Appendix M Landscape Effects Assessment

Fast-Track Approvals Act 2024 Substantive Application

Hinuera Solar Farm

Harmony Energy NZ #6 Limited

SLR Project No.: 880.016894.00001

19 August 2026

Landscape Effects Assessment

Hinuera Solar Farm

Hinuera

Prepared For:

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Landscape Planning & Strategy

Contents

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Introduction

This report has been prepared to provide an overview of the potential landscape effects of the proposed solar farm at 4775 State Highway 29, Hinuera. The site comprises approximately 153 hectares of rural land currently operating as two dairy farms. It is bordered by State Highways 27 and 29 and the Kinleith Branch rail line. It lies within a flat, productive landscape typical of the Waikato Lowlands, bordered by the Kaimai Mamaku Ranges to the east.

The proposed activity is a solar farm and associated infrastructure. This report assesses how the proposed solar farm affects the existing rural character, visual amenity, and other landscape values of the Hinuera village and surrounds. Separate graphical attachments contain a context map, photographs, and visualisations to illustrate the proposal and its surrounding environment.

It is considered that the landscape effects of the proposal are low, which can be considered to be less than minor.

Methodology

The methodology used in this assessment is based on the *New Zealand Institute of Landscape Architects landscape assessment guidelines: Te Tangi a te Manu*. The assessment has been undertaken by Shannon Bray with qualifications as outlined in Appendix A, with support from Ben Ormsby, Liam Hosford and Brook O'Donnell of Wayfinder. This assessment:

- summarises key elements of the proposal
- describes the landscape context including physical, perceptual and associative dimensions of landscape and landscape values
- identifies and describes effects on landscape values based on landscape changes as a result of the proposal
- provides visualisations that are used to demonstrate the likely landscape and visual change

Site & Locality Visit

A site and locality visit was undertaken on 30 October 2025. This included visiting the following locations by vehicle:

- various areas of the proposal site
- the extent of the proposal site's roadside boundaries on State Highways 27 and 29, and the intersection of the state highways by vehicle
- the full length of Gore Road by vehicle

- Hinuera village environs including Hinuera Bowling Club, Rugby and Sports Club, School and Hall, and commercial/industrial buildings by vehicle

Visual Materials

Graphical information has been appended to this report:

- Attachment 1 contains an assessment of individual dwellings in proximity to the proposal, with a location map, photograph/s of the dwelling as well as text describing the potential level of visual effects. This attachment is best printed at A4 Potrait.
- Attachment 2 contains a context map that identifies the proposal site, shows the panel layout and mitigation planting along the wetlands and waterways. Indicative screening boundary vegetation is also shown. This attachment is best printed at A3 Landscape.
- Attachment 3 is the Graphic Attachment (GA) that contains three visualisations of the proposal, together with a detailed methodology of how these have been prepared. The visualisations show the solar farm without screening or riparian vegetation in place. These visualisations have been prepared using Best Practice Guide: Visual Simulations BPG 10.2.0. For use in the field, this attachment is best printed on high quality paper stock at A2 Landscape (further instructions for printing this document are contained in the attachment). Note that the final layout of solar arrays is subject to further design.

The assessment to inform this report was undertaken using knowledge gained during the site visit, in addition to the above materials, and online tools such as Google Maps, Google Street View and the Council online GIS portal.

Scale of Effects

As noted above, *Te Tangi a te Manu* has informed the preparation of this document. This includes the use of a 7-point assessment rating scale which has been adopted for this report, as follows:

<table>
<tr><td>This Assessment</td><td>Very-Low</td><td>Low</td><td>Low-Mod</td><td>Moderate</td><td>Mod-High</td><td>High</td><td>Very-High</td></tr>
<tr><td rowspan="2">RMA</td><td colspan="2">Less than Minor</td><td>Minor</td><td colspan="4">More than Minor</td></tr>
<tr><td colspan="5"></td><td colspan="2">Significant</td></tr>
</table>

The scale deliberately avoids the use of more traditional RMA terminology, such as minor or less than minor, and (as the NZILA guidelines set out) caution is needed in directly translating the 7-point scale of each identified effects into an RMA terminology. Rather, the degree of individual effects are to be assessed first, and then – following that – an overall professional judgement can be made on the overall significance of effects in the context of relevant RMA or policy tests. Nevertheless, a broad scale translation of effects is provided for reference.

Determining the rating to be applied is achieved through a qualitative analysis of various values or factors. This requires consideration of what factors are relevant to the assessment, how each of these factors (or the combination of them) might be affected by the proposed solar farm, and to what degree. The following table describes in more detail how the factors are then rated across the 7-point scale:

Rating	Description
Very-Low	The landscape context is not particularly unique and not outstanding. The view of the landscape is either very broad and the Project occupies only a very small part of it detached from the main focal point, or is heavily restricted by dense vegetation, landforms or buildings which means views of the Project are difficult to obtain. It's more likely that only a section or parts of the solar farm are visible, or if the whole Project is visible then it is located some distance away (likely more than 5km). The Project is more likely to be in the south and/or experienced as a secondary view to the main primary outlook from the viewpoint or location.
Low	The landscape context is not particularly unique and not outstanding (or any outstanding element of the landscape is in the background). The view of the landscape is either broad and the Project occupies only a small part of it in the periphery of the main focal, or is somewhat restricted by dense vegetation, landforms or buildings which means views of the Project are snapshot only. It's more likely that only a section or parts of the solar panels themselves are visible, or if the whole Project (or large majority of it) is visible then it is located some distance away (likely more than 5km), and any vegetation associated with the Project is in keeping with the surrounding vegetation character. The Project is more likely to be in the south and/or experienced as a secondary view to the main primary outlook from the viewpoint or location.

Low-Moderate	The landscape context is not particularly unique and not outstanding (although may have an outstanding landscape as a distant background). The view of the landscape is either broad and the Project occupies a small but noticeable part of it, likely to be just removed from the main focal point, or the view is restricted in numerous places by dense vegetation, landforms or buildings which from the viewpoint provide partial screening of the Project. It's likely some of the solar panels will be visible, likely in the background, although it may be that there parts visible in the middle-ground, or if the whole Project (or large majority of it) is visible then it is likely to be relatively distant (3-5km away). The Project is more likely to be experienced as a secondary view to the main primary outlook from the viewpoint or location, or could be in the periphery.
Moderate	The landscape context is not particularly unique and not outstanding, but may have some particularly attractive features that draw the attention of the viewer and potentially may have an outstanding landscape as a background. The view of the landscape is either broad and the Project occupies a moderate but noticeable part of it, likely to be just removed from the main focal point, or the view is restricted in places by dense vegetation, landforms or buildings which from the viewpoint provide partial screening of the Project. It's likely a section of the solar farm will be visible, potentially in the middleground, although it may be that there are parts that are more prominently located which can catch the eye. If the whole Project (or large majority of it) is visible then it is likely to be somewhat distant (between 3-5km away). The Project is more likely to be experienced in the periphery of the main outlook.
Moderate-High	The landscape context is recognised as somewhat significant and is likely to have some particularly attractive features that draw the attention of the viewer, and potentially may have an outstanding landscape as a distant background. The view of the landscape is either broad and takes in a pleasing composition of the various features in the primary outlook from the viewpoint. The solar farm will become a visually prominent part of the view, but the majority of key landscape features will remain as the key focal points. The views towards the Project are likely to be relatively clear and unobstructed, and the Project will present as relatively prominent and somewhat cluttered. It is more likely to be relatively close (within 3km).
High	The landscape is highly significant and there is a clear and well composed view of it from the specific viewpoint (if the viewpoint is from a building, then it is probable that the orientation of the building is towards the Project). The Project will become a visually dominant part of the view, not necessarily the key focal point, but a distraction from it and occupying a large portion of the view. The views towards the Project are clear and generally unobstructed, and the Project presents as covering a large area, dominating and potentially cluttered. It is likely to be relatively close (within 2-3km).
Very High	The landscape is recognised as an Outstanding Natural Landscape or Feature, and there is a very clear, well framed or composed view of it from the specific viewpoint (if the viewpoint is from a building, then it is probable that the building has been specifically designed to make the most of the view). The Project will be centred on this view, occupying a large part of it, and will directly compromise the view such that the perception of the existing landscape is significantly diminished and the solar farm becomes the primary focal point.

It is important to recognise that potential adverse effects need to be considered in terms of the whole context of the landscape. During an assessment process it is easy to focus solely on the proposed site only, and not consider views or experiences in other directions which may be more interesting, captivating or memorable. It is also important to recognise that seeing a solar farm does not necessarily equate to an effect. The role of a landscape effects assessment is to identify the degree to which a solar farm affects a person's relationship to a landscape (including their appreciation of the view).

Reflected Light Assessment

A detailed Reflected Light Assessment is provided in Appendix B. This has been informed through the use of the industry-standard ForgeSolar modelling software and tested through various iterations. Details on how the analysis was undertaken is included in the appendix. A summary of the Reflected Light Assessment is included within the assessment and contributes to the final conclusions on potential effects.

Proposal

Full details of the proposal are contained within the Assessment of Environmental Effects and associated engineering plans (see also Attachment 2 Context map). In short, the proposal includes the installation of:

- A solar panel array of a single axis tracking system
- Internal infrastructure including power conversion units, operations, maintenance and storage buildings of up to 500m^2, meteorological stations and Battery Energy Storage System (BESS)
- Internal access roads, stormwater management/drainage
- Perimeter fencing of post and rail with heavy duty chain link, not exceeding 2.4m high and internal to any landscape/ecological planting
- Indigenous vegetation planting along the surface waterways in the north of the site, and indigenous screening vegetation on the northern, southern and southeastern boundaries of the site shown in Attachment 2.
- Temporary facilities required during construction and decommissioning phases

Landscape mitigation in proposal

As will be outlined in this report, without screening the solar farm has the potential to be highly visible from several nearby public places, particularly along SH27 and SH29.

To reduce the effects of this visibility a Planting Plan has been developed that identifies locations for screening vegetation and is an integral part of the proposal (included within Attachment 2, Sheet 06 and 07). The vegetation has been selected following research on the indigenous vegetation present prior to historic clearance and further refined based on suitability for cultivation and planting, alongside effectiveness for screening. The species list has been prepared in collaboration with the project ecologist. It is proposed that the vegetation will be continually maintained for the life of the solar farm. It is envisaged that it will take 4-5 years for the vegetation to grow above the visible height of the solar panels.

