10. SHADOW FLICKER

10.1 INTRODUCTION

This chapter assesses the likely significant direct and indirect effects of shadow flicker at nearby receptors during the construction, operation and decommissioning phases of the proposed project.

Full details of the proposed project are outlined in Chapter 2.

This chapter presents the results and findings of the assessment of the potential for shadow flicker effects at sensitive receptors within the study area and quantifies the theoretical maximum number of hours per day and per annum where shadow flicker might occur at a receptor.

The objectives of this chapter are to describe what shadow flicker is, describe the assessment methodology and guidance, describe the likely significant effects, mitigation measures, if required and any residual effects.

10.1.1 Conditions Required for Shadow Flicker

Under certain combinations of geographical position, wind direction, weather conditions, and times of day and year, the sun may pass behind the rotors of a wind turbine and cast a shadow over the windows of nearby receptors. When the blades rotate and the shadow passes a window, to a person within that room the shadow appears to 'flick' on and off; this effect is known as 'shadow flicker'. The phenomenon occurs only within buildings where shadows are cast across a window aperture, and the effects are typically considered up to a maximum distance of 10 times the rotor diameter from each wind turbine.

Rotating wind turbine blades can cause brightness levels to vary periodically at locations where they obstruct the sun's rays. This intermittent shadow flicker can be a cause of annoyance at residences near wind turbines, if it occurs for a significant period of time. Shadow flicker is largely dictated by the relative position of the turbine(s) and the window, in combination with weather conditions (i.e. presence of direct sunlight, wind speed and wind direction) and the time of day and year (i.e. affecting the position of the sun). Shadow flicker will only occur if the turbine rotors are located between an observer within a dwelling and the sun. The frequency of the flicker effect is related to the frequency of the rotating turbine blades. It can also be dependent on the number of individual turbine rotors that are casting shadows on a window.

The occurrence of shadow flicker effects is determined by a number of criteria as follows:

- **The presence of screening**: Screening can occur from a variety of sources including vegetation, terrain, and buildings. If screening is present between the receptor and the wind turbine/sun, then shadow flicker may not occur at that receptor or would be reduced.
- **The orientation of the property**: The windows of the sensitive receptor (see Chapter 5 for definition of sensitive receptor) must have windows that face the proposed turbines in order to be able to receive shadow flicker.
- **The distance of the receptor from turbines:** The potential effect of shadow flicker diminishes as distance from the turbine increases. The Wind Energy Development Guidelines (2006) (WEDGs), as later defined in Section 10.3.2, set a maximum limit of ten rotor diameters within which significant shadow flicker effects can occur.

- **The presence of direct sunlight**: Cloud cover can remove the presence of direct sunlight so that it is diffused and does not cast a shadow. If direct sunlight is present, the turbine blades must be located in the direct path between the sun and the affected window (or building façade).
- **The time of year and day:** The path of the sun varies over the seasons resulting in a changing potential for a shadow to be cast throughout the year. Similarly, the sun's position in the sky over the course of a day is changing such that the shadow cast by a turbine is constantly changing.
- **Wind speed**: In order for shadow flicker to occur, the turbine must be rotating. This requires a wind speed high enough to cause the turbine blades to rotate.
- **Direction of Wind**: The width of a shadow at any given receptor is dependent on the direction of the wind. This will be different on any given day at every receptor. The worst-case shadow occurs when the turbine faces directly towards or away from a receptor, while minimum flicker occurs when it faces perpendicular to the receptor.

10.1.2 Statement of Authority

This assessment has been carried out by TOBIN. The shadow flicker modelling and assessment was carried out by Samuele Pezzetta, GIS Manager in TOBIN. Samuele has over eight years of professional experience in building and environmental consulting including the preparation of shadow flicker impact assessments. Samuele has worked on a number of wind farms with various roles (which included carrying out shadow flicker modelling and providing content for reports). Samuele completed training with EMD International, a global consultancy providing software for wind energy projects including WindPRO, which has been used to model the shadow effects at this wind farm.

This chapter has been reviewed by Dr John Staunton, Associate Project Manager and Environmental Scientist in TOBIN. John has 18 years' postgraduate experience in both research and environmental consultancy, with 12 in the latter. John holds a BSc and PhD in Environmental Science, an advanced diploma in Planning and Environmental Law and is a Chartered Environmentalist. He has considerable experience in project managing wind energy developments and carrying out shadow flicker impact assessments.

10.1.3 Limitations Encountered in Compiling Information

No limitations or difficulties were encountered when undertaking this assessment or compiling the chapter.

10.2 Scoping and Consultation

As part of the EIA scoping process, an Environmental Scoping Report was prepared and submitted to relevant statutory and non-statutory bodies in February 2026 for review and comment. The Environmental Scoping Report was accompanied by a cover email introducing the proposed project and inviting comments or observations within a period of six weeks from the date of the email. Table 1-4, Section 1.9.2 of Chapter 1 provides a summary of the consultees and responses received (or not received). A copy of the issued Scoping Report is provided in Appendix 1-2 of this EIAR.

Responses can be found in Appendix 1-3 of this EIAR, which compiles the responses received from consultees, which have been considered in the preparation of this EIAR.

There were no responses in relation to shadow flicker.

10.3 Assessment Methodology

There are various sources of guidance with regard to the assessment and management of shadow flicker effects caused by wind turbines. Irish guidance relevant to the proposed project is summarised herein. Additional guidance from the UK is also presented to provide technical context.

10.3.1 Guidance

Wind Energy Development Guidelines (2006):

The 2006 Guidelines state that:

"Careful site selection, design and planning, and good use of relevant software, can help avoid the possibility of shadow flicker in the first instance. It is recommended that shadow flicker at neighbouring offices and dwellings within 500 m should not exceed 30 hours per year or 30 minutes per day".

The Guidelines also state that:

"At distances greater than 10 rotor diameters from a turbine, the potential for shadow flicker is very low. Where shadow flicker could be a problem, developers should provide calculations to quantify the effect and where appropriate take measures to prevent or ameliorate the potential effect, such as by turning off a particular turbine at certain times".

The shadow flicker modelling approach in this assessment is consistent with this recommendation.

Draft Revised Wind Energy Development Guidelines (2019):

Draft WEDGs were published in December 2019 and are subject to a consultation process. It is noted that at the time of writing (September 2026) the Draft 2019 WEDGs have not yet been adopted and the 2006 Guidelines referred to above remain in place. Nonetheless, this EIAR is cognisant of the content and proposed measures set out in the Draft 2019 WEDGs. The Draft 2019 WEDGs note that:

"Generally only properties within 130 degrees either side of north, relative to the turbines, can be affected at these latitudes in the UK and Ireland – turbines do not cast long shadows on their southern side."

The Draft 2019 WEDGs also outline that the time period in which a neighbouring property may be affected by shadow flicker is completely predictable from the relative locations of the wind turbine(s) and the property. To support this,

"A Shadow Flicker Study detailing the outcome of computational modelling for the potential for shadow flicker from the development should accompany all planning applications for wind energy development."

The Draft 2019 WEDGs advise that if shadow flicker prediction modelling indicates that there is potential for shadow flicker to occur at any particular dwelling or other potentially affected property, that a design review should be carried out to consider if one or more of the turbines can be relocated to eliminate the occurrence of shadow flicker. If this cannot be accommodated,

then measures which provide for automated turbine shutdown to eliminate shadow flicker would be required.

The Draft 2019 WEDGs also state that;

''*A condition should be attached to all planning permissions for wind energy development to ensure that there will be no shadow flicker at any existing nearby dwelling or other relevant existing affected sensitive property and that the necessary measures outlined in the shadow flicker assessment submitted with the application, such as turbine shut down during the associated time periods, should be taken by the wind energy developer or operator to eliminate the shadow flicker".*

This approach in the current draft of the Guidelines provides for the prevention of shadow flicker by automatic shutdown of the turbines. This means that turbines will need to be programmed to shut down when shadow flicker effects occur. The nature of the automatic shutdown process in modern turbine technology requires a very short period from when a shutdown (pause) command is sent to the turbine until the turbine blades and rotor reach an idle position. This is determined to be less than 60 seconds (depending on site specific wind conditions).

A Working Group from Wind Energy Ireland (WEI) (formerly Irish Wind Energy Association (IWEA)) have expressed concern at the proposed shadow flicker response requirements noting that, if implemented, they will be strictest in Europe[1]. The Working Group notes that the proposed requirements can be complied with subject to incorporation of some essential clarifications:

- A slowing-down period of a few minutes (technology dependent) permitted to allow safe and efficient shutdown once flicker is detected;
- The study area to be limited to 10 times rotor diameter or a maximum distance of 1.5 km; and
- Financially involved properties should be exempt from zero shadow flicker requirements.

<u>Parsons Brinckerhoff – Update of UK Shadow Flicker Evidence Base (2011)</u>

Parsons Brinckerhoff were commissioned by the Department of Energy and Climate Change in the UK to carry out a study to advance the understanding of the shadow flicker effect. The report *"presents an update of the evidence base which has been produced by carrying out a thorough review of international guidance on shadow flicker, an academic literature review and by investigating current assessment methodologies employed by developers and case study evidence".*

The report sets out that *"Consultation (by means of a questionnaire) was carried out with stakeholders in the UK onshore wind farm industry including developers, consultants and Local Planning Authorities (LPAs). This exercise was used to gauge their opinion and operational experience with shadow flicker, current guidance and the mitigation strategies that can and have been implemented."*

The report summarised that *"The current recommendation in Companion Guide to PPS22 (2004) to assess shadow flicker impacts within 130 degrees either side of north is considered*

[1] Blog: Draft Revised Wind Energy Development Guidelines (Accessed on 14 July 2026)

acceptable, as is the 10 rotor diameter distance from the nearest property", though it is mentioned that this approach may not be suitable at all latitudes.

The Companion Guide to PPS22 was a planning policy statement produced by the UK Government in 2004 and, in addition to the above, states that *"Shadow flicker only occurs inside buildings where the flicker appears through a narrow window opening"*.

In terms of shadow flicker modelling, the report states that *"The three key computer models used by the industry* [at that time] *are WindPRO, WindFarm and Windfarmer. It has been shown that the outputs of these packages do not have significant differences between them. All computer model assessment methods use a "worst case scenario" approach and don't consider "realistic" factors such as wind speed and cloud cover which can reduce the duration of the shadow flicker impact."* It is noted that the WindPRO modelling software has been used in the assessment of shadow flicker for the proposed project.

