	16	17:02 (4)
12	05:27	05:33			05:34			05:34			05:40			05:54		16:47 (4)
	18:13	18:06			17:48			17:28			17:17			17:21	16	17:03 (4)
13	05:27	05:33			05:34			05:34			05:40			05:55		16:47 (4)
	18:13	18:05			17:47			17:28			17:17			17:21	16	17:03 (4)
14	05:27	05:33			05:34			05:34			05:41			05:55		16:48 (4)
	18:13	18:05			17:47			17:27			17:17			17:22	16	17:04 (4)
15	05:28	05:33			05:34			05:34			05:41			05:56		16:48 (4)
	18:13	18:04			17:46			17:27			17:16			17:22	16	17:04 (4)
16	05:28	05:33			05:34			05:34			05:42			05:57		16:49 (4)
	18:13	18:04			17:45			17:26			17:16			17:23	15	17:04 (4)
17	05:28	05:33			05:34			05:34			05:42			05:57		16:49 (4)
	18:13	18:03			17:44			17:26			17:16			17:23	15	17:04 (4)
18	05:28	05:33			05:33		17:08 (2)	05:34			05:42			05:58		16:50 (4)
	18:12	18:03			17:44	9	17:17 (2)	17:25			17:16			17:24	15	17:05 (4)
19	05:29	05:34			05:33		17:04 (2)	05:34			05:43		16:46 (4)	05:58		16:50 (4)
	18:12	18:02			17:43	16	17:20 (2)	17:25			17:16	7	16:53 (4)	17:24	15	17:05 (4)
20	05:29	05:34			05:33		17:02 (2)	05:34			05:43		16:44 (4)	05:59		16:51 (4)
	18:12	18:02			17:42	19	17:21 (2)	17:24			17:16	11	16:55 (4)	17:24	15	17:06 (4)
21	05:29	05:34		17:31 (1)	05:33		17:00 (2)	05:34			05:44		16:43 (4)	05:59		16:51 (4)
	18:12	18:01	8	17:39 (1)	17:42	22	17:22 (2)	17:24			17:16	14	16:57 (4)	17:25	15	17:06 (4)
22	05:29	05:34		17:28 (1)	05:33		16:59 (2)	05:35			05:44		16:42 (4)	06:00		16:52 (4)
	18:12	18:01	13	17:41 (1)	17:41	24	17:23 (2)	17:23			17:16	16	16:58 (4)	17:25	15	17:07 (4)
23	05:30	05:34		17:26 (1)	05:33		16:58 (2)	05:35			05:45		16:42 (4)	06:00		16:52 (4)
	18:12	18:00	17	17:43 (1)	17:40	25	17:23 (2)	17:23			17:16	17	16:59 (4)	17:26	15	17:07 (4)
24	05:30	05:34		17:25 (1)	05:33		16:57 (2)	05:35			05:45		16:41 (4)	06:01		16:52 (4)
	18:12	18:00	17	17:42 (1)	17:40	25	17:22 (2)	17:22			17:17	17	16:58 (4)	17:26	15	17:07 (4)
25	05:30	05:34		17:24 (1)	05:33		16:56 (2)	05:35			05:46		16:41 (4)	06:01		16:53 (4)
	18:11	17:59	18	17:42 (1)	17:39	26	17:22 (2)	17:22			17:17	18	16:59 (4)	17:27	15	17:08 (4)
26	05:30	05:34		17:23 (1)	05:33		16:56 (2)	05:35			05:46		16:41 (4)	06:02		16:53 (4)
	18:11	17:59	18	17:41 (1)	17:38	25	17:21 (2)	17:21			17:17	18	16:59 (4)	17:27	15	17:08 (4)
27	05:30	05:34		17:22 (1)	05:33		16:56 (2)	05:35			05:47		16:41 (4)	06:02		16:54 (4)
	18:11	17:58	19	17:41 (1)	17:38	24	17:20 (2)	17:21			17:17	18	16:59 (4)	17:28	15	17:09 (4)
28	05:31	05:34		17:22 (1)	05:33		16:55 (2)	05:36			05:47		16:41 (4)	06:02		16:54 (4)
	18:11	17:57	18	17:40 (1)	17:37	25	17:20 (2)	17:21			17:17	18	16:59 (4)	17:29	16	17:10 (4)
29	05:31	05:34		17:22 (1)	05:33		16:56 (2)	05:36			05:48		16:41 (4)	06:03		16:55 (4)
	18:11	17:57	17	17:39 (1)	17:36	23	17:19 (2)	17:20			17:17	18	16:59 (4)	17:29	16	17:11 (4)
30	05:31	05:34		17:22 (1)	05:33		16:56 (2)	05:36			05:48		16:41 (4)	06:03		16:55 (4)
	18:10	17:56	17	17:39 (1)	17:36	22	17:18 (2)	17:20			17:17	18	16:59 (4)	17:30	16	17:11 (4)
31	05:31	05:34		17:22 (1)				05:36						06:04		16:55 (4)
	18:10	17:56	16	17:38 (1)				17:20						17:30	16	17:11 (4)
Potential sun hours	395	388			366			368			348			355		
Total, worst case			178			338			81			190			497	
Sun reduction			0.34			0.27			0.39			0.49			0.54	
Oper. time red.			1.00			1.00			1.00			1.00			1.00	
Wind dir. red.			0.49			0.42			0.41			0.36			0.36	
Total reduction			0.17			0.12			0.16			0.18			0.20	
Total, real			29			39			13			34			97	

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm) Sun set (hh:mm)	Minutes with flicker	First time (hh:mm) with flicker Last time (hh:mm) with flicker	(WTG causing flicker first time) (WTG causing flicker last time)

SHADOW - Calendar

Calculation: 0575014 - Loi Hai Real Case - Green Mode Shadow receptor: 365 - Shadow Receptor: 1.0 × 1.0 Azimuth: 0.0° Slope: 90.0° (1290)

Assumptions for shadow calculations

Sunshine probability S (Average daily sunshine hours) []

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
6.94	7.86	6.61	6.50	5.65	5.33	4.03	4.19	3.33	4.68	5.67	6.13

Operational time

N	NNE	ENE	E	ESE	SSE	S	SSW	WSW	W	WNW	NNW	Sum
4,347	1,305	385	237	166	149	140	105	105	96	96	1,629	8,760

	January			February			March	April	May			June		
1	06:04		11:45 (7)	06:09		13:17 (7)	06:00	05:41	05:25			05:19		16:51 (5)
	17:31	151	14:16 (7)	17:47	49	14:06 (7)	17:54	17:55	17:58			18:05	50	17:41 (5)
2	06:05		11:50 (7)	06:09		13:20 (7)	05:59	05:41	05:25			05:19		16:51 (5)
	17:32	145	14:15 (7)	17:47	45	14:05 (7)	17:54	17:55	17:58			18:05	50	17:41 (5)
3	06:05		11:55 (7)	06:09		13:23 (7)	05:59	05:40	05:24			05:19		16:51 (5)
	17:32	141	14:16 (7)	17:47	41	14:04 (7)	17:54	17:56	17:58			18:05	50	17:41 (5)
4	06:05		11:59 (7)	06:09		13:25 (7)	05:58	05:39	05:24			05:19		16:51 (5)
	17:33	137	14:16 (7)	17:48	38	14:03 (7)	17:54	17:56	17:58			18:06	50	17:41 (5)
5	06:06		12:03 (7)	06:08		13:27 (7)	05:58	05:39	05:24		17:07 (5)	05:19		16:51 (5)
	17:33	133	14:16 (7)	17:48	33	14:00 (7)	17:54	17:56	17:58	15	17:22 (5)	18:06	50	17:41 (5)
6	06:06		12:06 (7)	06:08		13:31 (7)	05:57	05:38	05:23		17:03 (5)	05:19		16:51 (5)
	17:34	130	14:16 (7)	17:48	27	13:58 (7)	17:54	17:56	17:59	21	17:24 (5)	18:06	50	17:41 (5)
7	06:06		12:10 (7)	06:08		13:34 (7)	05:56	05:37	05:23		17:01 (5)	05:19		16:51 (5)
	17:34	127	14:17 (7)	17:49	22	13:56 (7)	17:54	17:56	17:59	26	17:27 (5)	18:07	50	17:41 (5)
8	06:07		12:13 (7)	06:08		13:39 (7)	05:56	05:37	05:23		17:00 (5)	05:19		16:52 (5)
	17:35	123	14:16 (7)	17:49	13	13:52 (7)	17:54	17:56	17:59	29	17:29 (5)	18:07	49	17:41 (5)
9	06:07		12:16 (7)	06:08			05:55	05:36	05:22		16:57 (5)	05:20		16:52 (5)
	17:35	120	14:16 (7)	17:49			17:55	17:56	17:59	32	17:29 (5)	18:07	49	17:41 (5)
10	06:07		12:20 (7)	06:07			05:55	05:36	05:22		16:56 (5)	05:20		16:52 (5)
	17:36	117	14:17 (7)	17:50			17:55	17:56	17:59	35	17:31 (5)	18:07	50	17:42 (5)
11	06:08		12:23 (7)	06:07			05:54	05:35	05:22		16:56 (5)	05:20		16:52 (5)
	17:37	114	14:17 (7)	17:50			17:55	17:56	18:00	36	17:32 (5)	18:08	50	17:42 (5)
12	06:08		12:26 (7)	06:07			05:54	05:35	05:21		16:55 (5)	05:20		16:23 (6)
	17:37	111	14:17 (7)	17:50			17:55	17:56	18:00	38	17:33 (5)	18:08	59	17:43 (5)
13	06:08		12:28 (7)	06:06			05:53	05:34	05:21		16:53 (5)	05:20		16:21 (6)
	17:38	108	14:16 (7)	17:51			17:55	17:56	18:00	40	17:33 (5)	18:08	63	17:43 (5)
14	06:08		12:31 (7)	06:06			05:52	05:33	05:21		16:53 (5)	05:20		16:19 (6)
	17:38	105	14:16 (7)	17:51			17:55	17:56	18:00	41	17:34 (5)	18:09	67	17:43 (5)
15	06:08		12:35 (7)	06:06			05:52	05:33	05:21		16:52 (5)	05:20		16:18 (6)
	17:39	102	14:17 (7)	17:51			17:55	17:56	18:00	43	17:35 (5)	18:09	69	17:43 (5)
16	06:09		12:37 (7)	06:05			05:51	05:32	05:21		16:52 (5)	05:21		16:17 (6)
	17:39	99	14:16 (7)	17:51			17:55	17:56	18:01	44	17:36 (5)	18:09	71	17:43 (5)
17	06:09		12:40 (7)	06:05			05:51	05:32	05:20		16:52 (5)	05:21		16:16 (6)
	17:40	96	14:16 (7)	17:52			17:55	17:56	18:01	45	17:37 (5)	18:09	73	17:43 (5)
18	06:09		12:43 (7)	06:05			05:50	05:31	05:20		16:50 (5)	05:21		16:17 (6)
	17:40	93	14:16 (7)	17:52			17:55	17:56	18:01	46	17:36 (5)	18:10	74	17:44 (5)
19	06:09		12:45 (7)	06:04			05:49	05:31	05:20		16:50 (5)	05:21		16:16 (6)
	17:41	90	14:15 (7)	17:52			17:55	17:56	18:01	47	17:37 (5)	18:10	75	17:44 (5)
20	06:09		12:48 (7)	06:04			05:49	05:30	05:20		16:50 (5)	05:21		16:16 (6)
	17:41	87	14:15 (7)	17:52			17:55	17:56	18:02	48	17:38 (5)	18:10	74	17:44 (5)
21	06:09		12:50 (7)	06:03			05:48	05:30	05:20		16:50 (5)	05:22		16:16 (6)
	17:42	84	14:14 (7)	17:52			17:55	17:56	18:02	48	17:38 (5)	18:10	74	17:44 (5)
22	06:09		12:53 (7)	06:03			05:47	05:29	05:20		16:50 (5)	05:22		16:16 (6)
	17:42	81	14:14 (7)	17:53			17:55	17:57	18:02	48	17:38 (5)	18:10	74	17:44 (5)
23	06:09		12:55 (7)	06:03			05:47	05:29	05:19		16:50 (5)	05:22		16:17 (6)
	17:43	78	14:13 (7)	17:53			17:55	17:57	18:02	49	17:39 (5)	18:11	74	17:45 (5)
24	06:09		12:57 (7)	06:02			05:46	05:28	05:19		16:50 (5)	05:22		16:18 (6)
	17:43	76	14:13 (7)	17:53			17:55	17:57	18:03	49	17:39 (5)	18:11	74	17:45 (5)
25	06:09		13:00 (7)	06:02			05:46	05:28	05:19		16:50 (5)	05:22		16:18 (6)
	17:44	72	14:12 (7)	17:53			17:55	17:57	18:03	49	17:39 (5)	18:11	73	17:45 (5)
26	06:09		13:02 (7)	06:01			05:45	05:27	05:19		16:50 (5)	05:23		16:19 (6)
	17:44	69	14:11 (7)	17:53			17:55	17:57	18:03	50	17:40 (5)	18:11	72	17:45 (5)
27	06:09		13:05 (7)	06:01			05:44	05:27	05:19		16:50 (5)	05:23		16:20 (6)
	17:45	66	14:11 (7)	17:53			17:55	17:57	18:03	50	17:40 (5)	18:11	71	17:46 (5)
28	06:09		13:07 (7)	06:00			05:44	05:26	05:19		16:50 (5)	05:23		16:21 (6)
	17:45	63	14:10 (7)	17:54			17:55	17:57	18:04	50	17:40 (5)	18:12	69	17:46 (5)
29	06:09		13:10 (7)				05:43	05:26	05:19		16:50 (5)	05:23		16:23 (6)
	17:45	59	14:09 (7)				17:55	17:57	18:04	50	17:40 (5)	18:12	65	17:46 (5)
30	06:09		13:12 (7)				05:42	05:25	05:19		16:50 (5)	05:24		16:25 (6)
	17:46	56	14:08 (7)				17:55	17:58	18:04	51	17:41 (5)	18:12	61	17:46 (5)
31	06:09		13:15 (7)				05:42		05:19		16:50 (5)			
	17:46	52	14:07 (7)				17:55		18:05	51	17:41 (5)			
Potential sun hours	357			329			374	372	393			384		
Total, worst case		3085			268					1131			1880	
Sun reduction		0.60			0.67					0.45			0.42	
Oper. time red.		1.00			1.00					1.00			1.00	
Wind dir. red.		0.77			0.77					0.59			0.61	
Total reduction		0.46			0.51					0.26			0.25	
Total, real		1412			136					290			470	

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm) Sun set (hh:mm)	Minutes with flicker	First time (hh:mm) with flicker Last time (hh:mm) with flicker	(WTG causing flicker first time) (WTG causing flicker last time)

Licensed user:
ERM
Level 3, 09 Dinh Tien Hoang St
VN-DAKAO WARD, District 1

Phat Tran / phat.tran@erm.com
Calculated:
2/4/2021 1:12 PM/3.4.388

SHADOW - Calendar

Calculation: 0575014 - Loi Hai Real Case - Green Mode Shadow receptor: 365 - Shadow Receptor: 1.0 × 1.0 Azimuth: 0.0° Slope: 90.0° (1290)

Assumptions for shadow calculations

Sunshine probability S (Average daily sunshine hours) []

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
6.94	7.86	6.61	6.50	5.65	5.33	4.03	4.19	3.33	4.68	5.67	6.13

Operational time

N	NNE	ENE	E	ESE	SSE	S	SSW	WSW	W	WNW	NNW	Sum
4,347	1,305	385	237	166	149	140	105	105	96	96	1,629	8,760

	July			August			September	October	November			December		
1	05:24		16:57 (5)	05:31		17:05 (5)	05:34	05:33	05:37			05:49		12:05 (7)
	18:12	50	17:47 (5)	18:10	38	17:43 (5)	17:55	17:35	17:19			17:18	114	13:59 (7)
2	05:24		16:57 (5)	05:32		17:06 (5)	05:34	05:33	05:37			05:49		12:02 (7)
	18:12	50	17:47 (5)	18:10	36	17:42 (5)	17:54	17:35	17:19			17:18	117	13:59 (7)
3	05:25		16:57 (5)	05:32		17:07 (5)	05:34	05:33	05:37		13:07 (7)	05:50		12:00 (7)
	18:12	49	17:46 (5)	18:09	33	17:40 (5)	17:54	17:34	17:19	15	13:22 (7)	17:18	120	14:00 (7)
4	05:25		16:57 (5)	05:32		17:09 (5)	05:34	05:33	05:37		13:04 (7)	05:50		11:58 (7)
	18:12	49	17:46 (5)	18:09	31	17:40 (5)	17:53	17:33	17:18	22	13:26 (7)	17:18	122	14:00 (7)
5	05:25		16:57 (5)	05:32		17:10 (5)	05:34	05:33	05:38		13:00 (7)	05:51		11:55 (7)
	18:12	50	17:47 (5)	18:09	28	17:38 (5)	17:53	17:33	17:18	28	13:28 (7)	17:19	127	14:02 (7)
6	05:25		16:57 (5)	05:32		17:12 (5)	05:34	05:33	05:38		12:57 (7)	05:51		11:52 (7)
	18:13	50	17:47 (5)	18:08	24	17:36 (5)	17:52	17:32	17:18	33	13:30 (7)	17:19	130	14:02 (7)
7	05:26		16:57 (5)	05:32		17:14 (5)	05:34	05:33	05:38		12:55 (7)	05:52		11:50 (7)
	18:13	50	17:47 (5)	18:08	19	17:33 (5)	17:51	17:31	17:18	38	13:33 (7)	17:19	133	14:03 (7)
8	05:26		16:58 (5)	05:33		17:18 (5)	05:34	05:33	05:39		12:52 (7)	05:52		11:47 (7)
	18:13	50	17:48 (5)	18:08	11	17:29 (5)	17:51	17:31	17:18	42	13:34 (7)	17:20	137	14:04 (7)
9	05:26		16:58 (5)	05:33			05:34	05:33	05:39		12:51 (7)	05:53		11:44 (7)
	18:13	50	17:48 (5)	18:07			17:50	17:30	17:17	45	13:36 (7)	17:20	140	14:04 (7)
10	05:26		16:58 (5)	05:33			05:34	05:33	05:39		12:48 (7)	05:53		11:40 (7)
	18:13	50	17:48 (5)	18:07			17:49	17:30	17:17	49	13:37 (7)	17:20	145	14:05 (7)
11	05:27		16:58 (5)	05:33			05:34	05:34	05:40		12:46 (7)	05:54		11:36 (7)
	18:13	50	17:48 (5)	18:06			17:49	17:29	17:17	52	13:38 (7)	17:21	150	14:06 (7)
12	05:27		16:59 (5)	05:33			05:34	05:34	05:40		12:44 (7)	05:54		11:31 (7)
	18:13	50	17:49 (5)	18:06			17:48	17:28	17:17	56	13:40 (7)	17:21	156	14:07 (7)
13	05:27		16:58 (5)	05:33			05:34	05:34	05:40		12:42 (7)	05:55		11:25 (7)
	18:13	51	17:49 (5)	18:05			17:47	17:28	17:17	59	13:41 (7)	17:21	162	14:07 (7)
14	05:27		16:58 (5)	05:33			05:34	05:34	05:41		12:40 (7)	05:56		11:20 (7)
	18:13	51	17:49 (5)	18:05			17:47	17:27	17:17	63	13:43 (7)	17:22	168	14:08 (7)
15	05:28		16:58 (5)	05:33			05:34	05:34	05:41		12:38 (7)	05:56		11:16 (7)
	18:13	50	17:48 (5)	18:05			17:46	17:27	17:17	66	13:44 (7)	17:22	172	14:08 (7)
16	05:28		16:59 (5)	05:33			05:34	05:34	05:42		12:35 (7)	05:57		11:14 (7)
	18:13	50	17:49 (5)	18:04			17:45	17:26	17:17	69	13:44 (7)	17:23	175	14:09 (7)
17	05:28		16:59 (5)	05:33			05:34	05:34	05:42		12:34 (7)	05:57		11:12 (7)
	18:13	50	17:49 (5)	18:04			17:45	17:26	17:16	72	13:46 (7)	17:23	177	14:09 (7)
18	05:28		16:59 (5)	05:34			05:34	05:34	05:42		12:31 (7)	05:58		11:12 (7)
	18:13	50	17:49 (5)	18:03			17:44	17:25	17:16	76	13:47 (7)	17:24	178	14:10 (7)
19	05:29		16:59 (5)	05:34			05:34	05:34	05:43		12:30 (7)	05:58		11:11 (7)
	18:12	49	17:48 (5)	18:03			17:43	17:25	17:16	78	13:48 (7)	17:24	179	14:10 (7)
20	05:29		17:00 (5)	05:34			05:33	05:34	05:43		12:28 (7)	05:59		11:11 (7)
	18:12	49	17:49 (5)	18:02			17:43	17:24	17:16	81	13:49 (7)	17:25	180	14:11 (7)
21	05:29		17:00 (5)	05:34			05:33	05:34	05:44		12:26 (7)	05:59		11:11 (7)
	18:12	49	17:49 (5)	18:01			17:42	17:24	17:16	84	13:50 (7)	17:25	180	14:11 (7)
22	05:29		17:00 (5)	05:34			05:33	05:35	05:44		12:24 (7)	06:00		11:12 (7)
	18:12	48	17:48 (5)	18:01			17:41	17:23	17:16	87	13:51 (7)	17:26	180	14:12 (7)
23	05:30		17:00 (5)	05:34			05:33	05:35	05:45		12:22 (7)	06:00		11:12 (7)
	18:12	48	17:48 (5)	18:00			17:40	17:23	17:17	90	13:52 (7)	17:26	180	14:12 (7)
24	05:30		17:01 (5)	05:34			05:33	05:35	05:45		12:20 (7)	06:01		11:12 (7)
	18:12	47	17:48 (5)	18:00			17:40	17:22	17:17	93	13:53 (7)	17:27	180	14:12 (7)
25	05:30		17:01 (5)	05:34			05:33	05:35	05:46		12:18 (7)	06:01		11:14 (7)
	18:12	47	17:48 (5)	17:59			17:39	17:22	17:17	96	13:54 (7)	17:27	179	14:13 (7)
26	05:30		17:02 (5)	05:34			05:33	05:35	05:46		12:16 (7)	06:02		11:15 (7)
	18:11	45	17:47 (5)	17:59			17:38	17:22	17:17	98	13:54 (7)	17:28	178	14:13 (7)
27	05:31		17:02 (5)	05:34			05:33	05:35	05:47		12:14 (7)	06:02		11:18 (7)
	18:11	44	17:46 (5)	17:58			17:38	17:21	17:17	102	13:56 (7)	17:28	176	14:14 (7)
28	05:31		17:02 (5)	05:34			05:33	05:36	05:47		12:11 (7)	06:03		11:20 (7)
	18:11	44	17:46 (5)	17:58			17:37	17:21	17:17	105	13:56 (7)	17:29	174	14:14 (7)
29	05:31		17:04 (5)	05:34			05:33	05:36	05:48		12:10 (7)	06:03		11:25 (7)
	18:11	42	17:46 (5)	17:57			17:36	17:20	17:17	107	13:57 (7)	17:29	170	14:15 (7)
30	05:31		17:04 (5)	05:34			05:33	05:36	05:48		12:07 (7)	06:03		11:30 (7)
	18:10	41	17:45 (5)	17:56			17:36	17:20	17:18	111	13:58 (7)	17:30	165	14:15 (7)
31	05:31		17:05 (5)	05:34				05:36				06:04		11:37 (7)
	18:10	39	17:44 (5)	17:56				17:20				17:30	158	14:15 (7)
Potential sun hours	395			388			366	368	348			355		
Total, worst case		1492			220					1917			4902	
Sun reduction		0.32			0.34					0.49			0.54	
Oper. time red.		1.00			1.00					1.00			1.00	
Wind dir. red.		0.59			0.59					0.77			0.77	
Total reduction		0.18			0.19					0.37			0.41	
Total, real		272			42					712			1995	

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm) Sun set (hh:mm)	Minutes with flicker	First time (hh:mm) with flicker Last time (hh:mm) with flicker	(WTG causing flicker first time) (WTG causing flicker last time)

SHADOW - Calendar

Calculation: 0575014 - Loi Hai Real Case - Green Mode Shadow receptor: 365 - Shadow Receptor: 1.0 × 1.0 Azimuth: 0.0° Slope: 90.0° (1651)

Assumptions for shadow calculations

Sunshine probability S (Average daily sunshine hours) []

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
6.94	7.86	6.61	6.50	5.65	5.33	4.03	4.19	3.33	4.68	5.67	6.13

Operational time

N	NNE	ENE	E	ESE	SSE	S	SSW	WSW	W	WNW	NNW	Sum
4,347	1,305	385	237	166	149	140	105	105	96	96	1,629	8,760

	January	February	March	April	May	June	July	August	September	October	November	December
1	06:04	06:09	06:00	05:41	05:25	05:19	05:24	05:31	05:34	05:33	05:37	05:49
	17:31	17:47	17:54	17:55	17:58	18:05	18:12	18:10	17:55	17:35	17:19	17:18
2	06:05	06:09	05:59	05:40	05:25	05:19	05:24	05:32	05:34	05:33	05:37	05:49
	17:31	17:47	17:54	17:55	17:58	18:05	18:12	18:10	17:54	17:35	17:19	17:18
3	06:05	06:09	05:59	05:40	05:24	05:19	05:24	05:32	05:34	05:33	05:37	05:50
	17:32	17:47	17:54	17:56	17:58	18:06	18:12	18:09	17:54	17:34	17:19	17:18
4	06:06	06:09	05:58	05:39	05:24	05:19	05:25	05:32	05:34	05:33	05:37	05:50
	17:33	17:48	17:54	17:56	17:58	18:06	18:12	18:09	17:53	17:33	17:18	17:18
5	06:06	06:08	05:58	05:39	05:24	05:19	05:25	05:32	05:34	05:33	05:38	05:51
	17:33	17:48	17:54	17:56	17:58	18:06	18:13	18:09	17:53	17:33	17:18	17:19
6	06:06	06:08	05:57	05:38	05:23	05:19	05:25	05:32	05:34	05:33	05:38	05:51
	17:34	17:48	17:54	17:56	17:59	18:06	18:13	18:08	17:52	17:32	17:18	17:19
7	06:07	06:08	05:56	05:37	05:23	05:19	05:26	05:32	05:34	05:33	05:38	05:52
	17:34	17:49	17:54	17:56	17:59	18:07	18:13	18:08	17:51	17:31	17:18	17:19
8	06:07	06:08	05:56	05:37	05:23	05:19	05:26	05:33	05:34	05:33	05:39	05:52
	17:35	17:49	17:54	17:56	17:59	18:07	18:13	18:08	17:51	17:31	17:18	17:20
9	06:07	06:08	05:55	05:36	05:22	05:20	05:26	05:33	05:34	05:33	05:39	05:53
	17:35	17:49	17:55	17:56	17:59	18:07	18:13	18:07	17:50	17:30	17:17	17:20
10	06:07	06:07	05:55	05:36	05:22	05:20	05:26	05:33	05:34	05:33	05:39	05:53
	17:36	17:50	17:55	17:56	17:59	18:08	18:13	18:07	17:49	17:30	17:17	17:20
11	06:08	06:07	05:54	05:35	05:22	05:20	05:27	05:33	05:34	05:34	05:40	05:54
	17:36	17:50	17:55	17:56	18:00	18:08	18:13	18:06	17:49	17:29	17:17	17:21
12	06:08	06:07	05:54	05:34	05:21	05:20	05:27	05:33	05:34	05:34	05:40	05:55
	17:37	17:50	17:55	17:56	18:00	18:08	18:13	18:06	17:48	17:28	17:17	17:21
13	06:08	06:06	05:53	05:34	05:21	05:20	05:27	05:33	05:34	05:34	05:40	05:55
	17:38	17:51	17:55	17:56	18:00	18:08	18:13	18:05	17:47	17:28	17:17	17:21
14	06:08	06:06	05:52	05:33	05:21	05:20	05:27	05:33	05:34	05:34	05:41	05:56
	17:38	17:51	17:55	17:56	18:00	18:09	18:13	18:05	17:47	17:27	17:17	17:22
15	06:09	06:06	05:52	05:33	05:21	05:20	05:28	05:33	05:34	05:34	05:41	05:56
	17:39	17:51	17:55	17:56	18:00	18:09	18:13	18:05	17:46	17:27	17:17	17:22
16	06:09	06:05	05:51	05:32	05:20	05:21	05:28	05:33	05:34	05:34	05:42	05:57
	17:39	17:51	17:55	17:56	18:01	18:09	18:13	18:04	17:45	17:26	17:16	17:23
17	06:09	06:05	05:51	05:32	05:20	05:21	05:28	05:33	05:34	05:34	05:42	05:57
	17:40	17:52	17:55	17:56	18:01	18:09	18:13	18:04	17:45	17:26	17:16	17:23
18	06:09	06:05	05:50	05:31	05:20	05:21	05:28	05:34	05:34	05:34	05:42	05:58
	17:40	17:52	17:55	17:56	18:01	18:10	18:13	18:03	17:44	17:25	17:16	17:24
19	06:09	06:04	05:49	05:31	05:20	05:21	05:29	05:34	05:33	05:34	05:43	05:58
	17:41	17:52	17:55	17:56	18:01	18:10	18:12	18:03	17:43	17:25	17:16	17:24
20	06:09	06:04	05:49	05:30	05:20	05:21	05:29	05:34	05:33	05:34	05:43	05:59
	17:41	17:52	17:55	17:56	18:02	18:10	18:12	18:02	17:42	17:24	17:16	17:24
21	06:09	06:03	05:48	05:30	05:20	05:21	05:29	05:34	05:33	05:34	05:44	05:59
	17:42	17:52	17:55	17:57	18:02	18:10	18:12	18:01	17:42	17:24	17:16	17:25
22	06:09	06:03	05:47	05:29	05:20	05:22	05:29	05:34	05:33	05:35	05:44	06:00
	17:42	17:53	17:55	17:57	18:02	18:11	18:12	18:01	17:41	17:23	17:16	17:25
23	06:09	06:03	05:47	05:29	05:19	05:22	05:30	05:34	05:33	05:35	05:45	06:00
	17:43	17:53	17:55	17:57	18:02	18:11	18:12	18:00	17:40	17:23	17:17	17:26
24	06:09	06:02	05:46	05:28	05:19	05:22	05:30	05:34	05:33	05:35	05:45	06:01
	17:43	17:53	17:55	17:57	18:03	18:11	18:12	18:00	17:40	17:22	17:17	17:26
25	06:09	06:02	05:46	05:28	05:19	05:22	05:30	05:34	05:33	05:35	05:46	06:01
	17:44	17:53	17:55	17:57	18:03	18:11	18:12	17:59	17:39	17:22	17:17	17:27
26	06:09	06:01	05:45	05:27	05:19	05:23	05:30	05:34	05:33	05:35	05:46	06:02
	17:44	17:53	17:55	17:57	18:03	18:11	18:11	17:59	17:38	17:21	17:17	17:28
27	06:09	06:01	05:44	05:27	05:19	05:23	05:30	05:34	05:33	05:36	05:47	06:02
	17:44	17:53	17:55	17:57	18:04	18:11	18:11	17:58	17:38	17:21	17:17	17:28
28	06:09	06:00	05:44	05:26	05:19	05:23	05:31	05:34	05:33	05:36	05:47	06:03
	17:45	17:54	17:55	17:57	18:04	18:12	18:11	17:58	17:37	17:21	17:17	17:29
29	06:09		05:43	05:26	05:19	05:23	05:31	05:34	05:33	05:36	05:48	06:03
	17:45		17:55	17:57	18:04	18:12	18:11	17:57	17:36	17:20	17:17	17:29
30	06:09		05:42	05:25	05:19	05:24	05:31	05:34	05:33	05:36	05:48	06:03
	17:46		17:55	17:58	18:04	18:12	18:10	17:56	17:36	17:20	17:17	17:30
31	06:09		05:42		05:19		05:31	05:34		05:36		06:04
	17:46		17:55		18:05		18:10	17:56		17:20		17:30
Potential sun hours	357	329	374	372	393	384	395	388	366	368	348	355
Total, worst case												
Sun reduction												
Oper. time red.												
Wind dir. red.												
Total reduction												
Total, real												