Landscape Character

The site is located at 4775 State Highway 29, Hinuera. Hinuera is a small settlement in the Matamata Piako District, which is in the east of the Waikato Region of the North Island, New Zealand. The area features small villages and towns that serve the surrounding large areas of pastoral farming and other rural activities. The Kaimai Mamaku Range provides a clear boundary with Bay of Plenty to the east, and the Piako and Waihou Rivers and their catchments are significant features extending from the southern Waikato Region north to the Hauraki Plains and the Firth of Thames beyond.

Mana whenua of the Hinuera area are Ngāti Hinerangi, Ngati Hauā and Raukawa[1].

Physical

The geology of Hinuera is based on the Hinuera Formation, a deposit of ash and pumice from ancient volcanic eruptions. This formation is made up of a type of ignimbrite, known as Hinuera stone. The area was shaped by the former course of the Waikato River which flowed through what is known as the Hinuera Gap, before it was altered by a massive eruption approximately 26,500 years ago. The Hinuera Gap extends west and southwest from Hinuera to Piarere. The Waitoa River flows through the gap, with its source less than 1km from the Waikato River close to the intersection of SH1 and SH29. The route of SH29 is through the gap towards Hinuera and beyond to Bay of Plenty and follows the Hinuera Cliffs (Ongatiti Ignimbrite Bluffs) which is an outstanding feature[2] that includes a large quarry that extracts the Ignimbrite/Hinuera Stone for building and other purposes.

Hinuera is in the Waihou River catchment. The headwaters of the Waihou River originate in the Mamaku Plateau, draining from the western slopes of the Kaimai Mamaku Ranges. The river flows in a broadly northerly direction, with its catchment covering the eastern extent of the Hauraki Plains. In the lower reaches it passes by the towns of Te Aroha and Paeroa before meeting the Firth of Thames[3] just south of Thames township. Springs are notable in the Waihou catchment and some have small public baths associated with them. The lower Waihou River has major flood protection structures and these form part of the area's regionally significant infrastructure that protects large areas of the Hauraki Plains from inundation during flood events. The Waihou River and its tributaries provide fish habitat, including spawning for both rainbow and brown trout, and trout fisheries.

Hinuera is within the Waikato Lowlands landscape type. The local Hinuera topography is a flat to gently rolling alluvial plain, bordered by uplands to the east and characterised by rich volcanic sedimentary soils and distinctive terrace landforms. Soil types on the plains are largely a mix of gley soils with yellow brown loams.

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[1] Based on information from Te Kahui Mangai. https://www.tkm.govt.nz/region/tainui/ Accessed 11 November 2025

[2] Matamata Piako District Plan Schedule 3

[3] Waikato Regional Council. 2018. Waihou River ecosystem services assessment. https://www.waikatoregion.govt.nz/assets/WRC/WRC-2019/TR201810.pdf Accessed 07 November 2025.

Before human settlement, the area was covered in indigenous vegetation. The Waihou catchment still has a significant proportion of indigenous forest along the Kaimai Mamaku Ranges. There is a collection of protected trees at Te Poi on SH29 east from the intersection with SH27 including Black Locust/Acacia/Robinia, Chestnuts[4].

The Kaimai Ranges are identified as an outstanding natural feature in the district. The whole Kaimai Ranges unit is significant as it forms the main east-west divide between the Waikato and Bay of Plenty. The area is highly visible with extensive, contiguous native bush, rocky outcrops and large streams (see Attachment 2, Photo 04 and 05). The area identified as visually significant is the Kaimai-Mamaku Conservation Park and contiguous areas of native forest[5]. The Mamaku Plateau to the south east of Hinuera is identified as an area with high natural character, is physically cohesive and a legible indigenous forest area.

Hinuera has a mild, temperate maritime climate with warm, humid summers and cool, wet winters. Summer temperatures typically reach 20–25 °C, occasionally higher, while winter days average around 10–15 °C with cold, sometimes frosty nights. Rainfall is moderate and fairly evenly spread throughout the year with about 1,200–1,300 mm annually, although slightly wetter weather is usual in winter. The weather is influenced by the nearby Kaimai Ranges. Estimates of sunshine hours in Hinuera range in the 2,200 to 2,300 hours per year[6] which puts in in the higher rage of sunshine in New Zealand and compares to Hawke's Bay or inland Bay of Plenty.

Hinuera is a small locality with a population of approximately 160 about halfway between Hamilton and Tauranga. The built form has low scale small residential and community facilities. The commercial buildings are also mostly small scale but there are some larger warehouse/commercial or factory type structures (see Attachment 2, Photo 01 and 02). Matamata is the nearest urban centre, a rural service and tourism hub (with dairy, thoroughbred studs and Hobbiton Film set) approximately 7.5km to the north. Tīrau is a small tourism and boutique retail town to the south of Hinuera, known as the gateway to eastern Bay of Plenty, with the rural area of Okoroire between them. Okoroire features hot springs to the east which is a local attraction for visitors.

Te Poi is a small settlement to the east of Hinuera with a slightly larger population of approximately 230. It has a small number of commercial premises and public facilities such as a school and playcentre. It serves the local dairy and drystock farming community. Te Poi has three marae affiliated with Ngāti Raukawa hapū; Rengarenga Marae is affiliated with Ngāti Mōtai and Ngāti Te Apunga, Te Omeka Marae affiliated with Ngāti Kirihika and Te Ūkaipō Marae affiliated with Ngāti Kirihika and Ngāti Wehiwehi.

Ōkauia is a rural settlement east of Matamata. Ōkauia Springs is part of the geothermal taonga of Ngāti Hinerangi but is owned privately. Wairere Falls, the highest waterfall in the North Island, is northeast of Ōkauia. At Ōkauia along Douglas Road Ngāti Hinerangi have Te Ōhākī Marae affiliated to Ngāti Kura, Ngāti Te Riha, Ngāti Tokotoko and Ngāti whakamaungarangi, Hinerangi Tawhaki Marae affiliated with Ngāti Rangi, Ngāti Tamapango, Ngāti Tawhaki and Uri o Tangata, Tamapango Marae affiliated with Ngāti Rangi, Ngāti Tamapango and Ngāti Tawhaki. Tangata Marae is affiliated with Ngāti Tangata.

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[4] Matamata Piako District Plan Schedule 3

[5] Western Bay of Plenty District Plan Appendix 2

[6] NIWA Mean monthly sunshine (hours) https://niwa.co.nz/climate-and-weather/mean-monthly-sunshine-hours?utm_source=chatgpt.com Accessed 13 November 2025

The Hinuera area has infrastructure networks that comprise significant physical resources important for the wellbeing of the community. In the area are the East Coast Main Trunk and Kinleith Branch (and other rail corridors) which provide important freight links to Hamilton and the ports of Auckland and Tauranga. Road corridors that play an important role in the inter-regional movement of freight, and travellers including tourists, providing key road links between the major urban centres of Auckland, Hamilton and Tauranga. State Highway 29 is a heavily used route that connects Hamilton and Tauranga. State Highway 27 is an important north-south route through the Waihou Piako valley and (in conjunction with State Highway 2) is often used as an alternate route between Auckland and Tauranga, Rotorua or Taupō.

In addition to transport links, many other regionally significant infrastructure networks pass through the wider area such as the national electricity grid, telecommunication facilities, and gas transmission lines. There is an electricity substation south of Hinuera at Okoroire which connects to the regional electricity grid to the west at Karāpiro.

The area has a well-established dairy industry with a significant proportion of the land area being modified for farming. Dairy cattle are by far the most numerous of livestock with sheep, beef, deer, pigs and goats also farmed. The proximity of Matamata as a centre of equine racing and breeding also influences land-use in Hinuera.

European historic heritage is sparse in Hinuera. Hinuera Church known as the Church of the Good Shepherd (Anglican and Presbyterian) was built in 1916 and is a Category 2 Historic Place and listed in the District Plan as a heritage site. The church is located at 4843 State Highway 29, Hinuera.

Perceptual

Hinuera is a moderately to highly legible landscape. On a broad scale, the form and slope of the land is clear and readily traceable between the flow of the waterways broadly south to north on alluvial gradients that river flows have created, and the older, higher hill country that bounds the valley. The boundary between the old bedrock hills and the young fan deposits is generally obvious, marking the limit of an ancient floodplain, which is more obvious in places such as the high cliffs that parallel SH29. At a smaller scale, however, the legibility decreases. Vegetation cover, urban development, and agricultural modification obscure some of the subtle ridge-and-swale microrelief. In many places, drainage interventions have erased minor depressions and filled channels.

The highly legible Kaimai Mamaku Ranges mark a clear delineation of the Kerepehi fault that runs parallel. The ranges also show high coherence with obvious contrast between the pastoral farming activities of the flat plain and the steep forested hills (see Attachment 2, Photo 04). Similarly, the higher density of tall vegetation around the main channels of rivers reinforces the legibility and coherence of the river systems in the landscape.

Travelling east on SH29 there is a sense of orientation towards the Kaimai Mamaku ranges that increases the further east you travel. Heading west the sense of orientation is lower but the significant landmarks of Maungakawa and Maungatautari still provides orientation. The narrowing as you reach the Hinuera Gap in both directions provides a sense of arrival/departure or waypoint for journeys in both directions along SH29. The dramatic natural features including the Hinuera Gap and Cliffs are highly memorable and act as a landmark on SH29. They strongly define this portion of the route and provide a clear edge to the surrounds of the state highway through this area.

The town of Hinuera is not especially memorable except for the contrast between the large scale of the industrial buildings and the rural landscape. However, this is not unique as Te Poi provides a similar experience 8km to the east. The area is a mostly peaceful environment however in proximity to the main roads and railway there is more noise and sense of energy from the visual busyness of passing traffic. The isolated industrial or commercial activities also create a localised visual and auditory perception of more activity. These perceptual qualities have a broadly predictable rhythm and cycle as roads are busier during the day or industrial activities operate during working hours.

The orientation of SH29 through the Hinuera Gap reinforces the historic path of the Waikato River and current path of the Waitoa River. Many other roads are generally straight and flat and reinforce the generally flat condition of the plains. The further north on the plains, the more stopbanks, channelisation and other flood management infrastructure is present, reinforcing the gradient and low-lying nature of the land.

Coherence of vegetation in the rural landscape is moderate. Hedge rows tend to be low and deciduous trees planted in wider spacing indicating that shelter from wind may be less of a concern but that shade/shelter in summer and extra light penetration in winter is desired.