The report states, *"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".* Further discussion on shadow flicker and human health risks is contained in Chapter 5 (Population and Human Health) of this EIAR.

In summarising measures to minimise shadow flicker effects, *"Mitigation measures which have been employed to operational wind farms such as turbine shut down strategies, have proved very successful, to the extent that shadow flicker cannot be considered to be a major issue in the UK."*

<u>Onshore Wind Energy Planning Conditions Guidance Note – A Report for the Renewables Advisory Board and BERR (2007)</u>

This Wind Energy Guidance Note was prepared in the UK for the Renewables Advisory Board and Department for Business, Enterprise and Regulatory Reform (BERR) in 2007 and states that shadow flicker *"occurs only within buildings where the shadow appears through a narrow window opening"* and that *"Only dwellings within 130 degrees either side of north relative to a turbine can be affected and the shadow can be experienced only within 10 rotor diameters of the wind farm".*

The Guidance Note advises in terms of planning control that *"a local planning authority may consider it appropriate to impose a planning condition to provide that wind turbines should operate in accordance with a shadow flicker mitigation scheme…….unless a survey carried out on behalf of the developer in accordance with a methodology approved in advance by the local planning authority confirms that shadow flicker effects would not be experienced within habitable rooms within any dwelling".*

<u>Irish Wind Energy Association (IWEA) (now WEI) – Best Practice Guidelines for the Irish Wind Energy Industry (2012)</u>

The IWEA Best Practice Guidelines note that, *"At certain times of the year, the moving shadows of the turbine blades could periodically reduce light to a room causing the light to appear to flicker. This would not generally have any effect on health or safety but could on limited occasions present a brief nuisance effect for some neighbours."*

The Guidelines identify that modifications to predicted worst-case shadow flicker effects to account for sunshine probability and wind direction are reasonable and refers to mitigation

measures such as wind turbine operation controls and screening where shadow flicker is anticipated to lead to potential problems.

The Guidelines also include guidance on cumulative shadow flicker assessments, stating:

It is important to determine if there are other existing and/or permitted but not constructed wind farms in the vicinity of the proposed development which could contribute towards a cumulative shadow flicker impact on any receptors. Any such wind farm developments within 2 km of the proposed development should be considered in a separate cumulative shadow flicker assessment.

EPA EIAR Guidelines 2022

This assessment was undertaken in accordance with the EPA EIAR Guidelines 2022 as outlined in Chapter 1, Section 1.7.5, Table 1-1.

10.3.2 Assessment Study Area

As per the guideline documents set out in Section 10.3.2, it is industry best practice to use a distance of ten rotor diameters as a maximum limit within which significant shadow flicker effects can occur. The validity of this limit is discussed at length within the relevant literature, and guidance varies in different documents and countries, with some stating that effects can only occur within this distance and others stating that the risk beyond this distance is low. The Parsons Brinckerhoff Report referenced in Section 10.3.2 acknowledges that the latitude of the site will determine the distance from a wind turbine where shadow flicker can occur.

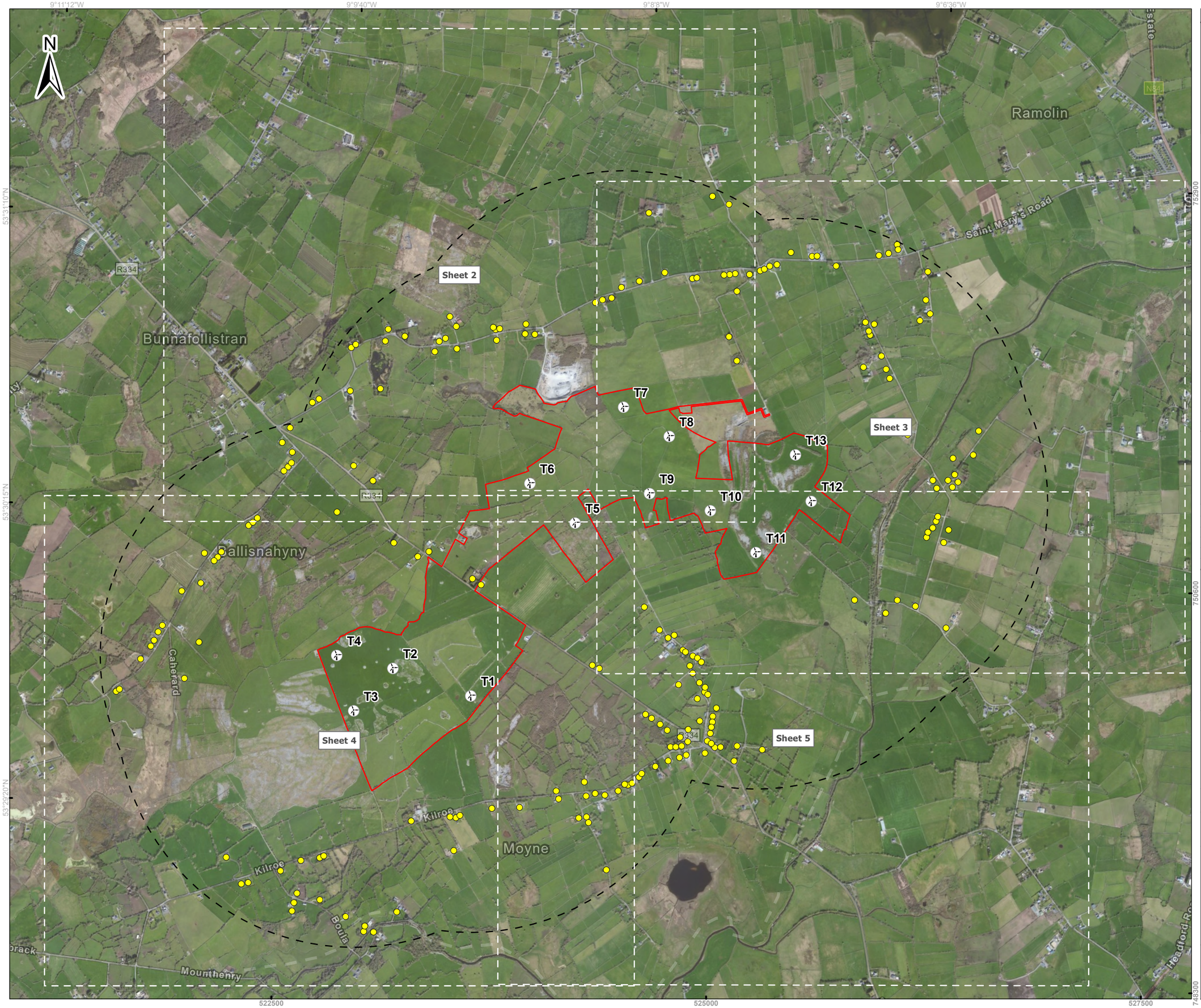
The Onshore Wind Energy Planning Conditions Guidance Note published in the UK in 2007 stated that *"shadow flicker has been proven to occur only within ten rotor diameters of a turbine position".* The Scottish Government *Onshore Wind Turbines: Planning Advice* (2014) states that *"where separation is provided between wind turbines and nearby dwellings (as a general rule 10 rotor diameters), "shadow flicker" should not be a problem".* The Northern Ireland (NI) Department of the Environment *Best Practice Guidance to Planning Policy Statement 18 'Renewable Energy'* (2009) states that *"At distances greater than 10 rotor diameters from a turbine, the potential for shadow flicker is very low"*.

The IWEA Guidelines referred to previously state that *"The assessment of potentially sensitive locations or receptors within a distance of ten rotor diameters from proposed turbine locations will normally be suitable for EIA purposes"* and refers to the 2006 WEDGs recommended threshold limits of 30 hours per year or 30 minutes per day for receptors within 500 m.

Ireland's 2006 Wind Energy Development Guidelines use the exact same wording as the NI Guidance above and, in addition, state that *"It is recommended that shadow flicker at neighbouring offices and dwellings within 500 m should not exceed 30 hours per year or 30 minutes per day".* It is noted that the Draft 2019 WEDGs do not specify a maximum distance for assessing shadow flicker. In reality, there is no fixed cut off distance at which effects can occur, as this is sensitive to many parameters including the exact latitude of the site and the terrain around the proposed wind farm site location.

Given the recommendations in the above Guidance documents, it is considered that an assessment of potential shadow flicker at properties within ten rotor diameters of the turbine locations is appropriate to provide a robust assessment of shadow flicker from the proposed project.

The rotor diameter of the turbines for the proposed project is 136 m, therefore, all sensitive receptors within 1.36 km of the proposed turbine locations have been included in the shadow flicker assessment (see Figure 10-1). For the purposes of this assessment, the 2006 WEDGs recommended maximum thresholds of 30 hours per year or 30 minutes per day have been applied to all sensitive receptor locations within 1.36 km of a proposed turbine location. Sensitive receptors for the purpose of this assessment are defined in Section 10.4.1





Legend

- Site Boundary
- Turbine Locations
- Receptors
- Shadow Flicker Study Area

0 500 1,000
Meters

Spatial Reference
Datum: IRENET95
EPSG: 2157

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Project:

Rooaunalaghta Green Energy Project

Title:

Figure 10-1 :
Shadow Flicker
Assessment Area
- Sheet 1 of 5 -

Scale @ A3:	1:20,000	
Prepared by:	Checked by:	Date:
S.Pezzetta	J.Staunton	September 2026

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53°3'110"N

53°3'015"N

752600

522500

525000

Bunnafollistran

Caherard

R334

SH109 - 183

SH108 - 178

SH117 - 193

SH116 - 190

SH100 - 164

SH115 - 189

SH112 - 186

SH111 - 185

SH106 - 170

SH114 - 188

SH139 - 238

SH137 - 236

SH118 - 200

SH136 - 235

SH193 - 356

SH119 - 201

SH113 - 187

SH107 - 171

SH134 - 233

SH141 - 240

SH123 - 205

SH194 - 366

SH124 - 215

SH135 - 234

SH120 - 202

SH110 - 184

SH105 - 169

SH144 - 244

SH121 - 203

SH122 - 204

SH99 - 163

SH142 - 242

SH133 - 232

SH138 - 237

SH143 - 243

SH140 - 239

SH201 - 377

SH147 - 247

SH145 - 245

SH146 - 246

SH174 - 302

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SH152 - 252

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SH151 - 251

SH172 - 300

SH176 - 304

SH171 - 299

SH154 - 254

T5

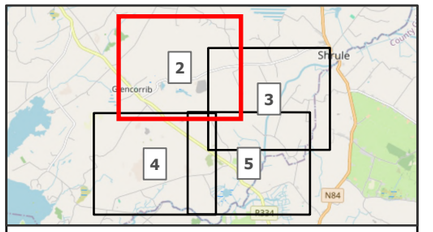
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T8