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm) Sun set (hh:mm)	Minutes with flicker	First time (hh:mm) with flicker Last time (hh:mm) with flicker	(WTG causing flicker first time) (WTG causing flicker last time)

Licensed user:
ERM
Level 3, 09 Dinh Tien Hoang St
VN-DAKAO WARD, District 1

Phat Tran / phat.tran@erm.com
Calculated:
2/4/2021 1:12 PM/3.4.388

SHADOW - Calendar

Calculation: 0575014 - Loi Hai Real Case - Green Mode Shadow receptor: 367 - Shadow Receptor: 1.0 × 1.0 Azimuth: 0.0° Slope: 90.0° (1291)

Assumptions for shadow calculations

Sunshine probability S (Average daily sunshine hours) []

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
6.94	7.86	6.61	6.50	5.65	5.33	4.03	4.19	3.33	4.68	5.67	6.13

Operational time

N	NNE	ENE	E	ESE	SSE	S	SSW	WSW	W	WNW	NNW	Sum
4,347	1,305	385	237	166	149	140	105	105	96	96	1,629	8,760

	January	February	March	April	May	June	July	August	September	October	November	December
1	06:04	06:09	06:00	05:41	05:25	16:43 (5)	05:19	14:38 (6)	05:24	14:41 (6)	05:31	15:10 (6)	05:34	05:33	05:37	05:49
	17:31	17:47	17:54	17:55	17:58 41	17:24 (5)	18:05 150	17:35 (5)	18:12 156	17:39 (5)	18:10 86	17:42 (5)	17:55	17:35	17:19	17:18
2	06:05	06:09	05:59	05:41	05:25	16:42 (5)	05:19	14:38 (6)	05:24	14:42 (6)	05:32	15:14 (6)	05:34	05:33	05:37	05:49
	17:32	17:47	17:54	17:55	17:58 44	17:26 (5)	18:05 151	17:35 (5)	18:12 155	17:39 (5)	18:10 75	17:41 (5)	17:54	17:35	17:19	17:18
3	06:05	06:09	05:59	05:40	05:24	16:40 (5)	05:19	14:38 (6)	05:25	14:42 (6)	05:32	16:45 (5)	05:34	05:33	05:37	05:50
	17:32	17:47	17:54	17:56	17:58 46	17:26 (5)	18:05 152	17:35 (5)	18:12 155	17:39 (5)	18:09 56	17:41 (5)	17:54	17:34	17:19	17:18
4	06:05	06:09	05:58	05:39	05:24	16:39 (5)	05:19	14:38 (6)	05:25	14:42 (6)	05:32	16:46 (5)	05:34	05:33	05:37	05:50
	17:33	17:48	17:54	17:56	17:58 48	17:27 (5)	18:06 153	17:35 (5)	18:12 155	17:39 (5)	18:09 55	17:41 (5)	17:53	17:33	17:18	17:18
5	06:06	06:08	05:58	05:39	05:24	16:39 (5)	05:19	14:37 (6)	05:25	14:43 (6)	05:32	16:47 (5)	05:34	05:33	05:38	05:51
	17:33	17:48	17:54	17:56	17:58 50	17:29 (5)	18:06 154	17:35 (5)	18:13 154	17:40 (5)	18:09 53	17:40 (5)	17:53	17:33	17:18	17:19
6	06:06	06:08	05:57	05:38	05:23	16:37 (5)	05:19	14:37 (6)	05:25	14:43 (6)	05:32	16:47 (5)	05:34	05:33	05:38	05:51
	17:34	17:48	17:54	17:56	17:59 52	17:29 (5)	18:06 154	17:35 (5)	18:13 154	17:41 (5)	18:08 52	17:39 (5)	17:52	17:32	17:18	17:19
7	06:06	06:08	05:56	05:37	05:23	16:37 (5)	05:19	14:37 (6)	05:26	14:43 (6)	05:32	16:47 (5)	05:34	05:33	05:38	05:52
	17:34	17:49	17:54	17:56	17:59 53	17:30 (5)	18:07 154	17:34 (5)	18:13 154	17:41 (5)	18:08 51	17:38 (5)	17:51	17:31	17:18	17:19
8	06:07	06:08	05:56	05:37	05:23	16:37 (5)	05:19	14:37 (6)	05:26	14:45 (6)	05:33	16:48 (5)	05:34	05:33	05:39	05:52
	17:35	17:49	17:54	17:56	17:59 53	17:30 (5)	18:07 154	17:34 (5)	18:13 153	17:42 (5)	18:08 49	17:37 (5)	17:51	17:31	17:18	17:20
9	06:07	06:08	05:55	05:36	05:22	16:35 (5)	05:20	14:37 (6)	05:26	14:45 (6)	05:33	16:49 (5)	05:34	05:33	05:39	05:53
	17:35	17:49	17:55	17:56	17:59 55	17:30 (5)	18:07 155	17:34 (5)	18:13 152	17:42 (5)	18:07 47	17:36 (5)	17:50	17:30	17:17	17:20
10	06:07	06:07	05:55	05:36	05:22	16:35 (5)	05:20	14:37 (6)	05:26	14:45 (6)	05:33	16:49 (5)	05:34	05:33	05:39	05:53
	17:36	17:50	17:55	17:56	17:59 56	17:31 (5)	18:07 155	17:34 (5)	18:13 151	17:42 (5)	18:07 46	17:35 (5)	17:49	17:30	17:17	17:20
11	06:08	06:07	05:54	05:35	05:22	15:02 (6)	05:20	14:36 (6)	05:27	14:45 (6)	05:33	16:51 (5)	05:34	05:34	05:40	05:54
	17:37	17:50	17:55	17:56	18:00 81	17:32 (5)	18:08 156	17:34 (5)	18:13 151	17:42 (5)	18:06 43	17:34 (5)	17:49	17:29	17:17	17:21
12	06:08	06:07	05:54	05:35	05:21	14:58 (6)	05:20	14:37 (6)	05:27	14:47 (6)	05:33	16:52 (5)	05:34	05:34	05:40	05:54
	17:37	17:50	17:55	17:56	18:00 90	17:32 (5)	18:08 156	17:35 (5)	18:13 150	17:43 (5)	18:06 41	17:33 (5)	17:48	17:28	17:17	17:21
13	06:08	06:06	05:53	05:34	05:21	14:55 (6)	05:20	14:37 (6)	05:27	14:47 (6)	05:33	16:53 (5)	05:34	05:34	05:40	05:55
	17:38	17:51	17:55	17:56	18:00 98	17:32 (5)	18:08 157	17:35 (5)	18:13 149	17:43 (5)	18:05 38	17:31 (5)	17:47	17:28	17:17	17:21
14	06:08	06:06	05:52	05:33	05:21	14:53 (6)	05:20	14:37 (6)	05:27	14:47 (6)	05:33	16:55 (5)	05:34	05:34	05:41	05:56
	17:38	17:51	17:55	17:56	18:00 103	17:32 (5)	18:09 157	17:35 (5)	18:13 147	17:43 (5)	18:05 34	17:29 (5)	17:47	17:27	17:17	17:22
15	06:08	06:06	05:52	05:33	05:21	14:51 (6)	05:20	14:37 (6)	05:28	14:48 (6)	05:33	16:56 (5)	05:34	05:34	05:41	05:56
	17:39	17:51	17:55	17:56	18:00 109	17:33 (5)	18:09 157	17:35 (5)	18:13 145	17:43 (5)	18:05 31	17:27 (5)	17:46	17:27	17:17	17:22
16	06:09	06:05	05:51	05:32	05:21	14:49 (6)	05:21	14:37 (6)	05:28	14:49 (6)	05:33	16:58 (5)	05:34	05:34	05:42	05:57
	17:39	17:51	17:55	17:56	18:01 114	17:33 (5)	18:09 158	17:35 (5)	18:13 144	17:44 (5)	18:04 26	17:24 (5)	17:45	17:26	17:17	17:23
17	06:09	06:05	05:51	05:32	05:20	14:48 (6)	05:21	14:37 (6)	05:28	14:49 (6)	05:34	17:01 (5)	05:34	05:34	05:42	05:57
	17:40	17:52	17:55	17:56	18:01 118	17:33 (5)	18:09 158	17:35 (5)	18:13 143	17:43 (5)	18:04 19	17:20 (5)	17:45	17:26	17:16	17:23
18	06:09	06:05	05:50	05:31	05:20	14:46 (6)	05:21	14:38 (6)	05:28	14:50 (6)	05:34	17:07 (5)	05:34	05:34	05:42	05:58
	17:40	17:52	17:55	17:56	18:01 122	17:33 (5)	18:10 158	17:36 (5)	18:13 140	17:43 (5)	18:03 7	17:14 (5)	17:44	17:25	17:16	17:24
19	06:09	06:04	05:49	05:31	05:20	14:45 (6)	05:21	14:38 (6)	05:29	14:50 (6)	05:34		05:34	05:34	05:43	05:58
	17:41	17:52	17:55	17:56	18:01 125	17:33 (5)	18:10 157	17:36 (5)	18:12 139	17:43 (5)	18:03		17:43	17:25	17:16	17:24
20	06:09	06:04	05:49	05:30	05:20	14:44 (6)	05:21	14:38 (6)	05:29	14:52 (6)	05:34		05:33	05:34	05:43	05:59
	17:41	17:52	17:55	17:56	18:02 128	17:33 (5)	18:10 157	17:36 (5)	18:12 137	17:44 (5)	18:02		17:43	17:24	17:16	17:25
21	06:09	06:03	05:48	05:30	05:20	14:44 (6)	05:22	14:38 (6)	05:29	14:53 (6)	05:34		05:33	05:34	05:44	05:59
	17:42	17:52	17:55	17:57	18:02 131	17:34 (5)	18:10 157	17:36 (5)	18:12 135	17:44 (5)	18:01		17:42	17:24	17:16	17:25
22	06:09	06:03	05:47	05:29	05:20	14:43 (6)	05:22	14:38 (6)	05:29	14:53 (6)	05:34		05:33	05:35	05:44	06:00
	17:42	17:53	17:55	17:57	18:02 134	17:34 (5)	18:10 157	17:36 (5)	18:12 133	17:44 (5)	18:01		17:41	17:23	17:17	17:26
23	06:09	06:03	05:47	05:29	05:19	14:42 (6)	05:22	14:39 (6)	05:30	14:54 (6)	05:34		05:33	05:35	05:45	06:00
	17:43	17:53	17:55	17:57	18:02 136	17:34 (5)	18:11 157	17:37 (5)	18:12 130	17:44 (5)	18:00		17:40	17:23	17:17	17:26
24	06:09	06:02	05:46	05:28	05:19	14:42 (6)	05:22	14:39 (6)	05:30	14:56 (6)	05:34		05:33	05:35	05:45	06:01
	17:43	17:53	17:55	17:57	18:03 137	17:34 (5)	18:11 157	17:37 (5)	18:12 126	17:44 (5)	18:00		17:40	17:22	17:17	17:27
25	06:09	06:02	05:46	05:28	17:00 (5) 05:19	14:41 (6)	05:22	14:39 (6)	05:30	14:57 (6)	05:34		05:33	05:35	05:46	06:01
	17:44	17:53	17:55	17:57 10	17:10 (5) 18:03	140 17:34 (5)	18:11 158	17:37 (5)	18:12 123	17:44 (5)	17:59		17:39	17:22	17:17	17:27
26	06:09	06:01	05:45	05:27	16:54 (5) 05:19	14:41 (6)	05:23	14:39 (6)	05:30	14:58 (6)	05:34		05:33	05:35	05:46	06:02
	17:44	17:53	17:55	17:57 20	17:14 (5) 18:03	141 17:34 (5)	18:11 158	17:37 (5)	18:11 120	17:44 (5)	17:59		17:38	17:22	17:17	17:28
27	06:09	06:01	05:44	05:27	16:51 (5) 05:19	14:40 (6)	05:23	14:40 (6)	05:31	14:59 (6)	05:34		05:33	05:35	05:47	06:02
	17:45	17:53	17:55	17:57 27	17:18 (5) 18:03	144 17:34 (5)	18:11 157	17:38 (5)	18:11 116	17:43 (5)	17:58		17:38	17:21	17:17	17:28
28	06:09	06:00	05:44	05:26	16:48 (5) 05:19	14:40 (6)	05:23	14:40 (6)	05:31	15:00 (6)	05:34		05:33	05:36	05:47	06:03
	17:45	17:54	17:55	17:57 31	17:19 (5) 18:04	145 17:35 (5)	18:12 157	17:38 (5)	18:11 112	17:43 (5)	17:58		17:37	17:21	17:17	17:29
29	06:09		05:43	05:26	16:46 (5) 05:19	14:39 (6)	05:23	14:40 (6)	05:31	15:03 (6)	05:34		05:33	05:36	05:48	06:03
	17:45		17:55	17:57 36	17:22 (5) 18:04	147 17:35 (5)	18:12 157	17:38 (5)	18:11 107	17:44 (5)	17:57		17:36	17:20	17:17	17:29
30	06:09		05:42	05:25	16:45 (5) 05:19	14:39 (6)	05:24	14:40 (6)	05:31	15:04 (6)	05:34		05:33	05:36	05:48	06:03
	17:46		17:55	17:58 39	17:24 (5) 18:04	148 17:35 (5)	18:12 157	17:38 (5)	18:10 102	17:43 (5)	17:56		17:36	17:20	17:18	17:30
31	06:09		05:42		05:19	14:39 (6)			05:31	15:07 (6)	05:34			05:36		06:04
	17:46		17:55		18:05 149	17:35 (5)			18:10 95	17:43 (5)	17:56			17:20		17:30
Potential sun hours	357	329	374	372	393	384	395	388	366	368	348	355
Total, worst case				163	3138	4675	4283	809				
Sun reduction				0.52	0.45	0.42	0.32	0.34				
Oper. time red.				1.00	1.00	1.00	1.00	1.00				
Wind dir. red.				0.57	0.64	0.67	0.66	0.58				
Total reduction				0.30	0.29	0.28	0.21	0.19				
Total, real				48	898	1314	899	156				

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm) Sun set (hh:mm)	Minutes with flicker	First time (hh:mm) with flicker Last time (hh:mm) with flicker	(WTG causing flicker first time) (WTG causing flicker last time)

SHADOW - Calendar

Calculation: 0575014 - Loi Hai Real Case - Green Mode Shadow receptor: 367 - Shadow Receptor: 1.0 × 1.0 Azimuth: 0.0° Slope: 90.0° (1650)

Assumptions for shadow calculations

Sunshine probability S (Average daily sunshine hours) []

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
6.94	7.86	6.61	6.50	5.65	5.33	4.03	4.19	3.33	4.68	5.67	6.13

Operational time

N	NNE	ENE	E	ESE	SSE	S	SSW	WSW	W	WNW	NNW	Sum
4,347	1,305	385	237	166	149	140	105	105	96	96	1,629	8,760

	January	February	March	April	May	June	July	August	September	October	November	December
1	06:04	06:09	06:00	05:41	05:25	05:19	05:24	05:31	05:34	05:33	05:37	05:49
	17:31	17:47	17:54	17:55	17:58	18:05	18:12	18:10	17:55	17:35	17:19	17:18
2	06:05	06:09	05:59	05:40	05:25	05:19	05:24	05:32	05:34	05:33	05:37	05:49
	17:32	17:47	17:54	17:55	17:58	18:05	18:12	18:10	17:54	17:35	17:19	17:18
3	06:05	06:09	05:59	05:40	05:24	05:19	05:24	05:32	05:34	05:33	05:37	05:50
	17:32	17:47	17:54	17:56	17:58	18:06	18:12	18:09	17:54	17:34	17:19	17:18
4	06:06	06:09	05:58	05:39	05:24	05:19	05:25	05:32	05:34	05:33	05:37	05:50
	17:33	17:48	17:54	17:56	17:58	18:06	18:12	18:09	17:53	17:33	17:18	17:18
5	06:06	06:08	05:58	05:39	05:24	05:19	05:25	05:32	05:34	05:33	05:38	05:51
	17:33	17:48	17:54	17:56	17:58	18:06	18:13	18:09	17:53	17:33	17:18	17:19
6	06:06	06:08	05:57	05:38	05:23	05:19	05:25	05:32	05:34	05:33	05:38	05:51
	17:34	17:48	17:54	17:56	17:59	18:06	18:13	18:08	17:52	17:32	17:18	17:19
7	06:07	06:08	05:56	05:37	05:23	05:19	05:26	05:32	05:34	05:33	05:38	05:52
	17:34	17:49	17:54	17:56	17:59	18:07	18:13	18:08	17:51	17:31	17:18	17:19
8	06:07	06:08	05:56	05:37	05:23	05:19	05:26	05:33	05:34	05:33	05:39	05:52
	17:35	17:49	17:54	17:56	17:59	18:07	18:13	18:08	17:51	17:31	17:18	17:20
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	17:35	17:49	17:55	17:56	17:59	18:07	18:13	18:07	17:50	17:30	17:17	17:20
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	17:36	17:50	17:55	17:56	17:59	18:08	18:13	18:07	17:49	17:30	17:17	17:20
11	06:08	06:07	05:54	05:35	05:22	05:20	05:27	05:33	05:34	05:34	05:40	05:54
	17:36	17:50	17:55	17:56	18:00	18:08	18:13	18:06	17:49	17:29	17:17	17:21
12	06:08	06:07	05:54	05:34	05:21	05:20	05:27	05:33	05:34	05:34	05:40	05:55
	17:37	17:50	17:55	17:56	18:00	18:08	18:13	18:06	17:48	17:28	17:17	17:21
13	06:08	06:06	05:53	05:34	05:21	05:20	05:27	05:33	05:34	05:34	05:40	05:55
	17:38	17:51	17:55	17:56	18:00	18:08	18:13	18:05	17:47	17:28	17:17	17:21
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	17:38	17:51	17:55	17:56	18:00	18:09	18:13	18:05	17:47	17:27	17:17	17:22
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	17:39	17:51	17:55	17:56	18:00	18:09	18:13	18:05	17:46	17:27	17:17	17:22
16	06:09	06:05	05:51	05:32	05:21	05:21	05:28	05:33	05:34	05:34	05:42	05:57
	17:39	17:51	17:55	17:56	18:01	18:09	18:13	18:04	17:45	17:26	17:16	17:23
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	17:40	17:52	17:55	17:56	18:01	18:09	18:13	18:04	17:45	17:26	17:16	17:23
18	06:09	06:05	05:50	05:31	05:20	05:21	05:28	05:34	05:34	05:34	05:42	05:58
	17:40	17:52	17:55	17:56	18:01	18:10	18:13	18:03	17:44	17:25	17:16	17:24
19	06:09	06:04	05:49	05:31	05:20	05:21	05:29	05:34	05:34	05:34	05:43	05:58
	17:41	17:52	17:55	17:56	18:01	18:10	18:12	18:03	17:43	17:25	17:16	17:24
20	06:09	06:04	05:49	05:30	05:20	05:21	05:29	05:34	05:33	05:34	05:43	05:59
	17:41	17:52	17:55	17:56	18:02	18:10	18:12	18:02	17:43	17:24	17:16	17:24
21	06:09	06:03	05:48	05:30	05:20	05:22	05:29	05:34	05:33	05:34	05:44	05:59
	17:42	17:52	17:55	17:57	18:02	18:10	18:12	18:02	17:42	17:24	17:16	17:25
22	06:09	06:03	05:47	05:29	05:20	05:22	05:29	05:34	05:33	05:35	05:44	06:00
	17:42	17:53	17:55	17:57	18:02	18:11	18:12	18:01	17:41	17:23	17:16	17:25
23	06:09	06:03	05:47	05:29	05:19	05:22	05:30	05:34	05:33	05:35	05:45	06:00
	17:43	17:53	17:55	17:57	18:02	18:11	18:12	18:00	17:40	17:23	17:17	17:26
24	06:09	06:02	05:46	05:28	05:19	05:22	05:30	05:34	05:33	05:35	05:45	06:01
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25	06:09	06:02	05:46	05:28	05:19	05:22	05:30	05:34	05:33	05:35	05:46	06:01
	17:44	17:53	17:55	17:57	18:03	18:11	18:12	17:59	17:39	17:22	17:17	17:27
26	06:09	06:01	05:45	05:27	05:19	05:23	05:30	05:34	05:33	05:35	05:46	06:02
	17:44	17:53	17:55	17:57	18:03	18:11	18:11	17:59	17:38	17:21	17:17	17:28
27	06:09	06:01	05:44	05:27	05:19	05:23	05:30	05:34	05:33	05:36	05:47	06:02
	17:44	17:53	17:55	17:57	18:04	18:11	18:11	17:58	17:38	17:21	17:17	17:28
28	06:09	06:00	05:44	05:26	05:19	05:23	05:31	05:34	05:33	05:36	05:47	06:03
	17:45	17:54	17:55	17:57	18:04	18:12	18:11	17:58	17:37	17:21	17:17	17:29
29	06:09		05:43	05:26	05:19	05:23	05:31	05:34	05:33	05:36	05:48	06:03
	17:45		17:55	17:57	18:04	18:12	18:11	17:57	17:36	17:20	17:17	17:29
30	06:09		05:42	05:25	05:19	05:24	05:31	05:34	05:33	05:36	05:48	06:03
	17:46		17:55	17:58	18:04	18:12	18:10	17:56	17:36	17:20	17:17	17:30
31	06:09		05:42		05:19		05:31	05:34		05:36		06:04
	17:46		17:55		18:05		18:10	17:56		17:20		17:30
Potential sun hours	357	329	374	372	393	384	395	388	366	368	348	355
Total, worst case												
Sun reduction												
Oper. time red.												
Wind dir. red.												
Total reduction												
Total, real												

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm) Sun set (hh:mm)	Minutes with flicker	First time (hh:mm) with flicker Last time (hh:mm) with flicker	(WTG causing flicker first time) (WTG causing flicker last time)

SHADOW - Calendar

Calculation: 0575014 - Loi Hai Real Case - Green Mode Shadow receptor: 368 - Shadow Receptor: 1.0 × 1.0 Azimuth: 0.0° Slope: 90.0° (1293)

Assumptions for shadow calculations

Sunshine probability S (Average daily sunshine hours) []

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
6.94	7.86	6.61	6.50	5.65	5.33	4.03	4.19	3.33	4.68	5.67	6.13

Operational time

N	NNE	ENE	E	ESE	SSE	S	SSW	WSW	W	WNW	NNW	Sum
4,347	1,305	385	237	166	149	140	105	105	96	96	1,629	8,760

	January	February	March		April		May		June		
1	06:04	06:09	06:00		05:41		14:08 (6)	05:25		14:00 (6)	05:19		13:58 (6)
	17:31	17:47	17:54		17:55	121	16:09 (6)	17:58	210	17:30 (5)	18:05	157	16:35 (6)
2	06:05	06:09	05:59		05:41		14:08 (6)	05:25		14:00 (6)	05:19		13:58 (6)
	17:32	17:47	17:54		17:55	123	16:11 (6)	17:58	210	17:30 (5)	18:05	157	16:35 (6)
3	06:05	06:09	05:59		05:40		14:07 (6)	05:24		14:00 (6)	05:19		13:58 (6)
	17:32	17:47	17:54		17:56	125	16:12 (6)	17:58	209	17:29 (5)	18:05	157	16:35 (6)
4	06:05	06:09	05:58		05:39		14:07 (6)	05:24		14:00 (6)	05:19		13:58 (6)
	17:33	17:48	17:54		17:56	126	16:13 (6)	17:58	209	17:29 (5)	18:06	157	16:35 (6)
5	06:06	06:08	05:58		05:39		14:07 (6)	05:24		14:00 (6)	05:19		13:58 (6)
	17:33	17:48	17:54		17:56	128	16:15 (6)	17:58	209	17:29 (5)	18:06	157	16:35 (6)
6	06:06	06:08	05:57		05:38		14:06 (6)	05:23		13:59 (6)	05:19		13:58 (6)
	17:34	17:48	17:54		17:56	136	17:08 (5)	17:59	209	17:28 (5)	18:06	158	16:36 (6)
7	06:06	06:08	05:56		05:37		14:05 (6)	05:23		13:59 (6)	05:19		13:58 (6)
	17:34	17:49	17:54		17:56	152	17:14 (5)	17:59	208	17:27 (5)	18:07	158	16:36 (6)
8	06:07	06:08	05:56		05:37		14:06 (6)	05:23		13:59 (6)	05:19		13:58 (6)
	17:35	17:49	17:54		17:56	159	17:18 (5)	17:59	208	17:27 (5)	18:07	158	16:36 (6)
9	06:07	06:08	05:55		05:36		14:05 (6)	05:22		13:58 (6)	05:20		13:58 (6)
	17:35	17:49	17:55		17:56	166	17:20 (5)	17:59	208	17:26 (5)	18:07	158	16:36 (6)
10	06:07	06:07	05:55		05:36		14:05 (6)	05:22		13:59 (6)	05:20		13:58 (6)
	17:36	17:50	17:55		17:56	171	17:22 (5)	17:59	207	17:26 (5)	18:07	158	16:36 (6)
11	06:08	06:07	05:54		05:35		14:05 (6)	05:22		13:59 (6)	05:20		13:58 (6)
	17:37	17:50	17:55		17:56	175	17:23 (5)	18:00	206	17:25 (5)	18:08	158	16:36 (6)
12	06:08	06:07	05:54		05:35		14:04 (6)	05:21		13:59 (6)	05:20		13:59 (6)
	17:37	17:50	17:55		17:56	180	17:24 (5)	18:00	205	17:25 (5)	18:08	158	16:37 (6)
13	06:08	06:06	05:53	14:45 (6)	05:34		14:04 (6)	05:21		13:58 (6)	05:20		13:59 (6)
	17:38	17:51	17:55	27	15:12 (6)	17:56	184	17:26 (5)	18:00	204	17:23 (5)	18:08	158	16:37 (6)
14	06:08	06:06	05:52	14:38 (6)	05:33		14:04 (6)	05:21		13:58 (6)	05:20		13:59 (6)
	17:38	17:51	17:55	44	15:22 (6)	17:56	186	17:26 (5)	18:00	204	17:23 (5)	18:09	158	16:37 (6)
15	06:08	06:06	05:52	14:33 (6)	05:33		14:04 (6)	05:21		13:58 (6)	05:20		13:59 (6)
	17:39	17:51	17:55	54	15:27 (6)	17:56	190	17:28 (5)	18:00	202	17:22 (5)	18:09	158	16:37 (6)
16	06:09	06:05	05:51	14:28 (6)	05:32		14:03 (6)	05:21		13:58 (6)	05:21		13:59 (6)
	17:39	17:51	17:55	64	15:32 (6)	17:56	193	17:28 (5)	18:01	201	17:22 (5)	18:09	158	16:37 (6)
17	06:09	06:05	05:51	14:26 (6)	05:32		14:04 (6)	05:20		13:58 (6)	05:21		13:59 (6)
	17:40	17:52	17:55	71	15:37 (6)	17:56	194	17:29 (5)	18:01	200	17:21 (5)	18:09	158	16:37 (6)
18	06:09	06:05	05:50	14:23 (6)	05:31		14:03 (6)	05:20		13:57 (6)	05:21		14:00 (6)
	17:40	17:52	17:55	77	15:40 (6)	17:56	196	17:29 (5)	18:01	198	17:19 (5)	18:10	158	16:38 (6)
19	06:09	06:04	05:49	14:20 (6)	05:31		14:03 (6)	05:20		13:57 (6)	05:21		14:00 (6)
	17:41	17:52	17:55	83	15:43 (6)	17:56	199	17:30 (5)	18:01	197	17:19 (5)	18:10	158	16:38 (6)
20	06:09	06:04	05:49	14:19 (6)	05:30		14:03 (6)	05:20		13:57 (6)	05:21		14:00 (6)
	17:41	17:52	17:55	87	15:46 (6)	17:56	200	17:30 (5)	18:02	196	17:18 (5)	18:10	158	16:38 (6)
21	06:09	06:03	05:48	14:17 (6)	05:30		14:03 (6)	05:20		13:57 (6)	05:22		14:00 (6)
	17:42	17:52	17:55	92	15:49 (6)	17:57	202	17:31 (5)	18:02	194	17:17 (5)	18:10	158	16:38 (6)
22	06:09	06:03	05:47	14:16 (6)	05:29		14:02 (6)	05:20		13:57 (6)	05:22		14:00 (6)
	17:42	17:53	17:55	96	15:52 (6)	17:57	203	17:30 (5)	18:02	191	17:16 (5)	18:10	158	16:38 (6)
23	06:09	06:03	05:47	14:15 (6)	05:29		14:02 (6)	05:19		13:57 (6)	05:22		14:01 (6)
	17:43	17:53	17:55	99	15:54 (6)	17:57	205	17:31 (5)	18:02	189	17:15 (5)	18:11	158	16:39 (6)
24	06:09	06:02	05:46	14:13 (6)	05:28		14:02 (6)	05:19		13:57 (6)	05:22		14:01 (6)
	17:43	17:53	17:55	103	15:56 (6)	17:57	206	17:31 (5)	18:03	188	17:14 (5)	18:11	158	16:39 (6)
25	06:09	06:02	05:46	14:13 (6)	05:28		14:02 (6)	05:19		13:57 (6)	05:22		14:01 (6)
	17:44	17:53	17:55	106	15:59 (6)	17:57	207	17:31 (5)	18:03	184	17:12 (5)	18:11	158	16:39 (6)
26	06:09	06:01	05:45	14:12 (6)	05:27		14:01 (6)	05:19		13:58 (6)	05:23		14:01 (6)
	17:44	17:53	17:55	108	16:00 (6)	17:57	208	17:30 (5)	18:03	180	17:11 (5)	18:11	158	16:39 (6)
27	06:09	06:01	05:44	14:11 (6)	05:27		14:01 (6)	05:19		13:58 (6)	05:23		14:02 (6)
	17:45	17:53	17:55	111	16:02 (6)	17:57	208	17:31 (5)	18:03	177	17:09 (5)	18:11	158	16:40 (6)
28	06:09	06:00	05:44	14:10 (6)	05:26		14:01 (6)	05:19		13:58 (6)	05:23		14:02 (6)
	17:45	17:54	17:55	114	16:04 (6)	17:57	208	17:30 (5)	18:04	172	17:07 (5)	18:12	158	16:40 (6)
29	06:09		05:43	14:10 (6)	05:26		14:01 (6)	05:19		13:58 (6)	05:23		14:02 (6)
	17:45		17:55	115	16:05 (6)	17:57	209	17:30 (5)	18:04	167	17:04 (5)	18:12	158	16:40 (6)
30	06:09		05:42	14:09 (6)	05:25		14:01 (6)	05:19		13:58 (6)	05:24		14:02 (6)
	17:46		17:55	117	16:06 (6)	17:58	210	17:31 (5)	18:04	157	16:35 (6)	18:12	158	16:40 (6)
31	06:09		05:42	14:09 (6)					05:19		13:58 (6)			
	17:46		17:55	119	16:08 (6)				18:05	157	16:35 (6)			
Potential sun hours	357	329	374		372		393		384		
Total, worst case				1687		5370		6056		4735	
Sun reduction				0.55		0.52		0.45		0.42	
Oper. time red.				1.00		1.00		1.00		1.00	
Wind dir. red.				0.55		0.54		0.54		0.55	
Total reduction				0.30		0.28		0.24		0.23	
Total, real				511		1529		1468		1091	