The landscape surrounding Hinuera has high levels of rural character defined by large mostly flat areas of exotic pasture, very low density of built structures, fencing and hedgerows defining paddocks and some larger exotic shade trees (see Attachment 2, Photo 06). The plains provide a generally open feel with long distance views possible in most directions with some interruptions of views by larger rows of tall trees. Smaller rises in topography provide limited variability to views at different locations.

Associative

Ngāti Hinerangi traces its origins in Te Rohe o Kōperu back to the ocean navigator and explorer, Ngāhue, from around the year 950 prior to the arrival of the Tainui waka in about 1300. Te Rohe o Kōperu, was the result of a conquest started by Kōperu and finished by his grandsons Tokotoko, Tangata and Te Riha. Ngāti Hinerangi hapū established coastal settlements at the Wairoa River which provided access to plentiful fishing grounds, kaimoana and coastal resources. The lands, forests and swamps in and around Matamata and the Kaimai Range provided access to further resources such as harakeke (flax), manu (birds), tuna (eels), ika (fish) and kiore (pacific rat). The forests provided access to trees, plants and other materials for food, clothing, buildings, waka as well as rongoā (medicine). Geothermal springs in Ōkauia, Waiteariki, Waiharakeke, Te Tuhi, Taihoa and Tūāraparaharaha were used by Ngāti Hinerangi tupuna (ancestors) for bathing, cooking and healing.

There are Raukawa hapū affiliated with Tangata Marae, Ūkaipō Marae and Rengarenga Marae in proximity to Hinuera which is the northern most area of association/rohe boundary of the iwi. Raukawa and Ngāti Hinerangi have close associations particularly at Tangata Marae. Over 600 years the mauri of the Waihou Awa (river) and the mauri of Raukawa are inextricably linked. Hinuera is also within the area of interest of Ngāti Hauā. They have cultural redress sites in the area such as Maungakawa (an approx. 629 ha scenic reserve to the west).

These iwi retain ongoing relationships with Hinuera, expressed through kaitiakitanga, marae-based connections, and active participation in local environmental management and cultural heritage initiatives. The landscape embodies spiritual and historical narratives central to iwi identity and wellbeing.

In 1769, Captain James Cook sailed into the Hauraki Gulf and explored the Waihou River, which he renamed The Thames (it was changed back to Waihou River in 1947). He was impressed by the rich stands of kahikatea, marking the area as one of the first timber export sites in New Zealand. By 1840, the first settlers arrived on the Waihou River near Paeroa. The district was mostly forested with kahikatea, flax, and raupō. Over time, timber milling became important, with mills cutting kahikatea from the flats and kauri from the hills.

The Waihou River served as the main transport route and was vital for moving settlers, supplies, and heavy mining machinery before railways existed. Steamers, barges, and scows carried thousands of tons of goods upriver to Paeroa and Te Aroha. As farming developed, J. C. Firth played a major role in the 1880s, purchasing the Matamata estate and clearing the Waihou River from Paeroa to Stanley Landing to create a 50-mile (80km) navigable waterway. With the advent of refrigeration, dairying became the dominant agricultural industry, transforming the valley's economy from gold and timber to pastoral and agricultural production.

Drainage schemes in the wetlands from the early 1900s further increased farmland extent. In 1895, the Waihou was declared a sludge channel to allow mining debris disposal, threatening farmland downstream. Subsequent flooding between 1907 and 1910 led to a Royal Commission in 1910, which recommended extensive improvements: removing willows, constructing stopbanks, and creating diversion canals such as the Ngarahi and Kouto cuts. The Public Works Department began construction in 1916, straightening and dredging the Waihou, building stopbanks from Mangaiti to Hikutaia, and installing floodgates[7]. This has resulted in the landscape that exists currently across the Waihou River catchment.

The physical qualities of the area make it highly suitable and therefore strongly associated with pastoral activities. The area is often associated with dairy farming and with the equine industry, and this is connected to coherence (noted above) of these activities with the physical landscape. The name Hinuera is also strongly associated with Hinuera Stone as a building and landscaping material, and this association reflects a broader community understanding of the physical landscape and association of quarrying activity with the area.

Hinuera has many community facilities that would be expected in a small rural centre including a playcentre, a bowling club, and a rugby and sports club. The Hobbiton movie set is a tourist attraction (and former film set) located nearby. The movie set site was chosen in part because of the pastoral and bucolic landscape of the area. This quality has been used in the film to represent an ideal of home and the simple life, an allegory for preindustrial England and the perceived moral goodness found in the small and ordinary.

Site description

The site is an irregularly shaped block of approximately 153Ha (see Attachment 2, Context Map). The northern boundary of the site follows SH29 for about 450m between two existing commercial developments before running approximately 950m south and then across to SH27. The eastern boundary follows the Kinleith Branch rail line. The western boundary follows SH27 and the southern boundary is an irregular shape bordering rural residential/equine uses on Gore Road.

The site is currently operating as two dairy farms over 4 property titles. The northern farm contains three dwellings, a dairy shed and a number of implement/farm sheds. There is an approximately 1.2Ha woodlot adjacent to the southern boundary of the property. The southern farm contains a dwelling and a dairy shed, with two implement sheds. Both properties have dispersed exotic trees throughout. The site is generally flat and

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[7] https://ohinemuri.org.nz/journals/journal-55-september-2011/waihou-and-ohinemuri-rivers-and-goldmining Accessed 07 November 2025

covered with exotic pasture grass. There is a small hill rising directly adjacent to SH27 for part of the eastern extent.

This site has been chosen as a suitable location for a solar farm because of its proximity to the Hinuera Substation and the 110Kv transmission line that connects it to the regional grid at Karāpiro powerstation/substation. The climate, ground conditions and topography are also suitable and there is an opportunity for ecological enhancement.

The site is visible from the following key locations:

- State Highways 27 and 29
- Kinleith Branch rail line
- Gore Road

Summary of Existing Landscape Character

Hinuera is a small rural settlement characterised by gently rolling alluvial plains that support extensive pastoral farming. It is framed to the east by the steep, forested slopes of the Kaimai Mamaku Ranges that form a natural boundary between Waikato and the Bay of Plenty and are recognised for their outstanding natural character. The area's geology is dominated by the Hinuera Formation, a deposit of ash and pumice from ancient volcanic eruptions, which includes the distinctive Hinuera stone. The landscape was shaped by the former course of the Waikato River, which once flowed through the Hinuera Gap before being diverted by a major volcanic event approximately 26,500 years ago. Hinuera lies within the catchment of the Waihou River, whose headwaters flow from the Mamaku Plateau north across the Hauraki Plains into the Firth of Thames. The climate is mild and temperate, with warm, humid summers, cool, wet winters, and evenly distributed rainfall of around 1,200 to 1,300 millimetres per year.

Historically, the Waihou River played a crucial role in early Māori settlement and later European development. It provided food, transport, and trade routes, and later served as a key waterway for settlers, timber mills, and miners. The Hinuera Church, built in 1916, stands as a local heritage landmark that reflects the area's early European settlement. The pastoral scenery of Hinuera, particularly the soft green and open plains, famously inspired the selection of nearby farmland as the setting for the Hobbiton Movie Set which is an enduring symbol of the region's idyllic rural charm.

Infrastructure networks are well established in the district, with Hinuera acting a notable interregional crossroad where major road and rail links intersect - State Highways 27 and 29 and the East Coast Main Trunk Line - connecting the area to Hamilton, Auckland, and Tauranga. Matamata is the nearest urban centre and Te Poi, Tīrau, and Ōkauia are nearby rural communities. These smaller settlements include marae connected to local iwi, including Ngāti Hinerangi, Raukawa, and Ngāti Hauā, all of whom maintain strong ancestral, cultural, and environmental relationships with the land, rivers, and other taonga of the area. Landmarks such as the Hinuera Gap and Cliffs are highly visible and memorable features that define travel along SH29, while the built environment remains sparse and modest, blending into the agricultural surroundings.

Planning Context

Resource Management Act

This assessment has considered Part 2 of the Resource Management Act including the Purpose under section 5, Matters of national importance under section 6, particularly (a) regarding preservation of natural character, (b) the protection of natural features and landscapes, (c) the protection of indigenous flora and fauna, (e) the relationship of Māori and their culture and traditions with ancestral taonga, and (f) the protection of historic heritage. Other matters in section 7 are also considered, including:

- Section 7(c) which requires maintenance and enhancement of amenity values - the natural or physical qualities and characteristics of an area that contribute to people's enjoyment and appreciation of its pleasantness, aesthetic coherence, and cultural and recreational features.
- Section 7(f) which emphasises maintaining and enhancing the quality of the environment - by protecting ecosystems and their components, including people and communities, as well as all natural and physical resources and amenity values. It also requires consideration of the social, economic, aesthetic, and cultural factors that influence or are influenced by them.

Matamata Piako District Plan

Under the Matamata Piako District Plan (the Plan) the proposal site is zoned rural. 'Other renewable energy generating facilities' are classified as a discretionary and assessed based on a set of criteria (Rule 8.10) outlined in the Plan. These matters are addressed where relevant in the assessment of landscape effects below.

Resource Management issues

2.3.8 Renewable electricity generation

In summary this section of the Plan notes that:

- Even with energy efficiency improvements, new energy generation and transmission will still be required.
- Renewable sources such as solar, wind, and biomass are the most sustainable options, helping conserve finite resources and reduce greenhouse gas emissions.
- Renewable energy projects can conflict with areas of natural, cultural, and historical significance, and may affect Māori relationships with their taonga.
- Despite these challenges, the government aims for 90% of electricity to come from renewable sources by 2025, supported by the National Policy Statement for Renewable Electricity Generation (NPS-REG) introduced in 2011.
- The NPS-REG mandates local plans to enable renewable generation activities, as failing to do so would hinder sustainable energy development and meeting future demand.

Sustainable management strategy

2.4.8. Energy efficiency and renewable energy generation

Objective 1: Energy demand is met in a sustainable manner that:

- Maximises the efficient use of energy; and:
- Enables the operation, maintenance, upgrading, and development of renewable energy generation activities and associated electricity transmission.

Policy 1: The national significance of renewable energy generation activities (including their contribution to the national renewable electricity generation target), and the national, regional, and local benefits of these activities are recognised.