T9

T10



Legend

- Site Boundary
- Turbine Locations
- Receptors
- Shadow Flicker Study Area

0 250 500
Meters

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Figure 10-1 :
Shadow Flicker
Assessment Area
- Sheet 2 of 5 -

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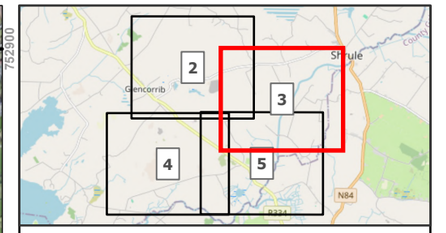
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Legend

- Site Boundary
- Turbine Locations
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0 250 500
Meters

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Figure 10-1 :
Shadow Flicker
Assessment Area
- Sheet 3 of 5 -

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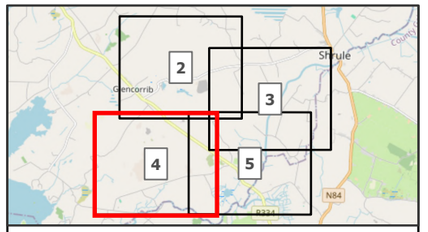
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53°30'15"N
53°29'20"N
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N
R334
Caherard
Ballisnahyny
Moyne
Mounthenry
Kilroe
Boula
SH170 - 298
SH177 - 305
SH192 - 354
SH167 - 294
SH168 - 296
SH169 - 297
SH181 - 309
SH182 - 310
SH132 - 225
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SH131 - 224
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SH160 - 260
SH9 - 12
SH4 - 7
SH5 - 8
SH1 - 4
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SH186 - 314
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SH191 - 342
SH162 - 262
SH8 - 11
SH157 - 257
SH2 - 5
SH3 - 6
SH6 - 9
SH7 - 10
SH15 - 28
SH21 - 34
SH10 - 20
SH20 - 33
SH16 - 29



Legend

- Site Boundary
- Turbine Locations
- Receptors
- Shadow Flicker Study Area

0 250 500
Meters

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Figure 10-1 :
Shadow Flicker
Assessment Area
- Sheet 4 of 5 -

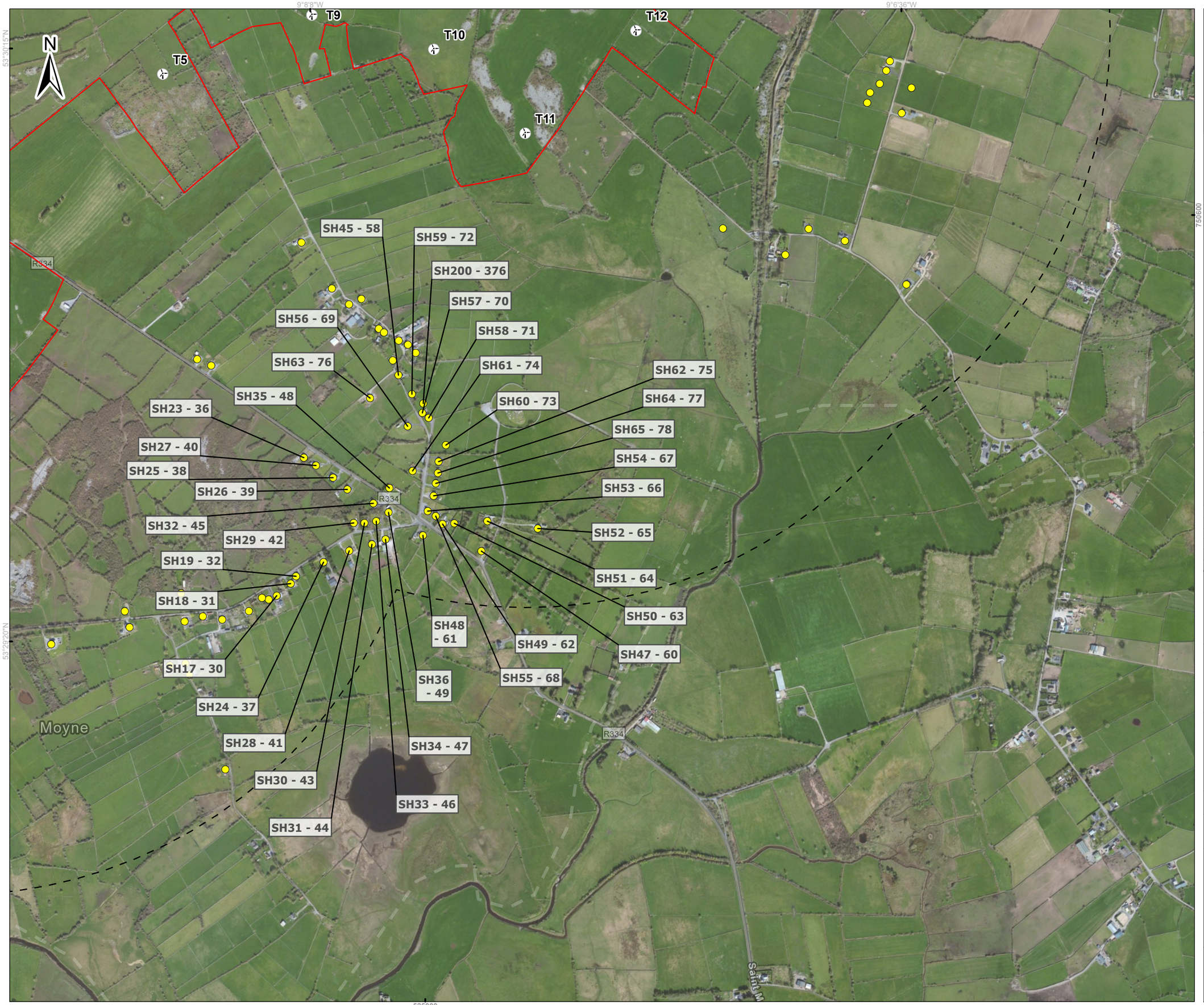
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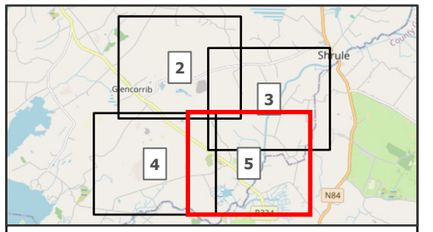
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Legend

- Site Boundary
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Meters

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Figure 10-1 :
Shadow Flicker
Assessment Area
- Sheet 5 of 5 -

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10.3.3 Shadow Flicker Modelling

The analysis has been undertaken using WindPRO: Shadow (by EMD International) which is one of the leading industry software packages for carrying out a shadow flicker simulation. It is a specialist modelling software package that incorporates:

- Wind turbine configuration;
- Terrain mapping;
- Sun path throughout the year at the development latitude; and
- Defined receptors.

The wind turbine dimensions inputted to the model are consistent with those discussed in Chapter 2. The proposed wind turbine includes a tip height of 150 m, a rotor diameter of 136 m, and a hub height of 82 m.

The ground level on which the wind turbines and surrounding properties are situated has been incorporated into the model using Digital Terrain Modelling. This terrain mapping ensures that the realistic elevation variations between the turbines and properties are accounted for. This includes a Zone of Visual Influence (ZVI) calculation that checks whether the terrain provides screening for a given receptor from each turbine and from the sun. This only considers the terrain and not intervening screening from vegetation.

The model allows for user defined receptor locations (i.e. size, position, and orientation of windows at a receptor/property location). The location of properties in the model has been defined using address data from the Geodirectory database which is used to populate Eircode's. This data has been used to define the sensitive receptor properties in the vicinity of the site and specifically in relation to this shadow flicker assessment, within 1.36 km of a proposed turbine location (i.e., 10 m x 136 m (rotor diameter) = approximately 1.36 km). A ground truthing exercise was carried out on this data in the area surrounding the proposed wind farm site to ensure accuracy of the identified sensitive receptors.

The model is set up to incorporate windows (typically with a size of 1 m x 1 m and an elevation of 1 m above ground level) directed towards the centre of the wind farm. This feature can be used to provide specific detailed analysis on the locations of windows and allow for modelling multiple windows on properties facing different groups of turbines. However, to ensure consideration of a worst-case scenario, these features are over-ridden in the model by the 'greenhouse mode' which assumes that shadows can be seen from 360 degrees at a receptor as opposed to only through windows facing the wind turbines.

The model default assumes that the turbine rotor is turning at all times. However, in practice, calm conditions, low wind speeds and maintenance shut-down will reduce the duration of operation of the turbines throughout the year and accordingly the potential flicker effect. The model default also assumes that the wind direction is such that the turbine rotor is always perpendicular to the direction of the receptor so that it casts the maximum shadow possible for each wind turbine. Again, in practice, the wind direction will change over the course of the day/year, the wind turbines are programmed to rotate around, or 'yaw', in order to face the wind direction.

The modelling software has built-in long-term solar statistics that accurately replicate the sun's path throughout the year at the development latitude. The model considers a minimum sun

elevation of 3 degrees over the horizon which is a typical value at this latitude to accommodate terrain obstruction at the horizon for low solar elevation angles.

There are a number of features of the software that can produce highly conservative or 'worst-case' results in terms of modelling the potential shadow flicker effect. For example, there are a range of factors that could diminish shadow flicker effects namely cloud cover, existing screening (treelines, hedgerows etc.), varying wind direction and low wind speed. In relation to cloud cover, the default annual shadow flicker calculated by the model for each receptor assumes 100% sunshine during daytime hours. However, Met Éireann data for this region shows that the sun shines on average for 30% of the daylight hours per year thus, the total hours per year of shadow flicker is likely to be significantly less than the theoretical worst-case durations produced by the model. The modelled results, therefore, overestimate the likely effects based on sunshine probability. Historic Data compiled by Met Éireann[2] at the nearest operating long-term weather station to the proposed project (Shannon Airport, Co. Clare, approximately 91 km from the proposed project) has been used to determine the average sunshine hours; this data is presented in Table 10-1.