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm) Sun set (hh:mm)	Minutes with flicker	First time (hh:mm) with flicker Last time (hh:mm) with flicker	(WTG causing flicker first time) (WTG causing flicker last time)

SHADOW - Calendar

Calculation: 0575014 - Loi Hai Real Case - Green Mode Shadow receptor: 368 - Shadow Receptor: 1.0 × 1.0 Azimuth: 0.0° Slope: 90.0° (1293)

Assumptions for shadow calculations

Sunshine probability S (Average daily sunshine hours) []

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
6.94	7.86	6.61	6.50	5.65	5.33	4.03	4.19	3.33	4.68	5.67	6.13

Operational time

N	NNE	ENE	E	ESE	SSE	S	SSW	WSW	W	WNW	NNW	Sum
4,347	1,305	385	237	166	149	140	105	105	96	96	1,629	8,760

	July		August		September		October		November	December
1	05:24		14:03 (6)	05:31	14:09 (6)	05:34	14:04 (6)	05:33	14:35 (6)	05:37	05:49
	18:12	158	16:41 (6)	18:10 206	17:35 (5)	17:55 175	17:22 (5)	17:35 6	14:41 (6)	17:19	17:18
2	05:24		14:03 (6)	05:32	14:09 (6)	05:34	14:03 (6)	05:33		05:37	05:49
	18:12	158	16:41 (6)	18:10 206	17:35 (5)	17:54 171	17:20 (5)	17:35		17:19	17:18
3	05:25		14:03 (6)	05:32	14:08 (6)	05:34	14:03 (6)	05:33		05:37	05:50
	18:12	158	16:41 (6)	18:09 208	17:36 (5)	17:54 166	17:18 (5)	17:34		17:19	17:18
4	05:25		14:03 (6)	05:32	14:09 (6)	05:34	14:03 (6)	05:33		05:37	05:50
	18:12	158	16:41 (6)	18:09 208	17:37 (5)	17:53 159	17:15 (5)	17:33		17:18	17:18
5	05:25		14:04 (6)	05:32	14:09 (6)	05:34	14:02 (6)	05:33		05:38	05:51
	18:13	158	16:42 (6)	18:09 208	17:37 (5)	17:53 152	17:11 (5)	17:33		17:18	17:19
6	05:25		14:04 (6)	05:32	14:09 (6)	05:34	14:02 (6)	05:33		05:38	05:51
	18:13	158	16:42 (6)	18:08 208	17:37 (5)	17:52 137	17:04 (5)	17:32		17:18	17:19
7	05:26		14:04 (6)	05:32	14:09 (6)	05:34	14:02 (6)	05:33		05:38	05:52
	18:13	158	16:42 (6)	18:08 209	17:38 (5)	17:51 128	16:10 (6)	17:31		17:18	17:19
8	05:26		14:05 (6)	05:33	14:09 (6)	05:34	14:02 (6)	05:33		05:39	05:52
	18:13	157	16:42 (6)	18:08 209	17:38 (5)	17:51 126	16:08 (6)	17:31		17:18	17:20
9	05:26		14:05 (6)	05:33	14:09 (6)	05:34	14:01 (6)	05:33		05:39	05:53
	18:13	157	16:42 (6)	18:07 209	17:38 (5)	17:50 125	16:06 (6)	17:30		17:17	17:20
10	05:26		14:05 (6)	05:33	14:08 (6)	05:34	14:01 (6)	05:33		05:39	05:53
	18:13	157	16:42 (6)	18:07 210	17:38 (5)	17:49 123	16:04 (6)	17:30		17:17	17:20
11	05:27		14:05 (6)	05:33	14:09 (6)	05:34	14:01 (6)	05:34		05:40	05:54
	18:13	157	16:42 (6)	18:06 210	17:39 (5)	17:49 122	16:03 (6)	17:29		17:17	17:21
12	05:27		14:06 (6)	05:33	14:09 (6)	05:34	14:01 (6)	05:34		05:40	05:54
	18:13	157	16:43 (6)	18:06 210	17:39 (5)	17:48 120	16:01 (6)	17:28		17:17	17:21
13	05:27		14:06 (6)	05:33	14:09 (6)	05:34	14:01 (6)	05:34		05:40	05:55
	18:13	157	16:43 (6)	18:05 209	17:38 (5)	17:47 118	15:59 (6)	17:28		17:17	17:21
14	05:27		14:06 (6)	05:33	14:09 (6)	05:34	14:00 (6)	05:34		05:41	05:56
	18:13	163	17:10 (5)	18:05 209	17:38 (5)	17:47 116	15:56 (6)	17:27		17:17	17:22
15	05:28		14:06 (6)	05:33	14:09 (6)	05:34	13:59 (6)	05:34		05:41	05:56
	18:13	171	17:14 (5)	18:05 208	17:38 (5)	17:46 114	15:53 (6)	17:27		17:17	17:22
16	05:28		14:07 (6)	05:33	14:08 (6)	05:34	14:00 (6)	05:34		05:42	05:57
	18:13	174	17:17 (5)	18:04 209	17:38 (5)	17:45 111	15:51 (6)	17:26		17:17	17:23
17	05:28		14:07 (6)	05:34	14:08 (6)	05:34	14:00 (6)	05:34		05:42	05:57
	18:13	179	17:19 (5)	18:04 207	17:37 (5)	17:45 109	15:49 (6)	17:26		17:16	17:23
18	05:28		14:07 (6)	05:34	14:08 (6)	05:34	14:00 (6)	05:34		05:42	05:58
	18:13	182	17:21 (5)	18:03 207	17:37 (5)	17:44 106	15:46 (6)	17:25		17:16	17:24
19	05:29		14:06 (6)	05:34	14:08 (6)	05:34	14:00 (6)	05:34		05:43	05:58
	18:12	186	17:22 (5)	18:03 205	17:36 (5)	17:43 103	15:43 (6)	17:25		17:16	17:24
20	05:29		14:07 (6)	05:34	14:07 (6)	05:33	14:01 (6)	05:34		05:43	05:59
	18:12	188	17:24 (5)	18:02 205	17:36 (5)	17:43 100	15:41 (6)	17:24		17:16	17:25
21	05:29		14:07 (6)	05:34	14:07 (6)	05:33	14:01 (6)	05:34		05:44	05:59
	18:12	190	17:25 (5)	18:01 203	17:35 (5)	17:42 97	15:38 (6)	17:24		17:16	17:25
22	05:29		14:07 (6)	05:34	14:07 (6)	05:33	14:02 (6)	05:35		05:44	06:00
	18:12	192	17:26 (5)	18:01 202	17:35 (5)	17:41 93	15:35 (6)	17:23		17:17	17:26
23	05:30		14:07 (6)	05:34	14:06 (6)	05:33	14:03 (6)	05:35		05:45	06:00
	18:12	194	17:27 (5)	18:00 201	17:34 (5)	17:40 88	15:31 (6)	17:23		17:17	17:26
24	05:30		14:08 (6)	05:34	14:06 (6)	05:33	14:04 (6)	05:35		05:45	06:01
	18:12	196	17:29 (5)	18:00 199	17:33 (5)	17:40 84	15:28 (6)	17:22		17:17	17:27
25	05:30		14:08 (6)	05:34	14:06 (6)	05:33	14:05 (6)	05:35		05:46	06:01
	18:12	197	17:30 (5)	17:59 196	17:32 (5)	17:39 79	15:24 (6)	17:22		17:17	17:27
26	05:30		14:08 (6)	05:34	14:06 (6)	05:33	14:07 (6)	05:35		05:46	06:02
	18:11	199	17:31 (5)	17:59 194	17:31 (5)	17:38 73	15:20 (6)	17:22		17:17	17:28
27	05:31		14:08 (6)	05:34	14:05 (6)	05:33	14:09 (6)	05:36		05:47	06:02
	18:11	200	17:31 (5)	17:58 193	17:30 (5)	17:38 66	15:15 (6)	17:21		17:17	17:28
28	05:31		14:08 (6)	05:34	14:05 (6)	05:33	14:12 (6)	05:36		05:47	06:03
	18:11	201	17:32 (5)	17:58 190	17:29 (5)	17:37 58	15:10 (6)	17:21		17:17	17:29
29	05:31		14:09 (6)	05:34	14:05 (6)	05:33	14:16 (6)	05:36		05:48	06:03
	18:11	203	17:34 (5)	17:57 186	17:27 (5)	17:36 48	15:04 (6)	17:20		17:17	17:29
30	05:31		14:09 (6)	05:34	14:04 (6)	05:33	14:22 (6)	05:36		05:48	06:03
	18:10	204	17:34 (5)	17:56 184	17:26 (5)	17:36 34	14:56 (6)	17:20		17:18	17:30
31	05:31		14:09 (6)	05:34	14:04 (6)			05:36			06:04
	18:10	205	17:35 (5)	17:56 180	17:24 (5)			17:20			17:30
Potential sun hours	395			388		366		368		348	355
Total, worst case		5472		6288		3301		6			
Sun reduction		0.32		0.34		0.27		0.39			
Oper. time red.		1.00		1.00		1.00		1.00			
Wind dir. red.		0.55		0.54		0.55		0.55			
Total reduction		0.17		0.18		0.15		0.22			
Total, real		949		1138		496		1			

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm) Sun set (hh:mm)	Minutes with flicker	First time (hh:mm) with flicker Last time (hh:mm) with flicker	(WTG causing flicker first time) (WTG causing flicker last time)

SHADOW - Calendar

Calculation: 0575014 - Loi Hai Real Case - Green Mode Shadow receptor: 368 - Shadow Receptor: 1.0 × 1.0 Azimuth: 0.0° Slope: 90.0° (1653)

Assumptions for shadow calculations

Sunshine probability S (Average daily sunshine hours) []

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
6.94	7.86	6.61	6.50	5.65	5.33	4.03	4.19	3.33	4.68	5.67	6.13

Operational time

N	NNE	ENE	E	ESE	SSE	S	SSW	WSW	W	WNW	NNW	Sum
4,347	1,305	385	237	166	149	140	105	105	96	96	1,629	8,760

	January	February	March	April	May	June	July	August	September	October	November	December
1	06:04	06:09	06:00	05:41	05:25	05:19	05:24	05:31	05:34	05:33	05:37	05:49
	17:31	17:47	17:54	17:55	17:58	18:05	18:12	18:10	17:55	17:35	17:19	17:18
2	06:05	06:09	05:59	05:40	05:25	05:19	05:24	05:32	05:34	05:33	05:37	05:49
	17:31	17:47	17:54	17:55	17:58	18:05	18:12	18:10	17:54	17:35	17:19	17:18
3	06:05	06:09	05:59	05:40	05:24	05:19	05:24	05:32	05:34	05:33	05:37	05:50
	17:32	17:47	17:54	17:56	17:58	18:06	18:12	18:09	17:54	17:34	17:19	17:18
4	06:06	06:09	05:58	05:39	05:24	05:19	05:25	05:32	05:34	05:33	05:37	05:50
	17:33	17:48	17:54	17:56	17:58	18:06	18:12	18:09	17:53	17:33	17:18	17:18
5	06:06	06:08	05:58	05:39	05:24	05:19	05:25	05:32	05:34	05:33	05:38	05:51
	17:33	17:48	17:54	17:56	17:58	18:06	18:13	18:09	17:53	17:33	17:18	17:19
6	06:06	06:08	05:57	05:38	05:23	05:19	05:25	05:32	05:34	05:33	05:38	05:51
	17:34	17:48	17:54	17:56	17:59	18:06	18:13	18:08	17:52	17:32	17:18	17:19
7	06:07	06:08	05:56	05:37	05:23	05:19	05:26	05:32	05:34	05:33	05:38	05:52
	17:34	17:49	17:54	17:56	17:59	18:07	18:13	18:08	17:51	17:31	17:18	17:19
8	06:07	06:08	05:56	05:37	05:23	05:19	05:26	05:33	05:34	05:33	05:39	05:52
	17:35	17:49	17:54	17:56	17:59	18:07	18:13	18:08	17:51	17:31	17:18	17:20
9	06:07	06:08	05:55	05:36	05:22	05:20	05:26	05:33	05:34	05:33	05:39	05:53
	17:35	17:49	17:55	17:56	17:59	18:07	18:13	18:07	17:50	17:30	17:17	17:20
10	06:07	06:07	05:55	05:36	05:22	05:20	05:26	05:33	05:34	05:33	05:39	05:53
	17:36	17:50	17:55	17:56	17:59	18:08	18:13	18:07	17:49	17:30	17:17	17:20
11	06:08	06:07	05:54	05:35	05:22	05:20	05:27	05:33	05:34	05:34	05:40	05:54
	17:36	17:50	17:55	17:56	18:00	18:08	18:13	18:06	17:49	17:29	17:17	17:21
12	06:08	06:07	05:54	05:34	05:21	05:20	05:27	05:33	05:34	05:34	05:40	05:55
	17:37	17:50	17:55	17:56	18:00	18:08	18:13	18:06	17:48	17:28	17:17	17:21
13	06:08	06:06	05:53	05:34	05:21	05:20	05:27	05:33	05:34	05:34	05:40	05:55
	17:38	17:51	17:55	17:56	18:00	18:08	18:13	18:05	17:47	17:28	17:17	17:21
14	06:08	06:06	05:52	05:33	05:21	05:20	05:27	05:33	05:34	05:34	05:41	05:56
	17:38	17:51	17:55	17:56	18:00	18:09	18:13	18:05	17:47	17:27	17:17	17:22
15	06:09	06:06	05:52	05:33	05:21	05:20	05:28	05:33	05:34	05:34	05:41	05:56
	17:39	17:51	17:55	17:56	18:00	18:09	18:13	18:05	17:46	17:27	17:17	17:22
16	06:09	06:05	05:51	05:32	05:20	05:21	05:28	05:33	05:34	05:34	05:42	05:57
	17:39	17:51	17:55	17:56	18:01	18:09	18:13	18:04	17:45	17:26	17:16	17:23
17	06:09	06:05	05:51	05:32	05:20	05:21	05:28	05:33	05:34	05:34	05:42	05:57
	17:40	17:52	17:55	17:56	18:01	18:09	18:13	18:04	17:45	17:26	17:16	17:23
18	06:09	06:05	05:50	05:31	05:20	05:21	05:28	05:34	05:34	05:34	05:42	05:58
	17:40	17:52	17:55	17:56	18:01	18:10	18:13	18:03	17:44	17:25	17:16	17:24
19	06:09	06:04	05:49	05:31	05:20	05:21	05:29	05:34	05:33	05:34	05:43	05:58
	17:41	17:52	17:55	17:56	18:01	18:10	18:12	18:03	17:43	17:25	17:16	17:24
20	06:09	06:04	05:49	05:30	05:20	05:21	05:29	05:34	05:33	05:34	05:43	05:59
	17:41	17:52	17:55	17:56	18:02	18:10	18:12	18:02	17:42	17:24	17:16	17:24
21	06:09	06:03	05:48	05:30	05:20	05:21	05:29	05:34	05:33	05:34	05:44	05:59
	17:42	17:52	17:55	17:57	18:02	18:10	18:12	18:01	17:42	17:24	17:16	17:25
22	06:09	06:03	05:47	05:29	05:20	05:22	05:29	05:34	05:33	05:35	05:44	06:00
	17:42	17:53	17:55	17:57	18:02	18:11	18:12	18:01	17:41	17:23	17:16	17:25
23	06:09	06:03	05:47	05:29	05:19	05:22	05:30	05:34	05:33	05:35	05:45	06:00
	17:43	17:53	17:55	17:57	18:02	18:11	18:12	18:00	17:40	17:23	17:17	17:26
24	06:09	06:02	05:46	05:28	05:19	05:22	05:30	05:34	05:33	05:35	05:45	06:01
	17:43	17:53	17:55	17:57	18:03	18:11	18:12	18:00	17:40	17:22	17:17	17:26
25	06:09	06:02	05:46	05:28	05:19	05:22	05:30	05:34	05:33	05:35	05:46	06:01
	17:44	17:53	17:55	17:57	18:03	18:11	18:12	17:59	17:39	17:22	17:17	17:27
26	06:09	06:01	05:45	05:27	05:19	05:23	05:30	05:34	05:33	05:35	05:46	06:02
	17:44	17:53	17:55	17:57	18:03	18:11	18:11	17:59	17:38	17:21	17:17	17:28
27	06:09	06:01	05:44	05:27	05:19	05:23	05:30	05:34	05:33	05:36	05:47	06:02
	17:44	17:53	17:55	17:57	18:04	18:11	18:11	17:58	17:38	17:21	17:17	17:28
28	06:09	06:00	05:44	05:26	05:19	05:23	05:31	05:34	05:33	05:36	05:47	06:03
	17:45	17:54	17:55	17:57	18:04	18:12	18:11	17:58	17:37	17:21	17:17	17:29
29	06:09		05:43	05:26	05:19	05:23	05:31	05:34	05:33	05:36	05:48	06:03
	17:45		17:55	17:57	18:04	18:12	18:11	17:57	17:36	17:20	17:17	17:29
30	06:09		05:42	05:25	05:19	05:24	05:31	05:34	05:33	05:36	05:48	06:03
	17:46		17:55	17:58	18:04	18:12	18:10	17:56	17:36	17:20	17:17	17:30
31	06:09		05:42		05:19		05:31	05:34		05:36		06:04
	17:46		17:55		18:05		18:10	17:56		17:20		17:30
Potential sun hours	357	329	374	372	393	384	395	388	366	368	348	355
Total, worst case												
Sun reduction												
Oper. time red.												
Wind dir. red.												
Total reduction												
Total, real												

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm) Sun set (hh:mm)	Minutes with flicker	First time (hh:mm) with flicker Last time (hh:mm) with flicker	(WTG causing flicker first time) (WTG causing flicker last time)

SHADOW - Calendar

Calculation: 0575014 - Loi Hai Real Case - Green Mode Shadow receptor: 369 - Shadow Receptor: 1.0 × 1.0 Azimuth: 0.0° Slope: 90.0° (1292)

Assumptions for shadow calculations

Sunshine probability S (Average daily sunshine hours) []

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
6.94	7.86	6.61	6.50	5.65	5.33	4.03	4.19	3.33	4.68	5.67	6.13

Operational time

N	NNE	ENE	E	ESE	SSE	S	SSW	WSW	W	WNW	NNW	Sum
4,347	1,305	385	237	166	149	140	105	105	96	96	1,629	8,760

	January			February		March			April			May			June		
1	06:04		07:05 (7)	06:09		06:00			05:41		07:16 (6)	05:25		06:45 (6)	05:19		06:44 (6)
	17:31	39	07:44 (7)	17:47		17:54			17:55	125	09:21 (6)	17:58	225	17:00 (5)	18:05	259	17:18 (5)
2	06:05		07:06 (7)	06:09		05:59			05:41		07:15 (6)	05:25		06:45 (6)	05:19		06:44 (6)
	17:32	38	07:44 (7)	17:47		17:54			17:55	126	09:21 (6)	17:58	227	17:01 (5)	18:05	260	17:19 (5)
3	06:05		07:08 (7)	06:09		05:59			05:40		07:13 (6)	05:24		06:44 (6)	05:19		06:44 (6)
	17:32	36	07:44 (7)	17:47		17:54			17:56	128	09:21 (6)	17:58	230	17:02 (5)	18:05	260	17:19 (5)
4	06:05		07:09 (7)	06:09		05:58			05:39		07:11 (6)	05:24		06:44 (6)	05:19		06:44 (6)
	17:33	34	07:43 (7)	17:48		17:54			17:56	129	09:20 (6)	17:58	232	17:03 (5)	18:06	260	17:19 (5)
5	06:06		07:10 (7)	06:08		05:58			05:39		07:10 (6)	05:24		06:44 (6)	05:19		06:44 (6)
	17:33	33	07:43 (7)	17:48		17:54			17:56	130	09:20 (6)	17:58	233	17:04 (5)	18:06	261	17:19 (5)
6	06:06		07:12 (7)	06:08		05:57			05:38		07:08 (6)	05:23		06:43 (6)	05:19		06:44 (6)
	17:34	30	07:42 (7)	17:48		17:54			17:56	132	09:20 (6)	17:59	237	17:05 (5)	18:06	261	17:19 (5)
7	06:07		07:14 (7)	06:08		05:56			05:37		07:06 (6)	05:23		06:43 (6)	05:19		06:44 (6)
	17:34	27	07:41 (7)	17:49		17:54			17:56	133	09:19 (6)	17:59	238	17:06 (5)	18:07	262	17:20 (5)
8	06:07		07:16 (7)	06:08		05:56			05:37		07:05 (6)	05:23		06:43 (6)	05:19		06:45 (6)
	17:35	24	07:40 (7)	17:49		17:55			17:56	134	09:19 (6)	17:59	240	17:07 (5)	18:07	261	17:20 (5)
9	06:07		07:18 (7)	06:08		05:55			05:36		07:04 (6)	05:22		06:42 (6)	05:20		06:45 (6)
	17:35	20	07:38 (7)	17:49		17:55			17:56	135	09:19 (6)	17:59	241	17:07 (5)	18:07	261	17:20 (5)
10	06:07		07:22 (7)	06:07		05:55			05:36		07:03 (6)	05:22		06:43 (6)	05:20		06:45 (6)
	17:36	15	07:37 (7)	17:50		17:55			17:56	136	09:19 (6)	17:59	242	17:08 (5)	18:07	261	17:20 (5)
11	06:08		07:26 (7)	06:07		05:54		08:24 (6)	05:35		07:01 (6)	05:22		06:43 (6)	05:20		06:45 (6)
	17:37	7	07:33 (7)	17:50		17:55	31	08:55 (6)	17:56	137	09:18 (6)	18:00	244	17:09 (5)	18:08	262	17:20 (5)
12	06:08			06:07		05:54		08:17 (6)	05:35		07:00 (6)	05:21		06:43 (6)	05:20		06:46 (6)
	17:37			17:50		17:55	45	09:02 (6)	17:56	137	09:17 (6)	18:00	245	17:10 (5)	18:08	262	17:21 (5)
13	06:08			06:06		05:53		08:10 (6)	05:34		06:59 (6)	05:21		06:42 (6)	05:20		06:46 (6)
	17:38			17:51		17:55	56	09:06 (6)	17:56	139	09:18 (6)	18:00	247	17:10 (5)	18:08	262	17:21 (5)
14	06:08			06:06		05:52		08:06 (6)	05:33		06:58 (6)	05:21		06:42 (6)	05:20		06:46 (6)
	17:38			17:51		17:55	64	09:10 (6)	17:56	139	09:17 (6)	18:00	247	17:10 (5)	18:09	262	17:21 (5)
15	06:08			06:06		05:52		08:01 (6)	05:33		06:57 (6)	05:21		06:42 (6)	05:20		06:46 (6)
	17:39			17:51		17:55	71	09:12 (6)	17:56	140	09:17 (6)	18:00	248	17:11 (5)	18:09	263	17:22 (5)
16	06:09			06:05		05:51		07:56 (6)	05:32		06:56 (6)	05:21		06:42 (6)	05:21		06:46 (6)
	17:39			17:51		17:55	78	09:14 (6)	17:56	141	09:17 (6)	18:01	251	17:12 (5)	18:09	263	17:22 (5)
17	06:09			06:05		05:51		07:53 (6)	05:32		06:55 (6)	05:20		06:42 (6)	05:21		06:46 (6)
	17:40			17:52		17:55	83	09:16 (6)	17:56	142	09:17 (6)	18:01	252	17:13 (5)	18:09	263	17:22 (5)
18	06:09			06:05		05:50		07:49 (6)	05:31		06:54 (6)	05:20		06:41 (6)	05:21		06:47 (6)
	17:40			17:52		17:55	88	09:17 (6)	17:56	142	09:16 (6)	18:01	252	17:12 (5)	18:10	263	17:23 (5)
19	06:09			06:04		05:49		07:46 (6)	05:31		06:54 (6)	05:20		06:42 (6)	05:21		06:47 (6)
	17:41			17:52		17:55	92	09:18 (6)	17:56	142	09:16 (6)	18:01	253	17:13 (5)	18:10	263	17:23 (5)
20	06:09			06:04		05:49		07:43 (6)	05:30		06:52 (6)	05:20		06:42 (6)	05:21		06:47 (6)
	17:41			17:52		17:55	96	09:19 (6)	17:56	167	16:33 (5)	18:02	253	17:13 (5)	18:10	263	17:23 (5)
21	06:09			06:03		05:48		07:40 (6)	05:30		06:52 (6)	05:20		06:42 (6)	05:22		06:47 (6)
	17:42			17:52		17:55	99	09:19 (6)	17:57	178	16:39 (5)	18:02	254	17:14 (5)	18:10	263	17:23 (5)
22	06:09			06:03		05:47		07:38 (6)	05:29		06:51 (6)	05:20		06:42 (6)	05:22		06:47 (6)
	17:42			17:53		17:55	103	09:21 (6)	17:57	185	16:42 (5)	18:02	255	17:15 (5)	18:10	263	17:23 (5)
23	06:09			06:03		05:47		07:35 (6)	05:29		06:50 (6)	05:19		06:42 (6)	05:22		06:48 (6)
	17:43			17:53		17:55	106	09:21 (6)	17:57	194	16:46 (5)	18:02	256	17:15 (5)	18:11	263	17:24 (5)
24	06:09			06:02		05:46		07:32 (6)	05:28		06:49 (6)	05:19		06:42 (6)	05:22		06:48 (6)
	17:43			17:53		17:55	109	09:21 (6)	17:57	199	16:48 (5)	18:03	256	17:15 (5)	18:11	263	17:24 (5)
25	06:09			06:02		05:46		07:30 (6)	05:28		06:49 (6)	05:19		06:42 (6)	05:22		06:48 (6)
	17:44			17:53		17:55	111	09:21 (6)	17:57	202	16:50 (5)	18:03	257	17:16 (5)	18:11	263	17:24 (5)
26	06:09			06:01		05:45		07:28 (6)	05:27		06:48 (6)	05:19		06:43 (6)	05:23		06:48 (6)
	17:44			17:53		17:55	113	09:21 (6)	17:57	207	16:52 (5)	18:03	256	17:16 (5)	18:11	263	17:24 (5)
27	06:09			06:01		05:44		07:25 (6)	05:27		06:48 (6)	05:19		06:43 (6)	05:23		06:49 (6)
	17:45			17:53		17:55	116	09:21 (6)	17:57	211	16:54 (5)	18:03	258	17:17 (5)	18:11	263	17:25 (5)
28	06:09			06:00		05:44		07:24 (6)	05:26		06:47 (6)	05:19		06:43 (6)	05:23		06:49 (6)
	17:45			17:54		17:55	118	09:22 (6)	17:57	214	16:55 (5)	18:04	258	17:17 (5)	18:12	262	17:24 (5)
29	06:09					05:43		07:21 (6)	05:26		06:47 (6)	05:19		06:43 (6)	05:23		06:49 (6)
	17:45					17:55	120	09:21 (6)	17:57	217	16:57 (5)	18:04	258	17:17 (5)	18:12	262	17:24 (5)
30	06:09					05:42		07:19 (6)	05:26		06:46 (6)	05:19		06:43 (6)	05:24		06:49 (6)
	17:46					17:55	122	09:21 (6)	17:58	222	16:59 (5)	18:04	259	17:18 (5)	18:12	262	17:24 (5)
31	06:09					05:42		07:18 (6)				05:19		06:43 (6)			
	17:46					17:55	123	09:21 (6)				18:05	260	17:18 (5)			
Potential sun hours	357			329		374			372			393			384		
Total, worst case		303					1944			4763			7664			7859	
Sun reduction		0.60					0.55			0.52			0.45			0.42	
Oper. time red.		1.00					1.00			1.00			1.00			1.00	
Wind dir. red.		0.72					0.30			0.33			0.41			0.42	
Total reduction		0.43					0.16			0.17			0.18			0.17	
Total, real		131					312			827			1402			1367	

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm) Sun set (hh:mm)	Minutes with flicker	First time (hh:mm) with flicker Last time (hh:mm) with flicker	(WTG causing flicker first time) (WTG causing flicker last time)

SHADOW - Calendar

Calculation: 0575014 - Loi Hai Real Case - Green Mode Shadow receptor: 369 - Shadow Receptor: 1.0 × 1.0 Azimuth: 0.0° Slope: 90.0° (1292)

Assumptions for shadow calculations

Sunshine probability S (Average daily sunshine hours) []

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
6.94	7.86	6.61	6.50	5.65	5.33	4.03	4.19	3.33	4.68	5.67	6.13