Policy 2: Investigation into, operation, maintenance, upgrading, and development of new and existing renewable energy generation activities (including small and community scale renewable electricity generation) and their connections to the electricity transmission grid are enabled while managing:

- Significant adverse effects on the environment and ensuring that any residual environmental effects which cannot be avoided remedied or mitigated can be offset or compensated to benefit the affected community or the region; and:
- The potential for conflict with existing land uses/natural and physical resources.

Policy 3: The practical constraints associated with the operation, maintenance, upgrading, and development of renewable electricity generation activities and associated electricity transmission are recognised.

Methods: Works and Network Utilities, Section 8

8.3.1 (5.) Other renewable energy generating facilities are discretionary in the rural zone. Council is directed by the Plan to have regard to the following criteria:

1. The national significance of renewable energy generation activities (including their contribution to the national renewable electricity generation target), and the national, regional, and local benefits of these activities;
2. The matters (as relevant) listed in Rule 8.10.

The following list of factors warrant consideration for this proposal and has been informed by the matters in Rule 8.10:

1. Landscape Character and Context

- What is the extent of openness and scale of the landscape, how does the typical viewer elevation influence this experience, and what is the overall character of the site and its surrounds?
- What is the level of modification to the site and surrounding area – how strongly does rural or natural character prevail?
- What is the landscape's significance (ecological, cultural, associative, or visual), and how does the site contribute to broader landscape values or a distinctive sense of place?
- How unique or memorable is the site, and does it contribute to or detract from the memorable qualities of the wider landscape?
- What are the geomorphic and ecological characteristics of the landform, including notable features, visible processes, flora, and fauna?

- What are the transient qualities of the landscape, such as changes due to weather, light, seasons, or land use (e.g. cropping)?
- Will the proposal affect the health, safety, or wellbeing that people and communities derive from the existing landscape character?
- Will the proposal affect the amenity values of the surrounding landscape due to noise generation, and to what extent?
- What is the functional need for the proposal to be in this landscape, based on its character and physical attributes?
- Will the proposal affect historic heritage, social infrastructure, or wāhi tapu/sites of significance?
- Will the proposal affect surface water quality or amenity, and what will be the implications for stormwater and floodplain management?

2. Relationship to Other Development

- What is the extent of other solar or similar developments in the area, and will the proposal be visually consistent, different, or disconnected from them?
- Will it result in cumulative visual or landscape effects associated with electricity infrastructure?
- Will it conflict with or constrain foreseeable future development as a result of its landscape effects?
- Will it affect the integrity, resilience, or security of the electricity network?
- Will there be adequate separation distances or mitigation to ensure effects on existing dwellings are avoided, remedied, or mitigated?

3. Visual Effects and Viewpoints

- Where are the main viewpoints located, how are they oriented in relation to the proposal, and how frequently are they used (e.g., living, recreational, or travel spaces)?
- Are the views toward the proposal open or partially screened, and is the proposal situated in the foreground, middle-ground, or background of these views?
- Is the viewpoint part of a sequence of views, and how does the prominence of the solar array vary along that sequence?
- What is the design, height, and scale of the solar panels relative to the viewer and surrounding landform – do they screen or interrupt wider views?
- Will the panels dominate or draw the viewer's attention compared with other landscape features, and how might this change as the panels tilt or move throughout the day?
- Will the proposal compromise or obstruct valued landscape features, skylines, or long-distance views?
- Will the proposal modify landform, change the skyline, or create exposed cut or fill surfaces?
- Will it result in loss of vegetation or reduction in fauna habitat, and can existing or new planting effectively mitigate these visual impacts?

- If the number of antennae or vertical elements increases, what would be the extent of resulting effects on landscape character and amenity?

National Policy Statement for Renewable Electricity Generation

The National Policy Statement for Renewable Electricity Generation 2011 (NPS-REG) sets out the role that renewables play in meeting New Zealand's demand for energy while reducing greenhouse gas emissions and delivering clean, secure, affordable energy. NPS-REG acknowledges that both positive and adverse effects from renewables can span local, regional and national scales.

Overall, renewable energy generation is a matter of national significance and there is a need to develop, operate, maintain and upgrade generation activities throughout New Zealand. Decision makers must recognise and provide for the national significance of renewable electricity generation activities while acknowledging the practical implications and constraints of achieving New Zealand's target, including:

- meeting or exceeding the New Zealand Government's national target for the generation of electricity from renewable resources will require the significant development of renewable electricity generation activities.
- the need to locate the renewable electricity generation activity where the renewable energy resource is available
- the location of existing structures and infrastructure including, but not limited to, roads, navigation and telecommunication structures and facilities, the distribution network and the national grid in relation to the renewable electricity generation activity, and the need to connect renewable electricity generation activity to the national grid

Taking these requirements into account, the proposal site is well suited to solar electricity generation. The proposal provides a significant amount of renewable energy generation, is in an area with high solar resource and is suitably located to make use of existing infrastructure including roads and the national grid.

Renewable Energy Context

Consideration of Landscape Effects of Renewable Energy at a National Scale

In recent years, there has been a growing demand for energy in New Zealand and a need to construct generation facilities in response. This demand has resulted in increasing tensions between sections 6(b), 7(c) and 7(j) of the Resource Management Act – how to balance the protection of outstanding natural features and landscapes, the maintenance and enhancement of amenity values, and the benefits to be derived from the use and development of renewable energy. For effects on landscape, there is relevance in considering at a broad national scale how to best accommodate New Zealand's essential need for energy.

For context, the Ministry of Business Innovation and Employment Hīkina Whakatutuki (MBIE) recently published a document which explores New Zealand's future energy demands[8]. MBIE predicts a 35.3% to 82.0% increase in energy demand by 2050, half of which will be provided through electricity. It estimates that between 96.2% and 98.3% of this electricity demand will be met through renewable generation methods. MBIE highlights that approximately one third of this demand comes from households, over a third from industrial sectors, one quarter from commercial sectors and the remainder from various other primary production or transport sectors.[9] Contributing to this demand is population growth, which since 2018 has added roughly the equivalent of two cities the size of Hamilton.[10] Converting this to more physically understood terms, New Zealand's electricity consumption in 2024 was estimated by MBIE to be around 39,130GWh.[11] Using the percentage growth identified above, this represents a predicted additional production from renewables over the next 25 years of between 5,157GWh and 15,105GWh.[12]

These figures help understand the scale of potential impact of meeting the New Zealand renewable energy demands. Undoubtedly various energy sources, such as solar, wind, geothermal and potentially hydro[13] will need to be constructed to meet this demand.

These forecasts are highly relevant to the consideration of landscape effects at a national level, as renewable energy generation, including solar, inevitably results in effects on landscape values. Nationally, as the demand for energy increases, New Zealanders (and international visitors) will need to become more accepting of the inherent landscape effects that renewable energy generation sites create. Such plants need to be located somewhere – and in all cases (wind, solar, geothermal and hydro) the locations are governed by the available renewable resource, alongside other factors such as connectivity, constructability and efficiency.

In terms of landscape effects, wind generation is often considered to generate the greatest effects due to the sheer scale and visibility of turbines, and hydro projects usually result in significant, and permanent landscape change. By contrast, solar projects tend to have more localised landscape and visual effects (which can often be mitigated with planting, if required), however their demand for space is relatively high.[14] The reality is that all renewable generation options result in some type of landscape change.

[8] Electricity Demand and Generation Scenarios: Results Summary, Ministry of Business Innovation and Employment Hīkina Whakatutuki July 2024.

[9] https://www.mbie.govt.nz/building-and-energy/energy-and-natural-resources/energy-statistics-and-modelling/energy-statistics/electricity-statistics Accessed 11 November 2025

[10] https://www.stats.govt.nz/news/aotearoa-new-zealands-population-passes-5-3-million-people/ Accessed 11 November 2025

[11] Energy in New Zealand 2024, Ministry of Business Innovation and Employment Hīkina Whakatutuki September 2024.

[12] Calculated as follows: Lower Prediction = 39,130 x 35.3% predicted growth x 50% electricity x 96.2% renewable. Upper Prediction = 39,130 x 82.0% predicted growth x 50% electricity x 98.3% renewable.

[13] There have been no significant hydro-electricity proposals approved through the RMA, however the Taheke 8C proposal on the Ōkere River near Rotorua is targeted to produce approximately 85GWh per annum. Currently the largest solar farm is the Tauhei Solar Park near Te Aroha, covering approximately 182ha and targeted to generate approximately 280GWh per annum.

[14] Using a rough calculation, a total of 24 solar farms the size/capacity of Tauhei would be required to meet the predicted minimum demand, or an area of approximately 4,500ha (or 10,400ha to meet the highest predicted demand).

These trends and discussion points do not negate the need to assess and manage the landscape effects of solar farms in specific locations. However, it provides an important context in terms of how such effects might be considered, particularly in terms of perceptual and associative landscape values. Ultimately electricity generation is required for people in New Zealand to live in the way we want to live, and the demand for such energy is growing. The overwhelming preference (this accepting not everyone, but the larger proportion of society) of New Zealanders is for such energy to be generated from renewable sources, which will require the installation of more wind, solar, geothermal and hydro projects across the country. And, as identified, this generation needs to be located where the energy resource is available.

While an assessment of landscape effects at a site and immediate locality is essential, so too is benchmarking this assessment against other solar farm proposals in other locations. The assessment of effects of one solar farm needs to be commensurate with the assessment of effects of other renewable energy proposals.

This may not be an assessment of alternatives in the normal sense, but rather acknowledges the reality that New Zealand requires new renewable energy plants, and that all such proposals will have effects. In this context, the baseline must include the comparison of such effects to other proposals that have been assessed (and either approved or declined).

The Tauhei Solar Farm[15] near Te Aroha provides a useful comparison as this is a solar farm likely to have similar effects to the proposed Hinuera Solar Farm. The Tauhei Solar Farm was approved due to the positive effects, including generating renewable electricity for about 30,000 homes, reducing carbon emissions, improving energy security, and providing ecological enhancements such as wetland and riparian restoration, biodiversity corridors, and reduced nutrient runoff from converting dairy to sheep farming. The landscape aspects of this proposal are likely to reflect the same benefits albeit at a slightly smaller scale.

In addition, when considering potential adverse effects such as construction noise, dust, traffic, erosion, and sediment discharge, it is reasonable to consider that effects of the Hinuera proposal could similarly be managed through conditions and management plans. In the case of Tauhei Solar Farm, key landscape effects such as reflected light, rural character and amenity changes, and visual effects were assessed as temporary and able to be mitigated through planting/vegetation screening.