Table 10-1: Average Daily Sunshine Hours Per Month at Shannon Airport, Co. Clare, Station

Month	Mean Daily Sunshine Hours (hh:mm)
Jan	1.87
Feb	2.47
Mar	3.95
Apr	5.99
May	6.26
Jun	5.55
Jul	4.51
Aug	3.80
Sep	3.54
Oct	2.92
Nov	2.23
Dec	1.52

Similarly, the worst-case model inputs assume that the wind direction is such that all turbines are orientated to cast the maximum shadow over the identified receptors. However, Met Éireann meteorological data indicates that the prevailing wind direction across the country is

[2] https://www.met.ie/cms/assets/uploads/2023/07/www_met_ie_shannon_airport_9120.htm (Accessed 10 September 2026)

between south and west[3]. On-site wind measurements have confirmed this to be the case locally. Therefore, the direction that the blades of the turbine face (the turbine blades automatically orientate to face into the wind) will vary and, as such, will not always be perpendicular to the position of the receptors. The modelled results, therefore, overestimate the likely effects based on wind direction.

The worst-case modelled shadow flicker outputs assume unobstructed (from vegetation or other obstacles) visibility between a receptor and the turbine rotors, bright weather conditions, use of 'greenhouse mode' (i.e. the windows face the turbines) and rotor alignment with maximum potential to cast a shadow. These are worst-case conditions used to predict the maximum possible shadow flicker effect. In practice, over the course of any year, the actual weather conditions and any screening will reduce the worst-case modelled effects.

10.3.4 Cumulative Assessment

The only developments that have the potential for cumulative shadow flicker effects are other wind farms.

The shadow flicker assessment considers the 13 no. wind turbines that make up the proposed project and quantifies the worst-case potential shadow flicker effects that may arise from the proposed turbines.

Other wind farms have also been considered to assess any potential cumulative effects with regard to shadow flicker. A planning search was conducted using the Mayo County Council (MCC) website, An Coimisiún Pleanála (ACP) website and the EIA portal to identify any existing, consented or proposed wind farm developments in proximity to the proposed wind farm site.

As mentioned in Section 10.3.1, the IWEA (2012) Guidelines also includes guidance on cumulative shadow flicker assessments. The currently in planning Laurclavagh Wind Farm (ACP Planning Ref. 319307) is located approximately 14 km south-east of the currently proposed wind farm site respectively. The recently refused Shancloon Wind Farm (ACP Planning Ref. 323699) located approximately 6.5 km north-east was also considered in this assessment as it was in planning at the time of assessment and may still be subject to judicial review. The closest operational wind farm is Ugool wind farm (Galway County Council Planning ref. 11/1735), located approximately 19 km south-west of the proposed project. Given the distance of these wind farms to the proposed project, there will be no potential for cumulative shadow flicker effects.

10.3.5 Assessment of Significance of Effects

This chapter presents predicted shadow flicker effects at all identified receptors. These results quantify the theoretical maximum number of hours per year and per day during which shadow flicker effects may occur. Significance of effects has been determined with reference to the EPA Guidelines on the information to be contained in Environmental Impact Assessment Reports (2022). The EIA Guidelines present the approach to describing environmental effects as applied to this EIAR. In determining significance of effects, magnitude of change is considered in relation to the sensitivity of the receiving environment.

As mentioned in Section 10.3.2, for the purposes of this assessment, the 2006 WEDGs recommended maximum thresholds of 30 hours per year or 30 minutes per day have been

[3] Shannon Airport 1991–2020 averages

applied to all sensitive receptor locations within 1.36 km of a proposed turbine location in order to identify any shadow effect requiring mitigation. Any shadow flicker effect that exceeds the 2006 WEDGs recommended limits of 30 minutes per day or 30 hours per year at any sensitive receptor, unmitigated, is considered significant and adverse.

10.3.6 Use of Guidelines in the Assessment

With due consideration of the above, the assessment has been made as follows:

- A study area of 10 rotor diameters has been defined;
- The WEDG 2006 assessment criteria has been adopted but extended out to cover the entire study area; and,
- The Draft 2019 WEDG have been adopted with regard to mitigation i.e. mitigation is proposed to eliminate adverse shadow flicker.

In comparison to both the current WEDG and international recognised guidance, the assessment is therefore inherently conservative. By adopting mitigation to achieve near zero hours, the proposed project will minimise adverse effects.

10.3.7 Acceptable Limits

In accordance with the current WEDGs (2006), the acceptable limit for shadow flicker in Ireland is a maximum of 30 hours per year or 30 minutes per day at any one receptor. The assessment carried out in this Chapter is based on these current guidelines.

In the interests of developing best practice, The Applicant is proposing to use the currently available technology to minimise any adverse effects from the proposed project on the local community.

10.4 RECEIVING ENVIRONMENT

10.4.1 Shadow Flicker Receptors

The shadow flicker receptors identified for the purpose of this assessment are shown on Figure 10-1. The locations of the proposed turbines are also shown as well as the shadow flicker study area which extends to 1.36 km from the proposed turbine locations. The design of the wind farm layout incorporates a minimum set-back distance from the proposed turbine locations to dwellings and potential sensitive receptors, such that in general there are no sensitive receptors located within 600 m of a proposed turbine location (i.e., allowing for 4 times tip height). One residential dwelling, Receptor ID 377 (Shadow ID 201), is an involved landowner and has consented to the proposed wind turbines being placed within the 600 m setback distance.

During the verification process, any properties/buildings identified that would not be considered sensitive receptors (i.e. farm sheds, garages, etc.) were omitted. Only habitable dwellings, planning consented habitable dwellings and currently derelict dwellings were included as shadow flicker receptors. Unconstructed dwellings where the planning permission expiry period for development had elapsed were also excluded.

This verification process identified a total of 204 no. sensitive receptors were identified and are presented in Table 10-2 and Figure 10.2. Each receptor identified has been assigned an ID number in the shadow flicker modelling software for reference (see *SH "ID"* – "*ReceptorID*" labels on Figure 10-2 where *SH "ID"* refers to the shadow flicker modelling assigned labels and "*ReceptorID*" to sensitive receptors' IDs provided in Appendix 5-1).

10.5 Assessment of Effects

10.5.1 Embedded Mitigation

Through the development of the proposed project, measures have been adopted as part of the evolution of the design to avoid or reduce adverse effects on the environment. During the turbine layout optimisation key consideration was given to the layout of the turbines in order to minimise the potential for shadow flicker. However, this on its own cannot eliminate shadow flicker and as such further mitigation measures are needed in order to eliminate shadow flicker at dwellings or other potentially affected properties.

10.5.2 Future Baseline Scenario

The shadow flicker effects examined in this Chapter are entirely dependent on the installation and operation of wind turbines at the proposed wind farm site. In the event that the proposed project does not proceed, there will be no shadow flicker effects from this proposed project.

If the proposed project were not to proceed, the opportunity to capture part of Mayo's valuable renewable energy resource would be lost, as would the opportunity to contribute to meeting Government and EU targets for the production and consumption of electricity from renewable resources and the reduction of greenhouse gas emissions".

10.5.3 Construction Phase

There are no potential effects relating to shadow flicker during the construction phase of the proposed project as shadow flicker can only occur when the turbine blades are installed and rotating.

At the very end of the construction phase there may be a short time where there is a potential for shadow flicker to occur. This would be in the stage of testing and commissioning of the proposed turbines. As set out in in Chapter 2, the commissioning phase of the proposed project is anticipated to have a two-month duration. During this stage there would be a potential for a slight momentary effect on any receptor. During commissioning, the proposed turbine blades and shadow flicker management software will be installed and tested. Some shadow flicker may be experienced while the software is being refined but there will be no exceedance of the maximum daily limit of 30 minutes per day during this period. The potential effect from shadow flicker in the worst-case scenario at the defined receptors during commissioning will be slight over a temporary period and will have a momentary to brief effect with respect to the duration of the effect on a daily basis. During commissioning, shadow flicker will not exceed the 2006 WEDGs recommended limits of 30 minutes per day or 30 hours per year at any sensitive receptor. Therefore, effects from shadow flicker will not be significant during this phase.

The shadow flicker mitigation strategies described in Section 10.6 will be applied.

10.5.4 Operational Phase

The shadow flicker model provides a detailed report and illustration of the potential shadow effects on the identified receptors. The full report is provided in Appendix 10-1.

Table 10-2 details the predicted maximum daily shadow flicker representing the maximum number of hours in any one day when shadow flicker will be experienced at a receptor in the worst-case conditions. The number of days where the predicted daily shadow flicker exceeds the 30 minutes per day threshold is also detailed. Based on the worst-case conditions, it is

predicted that 92 no. shadow flicker receptors will experience daily shadow flicker in excess of the 2006 WEDGs threshold of 30 minutes per day.

The model inputs used to predict the daily shadow flicker levels have assumed worst-case conditions, including direct sunshine for the full duration of daylight hours throughout the year, that the turbine blades are always turning, that the turbine blades are always facing the receptors, the receptor has windows facing each turbine (i.e. 360 degree windows in 'greenhouse mode'), the receptor is always occupied and that there is no screening (vegetation or other obstacles). In reality, the actual occurrence and incidence of shadow flicker over the course of a day is likely to be significantly less than that of the maximum predicted in Table 10-2.

Table 10-2 also details the total shadow flicker hours per year for comparison against the 2006 WEDG threshold of 30 hours per year. The *'Worst Case Annual Shadow Flicker'* column in Table 10-1 represents the worst-case scenario which assumes 100% sunshine on every day during daylight hours as well as worst-case wind conditions resulting in maximum shadow cast in the direction of a receptor for the entire year.

As noted in Section 10.3.4, the Met Éireann data for this region shows that the sun shines on average for only 30% of the daylight hours per year. Accordingly, a sunshine reduction factor can be applied to account for the more realistic sunshine probability at the site. Additionally, as it is not possible for all turbines to face directly towards sensitive receptors at all times and wind direction is subject to change, a wind direction reduction factor can also be applied to the worst-case annual shadow flicker results. The WindPRO modelling software has built-in options to specify statistical weather data to produce more realistic (referred to as 'Expected' in the modelling software) predictions of annual shadow flicker effects. These predicted results are presented in the column titled *'Expected Annual Shadow Flicker'* in Table 10-2.