Operational time

N	NNE	ENE	E	ESE	SSE	S	SSW	WSW	W	WNW	NNW	Sum
4,347	1,305	385	237	166	149	140	105	105	96	96	1,629	8,760

	July		August		September		October		November	December		
1	05:24		06:50 (6)		05:32		06:53 (6)		05:34		07:00 (6)	
	18:12	262	17:25 (5)	244	18:10	137	17:19 (5)	136	17:55	09:17 (6)	17:35	50
2	05:24		06:50 (6)		05:32		06:53 (6)		05:34		07:01 (6)	
	18:12	261	17:25 (5)	243	18:10	136	17:19 (5)	135	17:54	09:17 (6)	17:35	37
3	05:25		06:50 (6)		05:32		06:54 (6)		05:34		07:02 (6)	
	18:12	261	17:25 (5)	242	18:09	135	17:19 (5)	134	17:54	09:17 (6)	17:34	18
4	05:25		06:50 (6)		05:32		06:53 (6)		05:34		07:02 (6)	
	18:12	261	17:25 (5)	241	18:09	134	17:18 (5)	133	17:53	09:16 (6)	17:33	
5	05:25		06:50 (6)		05:32		06:53 (6)		05:34		07:03 (6)	
	18:13	262	17:26 (5)	240	18:09	133	17:17 (5)	132	17:53	09:16 (6)	17:33	
6	05:25		06:50 (6)		05:32		06:53 (6)		05:34		07:04 (6)	
	18:13	261	17:25 (5)	237	18:08	132	17:15 (5)	131	17:52	09:16 (6)	17:32	
7	05:26		06:50 (6)		05:32		06:53 (6)		05:34		07:05 (6)	
	18:13	261	17:25 (5)	235	18:08	130	17:14 (5)	129	17:51	09:15 (6)	17:31	
8	05:26		06:51 (6)		05:33		06:53 (6)		05:34		07:06 (6)	
	18:13	261	17:26 (5)	233	18:08	129	17:13 (5)	128	17:51	09:15 (6)	17:31	
9	05:26		06:51 (6)		05:33		06:53 (6)		05:34		07:07 (6)	
	18:13	260	17:26 (5)	232	18:07	128	17:12 (5)	127	17:50	09:15 (6)	17:30	
10	05:26		06:51 (6)		05:33		06:53 (6)		05:34		07:08 (6)	
	18:13	260	17:26 (5)	229	18:07	126	17:10 (5)	125	17:49	09:14 (6)	17:30	
11	05:27		06:51 (6)		05:33		06:54 (6)		05:34		07:09 (6)	
	18:13	259	17:25 (5)	226	18:06	125	17:10 (5)	124	17:49	09:14 (6)	17:29	
12	05:27		06:51 (6)		05:33		06:54 (6)		05:34		07:10 (6)	
	18:13	260	17:26 (5)	224	18:06	123	17:08 (5)	122	17:48	09:13 (6)	17:28	
13	05:27		06:51 (6)		05:33		06:54 (6)		05:34		07:11 (6)	
	18:13	260	17:26 (5)	222	18:05	122	17:07 (5)	121	17:47	09:13 (6)	17:28	
14	05:27		06:51 (6)		05:33		06:55 (6)		05:34		07:11 (6)	
	18:13	259	17:26 (5)	217	18:05	120	17:05 (5)	119	17:47	09:11 (6)	17:27	
15	05:28		06:51 (6)		05:33		06:55 (6)		05:34		07:13 (6)	
	18:13	258	17:25 (5)	214	18:05	118	17:03 (5)	117	17:46	09:11 (6)	17:27	
16	05:28		06:52 (6)		05:33		06:55 (6)		05:34		07:14 (6)	
	18:13	258	17:26 (5)	211	18:04	116	17:01 (5)	115	17:45	09:10 (6)	17:26	
17	05:28		06:52 (6)		05:34		06:55 (6)		05:34		07:15 (6)	
	18:13	258	17:26 (5)	205	18:04	114	16:58 (5)	113	17:45	09:09 (6)	17:26	
18	05:28		06:52 (6)		05:34		06:55 (6)		05:34		07:17 (6)	
	18:13	256	17:25 (5)	202	18:03	112	16:56 (5)	111	17:44	09:09 (6)	17:25	
19	05:29		06:51 (6)		05:34		06:55 (6)		05:34		07:19 (6)	
	18:12	257	17:25 (5)	197	18:03	109	16:53 (5)	108	17:43	09:08 (6)	17:25	
20	05:29		06:52 (6)		05:34		06:56 (6)		05:33		07:20 (6)	
	18:12	256	17:25 (5)	191	18:02	107	16:50 (5)	106	17:43	09:07 (6)	17:24	
21	05:29		06:52 (6)		05:34		06:56 (6)		05:33		07:22 (6)	
	18:12	256	17:25 (5)	185	18:01	104	16:47 (5)	103	17:42	09:06 (6)	17:24	
22	05:29		06:52 (6)		05:34		06:56 (6)		05:33		07:24 (6)	
	18:12	254	17:24 (5)	176	18:01	101	16:42 (5)	100	17:41	09:05 (6)	17:23	
23	05:30		06:52 (6)		05:34		06:56 (6)		05:33		07:27 (6)	
	18:12	254	17:24 (5)	165	18:00	96	16:36 (5)	95	17:40	09:03 (6)	17:23	
24	05:30		06:53 (6)		05:34		06:57 (6)		05:33		07:29 (6)	
	18:12	253	17:24 (5)	142	18:00	93	09:19 (6)	92	17:40	09:02 (6)	17:22	
25	05:30		06:52 (6)		05:34		06:57 (6)		05:33		07:31 (6)	
	18:12	253	17:24 (5)	142	17:59	89	09:19 (6)	88	17:39	09:00 (6)	17:22	
26	05:30		06:52 (6)		05:34		06:57 (6)		05:33		07:34 (6)	
	18:11	252	17:23 (5)	142	17:59	85	09:19 (6)	84	17:38	08:59 (6)	17:22	
27	05:31		06:52 (6)		05:34		06:58 (6)		05:33		07:37 (6)	
	18:11	251	17:22 (5)	141	17:58	79	09:19 (6)	78	17:38	08:56 (6)	17:21	
28	05:31		06:52 (6)		05:34		06:58 (6)		05:33		07:40 (6)	
	18:11	250	17:22 (5)	140	17:58	74	09:18 (6)	73	17:37	08:54 (6)	17:21	
29	05:31		06:53 (6)		05:34		06:59 (6)		05:33		07:44 (6)	
	18:11	248	17:22 (5)	139	17:57	67	09:18 (6)	66	17:36	08:51 (6)	17:20	
30	05:31		06:53 (6)		05:34		06:59 (6)		05:33		07:48 (6)	
	18:10	247	17:21 (5)	139	17:56	59	09:18 (6)	58	17:36	08:47 (6)	17:20	
31	05:31		06:53 (6)		05:34		07:00 (6)				05:36	
	18:10	246	17:20 (5)	137	17:56	136	09:17 (6)	135			17:20	
Potential sun hours	395			388		366		368		348	355	
Total, worst case		7955			6133		3333		105			1160
Sun reduction		0.32			0.34		0.27		0.39			0.54
Oper. time red.		1.00			1.00		1.00		1.00			1.00
Wind dir. red.		0.42			0.38		0.30		0.30			0.72
Total reduction		0.13			0.12		0.08		0.12			0.39
Total, real		1045			766		267		12			447

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm) Sun set (hh:mm)	Minutes with flicker	First time (hh:mm) with flicker Last time (hh:mm) with flicker	(WTG causing flicker first time) (WTG causing flicker last time)

SHADOW - Calendar

Calculation: 0575014 - Loi Hai Real Case - Green Mode Shadow receptor: 370 - Shadow Receptor: 1.0 × 1.0 Azimuth: 0.0° Slope: 90.0° (1294)

Assumptions for shadow calculations

Sunshine probability S (Average daily sunshine hours) []

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
6.94	7.86	6.61	6.50	5.65	5.33	4.03	4.19	3.33	4.68	5.67	6.13

Operational time

N	NNE	ENE	E	ESE	SSE	S	SSW	WSW	W	WNW	NNW	Sum
4,347	1,305	385	237	166	149	140	105	105	96	96	1,629	8,760

	January	February		March		April		May		June		
1	06:04	06:09		06:00		07:56 (6)	05:41		07:19 (6)	05:25		07:09 (6)	05:19		07:20 (6)
	17:31	17:47		17:54	150	10:26 (6)	17:55	156	09:55 (6)	17:58	251	17:15 (5)	18:05	245	17:15 (5)
2	06:05	06:09		05:59		07:53 (6)	05:41		07:19 (6)	05:25		07:10 (6)	05:19		07:20 (6)
	17:32	17:47		17:54	153	10:26 (6)	17:55	177	16:41 (5)	17:58	251	17:16 (5)	18:05	244	17:15 (5)
3	06:05	06:09		05:59		07:52 (6)	05:40		07:18 (6)	05:24		07:09 (6)	05:19		07:21 (6)
	17:32	17:47		17:54	154	10:26 (6)	17:56	189	16:46 (5)	17:58	251	17:15 (5)	18:05	243	17:15 (5)
4	06:05	06:09		05:58		07:50 (6)	05:39		07:17 (6)	05:24		07:10 (6)	05:19		07:21 (6)
	17:33	17:48		17:54	155	10:25 (6)	17:56	196	16:49 (5)	17:58	252	17:16 (5)	18:06	244	17:15 (5)
5	06:06	06:08		05:58		07:49 (6)	05:39		07:17 (6)	05:24		07:10 (6)	05:19		07:21 (6)
	17:33	17:48		17:54	156	10:25 (6)	17:56	203	16:53 (5)	17:58	252	17:16 (5)	18:06	244	17:15 (5)
6	06:06	06:08		05:57		07:47 (6)	05:38		07:16 (6)	05:23		07:10 (6)	05:19		07:22 (6)
	17:34	17:48		17:54	156	10:23 (6)	17:56	208	16:55 (5)	17:59	251	17:16 (5)	18:06	242	17:15 (5)
7	06:07	06:08		05:56		07:46 (6)	05:37		07:15 (6)	05:23		07:10 (6)	05:19		07:22 (6)
	17:34	17:49		17:54	157	10:23 (6)	17:56	212	16:57 (5)	17:59	252	17:16 (5)	18:07	243	17:15 (5)
8	06:07	06:08	09:00 (6)	05:56		07:44 (6)	05:37		07:15 (6)	05:23		07:11 (6)	05:19		07:22 (6)
	17:35	17:49	09:35 (6)	17:55	157	10:21 (6)	17:56	215	16:59 (5)	17:59	251	17:16 (5)	18:07	243	17:15 (5)
9	06:07	06:08	08:53 (6)	05:55		07:43 (6)	05:36		07:14 (6)	05:22		07:10 (6)	05:20		07:23 (6)
	17:35	17:49	09:43 (6)	17:55	158	10:21 (6)	17:56	220	17:01 (5)	17:59	253	17:16 (5)	18:07	241	17:14 (5)
10	06:07	06:07	08:46 (6)	05:55		07:42 (6)	05:36		07:14 (6)	05:22		07:11 (6)	05:20		07:23 (6)
	17:36	17:50	09:48 (6)	17:55	157	10:19 (6)	17:56	223	17:03 (5)	17:59	252	17:16 (5)	18:07	241	17:14 (5)
11	06:08	06:07	08:42 (6)	05:54		07:40 (6)	05:35		07:13 (6)	05:22		07:11 (6)	05:20		07:23 (6)
	17:37	17:50	09:53 (6)	17:55	158	10:18 (6)	17:56	226	17:04 (5)	18:00	251	17:16 (5)	18:08	240	17:14 (5)
12	06:08	06:07	08:38 (6)	05:54		07:39 (6)	05:35		07:12 (6)	05:21		07:12 (6)	05:20		07:24 (6)
	17:37	17:50	09:58 (6)	17:55	158	10:17 (6)	17:56	229	17:05 (5)	18:00	251	17:16 (5)	18:08	241	17:15 (5)
13	06:08	06:06	08:34 (6)	05:53		07:37 (6)	05:34		07:12 (6)	05:21		07:11 (6)	05:20		07:25 (6)
	17:38	17:51	10:01 (6)	17:55	159	10:16 (6)	17:56	231	17:06 (5)	18:00	252	17:16 (5)	18:08	240	17:15 (5)
14	06:08	06:06	08:30 (6)	05:52		07:37 (6)	05:33		07:12 (6)	05:21		07:12 (6)	05:20		07:25 (6)
	17:38	17:51	10:04 (6)	17:55	158	10:15 (6)	17:56	233	17:07 (5)	18:00	252	17:16 (5)	18:09	240	17:15 (5)
15	06:08	06:06	08:28 (6)	05:52		07:35 (6)	05:33		07:12 (6)	05:21		07:13 (6)	05:20		07:25 (6)
	17:39	17:51	10:07 (6)	17:55	158	10:13 (6)	17:56	235	17:08 (5)	18:00	250	17:16 (5)	18:09	240	17:15 (5)
16	06:09	06:05	08:25 (6)	05:51		07:34 (6)	05:32		07:11 (6)	05:21		07:13 (6)	05:21		07:25 (6)
	17:39	17:51	10:11 (6)	17:55	158	10:12 (6)	17:56	237	17:09 (5)	18:01	251	17:16 (5)	18:09	240	17:15 (5)
17	06:09	06:05	08:21 (6)	05:51		07:33 (6)	05:32		07:11 (6)	05:20		07:14 (6)	05:21		07:25 (6)
	17:40	17:52	10:12 (6)	17:55	158	10:11 (6)	17:56	239	17:10 (5)	18:01	250	17:16 (5)	18:09	240	17:15 (5)
18	06:09	06:05	08:19 (6)	05:50		07:31 (6)	05:31		07:11 (6)	05:20		07:13 (6)	05:21		07:26 (6)
	17:40	17:52	10:15 (6)	17:55	159	10:10 (6)	17:56	239	17:10 (5)	18:01	250	17:15 (5)	18:10	240	17:16 (5)
19	06:09	06:04	08:16 (6)	05:49		07:30 (6)	05:31		07:11 (6)	05:20		07:14 (6)	05:21		07:26 (6)
	17:41	17:52	10:16 (6)	17:55	158	10:08 (6)	17:56	241	17:12 (5)	18:01	249	17:15 (5)	18:10	240	17:16 (5)
20	06:09	06:04	08:14 (6)	05:49		07:30 (6)	05:30		07:10 (6)	05:20		07:14 (6)	05:21		07:26 (6)
	17:41	17:52	10:19 (6)	17:55	158	10:08 (6)	17:56	243	17:12 (5)	18:02	249	17:15 (5)	18:10	240	17:16 (5)
21	06:09	06:03	08:12 (6)	05:48		07:28 (6)	05:30		07:10 (6)	05:20		07:15 (6)	05:22		07:26 (6)
	17:42	17:52	10:21 (6)	17:55	158	10:06 (6)	17:57	245	17:13 (5)	18:02	249	17:15 (5)	18:10	240	17:16 (5)
22	06:09	06:03	08:09 (6)	05:47		07:28 (6)	05:29		07:10 (6)	05:20		07:15 (6)	05:22		07:26 (6)
	17:42	17:53	10:22 (6)	17:55	158	10:06 (6)	17:57	245	17:13 (5)	18:02	248	17:15 (5)	18:10	240	17:16 (5)
23	06:09	06:03	08:07 (6)	05:47		07:26 (6)	05:29		07:10 (6)	05:19		07:16 (6)	05:22		07:27 (6)
	17:43	17:53	10:23 (6)	17:55	158	10:04 (6)	17:57	246	17:14 (5)	18:02	247	17:15 (5)	18:11	240	17:17 (5)
24	06:09	06:02	08:05 (6)	05:46		07:25 (6)	05:28		07:10 (6)	05:19		07:16 (6)	05:22		07:27 (6)
	17:43	17:53	10:24 (6)	17:55	158	10:03 (6)	17:57	246	17:14 (5)	18:03	248	17:15 (5)	18:11	240	17:17 (5)
25	06:09	06:02	08:03 (6)	05:46		07:25 (6)	05:28		07:10 (6)	05:19		07:17 (6)	05:22		07:27 (6)
	17:44	17:53	10:25 (6)	17:55	157	10:02 (6)	17:57	247	17:14 (5)	18:03	247	17:15 (5)	18:11	240	17:17 (5)
26	06:09	06:01	08:01 (6)	05:45		07:24 (6)	05:27		07:09 (6)	05:19		07:17 (6)	05:23		07:27 (6)
	17:44	17:53	10:25 (6)	17:55	157	10:01 (6)	17:57	248	17:14 (5)	18:03	247	17:15 (5)	18:11	240	17:17 (5)
27	06:09	06:01	07:59 (6)	05:44		07:22 (6)	05:27		07:10 (6)	05:19		07:18 (6)	05:23		07:28 (6)
	17:45	17:53	10:26 (6)	17:55	158	10:00 (6)	17:57	248	17:15 (5)	18:03	246	17:15 (5)	18:11	240	17:18 (5)
28	06:09	06:00	07:57 (6)	05:44		07:22 (6)	05:26		07:09 (6)	05:19		07:18 (6)	05:23		07:28 (6)
	17:45	17:54	10:26 (6)	17:55	157	09:59 (6)	17:57	250	17:15 (5)	18:04	246	17:15 (5)	18:12	240	17:18 (5)
29	06:09			05:43		07:21 (6)	05:26		07:10 (6)	05:19		07:19 (6)	05:23		07:28 (6)
	17:45			17:55	157	09:58 (6)	17:57	249	17:15 (5)	18:04	245	17:15 (5)	18:12	240	17:18 (5)
30	06:09			05:42		07:20 (6)	05:26		07:10 (6)	05:19		07:19 (6)	05:24		07:27 (6)
	17:46			17:55	157	09:57 (6)	17:58	250	17:16 (5)	18:04	245	17:15 (5)	18:12	241	17:18 (5)
31	06:09			05:42		07:20 (6)				05:19		07:19 (6)			
	17:46			17:55	156	09:56 (6)				18:05	245	17:15 (5)			
Potential sun hours	357	329		374			372			393			384		
Total, worst case			2275		4866			6826			7734			7232	
Sun reduction			0.67		0.55			0.52			0.45			0.42	
Oper. time red.			1.00		1.00			1.00			1.00			1.00	
Wind dir. red.			0.41		0.41			0.45			0.45			0.45	
Total reduction			0.28		0.23			0.23			0.20			0.19	
Total, real			626		1097			1602			1572			1367	

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm) Sun set (hh:mm)	Minutes with flicker	First time (hh:mm) with flicker Last time (hh:mm) with flicker	(WTG causing flicker first time) (WTG causing flicker last time)

Licensed user:
ERM
Level 3, 09 Dinh Tien Hoang St
VN-DAKAO WARD, District 1

Phat Tran / phat.tran@erm.com
Calculated:
2/4/2021 1:12 PM/3.4.388

SHADOW - Calendar

Calculation: 0575014 - Loi Hai Real Case - Green Mode Shadow receptor: 370 - Shadow Receptor: 1.0 × 1.0 Azimuth: 0.0° Slope: 90.0° (1294)

Assumptions for shadow calculations

Sunshine probability S (Average daily sunshine hours) []

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
6.94	7.86	6.61	6.50	5.65	5.33	4.03	4.19	3.33	4.68	5.67	6.13

Operational time

N	NNE	ENE	E	ESE	SSE	S	SSW	WSW	W	WNW	NNW	Sum
4,347	1,305	385	237	166	149	140	105	105	96	96	1,629	8,760

	July		August		September		October		November		December
1	05:24		07:28 (6)	05:32	07:22 (6)	05:34	07:12 (6)	05:33	07:18 (6)	05:37	08:17 (6)	05:49
	18:12	240	17:19 (5)	18:10 251	17:26 (5)	17:55 226	17:03 (5)	17:35 158	09:56 (6)	17:19 60	09:17 (6)	17:18
2	05:24		07:28 (6)	05:32	07:21 (6)	05:34	07:12 (6)	05:33	07:18 (6)	05:37	08:23 (6)	05:49
	18:12	241	17:19 (5)	18:10 251	17:26 (5)	17:54 223	17:01 (5)	17:35 159	09:57 (6)	17:19 48	09:11 (6)	17:18
3	05:25		07:28 (6)	05:32	07:22 (6)	05:34	07:12 (6)	05:33	07:19 (6)	05:37	08:31 (6)	05:50
	18:12	241	17:19 (5)	18:09 252	17:27 (5)	17:54 220	16:59 (5)	17:34 158	09:57 (6)	17:19 31	09:02 (6)	17:18
4	05:25		07:27 (6)	05:32	07:21 (6)	05:34	07:12 (6)	05:33	07:20 (6)	05:37		05:50
	18:12	243	17:20 (5)	18:09 252	17:27 (5)	17:53 215	16:56 (5)	17:33 158	09:58 (6)	17:18		17:18
5	05:25		07:28 (6)	05:32	07:21 (6)	05:34	07:12 (6)	05:33	07:21 (6)	05:38		05:51
	18:13	243	17:21 (5)	18:09 251	17:26 (5)	17:53 212	16:54 (5)	17:33 157	09:58 (6)	17:18		17:19
6	05:25		07:28 (6)	05:32	07:20 (6)	05:34	07:12 (6)	05:33	07:22 (6)	05:38		05:51
	18:13	242	17:21 (5)	18:08 252	17:26 (5)	17:52 208	16:51 (5)	17:32 157	09:59 (6)	17:18		17:19
7	05:26		07:28 (6)	05:32	07:20 (6)	05:34	07:12 (6)	05:33	07:23 (6)	05:38		05:52
	18:13	243	17:21 (5)	18:08 252	17:26 (5)	17:51 203	16:48 (5)	17:31 156	09:59 (6)	17:18		17:19
8	05:26		07:28 (6)	05:33	07:19 (6)	05:34	07:12 (6)	05:33	07:24 (6)	05:39		05:52
	18:13	244	17:22 (5)	18:08 252	17:25 (5)	17:51 197	16:45 (5)	17:31 155	09:59 (6)	17:18		17:20
9	05:26		07:28 (6)	05:33	07:19 (6)	05:34	07:12 (6)	05:33	07:25 (6)	05:39		05:53
	18:13	244	17:22 (5)	18:07 252	17:25 (5)	17:50 189	16:40 (5)	17:30 155	10:00 (6)	17:17		17:20
10	05:26		07:27 (6)	05:33	07:18 (6)	05:34	07:12 (6)	05:33	07:26 (6)	05:39		05:53
	18:13	244	17:22 (5)	18:07 251	17:24 (5)	17:49 178	16:34 (5)	17:30 154	10:00 (6)	17:17		17:20
11	05:27		07:27 (6)	05:33	07:19 (6)	05:34	07:12 (6)	05:34	07:27 (6)	05:40		05:54
	18:13	244	17:22 (5)	18:06 251	17:25 (5)	17:49 156	09:48 (6)	17:29 153	10:00 (6)	17:17		17:21
12	05:27		07:28 (6)	05:33	07:18 (6)	05:34	07:12 (6)	05:34	07:28 (6)	05:40		05:54
	18:13	245	17:23 (5)	18:06 250	17:24 (5)	17:48 156	09:48 (6)	17:28 151	09:59 (6)	17:17		17:21
13	05:27		07:27 (6)	05:33	07:18 (6)	05:34	07:12 (6)	05:34	07:29 (6)	05:40		05:55
	18:13	245	17:23 (5)	18:05 250	17:24 (5)	17:47 157	09:49 (6)	17:28 150	09:59 (6)	17:17		17:21
14	05:27		07:27 (6)	05:33	07:17 (6)	05:34	07:11 (6)	05:34	07:31 (6)	05:41		05:56
	18:13	245	17:23 (5)	18:05 250	17:23 (5)	17:47 157	09:48 (6)	17:27 148	09:59 (6)	17:17		17:22
15	05:28		07:26 (6)	05:33	07:17 (6)	05:34	07:11 (6)	05:34	07:32 (6)	05:41		05:56
	18:13	247	17:23 (5)	18:05 248	17:22 (5)	17:46 157	09:48 (6)	17:27 146	09:58 (6)	17:17		17:22
16	05:28		07:27 (6)	05:33	07:17 (6)	05:34	07:11 (6)	05:34	07:34 (6)	05:42		05:57
	18:13	246	17:24 (5)	18:04 248	17:22 (5)	17:45 158	09:49 (6)	17:26 144	09:58 (6)	17:17		17:23
17	05:28		07:26 (6)	05:34	07:16 (6)	05:34	07:12 (6)	05:34	07:36 (6)	05:42		05:57
	18:13	247	17:24 (5)	18:04 248	17:21 (5)	17:45 157	09:49 (6)	17:26 141	09:57 (6)	17:16		17:23
18	05:28		07:26 (6)	05:34	07:16 (6)	05:34	07:12 (6)	05:34	07:37 (6)	05:42		05:58
	18:13	246	17:24 (5)	18:03 247	17:20 (5)	17:44 157	09:49 (6)	17:25 138	09:55 (6)	17:16		17:24
19	05:29		07:25 (6)	05:34	07:15 (6)	05:34	07:12 (6)	05:34	07:39 (6)	05:43		05:58
	18:12	248	17:24 (5)	18:03 246	17:19 (5)	17:43 158	09:50 (6)	17:25 135	09:54 (6)	17:16		17:24
20	05:29		07:26 (6)	05:34	07:15 (6)	05:33	07:12 (6)	05:34	07:41 (6)	05:43		05:59
	18:12	248	17:25 (5)	18:02 246	17:19 (5)	17:43 158	09:50 (6)	17:24 131	09:52 (6)	17:16		17:25
21	05:29		07:25 (6)	05:34	07:15 (6)	05:33	07:13 (6)	05:34	07:43 (6)	05:44		05:59
	18:12	248	17:25 (5)	18:01 245	17:18 (5)	17:42 157	09:50 (6)	17:24 127	09:50 (6)	17:16		17:25
22	05:29		07:25 (6)	05:34	07:14 (6)	05:33	07:13 (6)	05:35	07:45 (6)	05:44		06:00
	18:12	249	17:25 (5)	18:01 245	17:17 (5)	17:41 158	09:51 (6)	17:23 123	09:48 (6)	17:17		17:26
23	05:30		07:24 (6)	05:34	07:14 (6)	05:33	07:13 (6)	05:35	07:48 (6)	05:45		06:00
	18:12	249	17:25 (5)	18:00 242	17:16 (5)	17:40 158	09:51 (6)	17:23 119	09:47 (6)	17:17		17:26
24	05:30		07:25 (6)	05:34	07:14 (6)	05:33	07:14 (6)	05:35	07:50 (6)	05:45		06:01
	18:12	249	17:26 (5)	18:00 241	17:15 (5)	17:40 158	09:52 (6)	17:22 114	09:44 (6)	17:17		17:27
25	05:30		07:24 (6)	05:34	07:14 (6)	05:33	07:14 (6)	05:35	07:52 (6)	05:46		06:01
	18:12	250	17:26 (5)	17:59 239	17:13 (5)	17:39 158	09:52 (6)	17:22 110	09:42 (6)	17:17		17:27
26	05:30		07:24 (6)	05:34	07:13 (6)	05:33	07:15 (6)	05:35	07:55 (6)	05:46		06:02
	18:11	250	17:26 (5)	17:59 238	17:12 (5)	17:38 158	09:53 (6)	17:22 104	09:39 (6)	17:17		17:28
27	05:31		07:23 (6)	05:34	07:13 (6)	05:33	07:15 (6)	05:36	07:57 (6)	05:47		06:02
	18:11	251	17:26 (5)	17:58 237	17:11 (5)	17:38 159	09:54 (6)	17:21 99	09:36 (6)	17:17		17:28
28	05:31		07:23 (6)	05:34	07:13 (6)	05:33	07:16 (6)	05:36	08:01 (6)	05:47		06:03
	18:11	250	17:26 (5)	17:58 235	17:09 (5)	17:37 158	09:54 (6)	17:21 92	09:33 (6)	17:17		17:29
29	05:31		07:23 (6)	05:34	07:13 (6)	05:33	07:16 (6)	05:36	08:04 (6)	05:48		06:03
	18:11	251	17:27 (5)	17:57 233	17:08 (5)	17:36 159	09:55 (6)	17:20 86	09:30 (6)	17:17		17:29
30	05:31		07:23 (6)	05:34	07:12 (6)	05:33	07:17 (6)	05:36	08:08 (6)	05:48		06:03
	18:10	252	17:27 (5)	17:56 231	17:06 (5)	17:36 158	09:55 (6)	17:20 78	09:26 (6)	17:18		17:30
31	05:31		07:22 (6)	05:34	07:12 (6)			05:36	08:13 (6)			06:04
	18:10	252	17:27 (5)	17:56 229	17:05 (5)			17:20 69	09:22 (6)			17:30
Potential sun hours	395			388		366		368		348		355
Total, worst case		7637		7615		5223		4125		139		
Sun reduction		0.32		0.34		0.27		0.39		0.49		
Oper. time red.		1.00		1.00		1.00		1.00		1.00		
Wind dir. red.		0.45		0.45		0.42		0.41		0.41		
Total reduction		0.14		0.15		0.12		0.16		0.20		
Total, real		1099		1157		602		669		28		

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm) Sun set (hh:mm)	Minutes with flicker	First time (hh:mm) with flicker Last time (hh:mm) with flicker	(WTG causing flicker first time) (WTG causing flicker last time)

SHADOW - Calendar

Calculation: 0575014 - Loi Hai Real Case - Green Mode Shadow receptor: 371 - Shadow Receptor: 1.0 × 1.0 Azimuth: 0.0° Slope: 90.0° (1295)

Assumptions for shadow calculations

Sunshine probability S (Average daily sunshine hours) []

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
6.94	7.86	6.61	6.50	5.65	5.33	4.03	4.19	3.33	4.68	5.67	6.13