Renewable Energy and Rural Character

To understand the effects of renewable (including solar) projects on the rural landscape, it is important to have a clear understanding of the meaning and interpretation of rural character, and how renewable energy projects contribute (or otherwise) to that character. Nearly all regionally or nationally significant generation projects in New Zealand are located rurally (excepting smaller, micro-generation sites that can be located on buildings). The scale requirements exclude the development of such plants in urban areas, and to date the economic and other challenges with the development of off-shore wind proposals off New Zealand's coastline have yet to be overcome.[16] Current national and local policy, together with understandable community aspirations, has largely

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[15] A Harmony Energy Ltd project that is currently under construction

[16] I am aware of the advances of national policy in regard to offshore energy development, and the current investigations being undertaken off the south Taranaki coastline for the installation of a 900MW offshore proposal

ruled out development of renewable energy projects in wild or highly scenic landscapes (such as National Parks).

Rural character is a construct used to define the landscape character, and/or landscape amenity value, of the rural environment. It is a technical term that has gained wider use in more recent years as development and urban sprawl puts increasing pressure on the rural landscape. Many descriptions of rural character share a commonality that it encapsulates the elements of an area that make it recognisable as rural rather than urban or wild. These elements will change depending on the nature of the area being considered and vary according to the individual perceptions of the concept. However, rural character is typically used to describe the character of a landscape where the amenity is largely derived from an outlook dominated by primary production activity. In contrast, wild areas or wild landscapes tend to be considered as those that have unconstrained natural habitat (typically covering expansive areas), and urban areas are those that contain a high density of built forms and infrastructure.

Importantly, rural production activity does not necessarily have to be pastoral related (although it is noted that the site is currently pastoral). There are vast rural landscapes across New Zealand dedicated to farming animals for meat or dairy, there are also orchards (apples, citrus, kiwifruit), extensive forestry plantations focussed on building materials, grape plantations that produce wine, and other alternative production such as maize, seeds, hemp, biofuels and energy. These are rural based activities, and all can represent a type of rural character.

Aligned with such production are ancillary built forms that include farm sheds, production facilities, transmission infrastructure, roading and housing. Although not as densely arranged as might be found in an urban landscape, such built forms generally feature in rural landscapes. Further, many production activities depend on structures such as powerlines, fenced paddocks, support frames, canopies, barns, implement sheds or even greenhouses. All such structures contribute to the perception and experience of rural character.

Renewable generation is also a form of production. Rather than using the soil and/or water resource, solar generation harnesses the solar resource to create a product that is used and valued by people. Its scale requires it to be in the rural landscape, in places where the solar resource is reliable and prevalent, and it must have connection to the electricity transmission grid. It is an increasingly recognisable activity across the country, like hydroelectricity infrastructure being commonly associated with rural landscapes (and sometimes wild landscapes), and wind farms being located on exposed pastoral hills.

These features are central to the definition of landscape, which is discussed to some level of detail in Section 04 of *Te Tangi a te Manu*. Rural character is heavily associated with associative values – "places where my food or my wood come from" – and how this contributes to our sense of wellbeing and identity (particularly as a country). Similar associations align with landscapes where energy comes from, given such energy, particularly renewable energy, is a fundamental need. In this regard, solar farms represent the use of the environment for the benefit of people, in the same way as farming operations, and as such are strongly aligned with rural character and what is rural.

(https://southtaranakioffshorewindproject.com/#:~:text=South%20Taranaki%20Offshore%20Wind%20is,industries%20in%20the%20Taranaki%20region)

Landscape Effects Assessment

Context

The development of the solar farm has gone through a sequence of design phases, with increasing refinement and optimisation of the proposal, including for landscape outcomes. The scale was initially defined by the site area of approximately 153Ha. The choice of single axis tracking arrays was made after assessing potential reflected light effects. This design process resulted in the addition of mitigation measures that are assessed as an integral part of the proposal.

Landscape Effects

The proposal is anticipated to contribute and not detract from the rural character of the area, with the physical structures reflecting the productive nature of the landscape. The proposal site is ideally located with high sunshine hours, flat topography and access to the electricity grid via the Hinuera Substation. The size of the solar farm enables efficiencies in energy production and transmission. The site is not particularly significant in the context of the rural landscape at Hinuera and its surrounds. It is typical of dairy farms in the area and not distinctive within the local context.

The design of the solar farm means that legibility of the landforms, waterways and distinction between the productive activity on the plains and the vegetated ranges is maintained. The proposed removal of existing vegetation on the site is likely to have low effect on the rural character values of the site. Sheep farming will continue underneath the panels and so pastoral farming of the site is not completely displaced but will be reduced in intensity.

As noted above, rural character is influenced by community perception of the landscape. It is likely that in this location the current perception of rural character is derived from the dominance of pastoral farming (and equine activity). However as solar farms become more widespread in the rural environment in the region and beyond, this perception is likely to shift as people recognise the inherent place of solar farms as part of rural production. The presence of the solar farm will reinforce growing associations of solar farms with 'where my electricity comes from' and the associated sense of wellbeing and connection with the rural landscape this creates. Policy at the national and district level also acknowledge the need to provide for solar farms and the suitability and legitimacy of locating them in the rural environment, and this proposal aligns well with that approach. Therefore, it is considered that the effects on rural character are likely to be low.

The site has some surface waterways in the north (for example see Attachment 2, Photo 01), which have been considered in the design of the panel layout. The proposal is to plant a 5m indigenous vegetation buffer along these waterways using locally sourced plants suited to the conditions (see Attachment 2, Context Map). The scale of the proposal is unlikely to have any impact on the landscape quality and amenity of any waterways and is very unlikely to have any adverse effects on floodplain management. It is considered that the proposal is likely to have a beneficial effect on surface water as natural character of the waterways is enhanced.

The use of screening and ecological indigenous vegetation as integral to the design is likely to reduce the potential effects by screening the most likely and dominant views of the solar farm. The screening vegetation has not been included on all external boundaries because of the need to balance screening of affected views with maintaining the openness and longer distance views of the broader rural landscape character. The indigenous vegetation will add to the local ecology and is likely to have a positive effect on the amenity and natural character values. Therefore, it is considered that the amenity and natural character effects resulting from the design of the proposal are low to very low.

There are effects for the health and safety of people and communities including benefits and contributions to the social and economic development of Hinuera and the wider community. This is because the proposal enhances positive perception and connection to the local generation of electricity in the local landscape. It is also likely to enhance the wellbeing of businesses, people and communities as a positive contribution to the productive landscape of the area. Therefore, it is considered that the perception and associations of wellbeing and connection to landscape in providing security of energy supply from renewable electricity generation is likely to be enhanced (albeit in a small way) by the proposal.

It is unlikely that the proposed solar farm will constrain future planned development. Foreseeable activities in the future at Hinuera are the existing small-scale commercial, industrial and residential uses. The rural production activity will remain the dominant activity as anticipated by the Matamata Piako District Plan. The pastoral grass across the site can continue growing underneath the panels and will be managed by grazing with sheep, mowing and weed control as required. The effects of the solar farm are also essentially reversible because the panels and infrastructure can be removed relatively easily at end of life. Therefore, with future landscape change anticipated to be limited, and the potentially temporary nature of the solar farm, it is considered that effects on current and future potential use of the surrounding landscape are likely to be very low.

The solar farm will generate noise but not impact on the existing amenity values of the surrounding land uses. Noise is produced by the BESS, and when the single-axis tracking panels are moving position including in the morning or when returning to their rest position at the end of the day and that is for a short duration. People are likely to associate the area with a working farm environment with some localised industrial or commercial activity, where machinery and other noisy activity occurs periodically as part of the rural productive environment. The roads and rail also generate noise and reflect the local rhythms, and the solar farm will add to the daily cycle of these rhythms both in noise and visual change. Therefore, it is considered that the noise resulting from the proposal is likely to have very low effects on the amenity of the surrounding land uses.

There are no heritage or other social facilities adjacent to the proposal and no wahi tapu[17] identified within or near to the proposal site. The Hinuera Church is the only heritage building in the area and is unlikely to have any view of the solar farm due to its orientation and intervening vegetation. Other social facilities are similarly positioned away from the site to the northwest with significant intervening vegetation and structures. Therefore, subject to confirmation from mana whenua regarding wahi tapu or other sites of significance, it is considered that there are likely to be very low to no effects on associative landscape values related to social infrastructure, historic heritage or wahi tapu.

[17] This assessment has been prepared without input from mana whenua or associated cultural impact statements or reports

Visual Effects Assessment

The assessment of the visual effects of the proposal is broken down into two main aspects of visual effects, firstly on residential dwellings in proximity to the proposal and secondly on road users travelling along roads bordering or leading to and from the proposal site. Other key visual effects that have been considered include transient effects particularly on light from panel orientation and movement, and the cumulative effect of the proposal on existing character.

An assessment of the potential visual effects of the proposal on neighbouring dwellings is contained in Attachment 1. Dwellings at 32, 34, 70A and 70B Gore Road, to the south of the proposal, have been identified through the assessment as likely to experience high visual effects without mitigation, as follows:

- 32 Gore Road; the visual effects are assessed as High. Planting within the property does provide a level of screening of the proposal from the dwelling, but it is considered not appropriate to rely on such screening over the longer term of the solar farm. However, with planting/vegetation screening within the solar farm site, combined with a degree of setback of the panels from the boundary, the effects could be reduced to Low.
- 34 Gore Road; the visual effects are assessed as High. Planting within the property does provide a level of screening of the proposal from the dwelling and a reasonable portion of the curtilage area, but it is considered not appropriate to rely on such screening over the longer term of the solar farm. However, with planting/vegetation screening within the solar farm site, combined with a degree of setback of the panels from the boundary, the effects could be reduced to Low.
- 70A Gore Road; the visual effects are assessed as High. It will not be possible to visually mitigate these effects using vegetation within the site.
- 70B Gore Road; the visual effects are assessed as High. It will not be possible to visually mitigate these effects using vegetation within the site.

Following the visual effects assessment, planting within the site has been developed and is identified in the Landscape Plan. As identified, for 32 and 34 Gore Road, screening will be undertaken within the solar farm site, along the relevant southern boundary. Although it will take up to five years for this planting to establish, it is considered that both these properties are afforded screening from planting within their property. During this interim period, the visual effects on the dwellings are likely to be low-moderate due to internal screening on each site, and this will, as identified, reduce to ***low*** once the proposed planting establishes.