The technical assessment (Table 10-2) shows that the guideline threshold limit of 30 hours per year is predicted to be exceeded at 86 no. receptors in the worst-case scenario and is expected to be exceeded at zero (0) receptors when the statistical sunshine probability[4] and wind reduction factors are taken into account (realistic (expected) scenario). Results of the worst case scenario can be seen in Figure 10-2.

For the operational phase of the proposed wind farm, the potential effect from shadow flicker in the worst-case scenario and before mitigation measures are applied, at a defined number of receptors as set out in Table 10-2 shadow flicker effects will likely be significant and periodic over the long-term and will have a momentary to brief effect with respect to the duration of the effect on a daily basis at certain times of the year at any receptor that does receive shadow flicker (with no effect at receptors that do not receive it). Therefore, significant shadow flicker effects will occur at sensitive receptors where the 2006 WEDGs recommended limits of 30 minutes per day or 30 hours per year are exceeded before mitigation measures are applied (see Table 10-2).

On the other hand, and as mentioned above, when taking into account the sunshine probability, the realistic (Expected) values for shadow flicker at the identified receptors are not exceeding

[4] 30 Year Average Data (1991-2020) – Shannon Airport, Co. Clare Weather Station (Accessed 31 March 2026)

the 2006 WEDGs recommended limits of 30 minutes per day or 30 hours per year. The effects during operational phase, in this scenario, are considered to be not significant.

As per Table 10-2, there are 23 no. identified receptors where no shadow flicker effect will occur and therefore there will be no impact.

Table 10-2: Predicted Daily and Annual Shadow Flicker Effects – Proposed Wind Turbines

Receptor ID for Shadow Flicker Model	Description	Worst Case Scenario		Expected (Realistic)	
		Maximum Daily Shadow Flicker (hrs:mins/day)	No. of Days exceeding 30 mins/day Threshold	Annual Shadow Flicker (hrs:mins/year)	Annual Shadow Flicker (hrs:mins/year)
1	Sensitive Receptor	00:31	**24**	39:43:00	07:57
2	Sensitive Receptor	00:29	**0**	34:50:00	06:58
3	Sensitive Receptor	00:25	**0**	27:23:00	05:30
4	Sensitive Receptor	00:37	**47**	49:06:00	09:53
5	Sensitive Receptor	00:26	**0**	36:37:00	07:22
6	Sensitive Receptor	00:26	**0**	29:14:00	05:51
7	Sensitive Receptor	00:24	**0**	26:33:00	05:19
8	Sensitive Receptor	00:31	**7**	32:28:00	06:31
9	Sensitive Receptor	00:20	**19**	22:23:00	04:27
10	Sensitive Receptor	00:19	**0**	10:29:00	02:05
11	Sensitive Receptor	00:48	**111**	115:55:00	20:58
12	Sensitive Receptor	00:43	**32**	40:52:00	08:04
13	Sensitive Receptor	01:04	**81**	98:24:00	20:04
14	Sensitive Receptor	00:47	**41**	51:47:00	10:12
15	Sensitive Receptor	00:32	**35**	41:51:00	08:26
16	Sensitive Receptor	00:32	**11**	42:07:00	08:29
17	Sensitive Receptor	00:32	**9**	38:03:00	07:41
18	Sensitive Receptor	00:31	**7**	25:16:00	05:10
19	Sensitive Receptor	00:30	**4**	22:39:00	04:36
20	Sensitive Receptor	00:33	**28**	43:48:00	08:49
21	Sensitive Receptor	00:34	**40**	45:57:00	09:15
22	Sensitive Receptor	00:33	**33**	42:24:00	08:32
23	Sensitive Receptor	00:36	**16**	18:25:00	03:53
24	Sensitive Receptor	00:28	**0**	16:25:00	03:18
25	Sensitive Receptor	00:32	**7**	14:54:00	03:07
26	Sensitive Receptor	00:30	**2**	11:12:00	02:20
27	Sensitive Receptor	00:34	**12**	16:58:00	03:34
28	Sensitive Receptor	00:26	**0**	10:42:00	02:09
29	Sensitive Receptor	00:27	**0**	10:01:00	02:02
30	Sensitive Receptor	00:27	**0**	9:27:00	01:55
31	Sensitive Receptor	00:24	**0**	8:50:00	01:47
32	Sensitive Receptor	00:27	**0**	9:18:00	01:55
33	Sensitive Receptor	00:26	**0**	8:45:00	01:47

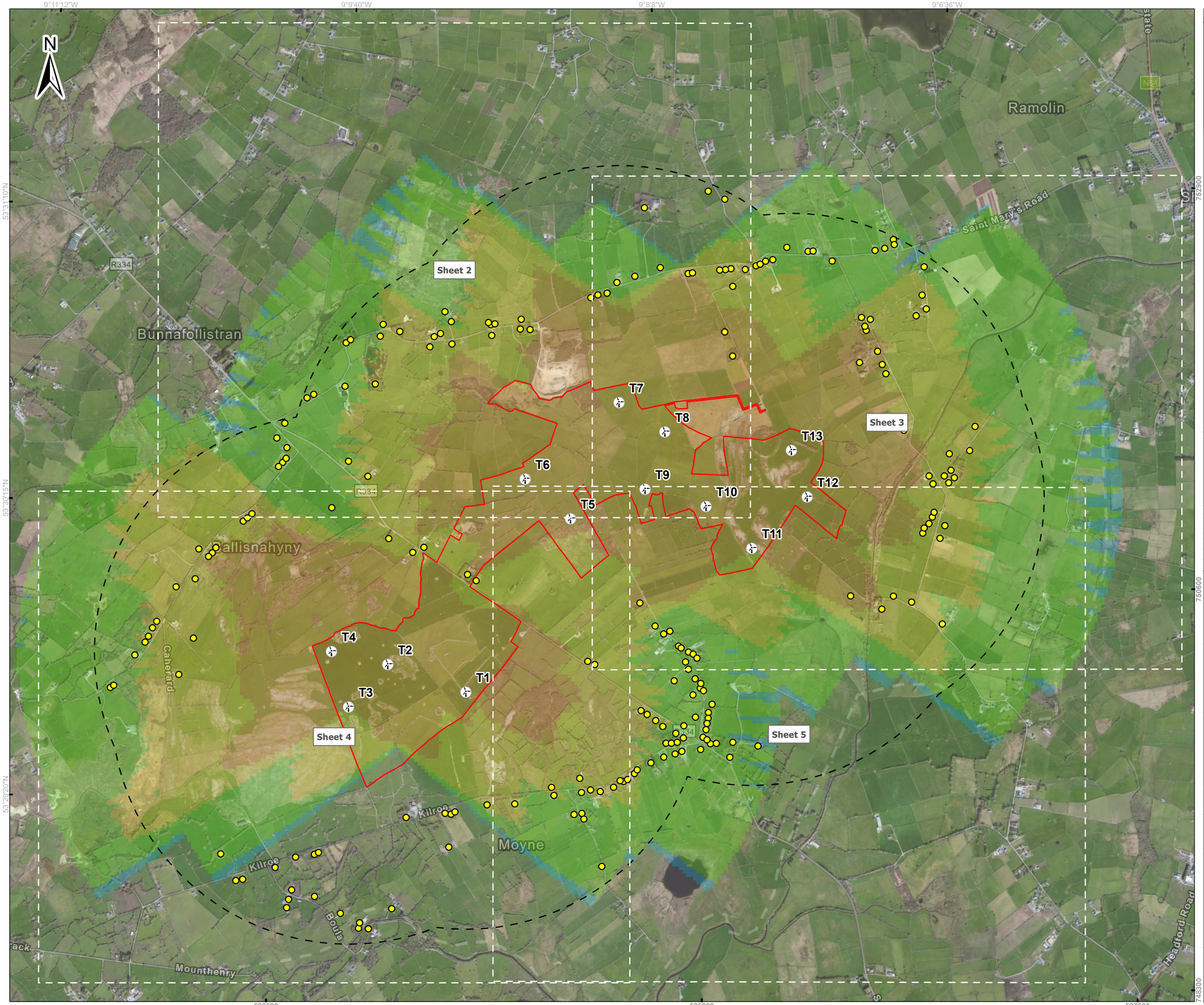
Receptor ID for Shadow Flicker Model	Description	Worst Case Scenario			Expected (Realistic)
		Maximum Daily Shadow Flicker (hrs:mins/day)	No. of Days exceeding 30 mins/day Threshold	Annual Shadow Flicker (hrs:mins/year)	Annual Shadow Flicker (hrs:mins/year)
34	Sensitive Receptor	00:24	**0**	8:09:00	01:38
35	Sensitive Receptor	00:26	**0**	9:02:00	01:54
36	Sensitive Receptor	00:26	**0**	8:24:00	01:43
37	Sensitive Receptor	00:27	**0**	17:07:00	03:16
38	Sensitive Receptor	00:25	**0**	12:15:00	02:19
39	Sensitive Receptor	00:23	**0**	10:36:00	02:01
40	Sensitive Receptor	00:23	**0**	10:21:00	01:58
41	Sensitive Receptor	00:22	**0**	9:36:00	01:50
42	Sensitive Receptor	00:22	**0**	9:16:00	01:46
43	Sensitive Receptor	00:21	**0**	9:04:00	01:44
44	Sensitive Receptor	00:23	**0**	10:06:00	01:56
45	Sensitive Receptor	00:23	**0**	9:49:00	01:54
46	Sensitive Receptor	00:24	**0**	11:26:00	02:09
47	Sensitive Receptor	00:18	**0**	4:45:00	00:58
48	Sensitive Receptor	00:21	**0**	6:20:00	01:17
49	Sensitive Receptor	00:20	**0**	5:31:00	01:08
50	Sensitive Receptor	00:19	**0**	5:14:00	01:05
51	Sensitive Receptor	00:18	**0**	4:23:00	00:55
52	Sensitive Receptor	00:15	**0**	3:21:00	00:42
53	Sensitive Receptor	00:20	**0**	5:55:00	01:14
54	Sensitive Receptor	00:20	**0**	5:44:00	01:13
55	Sensitive Receptor	00:20	**0**	5:44:00	01:11
56	Sensitive Receptor	00:25	**0**	9:28:00	01:57
57	Sensitive Receptor	00:23	**0**	8:47:00	01:45
58	Sensitive Receptor	00:21	**0**	5:46:00	01:07
59	Sensitive Receptor	00:22	**0**	9:22:00	01:50
60	Sensitive Receptor	00:20	**0**	5:13:00	01:05
61	Sensitive Receptor	00:24	**0**	8:23:00	01:48
62	Sensitive Receptor	00:21	**0**	5:31:00	01:11
63	Sensitive Receptor	00:25	**0**	11:39:00	02:18
64	Sensitive Receptor	00:20	**0**	5:32:00	01:12
65	Sensitive Receptor	00:20	**0**	5:38:00	01:13
66	Sensitive Receptor	00:45	**0**	42:39:00	00:00
67	Sensitive Receptor	00:42	**13**	34:12:00	05:11
68	Sensitive Receptor	00:38	**34**	34:21:00	05:01
69	Sensitive Receptor	00:48	**47**	52:54:00	10:31
70	Sensitive Receptor	00:46	**41**	48:18:00	09:34
71	Sensitive Receptor	00:49	**51**	56:32:00	11:10
72	Sensitive Receptor	00:55	**71**	73:17:00	14:24