Operational time

N	NNE	ENE	E	ESE	SSE	S	SSW	WSW	W	WNW	NNW	Sum
4,347	1,305	385	237	166	149	140	105	105	96	96	1,629	8,760

	January			February			March			April			May			June		
1	06:04		09:51 (6)	06:09		09:41 (6)	06:00		09:30 (6)	05:41		09:33 (6)	05:25		10:13 (6)	05:19		
	17:31	109	11:40 (6)	17:47	151	12:12 (6)	17:54	175	12:25 (6)	17:55	178	17:18 (5)	17:58	134	17:08 (5)	18:05		
2	06:05		09:51 (6)	06:09		09:40 (6)	05:59		09:29 (6)	05:41		09:34 (6)	05:25		10:16 (6)	05:19		
	17:32	109	11:40 (6)	17:47	153	12:13 (6)	17:54	176	12:25 (6)	17:55	178	17:19 (5)	17:58	126	17:07 (5)	18:05		
3	06:05		09:52 (6)	06:09		09:40 (6)	05:59		09:29 (6)	05:40		09:34 (6)	05:24		10:19 (6)	05:19		
	17:32	110	11:42 (6)	17:47	154	12:14 (6)	17:54	176	12:25 (6)	17:56	175	17:19 (5)	17:58	117	17:05 (5)	18:05		
4	06:05		09:51 (6)	06:09		09:40 (6)	05:58		09:29 (6)	05:39		09:34 (6)	05:24		10:23 (6)	05:19		
	17:33	112	11:43 (6)	17:48	155	12:15 (6)	17:54	176	12:25 (6)	17:56	174	17:19 (5)	17:58	108	17:05 (5)	18:06		
5	06:06		09:51 (6)	06:08		09:38 (6)	05:58		09:29 (6)	05:39		09:35 (6)	05:24		10:29 (6)	05:19		
	17:33	112	11:43 (6)	17:48	157	12:15 (6)	17:54	176	12:25 (6)	17:56	174	17:20 (5)	17:58	95	17:04 (5)	18:06		
6	06:06		09:50 (6)	06:08		09:38 (6)	05:57		09:29 (6)	05:38		09:36 (6)	05:23		10:36 (6)	05:19		
	17:34	114	11:44 (6)	17:48	158	12:16 (6)	17:54	175	12:24 (6)	17:56	173	17:20 (5)	17:59	78	17:02 (5)	18:06		
7	06:07		09:51 (6)	06:08		09:38 (6)	05:56		09:29 (6)	05:37		09:36 (6)	05:23		16:04 (5)	05:19		
	17:34	115	11:46 (6)	17:49	159	12:17 (6)	17:54	176	12:25 (6)	17:56	171	17:19 (5)	17:59	57	17:01 (5)	18:07		
8	06:07		09:51 (6)	06:08		09:38 (6)	05:56		09:28 (6)	05:37		09:37 (6)	05:23		16:05 (5)	05:19		
	17:35	116	11:47 (6)	17:49	160	12:18 (6)	17:55	176	12:24 (6)	17:56	170	17:20 (5)	17:59	55	17:00 (5)	18:07		
9	06:07		09:50 (6)	06:08		09:37 (6)	05:55		09:29 (6)	05:36		09:38 (6)	05:22		16:06 (5)	05:20		
	17:35	117	11:47 (6)	17:49	162	12:19 (6)	17:55	175	12:24 (6)	17:56	167	17:19 (5)	17:59	52	16:58 (5)	18:07		
10	06:07		09:51 (6)	06:07		09:36 (6)	05:55		09:28 (6)	05:36		09:39 (6)	05:22		16:07 (5)	05:20		
	17:36	118	11:49 (6)	17:50	162	12:18 (6)	17:55	176	12:24 (6)	17:56	166	17:20 (5)	17:59	50	16:57 (5)	18:07		
11	06:08		09:50 (6)	06:07		09:36 (6)	05:54		09:28 (6)	05:35		09:40 (6)	05:22		16:09 (5)	05:20		
	17:37	120	11:50 (6)	17:50	163	12:19 (6)	17:55	175	12:23 (6)	17:56	165	17:19 (5)	18:00	47	16:56 (5)	18:08		
12	06:08		09:50 (6)	06:07		09:36 (6)	05:54		09:28 (6)	05:35		09:40 (6)	05:21		16:10 (5)	05:20		
	17:37	121	11:51 (6)	17:50	164	12:20 (6)	17:55	175	12:23 (6)	17:56	165	17:19 (5)	18:00	44	16:54 (5)	18:08		
13	06:08		09:49 (6)	06:06		09:35 (6)	05:53		09:28 (6)	05:34		09:42 (6)	05:21		16:11 (5)	05:20		
	17:38	123	11:52 (6)	17:51	165	12:20 (6)	17:55	175	12:23 (6)	17:56	162	17:19 (5)	18:00	41	16:52 (5)	18:08		
14	06:08		09:48 (6)	06:06		09:35 (6)	05:52		09:29 (6)	05:33		09:43 (6)	05:21		16:13 (5)	05:20		
	17:38	125	11:53 (6)	17:51	166	12:21 (6)	17:55	174	12:23 (6)	17:56	160	17:18 (5)	18:00	37	16:50 (5)	18:09		
15	06:08		09:49 (6)	06:06		09:35 (6)	05:52		09:28 (6)	05:33		09:44 (6)	05:21		16:15 (5)	05:20		
	17:39	126	11:55 (6)	17:51	167	12:22 (6)	17:55	174	12:22 (6)	17:56	160	17:19 (5)	18:00	33	16:48 (5)	18:09		
16	06:09		09:48 (6)	06:05		09:34 (6)	05:51		09:28 (6)	05:32		09:45 (6)	05:21		16:17 (5)	05:21		
	17:39	128	11:56 (6)	17:51	169	12:23 (6)	17:55	187	16:50 (5)	17:56	158	17:18 (5)	18:01	29	16:46 (5)	18:09		
17	06:09		09:48 (6)	06:05		09:33 (6)	05:51		09:29 (6)	05:32		09:47 (6)	05:20		16:20 (5)	05:21		
	17:40	129	11:57 (6)	17:52	169	12:22 (6)	17:55	199	16:57 (5)	17:56	157	17:18 (5)	18:01	23	16:43 (5)	18:09		
18	06:09		09:47 (6)	06:05		09:33 (6)	05:50		09:28 (6)	05:31		09:48 (6)	05:20		16:23 (5)	05:21		
	17:40	131	11:58 (6)	17:52	170	12:23 (6)	17:55	206	17:00 (5)	17:56	155	17:17 (5)	18:01	16	16:39 (5)	18:10		
19	06:09		09:47 (6)	06:04		09:32 (6)	05:49		09:28 (6)	05:31		09:49 (6)	05:20			05:21		
	17:41	132	11:59 (6)	17:52	171	12:23 (6)	17:55	212	17:03 (5)	17:56	155	17:17 (5)	18:01			18:10		
20	06:09		09:46 (6)	06:04		09:32 (6)	05:49		09:29 (6)	05:30		09:50 (6)	05:20			05:21		
	17:41	134	12:00 (6)	17:52	172	12:24 (6)	17:55	201	17:06 (5)	17:56	153	17:16 (5)	18:02			18:10		
21	06:09		09:46 (6)	06:03		09:32 (6)	05:48		09:29 (6)	05:30		09:52 (6)	05:20			05:22		
	17:42	135	12:01 (6)	17:52	172	12:24 (6)	17:55	196	17:08 (5)	17:57	152	17:16 (5)	18:02			18:10		
22	06:09		09:45 (6)	06:03		09:32 (6)	05:47		09:30 (6)	05:29		09:53 (6)	05:20			05:22		
	17:42	137	12:02 (6)	17:53	172	12:24 (6)	17:55	192	17:10 (5)	17:57	153	17:15 (5)	18:02			18:10		
23	06:09		09:45 (6)	06:03		09:32 (6)	05:47		09:29 (6)	05:29		09:56 (6)	05:19			05:22		
	17:43	138	12:03 (6)	17:53	173	12:25 (6)	17:55	190	17:11 (5)	17:57	150	17:15 (5)	18:02			18:11		
24	06:09		09:44 (6)	06:02		09:31 (6)	05:46		09:29 (6)	05:28		09:57 (6)	05:19			05:22		
	17:43	140	12:04 (6)	17:53	173	12:24 (6)	17:55	188	17:12 (5)	17:57	151	17:13 (5)	18:03			18:11		
25	06:09		09:44 (6)	06:02		09:31 (6)	05:46		09:30 (6)	05:28		09:59 (6)	05:19			05:22		
	17:44	141	12:05 (6)	17:53	174	12:25 (6)	17:55	187	17:14 (5)	17:57	154	17:13 (5)	18:03			18:11		
26	06:09		09:43 (6)	06:01		09:30 (6)	05:45		09:30 (6)	05:27		10:01 (6)	05:19			05:23		
	17:44	143	12:06 (6)	17:53	174	12:24 (6)	17:55	187	17:15 (5)	17:57	165	17:12 (5)	18:03			18:11		
27	06:09		09:43 (6)	06:01		09:30 (6)	05:44		09:30 (6)	05:27		10:03 (6)	05:19			05:23		
	17:45	144	12:07 (6)	17:53	175	12:25 (6)	17:55	185	17:15 (5)	17:57	161	17:12 (5)	18:03			18:11		
28	06:09		09:42 (6)	06:00		09:30 (6)	05:44		09:31 (6)	05:26		10:05 (6)	05:19			05:23		
	17:45	146	12:08 (6)	17:54	175	12:25 (6)	17:55	183	17:17 (5)	17:57	154	17:10 (5)	18:04			18:12		
29	06:09		09:42 (6)				05:43		09:31 (6)	05:26		10:08 (6)	05:19			05:23		
	17:45	147	12:09 (6)				17:55	183	17:17 (5)	17:57	147	17:10 (5)	18:04			18:12		
30	06:09		09:42 (6)				05:42		09:31 (6)	05:26		10:10 (6)	05:19			05:24		
	17:46	148	12:10 (6)				17:55	181	17:17 (5)	17:58	141	17:09 (5)	18:04			18:12		
31	06:09		09:41 (6)				05:42		09:32 (6)				05:19					
	17:46	150	12:11 (6)				17:55	180	17:18 (5)				18:05					
Potential sun hours	357			329			374			372			393			384		
Total, worst case		3970			4635			5687			4844			1142				
Sun reduction		0.60			0.67			0.55			0.52			0.45				
Oper. time red.		1.00			1.00			1.00			1.00			1.00				
Wind dir. red.		0.80			0.80			0.75			0.64			0.55				
Total reduction		0.48			0.53			0.41			0.33			0.24				
Total, real		1892			2451			2306			1601			276				

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm) Sun set (hh:mm)	Minutes with flicker	First time (hh:mm) with flicker Last time (hh:mm) with flicker	(WTG causing flicker first time) (WTG causing flicker last time)

Licensed user:
ERM
Level 3, 09 Dinh Tien Hoang St
VN-DAKAO WARD, District 1

Phat Tran / phat.tran@erm.com
Calculated:
2/4/2021 1:12 PM/3.4.388

SHADOW - Calendar

Calculation: 0575014 - Loi Hai Real Case - Green Mode Shadow receptor: 371 - Shadow Receptor: 1.0 × 1.0 Azimuth: 0.0° Slope: 90.0° (1295)

Assumptions for shadow calculations

Sunshine probability S (Average daily sunshine hours) []

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
6.94	7.86	6.61	6.50	5.65	5.33	4.03	4.19	3.33	4.68	5.67	6.13

Operational time

N	NNE	ENE	E	ESE	SSE	S	SSW	WSW	W	WNW	NNW	Sum
4,347	1,305	385	237	166	149	140	105	105	96	96	1,629	8,760

	July			August			September			October			November			December		
1	05:24			05:32		16:20 (5)	05:34		09:39 (6)	05:33		09:08 (6)	05:37		09:06 (6)	05:49		09:32 (6)
	18:12			18:10	45	17:05 (5)	17:55	165	17:18 (5)	17:35	174	12:02 (6)	17:19	162	11:48 (6)	17:18	120	11:32 (6)
2	05:24			05:32		16:18 (5)	05:34		09:37 (6)	05:33		09:07 (6)	05:37		09:06 (6)	05:49		09:33 (6)
	18:12			18:10	48	17:06 (5)	17:54	166	17:18 (5)	17:35	175	12:02 (6)	17:19	161	11:47 (6)	17:18	118	11:31 (6)
3	05:25			05:32		16:18 (5)	05:34		09:36 (6)	05:33		09:07 (6)	05:37		09:07 (6)	05:50		09:34 (6)
	18:12			18:09	50	17:08 (5)	17:54	167	17:17 (5)	17:34	175	12:02 (6)	17:19	159	11:46 (6)	17:18	117	11:31 (6)
4	05:25			05:32		16:16 (5)	05:34		09:34 (6)	05:33		09:06 (6)	05:37		09:08 (6)	05:50		09:35 (6)
	18:12			18:09	53	17:09 (5)	17:53	170	17:17 (5)	17:33	176	12:02 (6)	17:18	159	11:47 (6)	17:18	116	11:31 (6)
5	05:25			05:32		16:15 (5)	05:34		09:33 (6)	05:33		09:06 (6)	05:38		09:08 (6)	05:51		09:36 (6)
	18:13			18:09	55	17:10 (5)	17:53	171	17:16 (5)	17:33	175	12:01 (6)	17:18	158	11:46 (6)	17:19	115	11:31 (6)
6	05:25			05:32		16:14 (5)	05:34		09:32 (6)	05:33		09:05 (6)	05:38		09:08 (6)	05:51		09:36 (6)
	18:13			18:08	57	17:11 (5)	17:52	173	17:16 (5)	17:32	176	12:01 (6)	17:18	157	11:45 (6)	17:19	114	11:30 (6)
7	05:26			05:32		10:43 (6)	05:34		09:31 (6)	05:33		09:05 (6)	05:38		09:10 (6)	05:52		09:38 (6)
	18:13			18:08	85	17:12 (5)	17:51	173	17:15 (5)	17:31	176	12:01 (6)	17:18	155	11:45 (6)	17:19	112	11:30 (6)
8	05:26			05:33		10:36 (6)	05:34		09:29 (6)	05:33		09:04 (6)	05:39		09:10 (6)	05:52		09:39 (6)
	18:13			18:08	100	17:13 (5)	17:51	174	17:14 (5)	17:31	176	12:00 (6)	17:18	154	11:44 (6)	17:20	112	11:31 (6)
9	05:26			05:33		10:31 (6)	05:34		09:28 (6)	05:33		09:04 (6)	05:39		09:11 (6)	05:53		09:40 (6)
	18:13			18:07	111	17:14 (5)	17:50	175	17:13 (5)	17:30	176	12:00 (6)	17:17	153	11:44 (6)	17:20	110	11:30 (6)
10	05:26			05:33		10:27 (6)	05:34		09:27 (6)	05:33		09:04 (6)	05:39		09:12 (6)	05:53		09:41 (6)
	18:13			18:07	121	17:15 (5)	17:49	177	17:12 (5)	17:30	175	11:59 (6)	17:17	151	11:43 (6)	17:20	110	11:31 (6)
11	05:27			05:33		10:24 (6)	05:34		09:26 (6)	05:34		09:03 (6)	05:40		09:12 (6)	05:54		09:41 (6)
	18:13			18:06	129	17:16 (5)	17:49	178	17:11 (5)	17:29	176	11:59 (6)	17:17	150	11:42 (6)	17:21	109	11:30 (6)
12	05:27			05:33		10:21 (6)	05:34		09:25 (6)	05:34		09:03 (6)	05:40		09:14 (6)	05:54		09:43 (6)
	18:13			18:06	136	17:17 (5)	17:48	179	17:10 (5)	17:28	175	11:58 (6)	17:17	148	11:42 (6)	17:21	107	11:30 (6)
13	05:27			05:33		10:18 (6)	05:34		09:23 (6)	05:34		09:03 (6)	05:40		09:14 (6)	05:55		09:43 (6)
	18:13			18:05	143	17:17 (5)	17:47	181	17:09 (5)	17:28	175	11:58 (6)	17:17	147	11:41 (6)	17:21	107	11:30 (6)
14	05:27			05:33		10:15 (6)	05:34		09:21 (6)	05:34		09:03 (6)	05:41		09:15 (6)	05:56		09:44 (6)
	18:13			18:05	150	17:18 (5)	17:47	183	17:07 (5)	17:27	174	11:57 (6)	17:17	146	11:41 (6)	17:22	107	11:31 (6)
15	05:28			05:33		10:12 (6)	05:34		09:20 (6)	05:34		09:02 (6)	05:41		09:16 (6)	05:56		09:44 (6)
	18:13			18:05	155	17:18 (5)	17:46	183	17:06 (5)	17:27	175	11:57 (6)	17:17	144	11:40 (6)	17:22	106	11:30 (6)
16	05:28			05:33		10:09 (6)	05:34		09:19 (6)	05:34		09:03 (6)	05:42		09:16 (6)	05:57		09:46 (6)
	18:13			18:04	162	17:19 (5)	17:45	185	17:04 (5)	17:26	174	11:57 (6)	17:17	143	11:39 (6)	17:23	105	11:31 (6)
17	05:28			05:34		10:07 (6)	05:34		09:18 (6)	05:34		09:03 (6)	05:42		09:18 (6)	05:57		09:46 (6)
	18:13			18:04	159	17:19 (5)	17:45	186	17:03 (5)	17:26	174	11:57 (6)	17:16	141	11:39 (6)	17:23	105	11:31 (6)
18	05:28			05:34		10:05 (6)	05:34		09:17 (6)	05:34		09:03 (6)	05:42		09:18 (6)	05:58		09:47 (6)
	18:13			18:03	152	17:19 (5)	17:44	188	17:01 (5)	17:25	173	11:56 (6)	17:16	140	11:38 (6)	17:24	104	11:31 (6)
19	05:29			05:34		10:02 (6)	05:34		09:17 (6)	05:34		09:03 (6)	05:43		09:20 (6)	05:58		09:47 (6)
	18:12			18:03	150	17:19 (5)	17:43	189	17:00 (5)	17:25	172	11:55 (6)	17:16	138	11:38 (6)	17:24	104	11:31 (6)
20	05:29			05:34		10:00 (6)	05:33		09:16 (6)	05:34		09:03 (6)	05:43		09:20 (6)	05:59		09:48 (6)
	18:12			18:02	151	17:20 (5)	17:43	191	16:58 (5)	17:24	172	11:55 (6)	17:16	137	11:37 (6)	17:25	104	11:32 (6)
21	05:29			05:34		09:58 (6)	05:33		09:15 (6)	05:34		09:02 (6)	05:44		09:22 (6)	05:59		09:48 (6)
	18:12			18:01	152	17:20 (5)	17:42	193	16:56 (5)	17:24	172	11:54 (6)	17:16	135	11:37 (6)	17:25	104	11:32 (6)
22	05:29			05:34		09:56 (6)	05:33		09:14 (6)	05:35		09:02 (6)	05:44		09:22 (6)	06:00		09:49 (6)
	18:12			18:01	152	17:20 (5)	17:41	194	16:53 (5)	17:23	171	11:53 (6)	17:17	134	11:36 (6)	17:26	104	11:33 (6)
23	05:30			05:34		09:54 (6)	05:33		09:13 (6)	05:35		09:03 (6)	05:45		09:24 (6)	06:00		09:49 (6)
	18:12			18:00	153	17:20 (5)	17:40	199	16:51 (5)	17:23	171	11:54 (6)	17:17	132	11:36 (6)	17:26	104	11:33 (6)
24	05:30			05:34		09:52 (6)	05:33		09:12 (6)	05:35		09:03 (6)	05:45		09:24 (6)	06:01		09:49 (6)
	18:12			18:00	156	17:20 (5)	17:40	213	16:48 (5)	17:22	170	11:53 (6)	17:17	131	11:35 (6)	17:27	104	11:33 (6)
25	05:30		16:37 (5)	05:34		09:50 (6)	05:33		09:12 (6)	05:35		09:03 (6)	05:46		09:26 (6)	06:01		09:50 (6)
	18:12	10	16:47 (5)	17:59	156	17:20 (5)	17:39	208	16:45 (5)	17:22	169	11:52 (6)	17:17	129	11:35 (6)	17:27	104	11:34 (6)
26	05:30		16:32 (5)	05:34		09:49 (6)	05:33		09:11 (6)	05:35		09:03 (6)	05:46		09:26 (6)	06:02		09:50 (6)
	18:11	20	16:52 (5)	17:59	157	17:20 (5)	17:38	202	16:41 (5)	17:22	168	11:51 (6)	17:17	128	11:34 (6)	17:28	104	11:34 (6)
27	05:31		16:29 (5)	05:34		09:47 (6)	05:33		09:10 (6)	05:36		09:04 (6)	05:47		09:28 (6)	06:02		09:51 (6)
	18:11	26	16:55 (5)	17:58	158	17:20 (5)	17:38	192	16:35 (5)	17:21	167	11:51 (6)	17:17	126	11:34 (6)	17:28	105	11:36 (6)
28	05:31		16:26 (5)	05:34		09:45 (6)	05:33		09:10 (6)	05:36		09:05 (6)	05:47		09:28 (6)	06:03		09:51 (6)
	18:11	31	16:57 (5)	17:58	160	17:20 (5)	17:37	173	12:03 (6)	17:21	166	11:51 (6)	17:17	125	11:33 (6)	17:29	105	11:36 (6)
29	05:31		16:25 (5)	05:34		09:43 (6)	05:33		09:09 (6)	05:36		09:05 (6)	05:48		09:30 (6)	06:03		09:51 (6)
	18:11	35	17:00 (5)	17:57	161	17:19 (5)	17:36	174	12:03 (6)	17:20	165	11:50 (6)	17:17	123	11:33 (6)	17:29	106	11:37 (6)
30	05:31		16:23 (5)	05:34		09:42 (6)	05:33		09:08 (6)	05:36		09:05 (6)	05:48		09:31 (6)	06:03		09:51 (6)
	18:10	39	17:02 (5)	17:56	162	17:19 (5)	17:36	175	12:03 (6)	17:20	164	11:49 (6)	17:18	121	11:32 (6)	17:30	107	11:38 (6)
31	05:31		16:21 (5)	05:34		09:40 (6)				05:36		09:06 (6)				06:04		09:51 (6)
	18:10	42	17:03 (5)	17:56	165	17:19 (5)				17:20	163	11:49 (6)				17:30	107	11:38 (6)
Potential sun hours	395			388			366			368			348			355		
Total, worst case		203			3944			5477			5340			4287			3356	
Sun reduction		0.32			0.34			0.27			0.39			0.49			0.54	
Oper. time red.		1.00			1.00			1.00			1.00			1.00			1.00	
Wind dir. red.		0.47			0.62			0.69			0.80			0.80			0.80	
Total reduction		0.15			0.20			0.19			0.31			0.39			0.42	
Total, real		30			804			1023			1664			1658			1421	

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm) Sun set (hh:mm)	Minutes with flicker	First time (hh:mm) with flicker Last time (hh:mm) with flicker	(WTG causing flicker first time) (WTG causing flicker last time)

Licensed user:
ERM
Level 3, 09 Dinh Tien Hoang St
VN-DAKAO WARD, District 1

Phat Tran / phat.tran@erm.com
Calculated:
2/4/2021 1:12 PM/3.4.388

SHADOW - Calendar

Calculation: 0575014 - Loi Hai Real Case - Green Mode Shadow receptor: 384 - Shadow Receptor: 1.0 × 1.0 Azimuth: 0.0° Slope: 90.0° (1322)

Assumptions for shadow calculations

Sunshine probability S (Average daily sunshine hours) []

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
6.94	7.86	6.61	6.50	5.65	5.33	4.03	4.19	3.33	4.68	5.67	6.13

Operational time

N	NNE	ENE	E	ESE	SSE	S	SSW	WSW	W	WNW	NNW	Sum
4,347	1,305	385	237	166	149	140	105	105	96	96	1,629	8,760

	January			February			March			April		May	June
1	06:04		06:43 (4)	06:09		06:40 (4)	06:00		06:47 (4)	05:41		05:25	05:19
	17:31	70	07:53 (4)	17:47	93	08:13 (4)	17:54	75	08:02 (4)	17:55		17:58	18:05
2	06:05		06:43 (4)	06:09		06:40 (4)	05:59		06:48 (4)	05:40		05:25	05:19
	17:32	71	07:54 (4)	17:47	94	08:14 (4)	17:54	73	08:01 (4)	17:55		17:58	18:05
3	06:05		06:43 (4)	06:09		06:40 (4)	05:59		06:49 (4)	05:40		05:24	05:19
	17:32	72	07:55 (4)	17:47	94	08:14 (4)	17:54	71	08:00 (4)	17:56		17:58	18:05
4	06:05		06:43 (4)	06:09		06:40 (4)	05:58		06:50 (4)	05:39		05:24	05:19
	17:33	72	07:55 (4)	17:48	94	08:14 (4)	17:54	68	07:58 (4)	17:56		17:58	18:06
5	06:06		06:43 (4)	06:08		06:39 (4)	05:58		06:52 (4)	05:39		05:24	05:19
	17:33	73	07:56 (4)	17:48	94	08:13 (4)	17:54	65	07:57 (4)	17:56		17:58	18:06
6	06:06		06:42 (4)	06:08		06:39 (4)	05:57		06:52 (4)	05:38		05:23	05:19
	17:34	74	07:56 (4)	17:48	95	08:14 (4)	17:54	63	07:55 (4)	17:56		17:59	18:06
7	06:06		06:43 (4)	06:08		06:39 (4)	05:56		06:54 (4)	05:37		05:23	05:19
	17:34	75	07:58 (4)	17:49	95	08:14 (4)	17:54	60	07:54 (4)	17:56		17:59	18:07
8	06:07		06:43 (4)	06:08		06:40 (4)	05:56		06:56 (4)	05:37		05:23	05:19
	17:35	76	07:59 (4)	17:49	94	08:14 (4)	17:54	56	07:52 (4)	17:56		17:59	18:07
9	06:07		06:42 (4)	06:08		06:40 (4)	05:55		06:58 (4)	05:36		05:22	05:20
	17:35	77	07:59 (4)	17:49	94	08:14 (4)	17:55	52	07:50 (4)	17:56		17:59	18:07
10	06:07		06:43 (4)	06:07		06:39 (4)	05:55		07:00 (4)	05:36		05:22	05:20
	17:36	78	08:01 (4)	17:50	94	08:13 (4)	17:55	48	07:48 (4)	17:56		17:59	18:07
11	06:08		06:43 (4)	06:07		06:39 (4)	05:54		07:02 (4)	05:35		05:22	05:20
	17:36	78	08:01 (4)	17:50	95	08:14 (4)	17:55	43	07:45 (4)	17:56		18:00	18:08
12	06:08		06:42 (4)	06:07		06:40 (4)	05:54		07:05 (4)	05:34		05:21	05:20
	17:37	80	08:02 (4)	17:50	94	08:14 (4)	17:55	37	07:42 (4)	17:56		18:00	18:08
13	06:08		06:42 (4)	06:06		06:39 (4)	05:53		07:08 (4)	05:34		05:21	05:20
	17:38	80	08:02 (4)	17:51	94	08:13 (4)	17:55	30	07:38 (4)	17:56		18:00	18:08
14	06:08		06:42 (4)	06:06		06:40 (4)	05:52		07:14 (4)	05:33		05:21	05:20
	17:38	81	08:03 (4)	17:51	93	08:13 (4)	17:55	20	07:34 (4)	17:56		18:00	18:09
15	06:08		06:42 (4)	06:06		06:40 (4)	05:52			05:33		05:21	05:20
	17:39	83	08:05 (4)	17:51	93	08:13 (4)	17:55			17:56		18:00	18:09
16	06:09		06:42 (4)	06:05		06:41 (4)	05:51			05:32		05:21	05:21
	17:39	83	08:05 (4)	17:51	92	08:13 (4)	17:55			17:56		18:01	18:09
17	06:09		06:42 (4)	06:05		06:41 (4)	05:51			05:32		05:20	05:21
	17:40	84	08:06 (4)	17:52	91	08:12 (4)	17:55			17:56		18:01	18:09
18	06:09		06:41 (4)	06:05		06:41 (4)	05:50			05:31		05:20	05:21
	17:40	85	08:06 (4)	17:52	90	08:11 (4)	17:55			17:56		18:01	18:10
19	06:09		06:41 (4)	06:04		06:41 (4)	05:49			05:31		05:20	05:21
	17:41	86	08:07 (4)	17:52	89	08:10 (4)	17:55			17:56		18:01	18:10
20	06:09		06:41 (4)	06:04		06:42 (4)	05:49			05:30		05:20	05:21
	17:41	86	08:07 (4)	17:52	88	08:10 (4)	17:55			17:56		18:02	18:10
21	06:09		06:41 (4)	06:03		06:42 (4)	05:48			05:30		05:20	05:22
	17:42	87	08:08 (4)	17:52	88	08:10 (4)	17:55			17:57		18:02	18:10
22	06:09		06:41 (4)	06:03		06:42 (4)	05:47			05:29		05:20	05:22
	17:42	88	08:09 (4)	17:53	87	08:09 (4)	17:55			17:57		18:02	18:10
23	06:09		06:40 (4)	06:03		06:43 (4)	05:47			05:29		05:19	05:22
	17:43	89	08:09 (4)	17:53	85	08:08 (4)	17:55			17:57		18:02	18:11
24	06:09		06:40 (4)	06:02		06:43 (4)	05:46			05:28		05:19	05:22
	17:43	90	08:10 (4)	17:53	84	08:07 (4)	17:55			17:57		18:03	18:11
25	06:09		06:40 (4)	06:02		06:44 (4)	05:46			05:28		05:19	05:22
	17:44	90	08:10 (4)	17:53	83	08:07 (4)	17:55			17:57		18:03	18:11
26	06:09		06:40 (4)	06:01		06:44 (4)	05:45			05:27		05:19	05:23
	17:44	91	08:11 (4)	17:53	81	08:05 (4)	17:55			17:57		18:03	18:11
27	06:09		06:40 (4)	06:01		06:46 (4)	05:44			05:27		05:19	05:23
	17:44	91	08:11 (4)	17:53	79	08:05 (4)	17:55			17:57		18:03	18:11
28	06:09		06:40 (4)	06:00		06:46 (4)	05:44			05:26		05:19	05:23
	17:45	92	08:12 (4)	17:54	77	08:03 (4)	17:55			17:57		18:04	18:12
29	06:09		06:40 (4)				05:43			05:26		05:19	05:23
	17:45	92	08:12 (4)				17:55			17:57		18:04	18:12
30	06:09		06:40 (4)				05:42			05:25		05:19	05:24
	17:46	92	08:12 (4)				17:55			17:58		18:04	18:12
31	06:09		06:40 (4)				05:42					05:19	
	17:46	93	08:13 (4)				17:55					18:05	
Potential sun hours	357			329			374			372		393	384
Total, worst case		2559			2524			761					
Sun reduction		0.60			0.67			0.55					
Oper. time red.		1.00			1.00			1.00					
Wind dir. red.		0.58			0.58			0.58					
Total reduction		0.35			0.39			0.32					
Total, real		890			974			241					

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm) Sun set (hh:mm)	Minutes with flicker	First time (hh:mm) with flicker Last time (hh:mm) with flicker	(WTG causing flicker first time) (WTG causing flicker last time)

SHADOW - Calendar

Calculation: 0575014 - Loi Hai Real Case - Green Mode Shadow receptor: 384 - Shadow Receptor: 1.0 × 1.0 Azimuth: 0.0° Slope: 90.0° (1322)

Assumptions for shadow calculations

Sunshine probability S (Average daily sunshine hours) []

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
6.94	7.86	6.61	6.50	5.65	5.33	4.03	4.19	3.33	4.68	5.67	6.13