For 70A and 70B Gore Road, it is understood that agreement has been reached with the landowner for planting to be undertaken within those properties, where it will be more effective in reducing views from the affected dwellings. This planting can be secured through an appropriately worded consent condition, and a recommended draft condition is included in the condition set contained in the planning evidence. With this planting installed, it is considered the visual effects on these properties will reduce to ***low*** over an establishment period of up to five years.

The Graphic Attachment (Attachment 3/GA) contains visualisations of the solar farm. Viewpoint C shows the visual change as a result of the proposal from within the village looking approximately south to southwest.

As noted above, there is screening vegetation, trees and hedge planting proposed as mitigation for the visual effects of the proposal (refer to Attachment 2, Sheet 06 and 07 for locations). This planting, together with additional agreed planting for the Gore Road properties, is considered to be sufficient to reduce the visual effects from high to low over time for several properties with views of the proposal (see Attachment 1). Some dwellings with lower ratings are unable to be mitigated due to topography and restrictions in height of vegetation due to the impacts of shading on panel function.

For westbound travellers on SH29 there will be a clear but distant view to the solar farm including through the SH27/29 intersection. Screening vegetation along SH29 will then generally obscure the view until travellers are past the solar farm and into Hinuera. For northbound travellers on SH27 (see GA ,Viewpoint A) but there will be a restricted view (if any) due to screening and hedge planting, before a hill obscures the view. The solar farm will become visible again after the hill but only briefly. For southbound travellers on SH27 the solar farm is unlikely to be visible at a distance and will come into view once travellers reach the intersection of SH27/29 where it will be clearly visible across the existing fields (see GA, Viewpoint B). For eastbound travellers on SH29 there are likely to be intermittent snapshot views of the proposal on approach to Hinuera. Once travellers have passed by the built-up part of the village the view to the solar farm will be partially screened by vegetation before coming in to view briefly (see GA, Viewpoint C).

On Hinuera Road (north of Hinuera, see Attachment 2, Sheet 02) travellers heading south are unlikely to get any view of the proposal due to distance, and intervening vegetation and structures. For travellers on Gore Road (south of the proposal, see Attachment 2, Sheet 02), screening vegetation within the solar farm site and agreed planting within the 70A and 70B Gore Road properties is likely to reduce views of the proposal over time.

The proposal is largely set back from the road with limited extent immediately next to road boundaries (some of which are planted with screening vegetation). Other existing activities provide some screening or otherwise diminish the presence of the proposal. Overall, it is considered that the visual effects of the proposal on travellers and views from public roads in the area is low.

The proposal is bordered to the west by the Kinleith branch rail line which is used to transport logs (i.e. freight only). While views of the proposal will be possible from the train operators, the visual effect (including potential reflected light effects) is likely to be very low to none.

Cut or fill to form internal access roadways will be minimised and result in internal arterial roads between 100 and 250mm above the 1% AEP. Earthworks will not result in any skyline modification. It is considered that visual effects as a result of earthworks is likely to be very low to no effect.

The proposed meteorological (weather) station is a maximum height of 10m and located towards the middle of the solar farm. They are very unlikely to be seen by anyone or contribute an additional effect from views of the overall proposal. Therefore, it is considered that there are no effects on visual amenity values from antennae as part of the proposal.

Hinuera is not known for special or distinctive transient aspects of light or other weather phenomenon. The solar farm is likely to create some interest from reflection and play of light as a result of panel reflectivity and colour changes that occur with changes in light or season. The movement of the panels and changes in tilt are likely to create some visual interest and changes in visual prominence, but these are likely to be subtle and follow a rhythm with seasonal changes and time of day. These transient qualities created by the solar farm in the landscape are considered to have low visual effect.

The Tauhei Solar Farm near Te Aroha to the north of Hinuera is under construction and is currently the largest solar farm in New Zealand at 180ha. The Hinuera area has very little electricity infrastructure besides the Hinuera substation and associated transmission line. This proposal is considered very unlikely to represent a tipping point in terms of change in character for Hinuera as a result of cumulative effects of electricity infrastructure. Given the approximately 40 km separation between the two solar farms and their respective positions in relation to major routes and destinations, it is highly unlikely that they would be encountered sequentially as part of a single journey. Therefore, there are considered to be no cumulative visual effects of the solar farm on the existing rural character.

Reflected Light Assessment

A detailed report of the reflected light assessment is attached as Appendix B. This report outlines that numerous iterations of testing potential reflected light tests were undertaken, and that the solar farm layout was iteratively changed to eliminate potential reflected light effects. This has been prepared using the industry-standard ForgeSolar modelling software. The final layout that is proposed has been analysed and it results in no predicated reflected light effects. As such, it is also considered that no planting mitigation is required for any reflected light effects.

It is noted that the model, type and configuration of the solar panels are indicative and will be subject to a detailed design process prior to construction. In addition, the software modelling is based on the use of industry-standard software and best-practice techniques but does include several assumptions (listed in this document and at the end of the Forge Solar output).

On this basis, it would be prudent to ensure that conditions are put in place to manage reflected light effects as the solar farm is developed and becomes operational, as follows:

- Following the detailed design of the solar farm and prior to it being constructed, further reflected light analysis is undertaken on the final layout to ensure that no ‘yellow glare’ will be generated beyond the boundaries of the site.
- If during the operation of the solar farm any verified complaints are received about reflected light effects (glint or glare) along State Highway 27 or 29, or from any residential dwellings, then the applicant must review the reported effect to determine whether it meets the threshold of being ‘yellow glare’ and if so implement appropriate mitigation measures to reduce it to the ‘green glare’ category (such as changing the tracking program or installing additional vegetation or screening).

As the visualisations show, from some angles and certain times of the day, there may be a low reflectance of the sky across the panels. In certain conditions, it may be possible that viewers can see reflected images of clouds. Such reflections are not considered to be a specific effect because they will be relatively soft, and as such they are not considered to be a distraction. Rather, this low-level reflection is considered to be part of the character of the solar farm.

As such, with the recommended conditions, it can be confirmed that the reflected light effects of the solar farm can be appropriately managed to have no more than a very low effect, if any.

Landscape Enhancement

To summarise the landscape effects of the proposal that are likely to result in enhancement are:

- Indigenous vegetation planting 5m buffer along the internal waterway and around wetlands, and screening vegetation along sections of the site boundary resulting in an increase in biodiversity and ecological function
- Increased sense of wellbeing of the local and national community from associations with the proposal and an increase in electricity supply, greater security of supply and positive contribution of the solar farm to productive use that connects people and landscape
- The solar farm is likely to create some interest from reflection and play of light as a result of panel reflectivity and colour changes that occur with changes in light or season.

Summary of Landscape Effects

The following list summarises the effects from a landscape perspective against the Plan criteria:

1. Landscape Character and Context

- The scale allows efficient solar energy production but does not dominate the rural character. The design maintains the rural productive landscape. Pastoral farming continues beneath panels, though reduced in intensity. Overall effects on rural character are considered low.
- The site is not distinctive or significant in the context of Hinuera; it is flat and is typical of local dairy farms. Proposed indigenous buffers and vegetation contribute positively to ecological and amenity values but do not alter the broader rural character significantly.
- The site is not unique or highly memorable; the proposal is unlikely to detract from memorable qualities of the surrounding landscape.
- Positive contributions to community wellbeing are anticipated through renewable energy generation and social/economic development. Effects on wellbeing are likely enhanced, albeit slightly.
- Limited noise from the BESS (with acoustic screening) and from panel movement (short duration) is compatible with the existing working farm environment; effects on amenity are very low.
- High sunshine hours, flat topography, and proximity to Hinuera Substation make the site technically and operationally suitable for a solar farm.
- No identified heritage buildings, social facilities, or wāhi tapu within or near the site. Hinuera Church is unlikely to have views of the solar farm. Effects are very low to none.
- Indigenous vegetation buffers along waterways are proposed, likely providing beneficial effects on surface water quality and ecology; floodplain management impacts are very unlikely.

2. Relationship to Other Development

- Cumulative visual or landscape effects are considered negligible; the proposal is unlikely to change the rural character or reach a “tipping point” in visual impact.

- The proposal is unlikely to constrain future small-scale commercial, industrial, or residential development. Pastoral activity continues, and the solar farm is relatively temporary. Effects on future land use are very low.

3. Visual Effects and Viewpoints

- Key viewpoints include SH29 (eastbound/westbound), SH27 (northbound/southbound), Hinuera Road, Gore Road, and nearby residences. Views along travel routes are intermittent and partially or fully screened; solar panels' visual prominence varies with location, topography, and vegetation but is generally limited.
- For most travellers, the solar farm is in the middle- to background, with intermittent glimpses and greater prominence in the midground at the SH27/29 intersection.
- Tracking panels: max 3.25m. Panel scale is modest relative to surrounding landform.
- Some transient visual effects from panel reflectivity, tilt movement, and seasonal light changes are expected, but these are subtle and low in effect.
- Legibility of landforms and waterways maintained.
- Earthworks are minimal, do not modify skylines, and have low visual effect.
- Proposed meteorological stations (max. 10m) are unlikely to be noticeable, no visual effect from antennae.
- Screening vegetation and setback within the solar farm site, together with agreed planting within the 70A and 70B Gore Road properties, will reduce visual effects on nearby dwellings over time. Views from nearby dwellings:
    - 32 Gore Road: High visual effect reduced to Low with mitigation established.
    - 34 Gore Road: High visual effect reduced to Low with mitigation established.
    - **70A Gore Road: High visual effect reduced over time through agreed planting within the property, secured by condition.**
    - **70B Gore Road: High visual effect reduced over time through agreed planting within the property, secured by condition.**

Summary of Planning Policy

Under the Matamata Piako District Plan solar electricity generation falls under ‘other renewable energy generating facilities’. It is a discretionary activity in the Rural Zone and is assessed against the national significance of renewable energy generation activities and the national, regional and local benefits of these activities, and matters listed in Rule 8.10. Based on the assessment of the proposal against the relevant landscape aspects of the criteria, the overall effects are considered to be low.

The National Policy Statement for Renewable Electricity Generation 2011 (NPS-REG) highlights the national importance of renewable energy in meeting New Zealand's energy demands, reducing greenhouse gas emissions, and providing clean, secure, and affordable energy. In this context, the proposal is well-suited due to its solar resource, generation potential, and access to existing roads and the national grid.