Receptor ID for Shadow Flicker Model	Description	Worst Case Scenario			Expected (Realistic)
		Maximum Daily Shadow Flicker (hrs:mins/day)	No. of Days exceeding 30 mins/day Threshold	Annual Shadow Flicker (hrs:mins/year)	Annual Shadow Flicker (hrs:mins/year)
73	Sensitive Receptor	00:44	**45**	50:38:00	10:01
74	Sensitive Receptor	00:48	**51**	54:27:00	10:39
75	Sensitive Receptor	00:41	**29**	38:38:00	07:30
76	Sensitive Receptor	00:20	**0**	11:59:00	01:43
77	Sensitive Receptor	00:48	**103**	85:57:00	17:17
78	Sensitive Receptor	00:48	**62**	77:24:00	15:43
79	Sensitive Receptor	00:53	**97**	96:36:00	19:38
80	Sensitive Receptor	00:53	**82**	84:12:00	17:13
81	Sensitive Receptor	00:31	**7**	16:24:00	03:18
82	Sensitive Receptor	00:56	**88**	72:19:00	14:29
83	Sensitive Receptor	00:53	**45**	51:43:00	10:23
84	Sensitive Receptor	01:05	**122**	103:24:00	19:01
85	Sensitive Receptor	00:43	**30**	39:53:00	07:59
86	Sensitive Receptor	00:18	**0**	9:13:00	01:30
87	Sensitive Receptor	00:17	**0**	7:51:00	01:17
88	Sensitive Receptor	00:16	**0**	4:17:00	00:41
89	Sensitive Receptor	00:16	**0**	4:14:00	00:40
90	Sensitive Receptor	00:55	**101**	101:51:00	16:15
91	Sensitive Receptor	01:00	**111**	92:45:00	14:41
92	Sensitive Receptor	01:18	**98**	108:43:00	17:07
93	Sensitive Receptor	01:07	**90**	86:55:00	13:35
94	Sensitive Receptor	01:01	**52**	66:37:00	10:01
95	Sensitive Receptor	00:59	**41**	60:40:00	09:03
96	Sensitive Receptor	00:55	**44**	53:01:00	07:51
97	Sensitive Receptor	00:53	**34**	44:31:00	06:37
98	Sensitive Receptor	00:24	**0**	22:41:00	03:19
99	Sensitive Receptor	01:56	**111**	132:01:00	19:40
100	Sensitive Receptor	00:39	**24**	31:49:00	04:44
101	Sensitive Receptor	00:34	**14**	25:23:00	03:50
102	Sensitive Receptor	00:30	**2**	22:24:00	03:24
103	Sensitive Receptor	00:28	**0**	19:23:00	02:57
104	Sensitive Receptor	00:29	**0**	19:42:00	03:01
105	Sensitive Receptor	00:47	**56**	40:07:00	05:50
106	Sensitive Receptor	00:50	**54**	42:20:00	06:07
107	Sensitive Receptor	00:53	**50**	43:17:00	06:11
108	Sensitive Receptor	00:00	**0**	0:00:00	00:00
109	Sensitive Receptor	00:00	**0**	0:00:00	00:00
110	Sensitive Receptor	00:50	**21**	31:19:00	04:20
111	Sensitive Receptor	00:23	**0**	18:49:00	02:44

Receptor ID for Shadow Flicker Model	Description	Worst Case Scenario			Expected (Realistic)
		Maximum Daily Shadow Flicker (hrs:mins/day)	No. of Days exceeding 30 mins/day Threshold	Annual Shadow Flicker (hrs:mins/year)	Annual Shadow Flicker (hrs:mins/year)
112	Sensitive Receptor	00:24	**0**	19:46:00	03:04
113	Sensitive Receptor	00:25	**0**	22:23:00	03:04
114	Sensitive Receptor	00:23	**0**	12:46:00	01:40
115	Sensitive Receptor	01:07	**30**	30:49:00	04:10
116	Sensitive Receptor	01:02	**32**	30:44:00	04:11
117	Sensitive Receptor	00:00	**0**	0:00:00	00:00
118	Sensitive Receptor	00:38	**23**	40:53:00	06:18
119	Sensitive Receptor	00:39	**25**	43:51:00	06:43
120	Sensitive Receptor	00:48	**49**	66:53:00	10:11
121	Sensitive Receptor	00:54	**58**	69:51:00	10:39
122	Sensitive Receptor	00:39	**24**	40:11:00	06:23
123	Sensitive Receptor	00:37	**22**	38:50:00	05:59
124	Sensitive Receptor	00:41	**32**	36:41:00	05:32
125	Sensitive Receptor	00:23	**0**	23:43:00	03:34
126	Sensitive Receptor	00:25	**0**	23:30:00	03:26
127	Sensitive Receptor	00:25	**0**	21:02:00	04:23
128	Sensitive Receptor	00:25	**0**	21:34:00	04:30
129	Sensitive Receptor	00:28	**0**	23:06:00	04:38
130	Sensitive Receptor	00:30	**2**	23:18:00	04:29
131	Sensitive Receptor	00:30	**4**	23:28:00	04:25
132	Sensitive Receptor	00:30	**7**	23:41:00	04:18
133	Sensitive Receptor	00:29	**0**	27:17:00	04:18
134	Sensitive Receptor	00:30	**4**	30:35:00	04:35
135	Sensitive Receptor	00:35	**24**	39:33:00	05:50
136	Sensitive Receptor	00:46	**28**	39:56:00	05:53
137	Sensitive Receptor	00:27	**0**	15:36:00	02:29
138	Sensitive Receptor	00:54	**49**	52:55:00	07:54
139	Sensitive Receptor	00:29	**0**	19:57:00	03:12
140	Sensitive Receptor	00:48	**54**	59:48:00	08:51
141	Sensitive Receptor	00:48	**40**	47:36:00	06:57
142	Sensitive Receptor	00:27	**0**	15:46:00	02:40
143	Sensitive Receptor	00:25	**0**	13:13:00	02:10
144	Sensitive Receptor	00:25	**0**	13:56:00	02:16
145	Sensitive Receptor	00:32	**12**	28:44:00	04:54
146	Sensitive Receptor	00:23	**0**	11:53:00	02:02
147	Sensitive Receptor	00:22	**0**	11:24:00	01:59
148	Sensitive Receptor	00:57	**185**	150:52:00	03:19
149	Sensitive Receptor	00:55	**127**	111:47:00	19:49
150	Sensitive Receptor	00:43	**94**	82:51:00	15:30

Receptor ID for Shadow Flicker Model	Description	Worst Case Scenario			Expected (Realistic)
		Maximum Daily Shadow Flicker (hrs:mins/day)	No. of Days exceeding 30 mins/day Threshold	Annual Shadow Flicker (hrs:mins/year)	Annual Shadow Flicker (hrs:mins/year)
151	Sensitive Receptor	00:34	**11**	29:02:00	05:55
152	Sensitive Receptor	00:30	**0**	20:16:00	03:52
153	Sensitive Receptor	00:45	**122**	108:32:00	19:33
154	Sensitive Receptor	00:25	**0**	22:15:00	04:12
155	Sensitive Receptor	00:00	**0**	0:00:00	00:00
156	Sensitive Receptor	00:00	**0**	0:00:00	00:00
157	Sensitive Receptor	00:00	**0**	0:00:00	00:00
158	Sensitive Receptor	00:00	**0**	0:00:00	00:00
159	Sensitive Receptor	00:00	**0**	0:00:00	00:00
160	Sensitive Receptor	00:00	**0**	0:00:00	00:00
161	Sensitive Receptor	00:00	**0**	0:00:00	00:00
162	Sensitive Receptor	00:00	**0**	0:00:00	00:00
163	Sensitive Receptor	00:00	**0**	0:00:00	00:00
164	Sensitive Receptor	00:00	**0**	0:00:00	00:00
165	Sensitive Receptor	00:00	**0**	0:00:00	00:00
166	Sensitive Receptor	00:00	**0**	0:00:00	00:00
167	Sensitive Receptor	00:59	**65**	67:46:00	10:12
168	Sensitive Receptor	00:59	**52**	63:50:00	09:43
169	Sensitive Receptor	00:59	**39**	59:22:00	09:09
170	Sensitive Receptor	00:54	**77**	62:18:00	09:11
171	Sensitive Receptor	00:54	**54**	58:17:00	08:25
172	Sensitive Receptor	00:20	**0**	14:38:00	02:22
173	Sensitive Receptor	00:20	**0**	12:26:00	01:06
174	Sensitive Receptor	00:20	**0**	7:43:00	01:25
175	Sensitive Receptor	00:21	**0**	7:57:00	01:26
176	Sensitive Receptor	00:20	**0**	16:35:00	02:36
177	Sensitive Receptor	00:54	**64**	61:14:00	08:56
178	Sensitive Receptor	00:21	**0**	8:42:00	01:37
179	Sensitive Receptor	00:36	**40**	44:07:00	09:05
180	Sensitive Receptor	00:31	**10**	24:04:00	04:17
181	Sensitive Receptor	00:41	**21**	30:31:00	05:12
182	Sensitive Receptor	00:50	**30**	40:26:00	06:37
183	Sensitive Receptor	00:18	**0**	11:42:00	02:26
184	Sensitive Receptor	00:00	**0**	0:00:00	00:00
185	Sensitive Receptor	00:00	**0**	0:00:00	00:00
186	Sensitive Receptor	00:00	**0**	0:00:00	00:00
187	Sensitive Receptor	00:00	**0**	0:00:00	00:00
188	Sensitive Receptor	00:00	**0**	0:00:00	00:00
189	Sensitive Receptor	00:00	**0**	0:00:00	00:00