Operational time

N	NNE	ENE	E	ESE	SSE	S	SSW	WSW	W	WNW	NNW	Sum
4,347	1,305	385	237	166	149	140	105	105	96	96	1,629	8,760

	July		August		September			October			November			December		
1	05:24		05:31		05:34			05:33		06:46 (4)	05:37		06:09 (4)	05:49		06:25 (4)
	18:12		18:10		17:55			17:35	34	07:20 (4)	17:19	94	07:43 (4)	17:18	78	07:43 (4)
2	05:24		05:32		05:34			05:33		06:42 (4)	05:37		06:09 (4)	05:49		06:25 (4)
	18:12		18:10		17:54			17:35	41	07:23 (4)	17:19	94	07:43 (4)	17:18	78	07:43 (4)
3	05:24		05:32		05:34			05:33		06:39 (4)	05:37		06:08 (4)	05:50		06:26 (4)
	18:12		18:09		17:54			17:34	46	07:25 (4)	17:19	95	07:43 (4)	17:18	77	07:43 (4)
4	05:25		05:32		05:34			05:33		06:36 (4)	05:37		06:09 (4)	05:50		06:27 (4)
	18:12		18:09		17:53			17:33	51	07:27 (4)	17:18	95	07:44 (4)	17:18	76	07:43 (4)
5	05:25		05:32		05:34			05:33		06:34 (4)	05:38		06:09 (4)	05:51		06:28 (4)
	18:13		18:09		17:53			17:33	54	07:28 (4)	17:18	95	07:44 (4)	17:19	75	07:43 (4)
6	05:25		05:32		05:34			05:33		06:31 (4)	05:38		06:09 (4)	05:51		06:28 (4)
	18:13		18:08		17:52			17:32	58	07:29 (4)	17:18	94	07:43 (4)	17:19	74	07:42 (4)
7	05:26		05:32		05:34			05:33		06:29 (4)	05:38		06:10 (4)	05:52		06:30 (4)
	18:13		18:08		17:51			17:31	62	07:31 (4)	17:18	94	07:44 (4)	17:19	73	07:43 (4)
8	05:26		05:33		05:34			05:33		06:28 (4)	05:39		06:10 (4)	05:52		06:31 (4)
	18:13		18:08		17:51			17:31	64	07:32 (4)	17:18	94	07:44 (4)	17:20	72	07:43 (4)
9	05:26		05:33		05:34			05:33		06:26 (4)	05:39		06:11 (4)	05:53		06:31 (4)
	18:13		18:07		17:50			17:30	67	07:33 (4)	17:17	94	07:45 (4)	17:20	72	07:43 (4)
10	05:26		05:33		05:34			05:33		06:24 (4)	05:39		06:11 (4)	05:53		06:33 (4)
	18:13		18:07		17:49			17:30	70	07:34 (4)	17:17	93	07:44 (4)	17:20	71	07:44 (4)
11	05:27		05:33		05:34			05:34		06:22 (4)	05:40		06:11 (4)	05:54		06:33 (4)
	18:13		18:06		17:49			17:29	72	07:34 (4)	17:17	93	07:44 (4)	17:21	70	07:43 (4)
12	05:27		05:33		05:34			05:34		06:21 (4)	05:40		06:12 (4)	05:54		06:34 (4)
	18:13		18:06		17:48			17:28	74	07:35 (4)	17:17	92	07:44 (4)	17:21	70	07:44 (4)
13	05:27		05:33		05:34			05:34		06:20 (4)	05:40		06:12 (4)	05:55		06:34 (4)
	18:13		18:05		17:47			17:28	76	07:36 (4)	17:17	92	07:44 (4)	17:21	69	07:43 (4)
14	05:27		05:33		05:34			05:34		06:18 (4)	05:41		06:13 (4)	05:56		06:36 (4)
	18:13		18:05		17:47			17:27	78	07:36 (4)	17:17	92	07:45 (4)	17:22	68	07:44 (4)
15	05:28		05:33		05:34			05:34		06:17 (4)	05:41		06:13 (4)	05:56		06:36 (4)
	18:13		18:05		17:46			17:27	80	07:37 (4)	17:17	91	07:44 (4)	17:22	68	07:44 (4)
16	05:28		05:33		05:34			05:34		06:17 (4)	05:42		06:13 (4)	05:57		06:37 (4)
	18:13		18:04		17:45			17:26	81	07:38 (4)	17:16	91	07:44 (4)	17:23	68	07:45 (4)
17	05:28		05:33		05:34			05:34		06:16 (4)	05:42		06:14 (4)	05:57		06:37 (4)
	18:13		18:04		17:45			17:26	83	07:39 (4)	17:16	90	07:44 (4)	17:23	67	07:44 (4)
18	05:28		05:34		05:34			05:34		06:15 (4)	05:42		06:14 (4)	05:58		06:38 (4)
	18:13		18:03		17:44			17:25	84	07:39 (4)	17:16	90	07:44 (4)	17:24	67	07:45 (4)
19	05:29		05:34		05:33			05:34		06:14 (4)	05:43		06:15 (4)	05:58		06:38 (4)
	18:12		18:03		17:43			17:25	85	07:39 (4)	17:16	89	07:44 (4)	17:24	67	07:45 (4)
20	05:29		05:34		05:33			05:34		06:13 (4)	05:43		06:16 (4)	05:59		06:39 (4)
	18:12		18:02		17:43			17:24	87	07:40 (4)	17:16	88	07:44 (4)	17:25	67	07:46 (4)
21	05:29		05:34		05:33			05:34		06:12 (4)	05:44		06:17 (4)	05:59		06:39 (4)
	18:12		18:01		17:42			17:24	88	07:40 (4)	17:16	87	07:44 (4)	17:25	67	07:46 (4)
22	05:29		05:34		05:33			05:35		06:11 (4)	05:44		06:17 (4)	06:00		06:40 (4)
	18:12		18:01		17:41			17:23	89	07:40 (4)	17:16	86	07:43 (4)	17:25	67	07:47 (4)
23	05:30		05:34		05:33			05:35		06:12 (4)	05:45		06:18 (4)	06:00		06:40 (4)
	18:12		18:00		17:40			17:23	89	07:41 (4)	17:17	86	07:44 (4)	17:26	67	07:47 (4)
24	05:30		05:34		05:33			05:35		06:11 (4)	05:45		06:18 (4)	06:01		06:40 (4)
	18:12		18:00		17:40			17:22	90	07:41 (4)	17:17	85	07:43 (4)	17:27	67	07:47 (4)
25	05:30		05:34		05:33			05:35		06:10 (4)	05:46		06:20 (4)	06:01		06:41 (4)
	18:12		17:59		17:39			17:22	92	07:42 (4)	17:17	84	07:44 (4)	17:27	67	07:48 (4)
26	05:30		05:34		05:33			05:35		06:10 (4)	05:46		06:20 (4)	06:02		06:41 (4)
	18:11		17:59		17:38			17:22	92	07:42 (4)	17:17	83	07:43 (4)	17:28	67	07:48 (4)
27	05:31		05:34		05:33			05:35		06:09 (4)	05:47		06:21 (4)	06:02		06:42 (4)
	18:11		17:58		17:38			17:21	93	07:42 (4)	17:17	83	07:44 (4)	17:28	67	07:49 (4)
28	05:31		05:34		05:33			05:36		06:10 (4)	05:47		06:22 (4)	06:03		06:42 (4)
	18:11		17:58		17:37			17:21	93	07:43 (4)	17:17	81	07:43 (4)	17:29	68	07:50 (4)
29	05:31		05:34		05:33		06:57 (4)	05:36		06:09 (4)	05:48		06:23 (4)	06:03		06:43 (4)
	18:11		17:57		17:36	14	07:11 (4)	17:20	94	07:43 (4)	17:17	80	07:43 (4)	17:29	68	07:51 (4)
30	05:31		05:34		05:33		06:50 (4)	05:36		06:09 (4)	05:48		06:23 (4)	06:03		06:42 (4)
	18:10		17:56		17:36	27	07:17 (4)	17:20	94	07:43 (4)	17:18	80	07:43 (4)	17:30	69	07:51 (4)
31	05:31		05:34					05:36		06:09 (4)				06:04		06:42 (4)
	18:10		17:56					17:20	95	07:44 (4)				17:30	70	07:52 (4)
Potential sun hours	395		388		366			368			348			355		
Total, worst case						41			2356			2685			2171	
Sun reduction						0.27			0.39			0.49			0.54	
Oper. time red.						1.00			1.00			1.00			1.00	
Wind dir. red.						0.58			0.58			0.58			0.58	
Total reduction						0.16			0.23			0.28			0.31	
Total, real						6			536			758			671	

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm) Sun set (hh:mm)	Minutes with flicker	First time (hh:mm) with flicker Last time (hh:mm) with flicker	(WTG causing flicker first time) (WTG causing flicker last time)

Licensed user:
ERM
Level 3, 09 Dinh Tien Hoang St
VN-DAKAO WARD, District 1

Phat Tran / phat.tran@erm.com
Calculated:
2/4/2021 1:12 PM/3.4.388

SHADOW - Calendar

Calculation: 0575014 - Loi Hai Real Case - Green Mode Shadow receptor: 385 - Shadow Receptor: 1.0 × 1.0 Azimuth: 0.0° Slope: 90.0° (1330)

Assumptions for shadow calculations

Sunshine probability S (Average daily sunshine hours) []

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
6.94	7.86	6.61	6.50	5.65	5.33	4.03	4.19	3.33	4.68	5.67	6.13

Operational time

N	NNE	ENE	E	ESE	SSE	S	SSW	WSW	W	WNW	NNW	Sum
4,347	1,305	385	237	166	149	140	105	105	96	96	1,629	8,760

	January		February			March		April		May		June		
1	06:04		06:45 (4)	06:09		06:00		12:31 (3)	05:41	11:51 (3)	05:25	11:42 (3)	05:19	05:47 (2)
	17:31	56	07:41 (4)	17:47		17:54	134	14:45 (3)	17:55	153	15:04 (3)	17:58	137	14:57 (3)	18:05	199	14:46 (3)
2	06:05		06:46 (4)	06:09		05:59		12:29 (3)	05:40	11:50 (3)	05:25	11:42 (3)	05:19	05:46 (2)
	17:32	55	07:41 (4)	17:47		17:54	137	14:46 (3)	17:55	151	15:05 (3)	17:58	137	14:57 (3)	18:05	200	14:46 (3)
3	06:05		06:47 (4)	06:09		05:59		12:27 (3)	05:40	11:49 (3)	05:24	11:42 (3)	05:19	05:45 (2)
	17:32	55	07:42 (4)	17:47		17:54	140	14:47 (3)	17:56	149	15:04 (3)	17:58	138	14:56 (3)	18:05	201	14:45 (3)
4	06:06		06:48 (4)	06:09		05:58		12:25 (3)	05:39	11:48 (3)	05:24	11:42 (3)	05:19	05:45 (2)
	17:33	53	07:41 (4)	17:48		17:54	143	14:48 (3)	17:56	147	15:04 (3)	17:58	139	14:56 (3)	18:06	200	14:45 (3)
5	06:06		06:48 (4)	06:08		05:58		12:24 (3)	05:39	11:48 (3)	05:24	11:43 (3)	05:19	05:44 (2)
	17:33	53	07:41 (4)	17:48		17:54	146	14:50 (3)	17:56	144	15:04 (3)	17:58	140	14:56 (3)	18:06	202	14:45 (3)
6	06:06		06:49 (4)	06:08		05:57		12:21 (3)	05:38	11:47 (3)	05:23	11:43 (3)	05:19	05:44 (2)
	17:34	52	07:41 (4)	17:48		17:54	150	14:51 (3)	17:56	144	15:04 (3)	17:59	140	14:55 (3)	18:06	202	14:45 (3)
7	06:07		06:51 (4)	06:08		05:56		12:20 (3)	05:37	11:46 (3)	05:23	11:43 (3)	05:19	05:43 (2)
	17:34	50	07:41 (4)	17:49		17:54	153	14:53 (3)	17:56	143	15:04 (3)	17:59	141	14:54 (3)	18:07	202	14:44 (3)
8	06:07		06:51 (4)	06:08		05:56		12:18 (3)	05:37	11:46 (3)	05:23	11:44 (3)	05:19	05:43 (2)
	17:35	50	07:41 (4)	17:49		17:54	155	14:53 (3)	17:56	142	15:04 (3)	17:59	143	14:54 (3)	18:07	203	14:44 (3)
9	06:07		06:52 (4)	06:08		05:55		12:17 (3)	05:36	11:46 (3)	05:22	11:43 (3)	05:20	05:42 (2)
	17:35	48	07:40 (4)	17:49		17:55	158	14:55 (3)	17:56	139	15:04 (3)	17:59	144	14:53 (3)	18:07	203	14:44 (3)
10	06:07		06:54 (4)	06:07		05:55		12:15 (3)	05:36	11:46 (3)	05:22	11:44 (3)	05:20	05:42 (2)
	17:36	47	07:41 (4)	17:50		17:55	160	14:55 (3)	17:56	139	15:04 (3)	17:59	145	14:53 (3)	18:07	204	14:44 (3)
11	06:08		06:55 (4)	06:07		05:54		12:13 (3)	05:35	11:45 (3)	05:22	11:44 (3)	05:20	05:42 (2)
	17:37	45	07:40 (4)	17:50		17:55	163	14:56 (3)	17:56	138	15:03 (3)	18:00	148	14:53 (3)	18:08	204	14:44 (3)
12	06:08		06:56 (4)	06:07	13:34 (3)	05:54		12:13 (3)	05:34	11:44 (3)	05:21	11:45 (3)	05:20	05:43 (2)
	17:37	43	07:39 (4)	17:50	13	13:47 (3)	17:55	164	14:57 (3)	17:56	137	15:03 (3)	18:00	149	14:53 (3)	18:08	204	14:45 (3)
13	06:08		06:57 (4)	06:06	13:22 (3)	05:53		12:11 (3)	05:34	11:44 (3)	05:21	11:45 (3)	05:20	05:42 (2)
	17:38	42	07:39 (4)	17:51	35	13:57 (3)	17:55	166	14:57 (3)	17:56	136	15:03 (3)	18:00	151	14:51 (3)	18:08	204	14:44 (3)
14	06:08		06:59 (4)	06:06	13:15 (3)	05:52		12:10 (3)	05:33	11:43 (3)	05:21	11:45 (3)	05:20	05:42 (2)
	17:38	39	07:38 (4)	17:51	49	14:04 (3)	17:55	169	14:59 (3)	17:56	136	15:03 (3)	18:00	154	14:51 (3)	18:09	204	14:44 (3)
15	06:08		07:01 (4)	06:06	13:10 (3)	05:52		12:08 (3)	05:33	12:48 (3)	05:21	11:46 (3)	05:20	05:42 (2)
	17:39	37	07:38 (4)	17:51	60	14:10 (3)	17:55	171	14:59 (3)	17:56	135	15:03 (3)	18:00	155	14:51 (3)	18:09	204	14:44 (3)
16	06:09		07:03 (4)	06:05	13:06 (3)	05:51		12:07 (3)	05:32	12:48 (3)	05:21	11:46 (3)	05:21	05:42 (2)
	17:39	34	07:37 (4)	17:51	68	14:14 (3)	17:55	172	14:59 (3)	17:56	134	15:02 (3)	18:01	160	14:51 (3)	18:09	204	14:44 (3)
17	06:09		07:05 (4)	06:05	13:02 (3)	05:51		12:06 (3)	05:32	12:48 (3)	05:20	11:47 (3)	05:21	05:42 (2)
	17:40	30	07:35 (4)	17:52	75	14:17 (3)	17:55	174	15:00 (3)	17:56	134	15:02 (3)	18:01	163	14:51 (3)	18:09	204	14:44 (3)
18	06:09		07:07 (4)	06:05	12:59 (3)	05:50		12:04 (3)	05:31	11:42 (3)	05:20	11:47 (3)	05:21	05:43 (2)
	17:40	26	07:33 (4)	17:52	82	14:21 (3)	17:55	177	15:01 (3)	17:56	135	15:02 (3)	18:01	168	14:49 (3)	18:10	204	14:45 (3)
19	06:09		07:10 (4)	06:04	12:55 (3)	05:49		12:03 (3)	05:31	12:48 (3)	05:20	11:47 (3)	05:21	05:43 (2)
	17:41	21	07:31 (4)	17:52	88	14:23 (3)	17:55	178	15:01 (3)	17:56	134	15:02 (3)	18:01	182	14:49 (3)	18:10	204	14:45 (3)
20	06:09		07:13 (4)	06:04	12:52 (3)	05:49		12:02 (3)	05:30	12:47 (3)	05:20	11:48 (3)	05:21	05:43 (2)
	17:41	15	07:28 (4)	17:52	94	14:26 (3)	17:55	180	15:02 (3)	17:56	134	15:01 (3)	18:02	181	14:49 (3)	18:10	204	14:45 (3)
21	06:09			06:03	12:50 (3)	05:48		12:01 (3)	05:30	12:48 (3)	05:20	11:48 (3)	05:22	05:43 (2)
	17:42			17:52	99	14:29 (3)	17:55	181	15:02 (3)	17:57	133	15:01 (3)	18:02	181	14:49 (3)	18:10	204	14:45 (3)
22	06:09			06:03	12:47 (3)	05:47		12:00 (3)	05:29	12:47 (3)	05:20	11:49 (3)	05:22	05:43 (2)
	17:42			17:53	104	14:31 (3)	17:55	183	15:03 (3)	17:57	133	15:00 (3)	18:02	179	14:48 (3)	18:10	204	14:45 (3)
23	06:09			06:03	12:44 (3)	05:47		11:59 (3)	05:29	12:47 (3)	05:19	11:50 (3)	05:22	05:44 (2)
	17:43			17:53	110	14:34 (3)	17:55	184	15:03 (3)	17:57	134	15:01 (3)	18:02	178	14:48 (3)	18:11	204	14:46 (3)
24	06:09			06:02	12:41 (3)	05:46		11:57 (3)	05:28	12:46 (3)	05:19	11:50 (3)	05:22	05:44 (2)
	17:43			17:53	114	14:35 (3)	17:55	186	15:03 (3)	17:57	134	15:00 (3)	18:03	178	14:48 (3)	18:11	204	14:46 (3)
25	06:09			06:02	12:40 (3)	05:46		11:57 (3)	05:28	12:46 (3)	05:19	11:51 (3)	05:22	05:44 (2)
	17:44			17:53	118	14:38 (3)	17:55	187	15:04 (3)	17:57	134	15:00 (3)	18:03	177	14:48 (3)	18:11	204	14:46 (3)
26	06:09			06:01	12:37 (3)	05:45		11:56 (3)	05:27	11:41 (3)	05:19	11:51 (3)	05:23	05:44 (2)
	17:44			17:53	122	14:39 (3)	17:55	188	15:04 (3)	17:57	135	14:59 (3)	18:03	176	14:47 (3)	18:11	205	14:46 (3)
27	06:09			06:01	12:35 (3)	05:44		11:55 (3)	05:27	11:42 (3)	05:19	05:56 (2)	05:23	05:45 (2)
	17:44			17:53	126	14:41 (3)	17:55	188	15:03 (3)	17:57	135	14:59 (3)	18:03	182	14:47 (3)	18:11	204	14:47 (3)
28	06:09			06:00	12:32 (3)	05:44		11:54 (3)	05:26	11:41 (3)	05:19	05:53 (2)	05:23	05:45 (2)
	17:45			17:54	131	14:43 (3)	17:55	174	15:04 (3)	17:57	135	14:58 (3)	18:04	189	14:47 (3)	18:12	204	14:47 (3)
29	06:09						05:43		11:53 (3)	05:26		11:42 (3)	05:19		05:51 (2)	05:23		05:45 (2)
	17:45						17:55	166	15:04 (3)	17:57	135	14:58 (3)	18:04	192	14:47 (3)	18:12	204	14:47 (3)
30	06:09						05:42		11:52 (3)	05:25		11:42 (3)	05:19		05:49 (2)	05:24		05:46 (2)
	17:46						17:55	161	15:04 (3)	17:58	137	14:58 (3)	18:04	194	14:46 (3)	18:12	204	14:48 (3)
31	06:09						05:42		11:52 (3)				05:19		05:48 (2)			
	17:46						17:55	156	15:04 (3)				18:05	196	14:46 (3)			
Potential sun hours	357		329			374			372			393			384			
Total, worst case		851			1488			5144			4149			5037			6097	
Sun reduction		0.60			0.67			0.55			0.52			0.45			0.42	
Oper. time red.		1.00			1.00			1.00			1.00			1.00			1.00	
Wind dir. red.		0.70			0.40			0.40			0.40			0.40			0.40	
Total reduction		0.42			0.27			0.22			0.21			0.18			0.16	
Total, real		353			395			1118			863			890			997	

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm) Sun set (hh:mm)	Minutes with flicker	First time (hh:mm) with flicker Last time (hh:mm) with flicker	(WTG causing flicker first time) (WTG causing flicker last time)

SHADOW - Calendar

Calculation: 0575014 - Loi Hai Real Case - Green Mode Shadow receptor: 385 - Shadow Receptor: 1.0 × 1.0 Azimuth: 0.0° Slope: 90.0° (1330)

Assumptions for shadow calculations

Sunshine probability S (Average daily sunshine hours) []

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
6.94	7.86	6.61	6.50	5.65	5.33	4.03	4.19	3.33	4.68	5.67	6.13

Operational time

N	NNE	ENE	E	ESE	SSE	S	SSW	WSW	W	WNW	NNW	Sum
4,347	1,305	385	237	166	149	140	105	105	96	96	1,629	8,760

	July		August		September		October		November		December		
1	05:24		05:47 (2)	05:31		11:55 (3)	05:34		11:44 (3)	05:33		11:51 (3)	05:37		05:49		06:37 (4)
	18:12	204	14:49 (3)	18:10	149	15:03 (3)	17:55	138	15:02 (3)	17:35	166	14:37 (3)	17:19		17:18	45	07:22 (4)
2	05:24		05:47 (2)	05:32		11:54 (3)	05:34		11:44 (3)	05:33		11:52 (3)	05:37		05:49		06:36 (4)
	18:12	204	14:49 (3)	18:10	147	15:03 (3)	17:54	139	15:02 (3)	17:35	163	14:35 (3)	17:19		17:18	47	07:23 (4)
3	05:24		05:47 (2)	05:32		11:54 (3)	05:34		11:44 (3)	05:33		11:53 (3)	05:37		05:50		06:36 (4)
	18:12	204	14:49 (3)	18:09	145	15:03 (3)	17:54	139	15:02 (3)	17:34	161	14:34 (3)	17:19		17:18	48	07:24 (4)
4	05:25		05:48 (2)	05:32		11:54 (3)	05:34		11:43 (3)	05:33		11:54 (3)	05:37		05:50		06:36 (4)
	18:12	202	14:49 (3)	18:09	143	15:04 (3)	17:53	142	15:01 (3)	17:33	158	14:32 (3)	17:18		17:18	49	07:25 (4)
5	05:25		05:49 (2)	05:32		11:53 (3)	05:34		11:43 (3)	05:33		11:55 (3)	05:38		05:51		06:36 (4)
	18:13	203	14:50 (3)	18:09	142	15:04 (3)	17:53	143	15:01 (3)	17:33	156	14:31 (3)	17:18		17:19	50	07:26 (4)
6	05:25		05:49 (2)	05:32		11:53 (3)	05:34		11:43 (3)	05:33		11:56 (3)	05:38		05:51		06:35 (4)
	18:13	203	14:51 (3)	18:08	142	15:05 (3)	17:52	144	15:00 (3)	17:32	153	14:29 (3)	17:18		17:19	52	07:27 (4)
7	05:26		05:50 (2)	05:32		11:52 (3)	05:34		11:43 (3)	05:33		11:57 (3)	05:38		05:52		06:35 (4)
	18:13	202	14:51 (3)	18:08	141	15:05 (3)	17:51	145	15:00 (3)	17:31	151	14:28 (3)	17:18		17:19	53	07:28 (4)
8	05:26		05:51 (2)	05:33		11:52 (3)	05:34		11:43 (3)	05:33		11:58 (3)	05:39		05:52		06:36 (4)
	18:13	202	14:52 (3)	18:08	140	15:05 (3)	17:51	147	14:59 (3)	17:31	148	14:26 (3)	17:18		17:20	53	07:29 (4)
9	05:26		05:52 (2)	05:33		11:51 (3)	05:34		11:43 (3)	05:33		11:59 (3)	05:39		05:53		06:35 (4)
	18:13	200	14:52 (3)	18:07	139	15:05 (3)	17:50	148	14:58 (3)	17:30	145	14:24 (3)	17:17		17:20	55	07:30 (4)
10	05:26		05:53 (2)	05:33		11:51 (3)	05:34		11:43 (3)	05:33		12:00 (3)	05:39		05:53		06:36 (4)
	18:13	199	14:52 (3)	18:07	138	15:05 (3)	17:49	151	14:58 (3)	17:30	142	14:22 (3)	17:17		17:20	55	07:31 (4)
11	05:27		05:53 (2)	05:33		11:51 (3)	05:34		11:44 (3)	05:34		12:02 (3)	05:40		05:54		06:35 (4)
	18:13	199	14:53 (3)	18:06	137	15:06 (3)	17:49	153	14:57 (3)	17:29	139	14:21 (3)	17:17		17:21	56	07:31 (4)
12	05:27		05:55 (2)	05:33		11:51 (3)	05:34		11:44 (3)	05:34		12:03 (3)	05:40		05:54		06:36 (4)
	18:13	198	14:54 (3)	18:06	136	15:06 (3)	17:48	155	14:56 (3)	17:28	136	14:19 (3)	17:17		17:21	56	07:32 (4)
13	05:27		05:56 (2)	05:33		11:50 (3)	05:34		11:44 (3)	05:34		12:05 (3)	05:40		05:55		06:36 (4)
	18:13	196	14:54 (3)	18:05	137	15:06 (3)	17:47	160	14:56 (3)	17:28	132	14:17 (3)	17:17		17:21	56	07:32 (4)
14	05:27		05:58 (2)	05:33		11:50 (3)	05:34		11:43 (3)	05:34		12:06 (3)	05:41		05:56		06:36 (4)
	18:13	193	14:54 (3)	18:05	135	15:06 (3)	17:47	165	14:54 (3)	17:27	129	14:15 (3)	17:17		17:22	58	07:34 (4)
15	05:28		06:00 (2)	05:33		11:49 (3)	05:34		11:43 (3)	05:34		12:08 (3)	05:41		05:56		06:36 (4)
	18:13	190	14:55 (3)	18:05	135	15:06 (3)	17:46	172	14:53 (3)	17:27	125	14:13 (3)	17:17		17:22	58	07:34 (4)
16	05:28		06:03 (2)	05:33		12:52 (3)	05:34		11:43 (3)	05:34		12:10 (3)	05:42		05:57		06:37 (4)
	18:13	186	14:56 (3)	18:04	134	15:06 (3)	17:45	190	14:53 (3)	17:26	121	14:11 (3)	17:16		17:23	58	07:35 (4)
17	05:28		12:01 (3)	05:33		11:48 (3)	05:34		11:44 (3)	05:34		12:12 (3)	05:42		05:57		06:37 (4)
	18:13	175	14:56 (3)	18:04	135	15:06 (3)	17:45	188	14:52 (3)	17:26	117	14:09 (3)	17:16		17:23	58	07:35 (4)
18	05:28		12:00 (3)	05:34		12:52 (3)	05:34		11:44 (3)	05:34		12:14 (3)	05:42		05:58		06:38 (4)
	18:13	176	14:56 (3)	18:03	134	15:06 (3)	17:44	187	14:51 (3)	17:25	113	14:07 (3)	17:16		17:24	58	07:36 (4)
19	05:29		12:00 (3)	05:34		12:52 (3)	05:34		11:44 (3)	05:34		12:16 (3)	05:43		05:58		06:38 (4)
	18:12	177	14:57 (3)	18:03	134	15:06 (3)	17:43	186	14:50 (3)	17:25	108	14:04 (3)	17:16		17:24	58	07:36 (4)
20	05:29		12:00 (3)	05:34		12:52 (3)	05:33		11:45 (3)	05:34		12:18 (3)	05:43		05:59		06:38 (4)
	18:12	178	14:58 (3)	18:02	134	15:06 (3)	17:43	184	14:49 (3)	17:24	103	14:01 (3)	17:16		17:25	59	07:37 (4)
21	05:29		11:59 (3)	05:34		12:52 (3)	05:33		11:45 (3)	05:34		12:21 (3)	05:44		05:59		06:38 (4)
	18:12	179	14:58 (3)	18:01	133	15:05 (3)	17:42	183	14:48 (3)	17:24	98	13:59 (3)	17:16		17:25	59	07:37 (4)
22	05:29		11:59 (3)	05:34		12:51 (3)	05:33		11:46 (3)	05:35		12:23 (3)	05:44	06:49 (4)	06:00		06:39 (4)
	18:12	180	14:59 (3)	18:01	134	15:05 (3)	17:41	181	14:47 (3)	17:23	93	13:56 (3)	17:16	15	07:04 (4)	17:25	59	07:38 (4)
23	05:30		11:58 (3)	05:34		12:51 (3)	05:33		11:46 (3)	05:35		12:27 (3)	05:45	06:47 (4)	06:00		06:39 (4)
	18:12	181	14:59 (3)	18:00	134	15:05 (3)	17:40	180	14:46 (3)	17:23	86	13:53 (3)	17:17	21	07:08 (4)	17:26	59	07:38 (4)
24	05:30		11:59 (3)	05:34		12:51 (3)	05:33		11:47 (3)	05:35		12:30 (3)	05:45	06:44 (4)	06:01		06:39 (4)
	18:12	181	15:00 (3)	18:00	134	15:05 (3)	17:40	178	14:45 (3)	17:22	80	13:50 (3)	17:17	26	07:10 (4)	17:27	59	07:38 (4)
25	05:30		11:58 (3)	05:34		11:45 (3)	05:33		11:47 (3)	05:35		12:33 (3)	05:46	06:43 (4)	06:01		06:41 (4)
	18:12	174	15:00 (3)	17:59	135	15:05 (3)	17:39	177	14:44 (3)	17:22	73	13:46 (3)	17:17	30	07:13 (4)	17:27	58	07:39 (4)
26	05:30		11:57 (3)	05:34		12:50 (3)	05:33		11:48 (3)	05:35		12:36 (3)	05:46	06:41 (4)	06:02		06:41 (4)
	18:11	166	15:00 (3)	17:59	134	15:04 (3)	17:38	175	14:43 (3)	17:22	66	13:42 (3)	17:17	33	07:14 (4)	17:28	58	07:39 (4)
27	05:31		11:57 (3)	05:34		12:50 (3)	05:33		11:48 (3)	05:36		12:41 (3)	05:47	06:40 (4)	06:02		06:42 (4)
	18:11	161	15:01 (3)	17:58	134	15:04 (3)	17:38	174	14:42 (3)	17:21	56	13:37 (3)	17:17	37	07:17 (4)	17:28	58	07:40 (4)
28	05:31		11:56 (3)	05:34		12:49 (3)	05:33		11:49 (3)	05:36		12:47 (3)	05:47	06:39 (4)	06:03		06:42 (4)
	18:11	158	15:01 (3)	17:58	135	15:04 (3)	17:37	171	14:40 (3)	17:21	46	13:33 (3)	17:17	39	07:18 (4)	17:29	58	07:40 (4)
29	05:31		11:57 (3)	05:34		11:44 (3)	05:33		11:50 (3)	05:36		12:53 (3)	05:48	06:38 (4)	06:03		06:43 (4)
	18:11	155	15:02 (3)	17:57	136	15:04 (3)	17:36	169	14:39 (3)	17:20	33	13:26 (3)	17:17	42	07:20 (4)	17:29	58	07:41 (4)
30	05:31		11:56 (3)	05:34		11:44 (3)	05:33		11:50 (3)	05:36			05:48	06:37 (4)	06:03		06:44 (4)
	18:10	152	15:02 (3)	17:56	136	15:03 (3)	17:36	168	14:38 (3)	17:20			17:18	43	07:20 (4)	17:30	56	07:40 (4)
31	05:31		11:55 (3)	05:34		11:44 (3)				05:36						06:04		06:44 (4)
	18:10	151	15:03 (3)	17:56	137	15:03 (3)				17:20						17:30	56	07:40 (4)
Potential sun hours	395			388			366			368			348			355		
Total, worst case		5729			4259			4932			3397			286			1720	
Sun reduction		0.32			0.34			0.27			0.39			0.49			0.54	
Oper. time red.		1.00			1.00			1.00			1.00			1.00			1.00	
Wind dir. red.		0.40			0.40			0.40			0.40			0.70			0.70	
Total reduction		0.12			0.13			0.11			0.16			0.34			0.37	
Total, real		716			566			534			531			96			635	

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm) Sun set (hh:mm)	Minutes with flicker	First time (hh:mm) with flicker Last time (hh:mm) with flicker	(WTG causing flicker first time) (WTG causing flicker last time)