Conclusion

This assessment described the landscape context, values and potential effects of the proposed solar farm at 4775 State Highway 29, Hinuera. The site is currently operating as two dairy farms with a combined area of approximately 153 hectares. The proposal includes installation of solar arrays, battery energy storage system and other supporting infrastructure, internal roads, fencing and vegetation for screening and ecological enhancement. This assessment follows *Te Tangi a te Manu* and included a site visit, landscape analysis and visualisations.

The proposed solar farm is located within a highly modified rural landscape characterised by flat, productive farmland. Its current use for dairy farming and proximity to existing transport and electricity infrastructure, including the Hinuera Substation, make it well suited for renewable energy generation.

The solar farm will introduce new built elements into the rural environment, but these will be consistent with the area's productive character and can be effectively integrated through site layout and planting design. Visual effects on most surrounding viewpoints, including key transport routes, are expected to be limited, with higher localised effects at a small number of nearby dwellings mitigated through proposed screening or hedge vegetation. The project is likely to maintain the legibility of local landforms and the distinction between the productive plains and the vegetated ranges.

It is considered that the landscape effects are likely to be low to very low and overall visual effects of the proposal are likely to be low, with the inclusion of the proposed planting both on the proposal site and on two private properties. It is anticipated it will take up to five years for this planting to become fully effective. There are no predicted reflected light effects. As such, the overall landscape effects of the proposal are assessed as low, equating to less than minor under the Resource Management Act.

Ben Ormsby
Landscape Architect

Shannon Bray
Registered Fellow Landscape Architect

Appendix A: Experience of Author – Shannon Bray

Qualifications:

- B.For.Sc. – Bachelor of Forestry Science, Canterbury University, 1993
- B.L.A.(Hons) – Bachelor of Landscape Architecture (Honours), Lincoln University (1995)
- Registered Fellow and Past President New Zealand Institute of Landscape Architects
- Making Good Decisions Current Certificate
- Current member of Tauranga Urban Design Panel (past member of Nelson UDP)

Key Assessment Projects (many of these also include master-planning and design phases):

- Hawke's Bay Film Studios (GripHQ)
- Waiaroha Water Treatment Plant & Discovery Centre, Hastings (Council)
- Frimley Water Storage, Hastings (Council)
- Te Awamutu Waste to Energy Plant (Private Client)
- Ravensdown Napier Plant Upgrade (Ravensdown)
- Hastings Golf Course Residential Masterplan and Rezoning, Hastings (Hastings Golf Developments)
- Cape Kidnappers Residential Masterplan, Hawke's Bay (Robertson)
- Mission Estate Winery Future Development Opportunities (Marist Holdings)
- Ara Hills Residental and Commercial Masterplan, Auckland (Ara Hills)
- 100+ other Residential subdivision proposals (Private Clients)
- Tararua Urban Growth Strategy and Development Guidelines (Council)
- 16 Solar Farm nationally (Private Clients, Council)
- 13 Wind Farms nationally (Private Clients, Council)
- 19 Transpower National Grid Projects nationally (Transpower)
- 50+ Telecommunication Masts nationally (Spark, OneNZ, Connexa, FortySouth)
- Taheke 8C Hydro Electricity Project, Rotorua (Taheke8C)
- Evendon Road Vehicle Energy Centre, Hastings (Private Client)
- Cameron Road, Tauranga (Council)
- Papakura to Drury SH1 Corridor, Auckland (NZTA)
- SH20B, Auckland (NZTA)

Appendix B
Reflected Light Effects Assessment

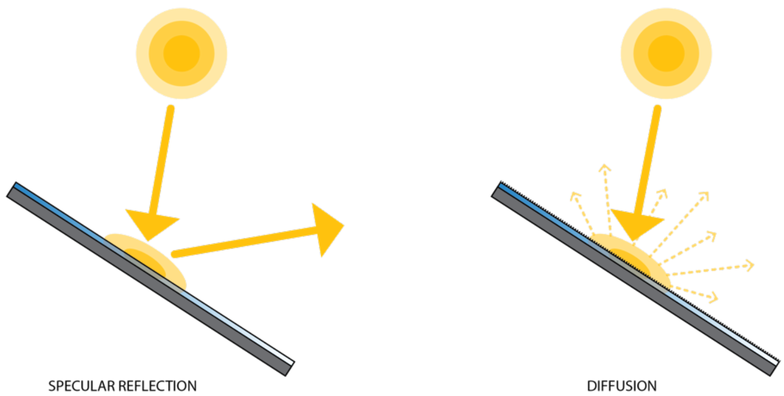
Introduction

The following report is a *Reflected Light* assessment of the proposed solar farm, assessing the photovoltaic (PV) modules in relation to their daytime reflective potential to surrounding dwellings and transport. The first part of this report is standardised and provides an overview of the technical aspects and methodology used for the assessment, and the second part provides the technical results from the solar farm being assessed. The interpretation of the technical results is included within the body of the landscape and visual effects assessment.

What is Reflected Light?

Reflected Light describes the sunlight that bounces off reflective surfaces, resulting in a brightness that is greater than the surrounding illumination and visible on the reflective surface.

All surfaces exhibit different reflectivity characteristics, leading to varying levels of reflectivity. Smooth surfaces reflect sunlight more intensely back to the observer, a phenomenon known as *specular reflection*. As a surface becomes more polished, it exhibits intensity. In contrast, rough or uneven surfaces scatter light diffusely, resulting in a less intense perception of brightness called *diffusion*.



The visual effect of Reflected Light can be perceived by both stationary and moving observers, manifesting in either, glare (a continuous source of bright light) or as glint (a momentary flash of bright light). Both of which can cause a blink response in the observer and a brief loss of vision that has the potential to cause an *after-image* once the exposure has passed.

The term after-image refers to a visual phenomenon that many people have encountered. A typical example is the brief appearance of spots in one's vision after a photo is taken with a flash, or a more intense version occurs when someone looks directly at the sun. Afterimages are caused by the temporary deactivation of retinal cells at the back of the eye when exposed to intense light.

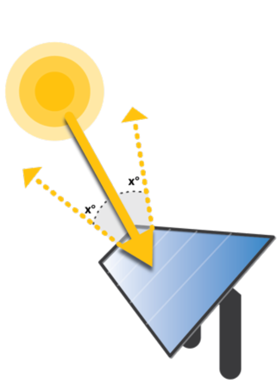
Solar retinopathy or retinal burns are not a concern with glare from solar arrays, as the PV modules do not concentrate the reflected sunlight enough to cause this effect.

How Solar Panels Reflect Light

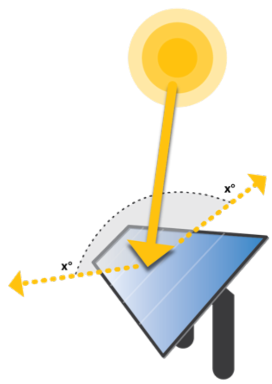
The amount of light reflected from a solar panel's surface is influenced by several factors, including the intensity of sunlight that strikes the surface, its reflectivity, geographic location, the season, cloud cover, and the orientation of the solar panel. During specific times of day, particularly during early morning and late evening when the sun is low on the horizon, the light reflected from solar panels can intensify, creating a potential for glare in particular directions.

Photovoltaic (PV) solar panels are made from dark materials that absorb about 90% of light and are generally coated with an anti-reflective layer aimed at maximizing light absorption while minimizing reflection through diffusion. This design enables the panels to convert sunlight into electricity as efficiently as possible, because of this the reflectivity of PV panels is generally lower than one might expect. But there is still the potential for the panels to reflect sunlight depending on the angle of the sun in relative to the angle of the panel known as the angle of incidence.

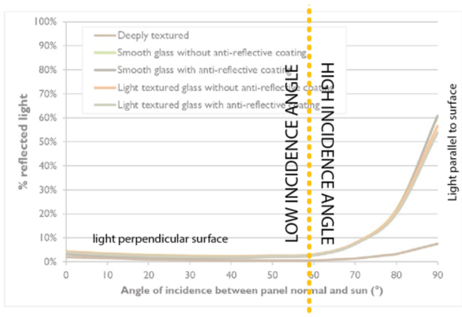
The angle of incidence is minimal when the panel is facing perpendicular to the sun and increases as the panel and sunlight angles deviate and become closer to parallel. This effect is more pronounced for fixed-mounted panels, as they are only optimally aligned with the sun for a limited duration each day.



LOW INCIDENCE ANGLE



HIGH INCIDENCE ANGLE



Standards

There is currently no planning guidance for the assessment of Reflected Light from solar panels towards roads, dwellings, aviation or railways in New Zealand.

However, there are two references to glare that occur in AS/NZ 1158.2:2020 & AS/NZ 4282:2019 in regard to Lighting for roads and outdoor lighting:

- Glare AS/NZ 1158.2:2020

Condition of vision in which there is a discomfort or a reduction in the ability to see, or both, caused by an unsuitable distribution or range of luminance, or to extreme contrast in the field of vision. Glare can include: (a) Disability Glare – glare that impairs the visibility of objects without necessarily causing discomfort. (b) Threshold Increment (TI) AS/NZ 4282:2019 Discomfort Glare – glare that causes discomfort without necessarily impairing the visibility of objects.

- Threshold Increment (TI) AS/NZ 4282:2019

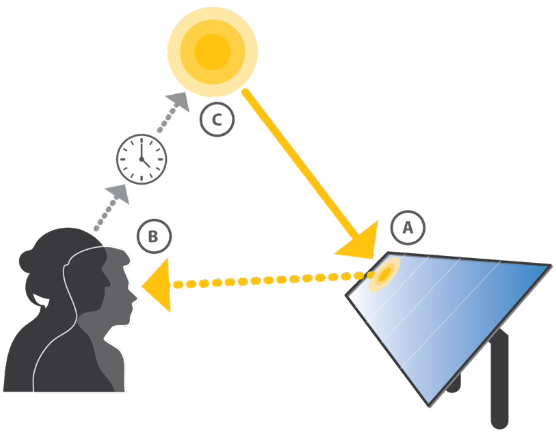
  TI is the measure of disability glare expressed as the percentage increase in contrast required between an object and its background for it to be seen equally well with a source of glare present. Higher TI values correspond to greater disability glare.

International studies and guidance that have formed the basis of the methodology of this assessment include:

- ForgeSolar published guidance and various downloadable references: https://www.forgesolar.com/help/
- Solar Photovoltaic and Building Development – Glint and Glare Guidance: PagerPower Urban & Renewables, Fourth Edition.

Parameters Influencing Reflected Light Effects

The following elements form the basis for determining whether the Reflected Light effects will produce an impact (low to high).