Receptor ID for Shadow Flicker Model	Description	Worst Case Scenario			Expected (Realistic)
		Maximum Daily Shadow Flicker (hrs:mins/day)	No. of Days exceeding 30 mins/day Threshold	Annual Shadow Flicker (hrs:mins/year)	Annual Shadow Flicker (hrs:mins/year)
190	Sensitive Receptor	00:00	**0**	0:00:00	00:00
191	Sensitive Receptor	00:00	**0**	0:00:00	00:00
192	Sensitive Receptor	00:55	**36**	51:59:00	08:02
193	Sensitive Receptor	01:09	**38**	48:55:00	06:39
194	Sensitive Receptor	00:50	**48**	58:44:00	08:53
195	Sensitive Receptor	00:40	**36**	40:43:00	07:38
196	Sensitive Receptor	00:56	**113**	105:30:00	21:05
197	Sensitive Receptor	00:59	**125**	109:00:00	21:50
198	Sensitive Receptor	00:54	**49**	69:27:00	13:45
199	Sensitive Receptor	00:25	**0**	15:12:00	02:20
200	Sensitive Receptor	00:21	**0**	8:42:00	01:43
201	Sensitive Receptor	01:51	**136**	191:43:00	05:33
202	Sensitive Receptor	00:58	**124**	105:35:00	21:20
203	Sensitive Receptor	01:13	**91**	101:51:00	20:23
204	Sensitive Receptor	00:37	**31**	36:46:00	06:45





Legend

- Site Boundary
- Turbine Locations
- Receptors
- Shadow Flicker Study Area

Shadow Flicker (Maximum Minutes per Day)

- 0.1 -< 10.0
- 10.0 -< 30.0
- 30.0 -< 60.0
- 60.0 <= 485

0 500 1,000
Meters

Spatial Reference
Datum: IRENET95
EPSG: 2157

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Rev	Date	Description	By	Chkd.
A	17/09/2026	First issue	S.P	J.S

Client: ROOAUNALAGHTA Green Energy

Project:

Rooaunalaghta Green Energy Project

Title:

Figure 10-2 :
Shadow Flicker Results
- Sheet 1 of 5 -

Scale @ A3: 1:20,000

Prepared by:	Checked by:	Date:
S.Pezzetta	J.Staunton	September 2026

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Map Ref: 11981-027-SHADW.FLCKR-SENS.R-TOB-A

Draft: A

9°9'40"W

9°8'8"W

53°3'110"N

53°3'015"N

752600

522500

525000

Bunnafollistran

Caherard

R334

SH109 - 183

SH108 - 178

SH117 - 193

SH139 - 238

SH116 - 190

SH112 - 186

SH100 - 164

SH115 - 189

SH137 - 236

SH111 - 185

SH106 - 170

SH114 - 188

SH118 - 200

SH136 - 235

SH193 - 356

SH119 - 201

SH113 - 187

SH107 - 171

SH134 - 233

SH141 - 240

SH123 - 205

SH194 - 366

SH124 - 215

SH135 - 234

SH120 - 202

SH110 - 184

SH105 - 169

SH144 - 244

SH121 - 203

SH122 - 204

SH99 - 163

SH142 - 242

SH133 - 232

SH138 - 237

SH143 - 243

SH140 - 239

SH201 - 377

SH147 - 247

SH145 - 245

SH146 - 246

SH174 - 302

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SH151 - 251

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SH176 - 304

SH171 - 299

SH154 - 254

T5

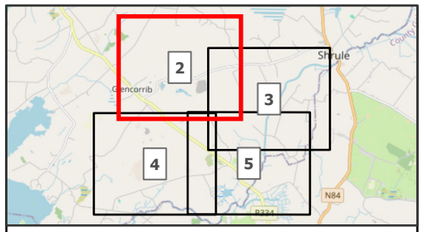
T6

T7

T8

T9

T10



Legend

- Site Boundary
- Turbine Locations
- Receptors
- Shadow Flicker Study Area

Shadow Flicker (Maximum Minutes per Day)

- 0.1 -< 10.0
- 10.0 -< 30.0
- 30.0 -< 60.0
- 60.0 <= 485

0 250 500
Meters

Spatial Reference
Datum: IRENET95
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A	17/09/2026	First issue	S.P	J.S

Client: ROOAUNALAGHTA Green Energy

Project:

Rooaunalaghta Green Energy Project

Title:

Figure 10-2 :
Shadow Flicker Results
- Sheet 2 of 5 -

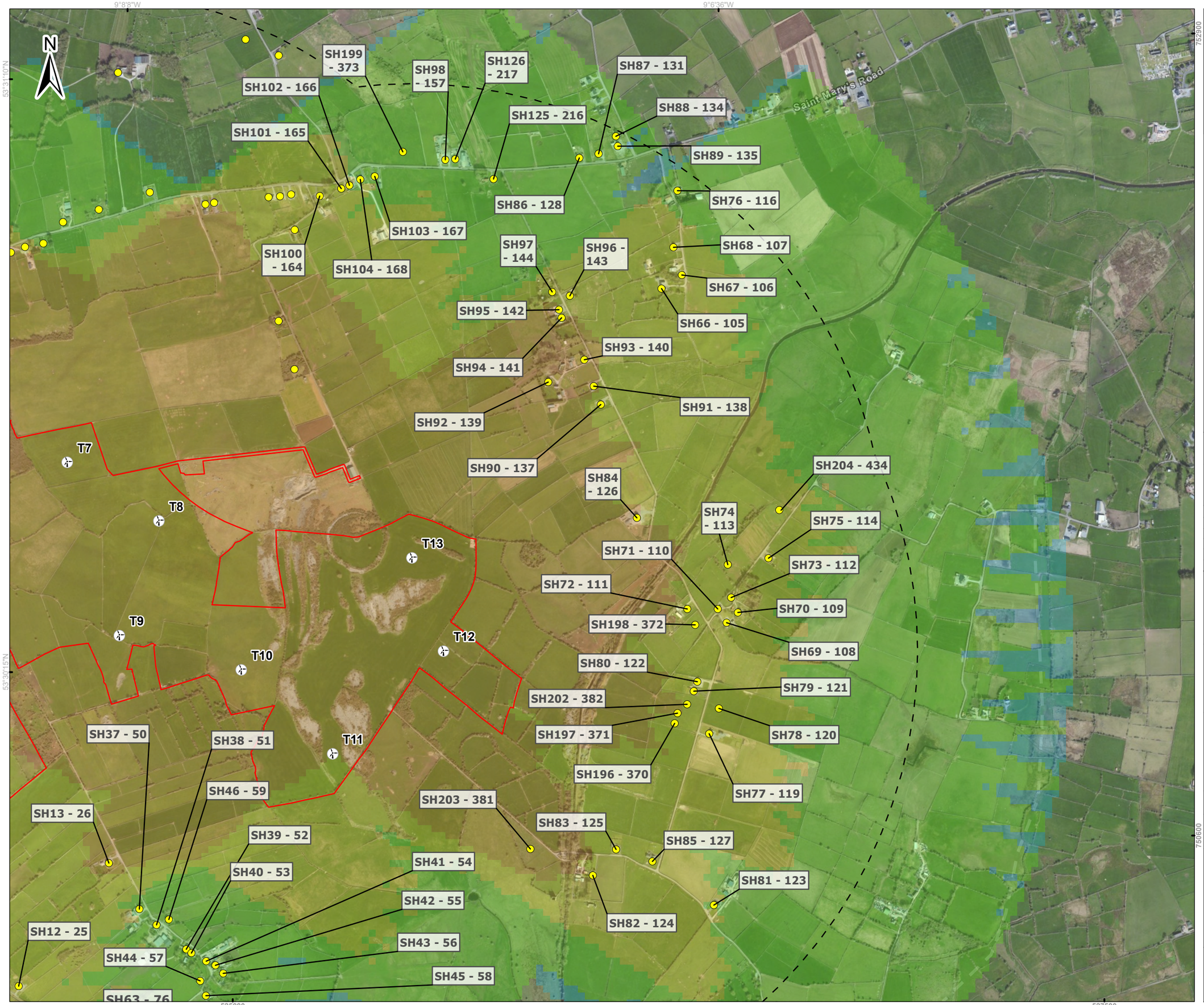
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Prepared by:	Checked by:	Date:
S.Pezzetta	J.Staunton	September 2026

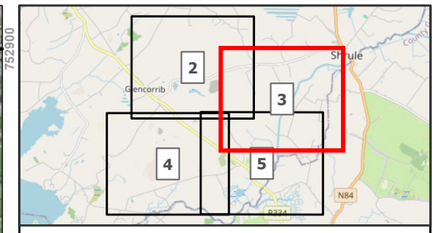
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Draft: A





Legend

- Site Boundary
- Turbine Locations
- Receptors
- Shadow Flicker Study Area

Shadow Flicker (Maximum Minutes per Day)

- 0.1 -< 10.0
- 10.0 -< 30.0
- 30.0 -< 60.0
- 60.0 <= 485

0 250 500
Meters

Spatial Reference
Datum: IRENET95
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A	17/09/2026	First issue	S.P	J.S

Client: ROOAUNALAGHTA Green Energy

Project:

Rooaunalaghta Green Energy Project

Title:

Figure 10-2 :
Shadow Flicker Results
- Sheet 3 of 5 -

Scale @ A3: 1:10,000

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S.Pezzetta	J.Staunton	September 2026

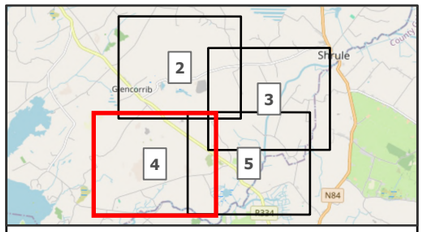
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Map Ref: 11981-027-SHADW.FLCKR-SENS.R-TOB-A_2