SHADOW - Calendar

Calculation: 0575014 - Loi Hai Real Case - Green Mode Shadow receptor: 386 - Shadow Receptor: 1.0 × 1.0 Azimuth: 0.0° Slope: 90.0° (1332)

Assumptions for shadow calculations

Sunshine probability S (Average daily sunshine hours) []

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
6.94	7.86	6.61	6.50	5.65	5.33	4.03	4.19	3.33	4.68	5.67	6.13

Operational time

N	NNE	ENE	E	ESE	SSE	S	SSW	WSW	W	WNW	NNW	Sum
4,347	1,305	385	237	166	149	140	105	105	96	96	1,629	8,760

	January			February			March			April			May	June
1	06:04		16:32 (4)	06:09		16:34 (4)	06:00			05:41		17:15 (3)	05:25	05:19
	17:31	29	17:01 (4)	17:47	46	17:20 (4)	17:54			17:55	10	17:25 (3)	17:58	18:05
2	06:05		16:32 (4)	06:09		16:35 (4)	05:59			05:40			05:25	05:19
	17:31	30	17:02 (4)	17:47	45	17:20 (4)	17:54			17:55			17:58	18:05
3	06:05		16:31 (4)	06:09		16:36 (4)	05:59			05:40			05:24	05:19
	17:32	31	17:02 (4)	17:47	44	17:20 (4)	17:54			17:55			17:58	18:05
4	06:05		16:32 (4)	06:09		16:37 (4)	05:58			05:39			05:24	05:19
	17:33	32	17:04 (4)	17:48	42	17:19 (4)	17:54			17:56			17:58	18:06
5	06:06		16:32 (4)	06:08		16:37 (4)	05:58			05:39			05:24	05:19
	17:33	32	17:04 (4)	17:48	41	17:18 (4)	17:54			17:56			17:58	18:06
6	06:06		16:31 (4)	06:08		16:37 (4)	05:57			05:38			05:23	05:19
	17:34	34	17:05 (4)	17:48	41	17:18 (4)	17:54			17:56			17:59	18:06
7	06:06		16:32 (4)	06:08		16:39 (4)	05:56			05:37			05:23	05:19
	17:34	35	17:07 (4)	17:49	38	17:17 (4)	17:54			17:56			17:59	18:07
8	06:07		16:32 (4)	06:08		16:40 (4)	05:56			05:37			05:23	05:19
	17:35	35	17:07 (4)	17:49	36	17:16 (4)	17:54			17:56			17:59	18:07
9	06:07		16:31 (4)	06:08		16:41 (4)	05:55			05:36			05:22	05:19
	17:35	37	17:08 (4)	17:49	35	17:16 (4)	17:55			17:56			17:59	18:07
10	06:07		16:31 (4)	06:07		16:42 (4)	05:55			05:36			05:22	05:20
	17:36	38	17:09 (4)	17:50	32	17:14 (4)	17:55			17:56			17:59	18:07
11	06:08		16:32 (4)	06:07		16:44 (4)	05:54			05:35			05:22	05:20
	17:36	38	17:10 (4)	17:50	28	17:12 (4)	17:55			17:56			17:59	18:08
12	06:08		16:31 (4)	06:07		16:46 (4)	05:54			05:34			05:21	05:20
	17:37	40	17:11 (4)	17:50	25	17:11 (4)	17:55			17:56			18:00	18:08
13	06:08		16:31 (4)	06:06		16:48 (4)	05:53			05:34			05:21	05:20
	17:38	41	17:12 (4)	17:51	19	17:07 (4)	17:55			17:56			18:00	18:08
14	06:08		16:31 (4)	06:06		16:51 (4)	05:52		17:24 (3)	05:33			05:21	05:20
	17:38	41	17:12 (4)	17:51	13	17:04 (4)	17:55	4	17:28 (3)	17:56			18:00	18:09
15	06:08		16:32 (4)	06:06			05:52		17:19 (3)	05:33			05:21	05:20
	17:39	42	17:14 (4)	17:51			17:55	13	17:32 (3)	17:56			18:00	18:09
16	06:09		16:31 (4)	06:05			05:51		17:15 (3)	05:32			05:20	05:21
	17:39	43	17:14 (4)	17:51			17:55	19	17:34 (3)	17:56			18:01	18:09
17	06:09		16:31 (4)	06:05			05:50		17:14 (3)	05:32			05:20	05:21
	17:40	44	17:15 (4)	17:52			17:55	22	17:36 (3)	17:56			18:01	18:09
18	06:09		16:31 (4)	06:05			05:50		17:12 (3)	05:31			05:20	05:21
	17:40	44	17:15 (4)	17:52			17:55	24	17:36 (3)	17:56			18:01	18:10
19	06:09		16:31 (4)	06:04			05:49		17:11 (3)	05:31			05:20	05:21
	17:41	45	17:16 (4)	17:52			17:55	26	17:37 (3)	17:56			18:01	18:10
20	06:09		16:31 (4)	06:04			05:49		17:10 (3)	05:30			05:20	05:21
	17:41	45	17:16 (4)	17:52			17:55	28	17:38 (3)	17:56			18:02	18:10
21	06:09		16:31 (4)	06:03			05:48		17:09 (3)	05:30			05:20	05:21
	17:42	46	17:17 (4)	17:52			17:55	29	17:38 (3)	17:56			18:02	18:10
22	06:09		16:31 (4)	06:03			05:47		17:09 (3)	05:29			05:20	05:22
	17:42	46	17:17 (4)	17:53			17:55	29	17:38 (3)	17:57			18:02	18:10
23	06:09		16:31 (4)	06:03			05:47		17:09 (3)	05:29			05:19	05:22
	17:43	47	17:18 (4)	17:53			17:55	29	17:38 (3)	17:57			18:02	18:11
24	06:09		16:31 (4)	06:02			05:46		17:08 (3)	05:28			05:19	05:22
	17:43	47	17:18 (4)	17:53			17:55	29	17:37 (3)	17:57			18:03	18:11
25	06:09		16:32 (4)	06:02			05:45		17:09 (3)	05:28			05:19	05:22
	17:44	47	17:19 (4)	17:53			17:55	28	17:37 (3)	17:57			18:03	18:11
26	06:09		16:32 (4)	06:01			05:45		17:08 (3)	05:27			05:19	05:23
	17:44	47	17:19 (4)	17:53			17:55	28	17:36 (3)	17:57			18:03	18:11
27	06:09		16:32 (4)	06:01			05:44		17:08 (3)	05:27			05:19	05:23
	17:44	47	17:19 (4)	17:53			17:55	27	17:35 (3)	17:57			18:03	18:11
28	06:09		16:32 (4)	06:00			05:44		17:09 (3)	05:26			05:19	05:23
	17:45	47	17:19 (4)	17:54			17:55	25	17:34 (3)	17:57			18:04	18:12
29	06:09		16:33 (4)				05:43		17:10 (3)	05:26			05:19	05:23
	17:45	47	17:20 (4)				17:55	22	17:32 (3)	17:57			18:04	18:12
30	06:09		16:33 (4)				05:42		17:10 (3)	05:25			05:19	05:24
	17:46	47	17:20 (4)				17:55	20	17:30 (3)	17:58			18:04	18:12
31	06:09		16:34 (4)				05:42		17:13 (3)				05:19	
	17:46	46	17:20 (4)				17:55	16	17:29 (3)				18:05	
Potential sun hours	357			329			374			372			393	384
Total, worst case		1270			485			418			10			
Sun reduction		0.60			0.67			0.55			0.52			
Oper. time red.		1.00			1.00			1.00			1.00			
Wind dir. red.		0.34			0.34			0.42			0.42			
Total reduction		0.21			0.23			0.23			0.22			
Total, real		266			113			98			2			

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm) Sun set (hh:mm)	Minutes with flicker	First time (hh:mm) with flicker Last time (hh:mm) with flicker	(WTG causing flicker first time) (WTG causing flicker last time)

SHADOW - Calendar

Calculation: 0575014 - Loi Hai Real Case - Green Mode Shadow receptor: 386 - Shadow Receptor: 1.0 × 1.0 Azimuth: 0.0° Slope: 90.0° (1332)

Assumptions for shadow calculations

Sunshine probability S (Average daily sunshine hours) []

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
6.94	7.86	6.61	6.50	5.65	5.33	4.03	4.19	3.33	4.68	5.67	6.13

Operational time

N	NNE	ENE	E	ESE	SSE	S	SSW	WSW	W	WNW	NNW	Sum
4,347	1,305	385	237	166	149	140	105	105	96	96	1,629	8,760

	July		August		September			October			November			December		
1	05:24		05:31		05:34			05:33			05:37		16:12 (4)	05:49		16:14 (4)
	18:12		18:10		17:55			17:35			17:19	32	16:44 (4)	17:18	38	16:52 (4)
2	05:24		05:32		05:34			05:33			05:37		16:10 (4)	05:49		16:14 (4)
	18:12		18:10		17:54			17:34			17:19	35	16:45 (4)	17:18	38	16:52 (4)
3	05:24		05:32		05:34			05:33			05:37		16:09 (4)	05:50		16:15 (4)
	18:12		18:09		17:54			17:34			17:19	36	16:45 (4)	17:18	37	16:52 (4)
4	05:25		05:32		05:34			05:33			05:37		16:08 (4)	05:50		16:15 (4)
	18:12		18:09		17:53			17:33			17:18	39	16:47 (4)	17:18	36	16:51 (4)
5	05:25		05:32		05:34			05:33			05:38		16:07 (4)	05:51		16:17 (4)
	18:12		18:09		17:53			17:33			17:18	41	16:48 (4)	17:19	35	16:52 (4)
6	05:25		05:32		05:34			05:33			05:38		16:06 (4)	05:51		16:17 (4)
	18:13		18:08		17:52			17:32			17:18	42	16:48 (4)	17:19	34	16:51 (4)
7	05:26		05:32		05:34			05:33			05:38		16:07 (4)	05:52		16:19 (4)
	18:13		18:08		17:51			17:31			17:18	42	16:49 (4)	17:19	32	16:51 (4)
8	05:26		05:33		05:34			05:33			05:39		16:06 (4)	05:52		16:19 (4)
	18:13		18:07		17:51			17:31			17:17	44	16:50 (4)	17:20	32	16:51 (4)
9	05:26		05:33		05:34			05:33			05:39		16:05 (4)	05:53		16:20 (4)
	18:13		18:07		17:50			17:30			17:17	45	16:50 (4)	17:20	31	16:51 (4)
10	05:26		05:33		05:34			05:33			05:39		16:05 (4)	05:53		16:22 (4)
	18:13		18:07		17:49			17:30			17:17	46	16:51 (4)	17:20	30	16:52 (4)
11	05:27		05:33		05:34		17:08 (3)	05:33			05:40		16:05 (4)	05:54		16:22 (4)
	18:13		18:06		17:49	9	17:17 (3)	17:29			17:17	46	16:51 (4)	17:21	29	16:51 (4)
12	05:27		05:33		05:34		17:05 (3)	05:34			05:40		16:05 (4)	05:54		16:23 (4)
	18:13		18:06		17:48	15	17:20 (3)	17:28			17:17	47	16:52 (4)	17:21	28	16:51 (4)
13	05:27		05:33		05:34		17:02 (3)	05:34			05:40		16:05 (4)	05:55		16:24 (4)
	18:13		18:05		17:47	19	17:21 (3)	17:28			17:17	47	16:52 (4)	17:21	27	16:51 (4)
14	05:27		05:33		05:34		17:00 (3)	05:34			05:41		16:05 (4)	05:56		16:25 (4)
	18:13		18:05		17:47	22	17:22 (3)	17:27			17:17	47	16:52 (4)	17:22	27	16:52 (4)
15	05:28		05:33		05:34		16:58 (3)	05:34			05:41		16:05 (4)	05:56		16:25 (4)
	18:13		18:04		17:46	25	17:23 (3)	17:27			17:17	47	16:52 (4)	17:22	26	16:51 (4)
16	05:28		05:33		05:34		16:57 (3)	05:34			05:42		16:05 (4)	05:57		16:27 (4)
	18:13		18:04		17:45	27	17:24 (3)	17:26			17:16	47	16:52 (4)	17:23	25	16:52 (4)
17	05:28		05:33		05:34		16:56 (3)	05:34			05:42		16:06 (4)	05:57		16:27 (4)
	18:13		18:04		17:45	28	17:24 (3)	17:26			17:16	47	16:53 (4)	17:23	24	16:51 (4)
18	05:28		05:34		05:33		16:56 (3)	05:34			05:42		16:05 (4)	05:58		16:28 (4)
	18:12		18:03		17:44	28	17:24 (3)	17:25			17:16	47	16:52 (4)	17:24	24	16:52 (4)
19	05:29		05:34		05:33		16:55 (3)	05:34			05:43		16:06 (4)	05:58		16:28 (4)
	18:12		18:03		17:43	29	17:24 (3)	17:25			17:16	47	16:53 (4)	17:24	24	16:52 (4)
20	05:29		05:34		05:33		16:55 (3)	05:34			05:43		16:06 (4)	05:59		16:29 (4)
	18:12		18:02		17:42	29	17:24 (3)	17:24			17:16	46	16:52 (4)	17:24	24	16:53 (4)
21	05:29		05:34		05:33		16:54 (3)	05:34			05:44		16:07 (4)	05:59		16:29 (4)
	18:12		18:01		17:42	29	17:23 (3)	17:24			17:16	46	16:53 (4)	17:25	24	16:53 (4)
22	05:29		05:34		05:33		16:54 (3)	05:35			05:44		16:07 (4)	06:00		16:30 (4)
	18:12		18:01		17:41	29	17:23 (3)	17:23			17:16	45	16:52 (4)	17:25	24	16:54 (4)
23	05:30		05:34		05:33		16:54 (3)	05:35			05:45		16:08 (4)	06:00		16:30 (4)
	18:12		18:00		17:40	28	17:22 (3)	17:23			17:17	45	16:53 (4)	17:26	24	16:54 (4)
24	05:30		05:34		05:33		16:55 (3)	05:35			05:45		16:08 (4)	06:01		16:30 (4)
	18:12		18:00		17:40	26	17:21 (3)	17:22			17:17	44	16:52 (4)	17:26	24	16:54 (4)
25	05:30		05:34		05:33		16:55 (3)	05:35			05:46		16:09 (4)	06:01		16:31 (4)
	18:12		17:59		17:39	25	17:20 (3)	17:22			17:17	44	16:53 (4)	17:27	24	16:55 (4)
26	05:30		05:34		05:33		16:56 (3)	05:35			05:46		16:09 (4)	06:02		16:31 (4)
	18:11		17:59		17:38	22	17:18 (3)	17:21			17:17	43	16:52 (4)	17:28	24	16:55 (4)
27	05:30		05:34		05:33		16:57 (3)	05:35			05:47		16:11 (4)	06:02		16:32 (4)
	18:11		17:58		17:38	20	17:17 (3)	17:21			17:17	42	16:53 (4)	17:28	25	16:57 (4)
28	05:31		05:34		05:33		16:59 (3)	05:36		16:20 (4)	05:47		16:11 (4)	06:02		16:32 (4)
	18:11		17:57		17:37	15	17:14 (3)	17:21	15	16:35 (4)	17:17	41	16:52 (4)	17:29	25	16:57 (4)
29	05:31		05:34		05:33		17:02 (3)	05:36		16:17 (4)	05:48		16:12 (4)	06:03		16:32 (4)
	18:11		17:57		17:36	9	17:11 (3)	17:20	21	16:38 (4)	17:17	41	16:53 (4)	17:29	26	16:58 (4)
30	05:31		05:34		05:33			05:36		16:14 (4)	05:48		16:12 (4)	06:03		16:32 (4)
	18:10		17:56		17:36			17:20	26	16:40 (4)	17:17	40	16:52 (4)	17:30	27	16:59 (4)
31	05:31		05:34					05:36		16:12 (4)				06:04		16:32 (4)
	18:10		17:56					17:20	30	16:42 (4)				17:30	27	16:59 (4)
Potential sun hours	395		388		366			368			348			355		
Total, worst case						434			92			1301			875	
Sun reduction						0.27			0.39			0.49			0.54	
Oper. time red.						1.00			1.00			1.00			1.00	
Wind dir. red.						0.42			0.34			0.34			0.34	
Total reduction						0.12			0.14			0.17			0.19	
Total, real						51			13			221			163	

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm) Sun set (hh:mm)	Minutes with flicker	First time (hh:mm) with flicker Last time (hh:mm) with flicker	(WTG causing flicker first time) (WTG causing flicker last time)

Licensed user:
ERM
Level 3, 09 Dinh Tien Hoang St
VN-DAKAO WARD, District 1

Phat Tran / phat.tran@erm.com
Calculated:
2/4/2021 1:12 PM/3.4.388

SHADOW - Calendar

Calculation: 0575014 - Loi Hai Real Case - Green Mode Shadow receptor: 387 - Shadow Receptor: 1.0 × 1.0 Azimuth: 0.0° Slope: 90.0° (1335)

Assumptions for shadow calculations

Sunshine probability S (Average daily sunshine hours) []

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
6.94	7.86	6.61	6.50	5.65	5.33	4.03	4.19	3.33	4.68	5.67	6.13

Operational time

N	NNE	ENE	E	ESE	SSE	S	SSW	WSW	W	WNW	NNW	Sum
4,347	1,305	385	237	166	149	140	105	105	96	96	1,629	8,760

	January		February		March		April		May		June		
1	06:04		09:39 (3)		06:09		09:51 (3)		06:00		10:02 (3)		05:41		10:28 (3)		05:25		05:48 (2)		05:19		05:41 (2)
	17:31	212	13:11 (3)		17:47	210	13:21 (3)		17:54	133	13:13 (3)		17:55	28	12:35 (3)		17:58	29	06:17 (2)		18:05	45	06:26 (2)
2	06:05		09:39 (3)		06:09		09:51 (3)		05:59		10:02 (3)		05:41		10:30 (3)		05:25		05:47 (2)		05:19		05:41 (2)
	17:32	212	13:11 (3)		17:47	210	13:21 (3)		17:54	127	13:12 (3)		17:55	26	12:34 (3)		17:58	32	06:19 (2)		18:05	45	06:26 (2)
3	06:05		09:41 (3)		06:09		09:52 (3)		05:59		10:03 (3)		05:40		10:31 (3)		05:24		05:45 (2)		05:19		05:42 (2)
	17:32	211	13:12 (3)		17:47	210	13:22 (3)		17:54	122	13:12 (3)		17:56	22	12:31 (3)		17:58	35	06:20 (2)		18:05	44	06:26 (2)
4	06:06		09:41 (3)		06:09		09:52 (3)		05:58		10:03 (3)		05:39		10:33 (3)		05:24		05:44 (2)		05:19		05:42 (2)
	17:33	211	13:12 (3)		17:48	210	13:22 (3)		17:54	116	13:10 (3)		17:56	18	10:51 (3)		17:58	37	06:21 (2)		18:06	44	06:26 (2)
5	06:06		09:41 (3)		06:08		09:52 (3)		05:58		10:04 (3)		05:39		10:35 (3)		05:24		05:43 (2)		05:19		05:42 (2)
	17:33	211	13:12 (3)		17:48	209	13:21 (3)		17:54	112	13:10 (3)		17:56	17	10:52 (3)		17:58	39	06:22 (2)		18:06	43	06:25 (2)
6	06:06		09:41 (3)		06:08		09:52 (3)		05:57		10:04 (3)		05:38		10:36 (3)		05:23		05:42 (2)		05:19		05:43 (2)
	17:34	212	13:13 (3)		17:48	209	13:21 (3)		17:54	108	13:09 (3)		17:56	16	10:52 (3)		17:59	40	06:22 (2)		18:06	42	06:25 (2)
7	06:07		09:42 (3)		06:08		09:53 (3)		05:56		10:05 (3)		05:37		10:38 (3)		05:23		05:41 (2)		05:19		05:43 (2)
	17:34	212	13:14 (3)		17:49	208	13:21 (3)		17:54	104	13:09 (3)		17:56	14	10:52 (3)		17:59	42	06:23 (2)		18:07	42	06:25 (2)
8	06:07		09:42 (3)		06:08		09:53 (3)		05:56		10:06 (3)		05:37		10:40 (3)		05:23		05:41 (2)		05:19		05:43 (2)
	17:35	212	13:14 (3)		17:49	208	13:21 (3)		17:54	99	13:07 (3)		17:56	13	10:53 (3)		17:59	43	06:24 (2)		18:07	42	06:25 (2)
9	06:07		09:42 (3)		06:08		09:54 (3)		05:55		10:07 (3)		05:36		10:42 (3)		05:22		05:40 (2)		05:20		05:44 (2)
	17:35	212	13:14 (3)		17:49	208	13:22 (3)		17:55	95	13:07 (3)		17:56	11	10:53 (3)		17:59	44	06:24 (2)		18:07	41	06:25 (2)
10	06:07		09:43 (3)		06:07		09:54 (3)		05:55		10:07 (3)		05:36		10:44 (3)		05:22		05:39 (2)		05:20		05:44 (2)
	17:36	212	13:15 (3)		17:50	207	13:21 (3)		17:55	91	13:05 (3)		17:56	11	10:55 (3)		17:59	45	06:24 (2)		18:07	41	06:25 (2)
11	06:08		09:44 (3)		06:07		09:54 (3)		05:54		10:07 (3)		05:35		10:46 (3)		05:22		05:39 (2)		05:20		05:44 (2)
	17:37	212	13:16 (3)		17:50	207	13:21 (3)		17:55	88	13:04 (3)		17:56	9	10:55 (3)		18:00	46	06:25 (2)		18:08	40	06:24 (2)
12	06:08		09:44 (3)		06:07		09:55 (3)		05:54		10:09 (3)		05:35		10:49 (3)		05:21		05:39 (2)		05:20		05:46 (2)
	17:37	212	13:16 (3)		17:50	206	13:21 (3)		17:55	84	13:04 (3)		17:56	6	10:55 (3)		18:00	46	06:25 (2)		18:08	39	06:25 (2)
13	06:08		09:44 (3)		06:06		09:55 (3)		05:53		10:09 (3)		05:34		10:52 (3)		05:21		05:38 (2)		05:20		05:46 (2)
	17:38	212	13:16 (3)		17:51	205	13:20 (3)		17:55	80	13:02 (3)		17:56	4	10:56 (3)		18:00	47	06:25 (2)		18:08	39	06:25 (2)
14	06:08		09:44 (3)		06:06		09:55 (3)		05:52		10:10 (3)		05:33				05:21		05:38 (2)		05:20		05:46 (2)
	17:38	212	13:16 (3)		17:51	205	13:20 (3)		17:55	77	13:02 (3)		17:56				18:00	47	06:25 (2)		18:09	39	06:25 (2)
15	06:09		09:45 (3)		06:06		09:56 (3)		05:52		10:11 (3)		05:33				05:21		05:38 (2)		05:20		05:46 (2)
	17:39	212	13:17 (3)		17:51	204	13:20 (3)		17:55	73	13:00 (3)		17:56				18:00	48	06:26 (2)		18:09	39	06:25 (2)
16	06:09		09:46 (3)		06:05		09:57 (3)		05:51		10:11 (3)		05:32				05:21		05:38 (2)		05:21		05:46 (2)
	17:39	212	13:18 (3)		17:51	203	13:20 (3)		17:55	72	12:59 (3)		17:56				18:01	48	06:26 (2)		18:09	39	06:25 (2)
17	06:09		09:46 (3)		06:05		09:56 (3)		05:51		10:12 (3)		05:32				05:20		05:38 (2)		05:21		05:47 (2)
	17:40	212	13:18 (3)		17:52	203	13:19 (3)		17:55	68	12:58 (3)		17:56				18:01	48	06:26 (2)		18:09	38	06:25 (2)
18	06:09		09:46 (3)		06:05		09:57 (3)		05:50		10:13 (3)		05:31				05:20		05:37 (2)		05:21		05:48 (2)
	17:40	212	13:18 (3)		17:52	202	13:19 (3)		17:55	64	12:56 (3)		17:56				18:01	49	06:26 (2)		18:10	38	06:26 (2)
19	06:09		09:46 (3)		06:04		09:57 (3)		05:49		10:13 (3)		05:31				05:20		05:37 (2)		05:21		05:48 (2)
	17:41	212	13:18 (3)		17:52	201	13:18 (3)		17:55	62	12:55 (3)		17:56				18:01	49	06:26 (2)		18:10	38	06:26 (2)
20	06:09		09:47 (3)		06:04		09:58 (3)		05:49		10:15 (3)		05:30				05:20		05:37 (2)		05:21		05:48 (2)
	17:41	212	13:19 (3)		17:52	200	13:18 (3)		17:55	59	12:54 (3)		17:56				18:02	49	06:26 (2)		18:10	38	06:26 (2)
21	06:09		09:47 (3)		06:03		09:59 (3)		05:48		10:15 (3)		05:30				05:20		05:38 (2)		05:22		05:48 (2)
	17:42	212	13:19 (3)		17:52	199	13:18 (3)		17:55	56	12:52 (3)		17:57				18:02	48	06:26 (2)		18:10	38	06:26 (2)
22	06:09		09:47 (3)		06:03		09:58 (3)		05:47		10:17 (3)		05:29				05:20		05:38 (2)		05:22		05:48 (2)
	17:42	212	13:19 (3)		17:53	199	13:17 (3)		17:55	54	12:52 (3)		17:57				18:02	48	06:26 (2)		18:10	38	06:26 (2)
23	06:09		09:47 (3)		06:03		09:59 (3)		05:47		10:18 (3)		05:29				05:19		05:38 (2)		05:22		05:49 (2)
	17:43	212	13:19 (3)		17:53	198	13:17 (3)		17:55	50	12:50 (3)		17:57				18:02	48	06:26 (2)		18:11	38	06:27 (2)
24	06:09		09:48 (3)		06:02		09:59 (3)		05:46		10:18 (3)		05:28				05:19		05:38 (2)		05:22		05:49 (2)
	17:43	212	13:20 (3)		17:53	176	13:16 (3)		17:55	48	12:48 (3)		17:57				18:03	48	06:26 (2)		18:11	38	06:27 (2)
25	06:09		09:48 (3)		06:02		10:00 (3)		05:46		10:20 (3)		05:28				05:19		05:39 (2)		05:22		05:49 (2)
	17:44	212	13:20 (3)		17:53	163	13:16 (3)		17:55	46	12:47 (3)		17:57				18:03	47	06:26 (2)		18:11	38	06:27 (2)
26	06:09		09:48 (3)		06:01		10:00 (3)		05:45		10:21 (3)		05:27				05:19		05:39 (2)		05:23		05:48 (2)
	17:44	212	13:20 (3)		17:53	153	13:15 (3)		17:55	42	12:45 (3)		17:57				18:03	47	06:26 (2)		18:11	39	06:27 (2)
27	06:09		09:49 (3)		06:01		10:01 (3)		05:44		10:22 (3)		05:27				05:19		05:39 (2)		05:23		05:49 (2)
	17:44	211	13:20 (3)		17:53	145	13:14 (3)		17:55	39	12:43 (3)		17:57				18:03	47	06:26 (2)		18:11	39	06:28 (2)
28	06:09		09:49 (3)		06:00		10:01 (3)		05:44		10:23 (3)		05:26				05:19		05:40 (2)		05:23		05:49 (2)
	17:45	211	13:20 (3)		17:54	139	13:13 (3)		17:55	38	12:42 (3)		17:57	12	06:09 (2)		18:04	46	06:26 (2)		18:12	39	06:28 (2)
29	06:09		09:50 (3)						05:43		10:24 (3)		05:26		05:53 (2)		05:19		05:40 (2)		05:23		05:49 (2)
	17:45	211	13:21 (3)						17:55	35	12:40 (3)		17:57	20	06:13 (2)		18:04	46	06:26 (2)		18:12	39	06:28 (2)
30	06:09		09:50 (3)						05:42		10:25 (3)		05:25		05:51 (2)		05:19		05:40 (2)		05:24		05:49 (2)
	17:46	211	13:21 (3)						17:55	33	12:38 (3)		17:58	25	06:16 (2)		18:04	46	06:26 (2)		18:12	39	06:28 (2)
31	06:09		09:50 (3)						05:42		10:27 (3)						05:19		05:41 (2)				
	17:46	211	13:21 (3)						17:55	30	12:37 (3)						18:05	45	06:26 (2)				
Potential sun hours	357				329				374				372				393				384		
Total, worst case		6564				5497				2305				252				1379				1201	
Sun reduction		0.60				0.67				0.55				0.52				0.45				0.42	
Oper. time red.		1.00				1.00				1.00				1.00				1.00				1.00	
Wind dir. red.		0.87				0.87				0.87				0.75				0.32				0.32	
Total reduction		0.51				0.57				0.47				0.38				0.14				0.13	
Total, real		3372				3133				1076				97				193				157	

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm) Sun set (hh:mm)	Minutes with flicker	First time (hh:mm) with flicker Last time (hh:mm) with flicker	(WTG causing flicker first time) (WTG causing flicker last time)

SHADOW - Calendar

Calculation: 0575014 - Loi Hai Real Case - Green Mode Shadow receptor: 387 - Shadow Receptor: 1.0 × 1.0 Azimuth: 0.0° Slope: 90.0° (1335)

Assumptions for shadow calculations

Sunshine probability S (Average daily sunshine hours) []

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
6.94	7.86	6.61	6.50	5.65	5.33	4.03	4.19	3.33	4.68	5.67	6.13

Operational time

N	NNE	ENE	E	ESE	SSE	S	SSW	WSW	W	WNW	NNW	Sum
4,347	1,305	385	237	166	149	140	105	105	96	96	1,629	8,760

	July		August		September		October		November		December	
1	05:24		05:49 (2)	05:31	05:49 (2)	05:34	10:45 (3)	05:33	09:48 (3)	05:37	09:24 (3)	05:49	09:26 (3)
	18:12	40	06:29 (2)	18:10 46	06:35 (2)	17:55 9	10:54 (3)	17:35 82	12:42 (3)	17:19 207	12:51 (3)	17:18 212	12:58 (3)
2	05:24		05:49 (2)	05:32	05:49 (2)	05:34	10:42 (3)	05:33	09:47 (3)	05:37	09:23 (3)	05:49	09:25 (3)
	18:12	41	06:30 (2)	18:10 46	06:35 (2)	17:54 11	10:53 (3)	17:35 86	12:43 (3)	17:19 208	12:51 (3)	17:18 212	12:57 (3)
3	05:24		05:49 (2)	05:32	05:49 (2)	05:34	10:40 (3)	05:33	09:46 (3)	05:37	09:22 (3)	05:50	09:26 (3)
	18:12	41	06:30 (2)	18:09 45	06:34 (2)	17:54 11	10:51 (3)	17:34 89	12:43 (3)	17:19 208	12:50 (3)	17:18 212	12:58 (3)
4	05:25		05:49 (2)	05:32	05:51 (2)	05:34	10:37 (3)	05:33	09:44 (3)	05:37	09:23 (3)	05:50	09:26 (3)
	18:12	41	06:30 (2)	18:09 43	06:34 (2)	17:53 13	10:50 (3)	17:33 94	12:44 (3)	17:18 208	12:51 (3)	17:18 212	12:58 (3)
5	05:25		05:49 (2)	05:32	05:51 (2)	05:34	10:35 (3)	05:33	09:43 (3)	05:38	09:22 (3)	05:51	09:27 (3)
	18:13	42	06:31 (2)	18:09 43	06:34 (2)	17:53 14	10:49 (3)	17:33 97	12:44 (3)	17:18 209	12:51 (3)	17:19 212	12:59 (3)
6	05:25		05:49 (2)	05:32	05:51 (2)	05:34	10:32 (3)	05:33	09:42 (3)	05:38	09:22 (3)	05:51	09:27 (3)
	18:13	42	06:31 (2)	18:08 42	06:33 (2)	17:52 16	10:48 (3)	17:32 101	12:44 (3)	17:18 209	12:51 (3)	17:19 212	12:59 (3)
7	05:26		05:49 (2)	05:32	05:52 (2)	05:34	10:30 (3)	05:33	09:41 (3)	05:38	09:22 (3)	05:52	09:28 (3)
	18:13	42	06:31 (2)	18:08 40	06:32 (2)	17:51 17	10:47 (3)	17:31 105	12:45 (3)	17:18 210	12:52 (3)	17:19 211	12:59 (3)
8	05:26		05:49 (2)	05:33	05:53 (2)	05:34	10:28 (3)	05:33	09:40 (3)	05:39	09:22 (3)	05:52	09:29 (3)
	18:13	43	06:32 (2)	18:08 38	06:31 (2)	17:51 18	10:46 (3)	17:31 109	12:45 (3)	17:18 210	12:52 (3)	17:20 211	13:00 (3)
9	05:26		05:49 (2)	05:33	05:53 (2)	05:34	10:26 (3)	05:33	09:39 (3)	05:39	09:22 (3)	05:53	09:29 (3)
	18:13	44	06:33 (2)	18:07 36	06:29 (2)	17:50 21	12:25 (3)	17:30 114	12:45 (3)	17:17 210	12:52 (3)	17:20 211	13:00 (3)
10	05:26		05:49 (2)	05:33	05:54 (2)	05:34	10:23 (3)	05:33	09:38 (3)	05:39	09:22 (3)	05:53	09:30 (3)
	18:13	44	06:33 (2)	18:07 34	06:28 (2)	17:49 26	12:27 (3)	17:30 119	12:46 (3)	17:17 210	12:52 (3)	17:20 211	13:01 (3)
11	05:27		05:48 (2)	05:33	05:57 (2)	05:34	10:21 (3)	05:34	09:37 (3)	05:40	09:21 (3)	05:54	09:29 (3)
	18:13	45	06:33 (2)	18:06 31	06:28 (2)	17:49 28	12:28 (3)	17:29 124	12:46 (3)	17:17 211	12:52 (3)	17:21 212	13:01 (3)
12	05:27		05:49 (2)	05:33	05:58 (2)	05:34	10:19 (3)	05:34	09:36 (3)	05:40	09:22 (3)	05:54	09:30 (3)
	18:13	45	06:34 (2)	18:06 28	06:26 (2)	17:48 30	12:29 (3)	17:28 128	12:46 (3)	17:17 211	12:53 (3)	17:21 212	13:02 (3)
13	05:27		05:48 (2)	05:33	06:00 (2)	05:34	10:17 (3)	05:34	09:35 (3)	05:40	09:22 (3)	05:55	09:30 (3)
	18:13	46	06:34 (2)	18:05 23	06:23 (2)	17:47 33	12:30 (3)	17:28 134	12:46 (3)	17:17 211	12:53 (3)	17:21 212	13:02 (3)
14	05:27		05:48 (2)	05:33	06:02 (2)	05:34	10:15 (3)	05:34	09:34 (3)	05:41	09:22 (3)	05:56	09:31 (3)
	18:13	46	06:34 (2)	18:05 19	06:21 (2)	17:47 34	12:30 (3)	17:27 141	12:46 (3)	17:17 211	12:53 (3)	17:22 212	13:03 (3)
15	05:28		05:48 (2)	05:33	06:06 (2)	05:34	10:13 (3)	05:34	09:33 (3)	05:41	09:22 (3)	05:56	09:31 (3)
	18:13	46	06:34 (2)	18:05 10	06:16 (2)	17:46 37	12:31 (3)	17:27 148	12:47 (3)	17:17 211	12:53 (3)	17:22 211	13:02 (3)
16	05:28		05:48 (2)	05:33		05:34	10:11 (3)	05:34	09:33 (3)	05:42	09:21 (3)	05:57	09:32 (3)
	18:13	47	06:35 (2)	18:04		17:45 39	12:32 (3)	17:26 157	12:48 (3)	17:16 212	12:53 (3)	17:23 211	13:03 (3)
17	05:28		05:48 (2)	05:33		05:34	10:09 (3)	05:34	09:32 (3)	05:42	09:22 (3)	05:57	09:32 (3)
	18:13	47	06:35 (2)	18:04		17:45 42	12:33 (3)	17:26 167	12:48 (3)	17:16 212	12:54 (3)	17:23 211	13:03 (3)
18	05:28		05:48 (2)	05:34		05:34	10:07 (3)	05:34	09:31 (3)	05:42	09:22 (3)	05:58	09:33 (3)
	18:13	47	06:35 (2)	18:03		17:44 46	12:34 (3)	17:25 182	12:48 (3)	17:16 212	12:54 (3)	17:24 211	13:04 (3)
19	05:29		05:48 (2)	05:34		05:34	10:06 (3)	05:34	09:30 (3)	05:43	09:22 (3)	05:58	09:33 (3)
	18:12	47	06:35 (2)	18:03		17:43 47	12:35 (3)	17:25 198	12:48 (3)	17:16 212	12:54 (3)	17:24 211	13:04 (3)
20	05:29		05:48 (2)	05:34		05:33	10:04 (3)	05:34	09:29 (3)	05:43	09:22 (3)	05:59	09:34 (3)
	18:12	48	06:36 (2)	18:02		17:43 50	12:36 (3)	17:24 199	12:48 (3)	17:16 212	12:54 (3)	17:25 211	13:05 (3)
21	05:29		05:48 (2)	05:34		05:33	10:02 (3)	05:34	09:28 (3)	05:44	09:23 (3)	05:59	09:34 (3)
	18:12	48	06:36 (2)	18:01		17:42 53	12:36 (3)	17:24 200	12:48 (3)	17:16 212	12:55 (3)	17:25 211	13:05 (3)
22	05:29		05:48 (2)	05:34		05:33	10:01 (3)	05:35	09:27 (3)	05:44	09:23 (3)	06:00	09:35 (3)
	18:12	48	06:36 (2)	18:01		17:41 55	12:37 (3)	17:23 201	12:48 (3)	17:16 212	12:55 (3)	17:25 211	13:06 (3)
23	05:30		05:48 (2)	05:34		05:33	09:59 (3)	05:35	09:28 (3)	05:45	09:23 (3)	06:00	09:35 (3)
	18:12	48	06:36 (2)	18:00		17:40 59	12:38 (3)	17:23 201	12:49 (3)	17:17 212	12:55 (3)	17:26 211	13:06 (3)
24	05:30		05:48 (2)	05:34		05:33	09:58 (3)	05:35	09:27 (3)	05:45	09:23 (3)	06:01	09:35 (3)
	18:12	49	06:37 (2)	18:00		17:40 61	12:39 (3)	17:22 202	12:49 (3)	17:17 212	12:55 (3)	17:27 211	13:06 (3)
25	05:30		05:48 (2)	05:34		05:33	09:56 (3)	05:35	09:26 (3)	05:46	09:24 (3)	06:01	09:36 (3)
	18:12	49	06:37 (2)	17:59		17:39 64	12:39 (3)	17:22 203	12:49 (3)	17:17 212	12:56 (3)	17:27 211	13:07 (3)
26	05:30		05:48 (2)	05:34		05:33	09:55 (3)	05:35	09:25 (3)	05:46	09:24 (3)	06:02	09:36 (3)
	18:11	48	06:36 (2)	17:59		17:38 66	12:40 (3)	17:22 204	12:49 (3)	17:17 212	12:56 (3)	17:28 211	13:07 (3)
27	05:31		05:48 (2)	05:34		05:33	09:54 (3)	05:36	09:25 (3)	05:47	09:24 (3)	06:02	09:37 (3)
	18:11	48	06:36 (2)	17:58		17:38 69	12:40 (3)	17:21 204	12:49 (3)	17:17 212	12:56 (3)	17:28 211	13:08 (3)
28	05:31		05:48 (2)	05:34		05:33	09:52 (3)	05:36	09:25 (3)	05:47	09:24 (3)	06:03	09:37 (3)
	18:11	48	06:36 (2)	17:58		17:37 73	12:41 (3)	17:21 205	12:50 (3)	17:17 212	12:56 (3)	17:29 211	13:08 (3)
29	05:31		05:49 (2)	05:34		05:33	09:51 (3)	05:36	09:24 (3)	05:48	09:25 (3)	06:03	09:38 (3)
	18:11	48	06:37 (2)	17:57		17:36 75	12:41 (3)	17:20 206	12:50 (3)	17:17 212	12:57 (3)	17:29 212	13:10 (3)
30	05:31		05:49 (2)	05:34	10:52 (3)	05:33	09:49 (3)	05:36	09:24 (3)	05:48	09:25 (3)	06:03	09:38 (3)
	18:10	47	06:36 (2)	17:56 4	10:56 (3)	17:36 80	12:42 (3)	17:20 206	12:50 (3)	17:18 212	12:57 (3)	17:30 212	13:10 (3)
31	05:31		05:49 (2)	05:34	10:48 (3)			05:36	09:24 (3)			06:04	09:38 (3)
	18:10	47	06:36 (2)	17:56 7	10:55 (3)			17:20 207	12:51 (3)			17:30 212	13:10 (3)
Potential sun hours	395		388		366		368		348		355		
Total, worst case		1412		535		1197		4813		6324		6554	
Sun reduction		0.32		0.34		0.27		0.39		0.49		0.54	
Oper. time red.		1.00		1.00		1.00		1.00		1.00		1.00	
Wind dir. red.		0.32		0.33		0.87		0.87		0.87		0.87	
Total reduction		0.10		0.11		0.23		0.34		0.42		0.46	
Total, real		140		58		279		1617		2637		2992	

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm) Sun set (hh:mm)	Minutes with flicker	First time (hh:mm) with flicker Last time (hh:mm) with flicker	(WTG causing flicker first time) (WTG causing flicker last time)

Licensed user:
ERM
Level 3, 09 Dinh Tien Hoang St
VN-DAKAO WARD, District 1

Phat Tran / phat.tran@erm.com
Calculated:
2/4/2021 1:12 PM/3.4.388

SHADOW - Calendar

Calculation: 0575014 - Loi Hai Real Case - Green Mode Shadow receptor: 393 - Shadow Receptor: 1.0 × 1.0 Azimuth: 0.0° Slope: 90.0° (1531)

Assumptions for shadow calculations

Sunshine probability S (Average daily sunshine hours) []

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
6.94	7.86	6.61	6.50	5.65	5.33	4.03	4.19	3.33	4.68	5.67	6.13

Operational time

N	NNE	ENE	E	ESE	SSE	S	SSW	WSW	W	WNW	NNW	Sum
4,347	1,305	385	237	166	149	140	105	105	96	96	1,629	8,760

	January			February			March			April			May		June
1	06:04		15:08 (1)	06:09		14:49 (1)	06:00		14:49 (1)	05:41		14:58 (1)	05:25		05:19
	17:31	45	15:53 (1)	17:47	109	16:38 (1)	17:54	123	16:52 (1)	17:55	89	16:27 (1)	17:58		18:05
2	06:05		15:07 (1)	06:09		14:49 (1)	05:59		14:48 (1)	05:40		14:59 (1)	05:25		05:19
	17:31	47	15:54 (1)	17:47	110	16:39 (1)	17:54	123	16:51 (1)	17:55	87	16:26 (1)	17:58		18:05
3	06:05		15:07 (1)	06:09		14:49 (1)	05:59		14:49 (1)	05:40		14:59 (1)	05:24		05:19
	17:32	49	15:56 (1)	17:47	111	16:40 (1)	17:54	122	16:51 (1)	17:55	85	16:24 (1)	17:58		18:05
4	06:05		15:06 (1)	06:09		14:49 (1)	05:58		14:49 (1)	05:39		15:00 (1)	05:24		05:19
	17:33	52	15:58 (1)	17:48	113	16:42 (1)	17:54	122	16:51 (1)	17:56	82	16:22 (1)	17:58		18:06
5	06:06		15:05 (1)	06:08		14:48 (1)	05:58		14:50 (1)	05:39		15:01 (1)	05:24		05:19
	17:33	54	15:59 (1)	17:48	114	16:42 (1)	17:54	121	16:51 (1)	17:56	80	16:21 (1)	17:58		18:06
6	06:06		15:04 (1)	06:08		14:48 (1)	05:57		14:49 (1)	05:38		15:01 (1)	05:23		05:19
	17:34	56	16:00 (1)	17:48	115	16:43 (1)	17:54	121	16:50 (1)	17:56	77	16:18 (1)	17:59		18:06
7	06:06		15:04 (1)	06:08		14:48 (1)	05:56		14:50 (1)	05:37		15:02 (1)	05:23		05:19
	17:34	59	16:03 (1)	17:49	116	16:44 (1)	17:54	121	16:51 (1)	17:56	74	16:16 (1)	17:59		18:07
8	06:07		15:03 (1)	06:08		14:48 (1)	05:56		14:50 (1)	05:37		15:03 (1)	05:23		05:19
	17:35	61	16:04 (1)	17:49	117	16:45 (1)	17:54	120	16:50 (1)	17:56	71	16:14 (1)	17:59		18:07
9	06:07		15:02 (1)	06:08		14:48 (1)	05:55		14:51 (1)	05:36		15:04 (1)	05:22		05:20
	17:35	63	16:05 (1)	17:49	118	16:46 (1)	17:55	119	16:50 (1)	17:56	68	16:12 (1)	17:59		18:07
10	06:07		15:02 (1)	06:07		14:47 (1)	05:55		14:51 (1)	05:36		15:05 (1)	05:22		05:20
	17:36	66	16:08 (1)	17:50	119	16:46 (1)	17:55	118	16:49 (1)	17:56	65	16:10 (1)	17:59		18:07
11	06:08		15:01 (1)	06:07		14:47 (1)	05:54		14:50 (1)	05:35		15:06 (1)	05:22		05:20
	17:36	68	16:09 (1)	17:50	120	16:47 (1)	17:55	118	16:48 (1)	17:56	61	16:07 (1)	18:00		18:08
12	06:08		15:00 (1)	06:07		14:47 (1)	05:54		14:51 (1)	05:34		15:07 (1)	05:21		05:20
	17:37	71	16:11 (1)	17:50	121	16:48 (1)	17:55	117	16:48 (1)	17:56	57	16:04 (1)	18:00		18:08
13	06:08		14:59 (1)	06:06		14:47 (1)	05:53		14:51 (1)	05:34		15:09 (1)	05:21		05:20
	17:38	73	16:12 (1)	17:51	120	16:47 (1)	17:55	116	16:47 (1)	17:56	53	16:02 (1)	18:00		18:08
14	06:08		14:58 (1)	06:06		14:47 (1)	05:52		14:52 (1)	05:33		15:11 (1)	05:21		05:20
	17:38	75	16:13 (1)	17:51	121	16:48 (1)	17:55	115	16:47 (1)	17:56	48	15:59 (1)	18:00		18:09
15	06:08		14:59 (1)	06:06		14:47 (1)	05:52		14:52 (1)	05:33		15:13 (1)	05:21		05:20
	17:39	77	16:16 (1)	17:51	122	16:49 (1)	17:55	114	16:46 (1)	17:56	43	15:56 (1)	18:00		18:09
16	06:09		14:58 (1)	06:05		14:47 (1)	05:51		14:52 (1)	05:32		15:15 (1)	05:20		05:21
	17:39	79	16:17 (1)	17:51	122	16:49 (1)	17:55	113	16:45 (1)	17:56	37	15:52 (1)	18:01		18:09
17	06:09		14:57 (1)	06:05		14:47 (1)	05:51		14:53 (1)	05:32		15:19 (1)	05:20		05:21
	17:40	82	16:19 (1)	17:52	123	16:50 (1)	17:55	112	16:45 (1)	17:56	29	15:48 (1)	18:01		18:09
18	06:09		14:56 (1)	06:05		14:47 (1)	05:50		14:53 (1)	05:31		15:23 (1)	05:20		05:21
	17:40	84	16:20 (1)	17:52	123	16:50 (1)	17:55	110	16:43 (1)	17:56	18	15:41 (1)	18:01		18:10
19	06:09		14:55 (1)	06:04		14:47 (1)	05:49		14:52 (1)	05:31			05:20		05:21
	17:41	86	16:21 (1)	17:52	123	16:50 (1)	17:55	110	16:42 (1)	17:56			18:01		18:10
20	06:09		14:55 (1)	06:04		14:47 (1)	05:49		14:53 (1)	05:30			05:20		05:21
	17:41	88	16:23 (1)	17:52	124	16:51 (1)	17:55	109	16:42 (1)	17:56			18:02		18:10
21	06:09		14:54 (1)	06:03		14:48 (1)	05:48		14:53 (1)	05:30			05:20		05:21
	17:42	90	16:24 (1)	17:52	124	16:52 (1)	17:55	108	16:41 (1)	17:56			18:02		18:10
22	06:09		14:53 (1)	06:03		14:47 (1)	05:47		14:54 (1)	05:29			05:20		05:22
	17:42	93	16:26 (1)	17:53	124	16:51 (1)	17:55	106	16:40 (1)	17:57			18:02		18:10
23	06:09		14:53 (1)	06:03		14:48 (1)	05:47		14:54 (1)	05:29			05:19		05:22
	17:43	94	16:27 (1)	17:53	124	16:52 (1)	17:55	105	16:39 (1)	17:57			18:02		18:11
24	06:09		14:52 (1)	06:02		14:47 (1)	05:46		14:54 (1)	05:28			05:19		05:22
	17:43	96	16:28 (1)	17:53	124	16:51 (1)	17:55	103	16:37 (1)	17:57			18:03		18:11
25	06:09		14:52 (1)	06:02		14:48 (1)	05:46		14:55 (1)	05:28			05:19		05:22
	17:44	97	16:29 (1)	17:53	124	16:52 (1)	17:55	102	16:37 (1)	17:57			18:03		18:11
26	06:09		14:51 (1)	06:01		14:48 (1)	05:45		14:55 (1)	05:27			05:19		05:23
	17:44	100	16:31 (1)	17:53	123	16:51 (1)	17:55	100	16:35 (1)	17:57			18:03		18:11
27	06:09		14:51 (1)	06:01		14:48 (1)	05:44		14:55 (1)	05:27			05:19		05:23
	17:44	101	16:32 (1)	17:53	124	16:52 (1)	17:55	99	16:34 (1)	17:57			18:03		18:11
28	06:09		14:50 (1)	06:00		14:48 (1)	05:44		14:56 (1)	05:26			05:19		05:23
	17:45	103	16:33 (1)	17:54	123	16:51 (1)	17:55	97	16:33 (1)	17:57			18:04		18:12
29	06:09		14:50 (1)				05:43		14:56 (1)	05:26			05:19		05:23
	17:45	105	16:35 (1)				17:55	95	16:31 (1)	17:57			18:04		18:12
30	06:09		14:50 (1)				05:42		14:57 (1)	05:25			05:19		05:24
	17:46	106	16:36 (1)				17:55	93	16:30 (1)	17:58			18:04		18:12
31	06:09		14:49 (1)				05:42		14:58 (1)				05:19		
	17:46	108	16:37 (1)				17:55	91	16:29 (1)				18:05		
Potential sun hours	357			329			374			372			393		384
Total, worst case		2428			3351			3443			1124				
Sun reduction		0.60			0.67			0.55			0.52				
Oper. time red.		1.00			1.00			1.00			1.00				
Wind dir. red.		0.30			0.30			0.30			0.30				
Total reduction		0.18			0.20			0.16			0.16				
Total, real		436			668			562			176				

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm) Sun set (hh:mm)	Minutes with flicker	First time (hh:mm) with flicker Last time (hh:mm) with flicker	(WTG causing flicker first time) (WTG causing flicker last time)

SHADOW - Calendar

Calculation: 0575014 - Loi Hai Real Case - Green Mode Shadow receptor: 393 - Shadow Receptor: 1.0 × 1.0 Azimuth: 0.0° Slope: 90.0° (1531)

Assumptions for shadow calculations

Sunshine probability S (Average daily sunshine hours) []

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
6.94	7.86	6.61	6.50	5.65	5.33	4.03	4.19	3.33	4.68	5.67	6.13

Operational time

N	NNE	ENE	E	ESE	SSE	S	SSW	WSW	W	WNW	NNW	Sum
4,347	1,305	385	237	166	149	140	105	105	96	96	1,629	8,760

	July	August		September		October		November		December	
1	05:24	05:31		05:34		15:05 (1)	05:33		14:31 (1)	05:37		14:17 (1)	05:49		14:43 (1)
	18:12	18:10		17:55	61	16:06 (1)	17:35	116	16:27 (1)	17:19	119	16:16 (1)	17:18	68	15:51 (1)
2	05:24	05:32		05:34		15:03 (1)	05:33		14:30 (1)	05:37		14:17 (1)	05:49		14:44 (1)
	18:12	18:10		17:54	65	16:08 (1)	17:35	117	16:27 (1)	17:19	118	16:15 (1)	17:18	66	15:50 (1)
3	05:24	05:32		05:34		15:02 (1)	05:33		14:29 (1)	05:37		14:17 (1)	05:50		14:46 (1)
	18:12	18:09		17:54	68	16:10 (1)	17:34	118	16:27 (1)	17:19	117	16:14 (1)	17:18	63	15:49 (1)
4	05:25	05:32		05:34		15:00 (1)	05:33		14:28 (1)	05:37		14:18 (1)	05:50		14:47 (1)
	18:12	18:09		17:53	71	16:11 (1)	17:33	119	16:27 (1)	17:18	116	16:14 (1)	17:18	61	15:48 (1)
5	05:25	05:32		05:34		14:59 (1)	05:33		14:27 (1)	05:38		14:18 (1)	05:51		14:49 (1)
	18:13	18:09		17:53	74	16:13 (1)	17:33	120	16:27 (1)	17:18	115	16:13 (1)	17:19	59	15:48 (1)
6	05:25	05:32		05:34		14:57 (1)	05:33		14:26 (1)	05:38		14:18 (1)	05:51		14:50 (1)
	18:13	18:08		17:52	77	16:14 (1)	17:32	121	16:27 (1)	17:18	113	16:11 (1)	17:19	56	15:46 (1)
7	05:26	05:32		05:34		14:56 (1)	05:33		14:26 (1)	05:38		14:19 (1)	05:52		14:52 (1)
	18:13	18:08		17:51	79	16:15 (1)	17:31	120	16:26 (1)	17:18	112	16:11 (1)	17:19	54	15:46 (1)
8	05:26	05:33		05:34		14:55 (1)	05:33		14:25 (1)	05:39		14:19 (1)	05:52		14:54 (1)
	18:13	18:08		17:51	82	16:17 (1)	17:31	121	16:26 (1)	17:18	111	16:10 (1)	17:20	52	15:46 (1)
9	05:26	05:33		05:34		14:53 (1)	05:33		14:24 (1)	05:39		14:20 (1)	05:53		14:55 (1)
	18:13	18:07		17:50	85	16:18 (1)	17:30	122	16:26 (1)	17:17	110	16:10 (1)	17:20	49	15:44 (1)
10	05:26	05:33		05:34		14:52 (1)	05:33		14:23 (1)	05:39		14:20 (1)	05:53		14:57 (1)
	18:13	18:07		17:49	87	16:19 (1)	17:30	123	16:26 (1)	17:17	109	16:09 (1)	17:20	47	15:44 (1)
11	05:27	05:33		05:34		14:51 (1)	05:34		14:23 (1)	05:40		14:20 (1)	05:54		14:58 (1)
	18:13	18:06		17:49	89	16:20 (1)	17:29	122	16:25 (1)	17:17	108	16:08 (1)	17:21	45	15:43 (1)
12	05:27	05:33		05:34		14:50 (1)	05:34		14:22 (1)	05:40		14:22 (1)	05:54		15:00 (1)
	18:13	18:06		17:48	91	16:21 (1)	17:28	123	16:25 (1)	17:17	106	16:08 (1)	17:21	43	15:43 (1)
13	05:27	05:33		05:34		14:49 (1)	05:34		14:21 (1)	05:40		14:22 (1)	05:55		15:01 (1)
	18:13	18:05		17:47	92	16:21 (1)	17:28	124	16:25 (1)	17:17	104	16:06 (1)	17:21	41	15:42 (1)
14	05:27	05:33		05:34		14:47 (1)	05:34		14:21 (1)	05:41		14:23 (1)	05:56		15:02 (1)
	18:13	18:05		17:47	94	16:21 (1)	17:27	123	16:24 (1)	17:17	103	16:06 (1)	17:22	40	15:42 (1)
15	05:28	05:33		05:34		14:46 (1)	05:34		14:20 (1)	05:41		14:24 (1)	05:56		15:03 (1)
	18:13	18:05		17:46	96	16:22 (1)	17:27	124	16:24 (1)	17:17	101	16:05 (1)	17:22	38	15:41 (1)
16	05:28	05:33		05:34		14:45 (1)	05:34		14:20 (1)	05:42		14:24 (1)	05:57		15:05 (1)
	18:13	18:04		17:45	98	16:23 (1)	17:26	124	16:24 (1)	17:16	100	16:04 (1)	17:23	36	15:41 (1)
17	05:28	05:33		05:34		14:43 (1)	05:34		14:20 (1)	05:42		14:26 (1)	05:57		15:06 (1)
	18:13	18:04		17:45	100	16:23 (1)	17:26	124	16:24 (1)	17:16	97	16:03 (1)	17:23	34	15:40 (1)
18	05:28	05:34		05:34		14:42 (1)	05:34		14:19 (1)	05:42		14:26 (1)	05:58		15:07 (1)
	18:13	18:03		17:44	102	16:24 (1)	17:25	124	16:23 (1)	17:16	96	16:02 (1)	17:24	33	15:40 (1)
19	05:29	05:34		05:33		14:41 (1)	05:34		14:19 (1)	05:43		14:28 (1)	05:58		15:08 (1)
	18:12	18:03		17:43	103	16:24 (1)	17:25	124	16:23 (1)	17:16	94	16:02 (1)	17:24	32	15:40 (1)
20	05:29	05:34		05:33		14:40 (1)	05:34		14:18 (1)	05:43		14:28 (1)	05:59		15:09 (1)
	18:12	18:02		17:42	105	16:25 (1)	17:24	124	16:22 (1)	17:16	93	16:01 (1)	17:24	32	15:41 (1)
21	05:29	05:34		05:33		14:40 (1)	05:34		14:18 (1)	05:44		14:30 (1)	05:59		15:09 (1)
	18:12	18:01		17:42	105	16:25 (1)	17:24	123	16:21 (1)	17:16	90	16:00 (1)	17:25	31	15:40 (1)
22	05:29	05:34		05:33		14:39 (1)	05:35		14:17 (1)	05:44		14:31 (1)	06:00		15:10 (1)
	18:12	18:01		17:41	107	16:26 (1)	17:23	124	16:21 (1)	17:16	88	15:59 (1)	17:25	31	15:41 (1)
23	05:30	05:34		05:33		14:38 (1)	05:35		14:18 (1)	05:45		14:32 (1)	06:00		15:10 (1)
	18:12	18:00		17:40	108	16:26 (1)	17:23	123	16:21 (1)	17:17	86	15:58 (1)	17:26	32	15:42 (1)
24	05:30	05:34		05:33		14:37 (1)	05:35		14:17 (1)	05:45		14:33 (1)	06:01		15:10 (1)
	18:12	18:00		17:40	109	16:26 (1)	17:22	123	16:20 (1)	17:17	84	15:57 (1)	17:26	32	15:42 (1)
25	05:30	05:34	15:25 (1)	05:33		14:36 (1)	05:35		14:17 (1)	05:46		14:35 (1)	06:01		15:10 (1)
	18:12	17:59	20 15:45 (1)	17:39	110	16:26 (1)	17:22	122	16:19 (1)	17:17	82	15:57 (1)	17:27	33	15:43 (1)
26	05:30	05:34	15:20 (1)	05:33		14:35 (1)	05:35		14:17 (1)	05:46		14:36 (1)	06:02		15:10 (1)
	18:11	17:59	30 15:50 (1)	17:38	112	16:27 (1)	17:21	122	16:19 (1)	17:17	79	15:55 (1)	17:28	34	15:44 (1)
27	05:30	05:34	15:17 (1)	05:33		14:34 (1)	05:35		14:16 (1)	05:47		14:37 (1)	06:02		15:10 (1)
	18:11	17:58	37 15:54 (1)	17:38	113	16:27 (1)	17:21	122	16:18 (1)	17:17	78	15:55 (1)	17:28	36	15:46 (1)
28	05:31	05:34	15:14 (1)	05:33		14:33 (1)	05:36		14:17 (1)	05:47		14:38 (1)	06:03		15:09 (1)
	18:11	17:58	43 15:57 (1)	17:37	114	16:27 (1)	17:21	121	16:18 (1)	17:17	76	15:54 (1)	17:29	37	15:46 (1)
29	05:31	05:34	15:11 (1)	05:33		14:32 (1)	05:36		14:17 (1)	05:48		14:40 (1)	06:03		15:10 (1)
	18:11	17:57	49 16:00 (1)	17:36	115	16:27 (1)	17:20	120	16:17 (1)	17:17	73	15:53 (1)	17:29	38	15:48 (1)
30	05:31	05:34	15:09 (1)	05:33		14:31 (1)	05:36		14:16 (1)	05:48		14:41 (1)	06:03		15:09 (1)
	18:10	17:56	53 16:02 (1)	17:36	116	16:27 (1)	17:20	120	16:16 (1)	17:17	71	15:52 (1)	17:30	40	15:49 (1)
31	05:31	05:34	15:07 (1)				05:36		14:17 (1)				06:04		15:08 (1)
	18:10	17:56	58 16:05 (1)				17:20	119	16:16 (1)				17:30	42	15:50 (1)
Potential sun hours	395	388		366			368			348			355		
Total, worst case			290		2828			3772			2949			1335	
Sun reduction			0.33		0.27			0.39			0.49			0.54	
Oper. time red.			1.00		1.00			1.00			1.00			1.00	
Wind dir. red.			0.30		0.30			0.30			0.30			0.30	
Total reduction			0.10		0.08			0.12			0.15			0.16	
Total, real			29		230			443			430			213	

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm) Sun set (hh:mm)	Minutes with flicker	First time (hh:mm) with flicker Last time (hh:mm) with flicker	(WTG causing flicker first time) (WTG causing flicker last time)

ERM has over 160 offices across the following countries and territories worldwide

Argentina
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