Draft: A

9°11'12"W
9°9'40"W
53°30'15"N
53°29'20"N
750600
522500
N
R334
Caherard
Ballisnahyny
Kilroe
Boula
Moyne
Mountenry
SH170 - 298
SH177 - 305
SH192 - 354
SH167 - 294
SH168 - 296
SH169 - 297
SH181 - 309
SH182 - 310
SH132 - 225
SH131 - 224
SH180 - 308
SH130 - 223
SH195 - 367
SH129 - 222
SH179 - 307
SH128 - 221
SH127 - 220
SH150 - 250
SH149 - 249
SH153 - 253
SH148 - 248
SH11 - 23
T5
T4
T2
T1
T3
SH14 - 27
SH159 - 259
SH161 - 261
SH160 - 260
SH158 - 258
SH155 - 255
SH156 - 256
SH189 - 317
SH183 - 311
SH185 - 313
SH184 - 312
SH188 - 316
SH190 - 318
SH166 - 266
SH187 - 315
SH163 - 263
SH186 - 314
SH164 - 264
SH165 - 265
SH191 - 342
SH162 - 262
SH157 - 257
SH9 - 12
SH8 - 11
SH4 - 7
SH5 - 8
SH1 - 4
SH22 - 35
SH2 - 5
SH3 - 6
SH6 - 9
SH7 - 10
SH15 - 28
SH21 - 34
SH10 - 20
SH20 - 33
SH16 - 29



Legend

- Site Boundary
- Turbine Locations
- Receptors
- Shadow Flicker Study Area

Shadow Flicker (Maximum Minutes per Day)

- 0.1 -< 10.0
- 10.0 -< 30.0
- 30.0 -< 60.0
- 60.0 <= 485

0 250 500
Meters

Spatial Reference
Datum: IRENET95
EPSG: 2157

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Client: ROOAUNALAGHTA Green Energy

Project:

Rooaunalaghta Green Energy Project

Title:

Figure 10-2 :
Shadow Flicker Results
- Sheet 4 of 5 -

Scale @ A3: 1:10,000

Prepared by:	Checked by:	Date:
S.Pezzetta	J.Staunton	September 2026

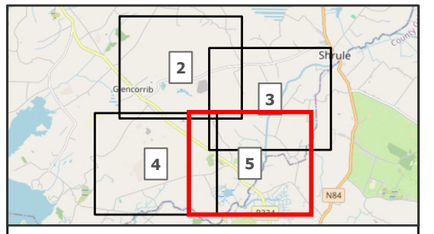
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Map Ref: 11981-027-SHADW.FLCKR-SENS.R-TOB-A_3

Draft: A

9°8'8"W
9°6'36"W
53°30'15"N
53°29'20"N
750600
525000
N
T5
T9
T10
T11
T12
SH45 - 58
SH59 - 72
SH200 - 376
SH57 - 70
SH56 - 69
SH58 - 71
SH63 - 76
SH61 - 74
SH62 - 75
SH35 - 48
SH60 - 73
SH64 - 77
SH23 - 36
SH65 - 78
SH27 - 40
SH54 - 67
SH25 - 38
SH53 - 66
SH26 - 39
SH32 - 45
SH52 - 65
SH29 - 42
SH19 - 32
SH51 - 64
SH18 - 31
SH50 - 63
SH48 - 61
SH49 - 62
SH47 - 60
SH17 - 30
SH55 - 68
SH36 - 49
SH24 - 37
SH28 - 41
SH34 - 47
SH30 - 43
SH33 - 46
SH31 - 44
R334
Moyne
Sandy M



Legend

- Site Boundary
- Turbine Locations
- Receptors
- Shadow Flicker Study Area

Shadow Flicker (Maximum Minutes per Day)

- 0.1 -< 10.0
- 10.0 -< 30.0
- 30.0 -< 60.0
- 60.0 <= 485

0 250 500
Meters

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Project:

Rooaunalaghta Green Energy Project

Title:

Figure 10-2 :
Shadow Flicker Results
- Sheet 5 of 5 -

Scale @ A3: 1:10,000

Prepared by:	Checked by:	Date:
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Draft: A

10.5.5 Decommissioning Phase

There are no potential effects relating to shadow flicker during the decommissioning phase of the proposed project as shadow flicker can only occur when the turbine blades are installed and rotating. Turbines would not be rotating during this phase. It is therefore considered that there will be no effects from shadow flicker in the decommissioning phase.

10.6 Mitigation Measures

Shadow flicker almost exclusively occurs in the operational phase of a wind farm. While there is a potential for minimal momentary effects to occur during turbine commissioning at the end of the construction phase (while the mitigation strategy is being refined, no likely significant effects are expected. This is due to the short timeframe that the commissioning stage takes (approximately 2 months), the fact that turbines are often left stationary (i.e. not rotating) during it, unless it is required for them to be rotating and the fact that the turbine control software will be operated and tested during this period. All of the mitigation described herein would apply during the final stage of the construction phase also.

The mitigation measures detailed herein will be put in place at the turbines to ensure that the current adopted 2006 DoEHLG guidelines are complied with at any sensitive receptors within the study area. The same mitigation measures also demonstrate that the proposed project can be operated having due regard to the shadow flicker requirements of the Draft Revised Wind Energy Development Guidelines (2019), i.e. eliminate adverse shadow flicker occurrences (allowing a very short period from when a shutdown (pause) command is sent to the turbine until the turbine blades and rotor reach an idle position), should they be adopted while the planning application is being determined.

10.6.1 Shadow Flicker Control System

Shadow flicker control systems, consisting of light sensors and specialised software, will be installed on each of the wind turbines. The control system will calculate, in real-time:

- Whether shadow flicker has the potential to affect nearby sensitive receptors, based on pre-programmed co-ordinates for the sensitive receptors and turbines;
- Wind speed (can affect how fast the turbine will turn and how quickly the flicker will occur);
- Wind direction; and
- The intensity of the sunlight.

When the control system detects that the sunlight is strong enough to cast a shadow, and the shadow falls on a sensitive receptor or sensitive receptors, then the turbine will automatically shut down; and will restart when the potential for shadow flicker ceases at the affected sensitive receptors.

The atmospheric variables that determine whether shadow flicker will occur or not, will be continuously monitored at the wind farm site and the data fed into the wind farm's SCADA control system. The strength of direct sunlight is measured by way of photocells, and if the sunlight is of sufficient strength to cast a shadow, the shadow flicker control mechanisms come into effect. Wind speed and direction are measured by anemometers and wind vanes on each

turbine and on the wind farm's LiDAR unit, and if wind speed and direction is such that a shadow will be cast, the shadow flicker control mechanisms come into effect. The moving blades of the turbine will require a short period of time to cease rotating and as such there may be a very short period (less than 60 seconds (depending on site specific wind conditions)) during which the blades are slowed to a complete halt.

The proposed method of mitigation will be implemented to mitigate shadow flicker effects at all sensitive receptors within the study area, allowing for a short period of time for the rotor to come to a stop. Appendix 10-1 contains all calculated potential shadow flicker periods for each turbine. The relevant data will be input into the turbine control software. In the event that complaints of shadow flicker are received by the Applicant / site operator or by the local authority, the Applicant will conduct an investigation and the complaints frequency, duration and time of complaints will be considered and specialist modelling software will be used to confirm the occurrence(s). Should the complaint persist, a shadow flicker survey involving the collection of light data will also be carried out at the sensitive receptor in which the complaint was made. Further refinement of the shadow control system will be conducted to mitigate adverse shadow flicker occurrence.

10.7 Residual Effects

The Applicant is committed to minimising any adverse effects from the proposed project on the local community.

During commissioning in the construction phase, the shadow flicker effect on the identified receptors will be brief to temporary and will have a momentary to brief effect with respect to the duration. There will be no effects during the rest of the construction phase, or during the decommissioning phase. The residual effects from both the construction and decommissioning phases will be **imperceptible, adverse and momentary (over a short term period)**.

During the operational phase, a shadow flicker control system will be implemented to mitigate shadow flicker effects at all sensitive receptors within the study area. As described in Section 10.6 the mitigation measure proposed is to measure the strength of direct sunlight by way of photocells and specialised software to automatically control turbines to eliminate adverse shadow flicker, allowing for a short period for the turbine to come to a stop (less than 60 seconds (depending on site specific wind conditions)).

Following application of the proposed shadow flicker mitigation measure during the operational phase, it is concluded that residual shadow flicker effects would avoid significant adverse impacts on residential amenity in respect of shadow flicker, align with the requirements of the Draft Revised Wind Energy Development Guidelines 2019 and would be well below the Wind Energy Guidelines (2006) threshold limits, and would therefore be **not significant, adverse and momentary (over a long term period)**.

10.8 CUMULATIVE EFFECTS

The IWEA (2012) Guidelines recommend that all existing and / or permitted wind farm developments within 2 km of a proposed development should be considered in a cumulative shadow flicker assessment, however, the key factor to determine whether cumulative effects may occur is whether receptors are located within overlapping 10 rotor diameter areas around multiple wind farms.

As mentioned in Section 10.3.1, the IWEA (2012) Guidelines also includes guidance on cumulative shadow flicker assessments. All operational wind farms and those in planning within the study area have been considered in the cumulative assessment. Study areas have been defined based on 10 rotor diameters from each of the developments mentioned above. Given the distance of these wind farms to the proposed project, there will be **no potential for cumulative shadow flicker effects**.

10.9 CONCLUSION

The incorporation of set-back distances from the proposed turbines to receptors, which have been considered and implemented in the design of the proposed wind farm site layout, means that there are no sensitive receptors located within <600 m of a proposed turbine location except for an involved landowner (Receptor ID 377 / Shadow ID 201) who has consented to the proposed wind turbines being placed within the 600 m setback distance.

This design measure, along with the implementation of mitigation measures as detailed in Section 10.6, will ensure that there are **no significant residual effects** of shadow flicker on the local community. It is also noted that the modelled shadow flicker effects in this assessment are based on worst-case conditions and, as a result, are highly conservative and overestimate the potential for, frequency and duration of the effects.

Effects from shadow flicker will not be significant during the construction and decommissioning phases. During the operational phase, mitigation measures will be implemented to minimise any adverse effects from the turbines. The operational software used to automatically stop turbines will be installed as standard practice and the implementation of the shadow flicker control system will take place as set out in Section 10.6.1.

10.10 REFERENCES

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