- A - The reflection can be observed when there is a clear line of sight between the observer (receptor) and the solar panel, along with a consideration of the panel's angle.
- B - The position of the observer (receptor) relative to the solar reflection influences its significance. When the reflection does not align with the direction of the Sun, its impact is reduced, particularly when the observer is already facing directly toward the Sun.
- C - The time of day and the angle of the Sun relative to a solar panel can influence the intensity of the reflection directed towards an observer (receptor). Some times of day may be more critical than others, with brief exposures having less impact than prolonged ones. Consequently, the duration of the solar reflection should be taken into account when assessing its effect on stationary receptors.
- D – Weather conditions, such as whether it is overcast or sunny, significantly affect the intensity of the reflection. Depending on the location, data on average sunshine and overcast hours can be used in the analysis to assess these effects.

- **E** – Other factors such as terrain and vegetation also influence the reflection. For instance, there may be situations where observers are obstructed by surrounding vegetation, or where the elevation of a hill provides a clear line of sight to the solar field.

Modelling Reflected Light Effects: Software Inputs

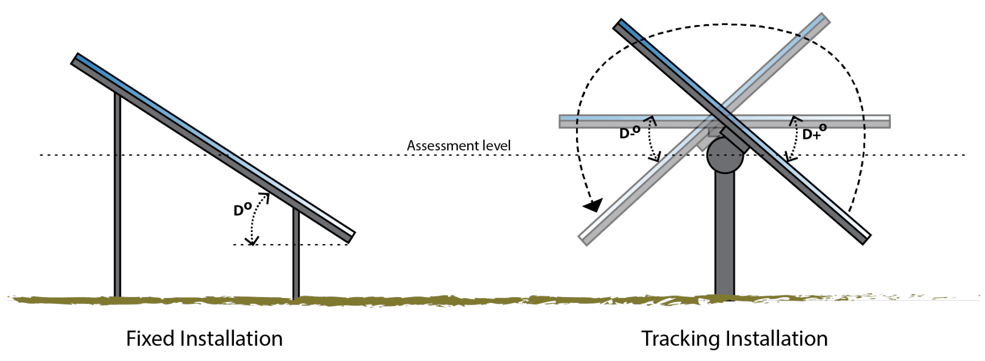
The software originally developed by Sandia National Laboratories to assess glare for aviation, known as the *Solar Glare Hazard Analysis Tool (SGHAT)*, has been adapted by *ForgeSolar* for glare analysis for commercial applications.

The following parameters are entered directly into the software to create an accurate model of the proposal being assessed:

Solar Farm Design

The following parameters of the solar farm are entered into the software:

- The latitude, longitude and elevation of the solar farm. If the solar farm is large, then the assessment may be broken into sections of the farm to assist with analysing the results of the output.
- The tilt and angle of the solar panel and their relation to north.
- The overall layout of the array, including how the panels are grouped or aligned.
- Whether the panels are fixed or tilting, and if tilting what the limits or parameters of the tracking system that are used.
- The height of the solar panels at the midpoint of fixed panels or the rotation axis if tilting.



The orientation of solar panels is defined as 0 degrees pointing north. For fixed installations, 90 degrees corresponds to east. In the case of tracking systems, 0 degrees refers to the direction of the rotating axis, with the panels oriented toward the east.

Receptors

To enable the software to calculate instances of Reflected Light, receptors must be positioned at specified locations within the software. The methodology for the placement of receptors varies depending on its typology outlined as the following.

- **Dwellings** - Receptors are positioned on properties located within approximately 1 km of a proposed solar farm development or those that may have a view of the PV panels due to the terrain. The height of the receptor at the dwelling should consider both the eye level of individuals within the building and the relevant floor levels of the structure.
- **Roading/Rail** - Major roads, including state highways and key arterial routes located within 1 km of the proposed solar installation, will be assessed, along with roads that may have a line of sight to the photovoltaic (PV) panels. Potential views from elevated terrain will also be considered, as well as the height of the road users.
- **Aviation** - Outside the two-mile radius around the solar farm, glare and glint is considered not to have any discernible effect on aircraft approach or landing pattern. Although, where aviation still occurs within 30 km from the proposed solar farm, the assessment should include aviation receptors. Standard receptors to be modelled typically consist of the Air Traffic Control (ATC) tower and a 2-mile (3.2km) approach path for the relevant runway. Additional receptors may be considered if solar reflection poses a potential safety hazard, such as near helipads.

Weather

The software used to calculate Reflected Light assumes clear skies throughout the entire year. As a result, the total annual duration of potential glare conditions predicted by the software can be adjusted downward by applying an appropriate overcast days factor, leading to a reduction in the overall calculated impact.

Topography / Terrain

The software currently does not support the modelling of obstructions from landform and natural obstacles. However, it does allow for the ability to add shelterbelts and other existing vegetation, which are represented as solid masses (similar to walls) in the model, without accounting for any natural permeability that vegetation might provide.These are entered using the inbuilt mapping tools.

In cases where reflection detection is identified by a receptor, combining an overlay with a viewshed analysis could assist in eliminating scenarios where the terrain naturally obstructs the visibility of the solar field.

The software input parameters for the proposed solar farm are included at the rear of this appendix.

Modelling Reflected Light Effects: Software Outputs

The Reflected Light analysis software used to evaluate this project assesses this occurrence of reflectance on a minute-by-minute basis. The assessment considers the impact of Reflected Light during the day and at night for the following potential observers, depending on the location of the proposed solar farm and potential observers:

- Reflective *glare* and *glint* arising from the solar array
- Motorist *disability* reflective glare and glint
- Pedestrian *discomfort* reflective glare and glint

- Rail operator reflective glare and glint
- Aviation sector reflective glare and glint
- Residential *nuisance* glare and glint

The assessment does not consider the Reflected Light from the moon as this is not considered to be bright enough to cause a measurable impact.

The glare hazard graph (Figure 1) presents the expected ocular impact of each minute of predicted glare. The x-axis represents the angle subtended by the visible glare spot. The y-axis represents the retinal irradiance impacting the observer. The occurrence of glare is shown in the plot as a series of orange circles, one circle for each minute that a reflection is visible.

The chart is categorised into three SGHAT hazard zones;

- **Green** - low potential to cause after-image (flash blindness)
- **Yellow** - potential to cause temporary after-image
- **Red** - potential to cause retinal burn (permanent eye damage)

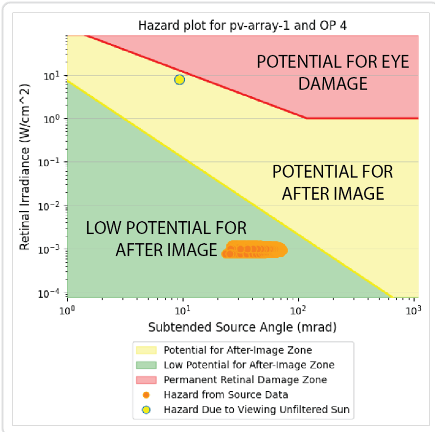


Figure 1: Glare Hazard Graph

In addition to the Hazard Plot assessment, the software package also provides data on the visibility range of reflections from each receptor and the duration of exposure. These results are presented in the form of graphical outputs (Figure 2), which displayed the following information:

- Indicates the specific locations within the solar farm panel array from which the reflection rays of interest are emanating.
- Months of the year and the specific minutes each day when reflections take place at a given position.
- Periods during which reflections are detected at a particular receptor throughout the day.

The software outputs for the proposed solar farm are included at the rear of this appendix.

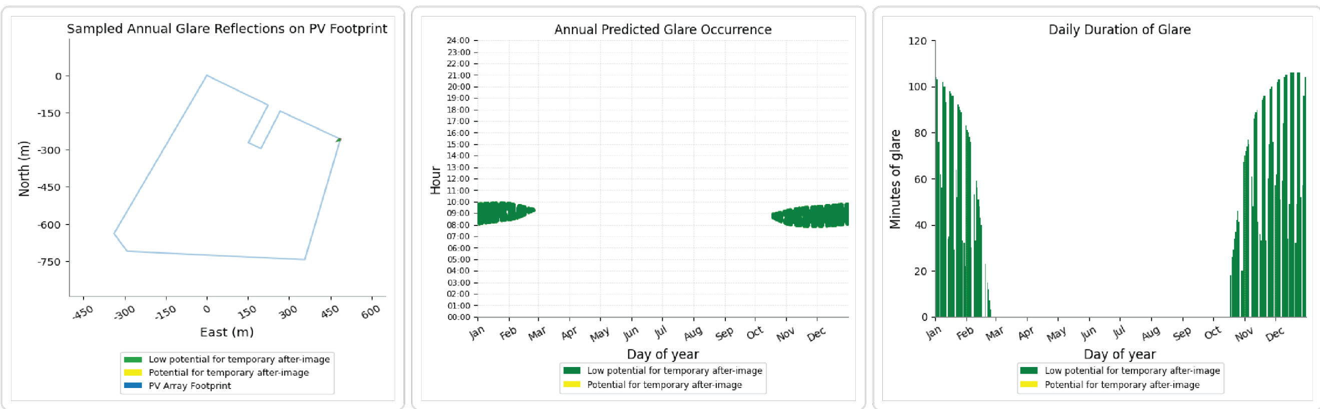


Figure 2: Examples of the various graphs produced by the forge-solar software (not specific to this project)

Final Assessment

A qualitative assessment of the potential Reflected Light effects is prepared using the Modelling Software outputs. This is provided by way of a commentary within the body of the Landscape and Visual Effects Assessment.

The significance of effects and requirement for mitigation against Reflected Light is considered within the following ratings:

- **No Impact** – A solar reflection is not geometrically possible or will not be visible from the assessed receptor. No mitigation is required.
- **Low** – A solar reflection is geometrically possible however any impact is considered to be for short durations in the Yellow category or is in the Green category. No mitigation is required (or may already exist).
- **Moderate** – A solar reflection is geometrically possible and visible however could be for extended periods in the Yellow category. Mitigation against the reflected light is recommended.
- **High** – A solar reflection is geometrically possible and visible under conditions that will produce a significant impact, either for very long periods in the Yellow category and/or any period in the Red category. Mitigation is necessary to reduce the effect.

No guidance is provided internationally for what is determined a *short duration* of exposure to Reflected Light. However, generally agreed guidance from shadow flicker from wind turbines in regard to wind farms indicates a tolerance of no more than 10 hours flicker per year is acceptable (including the consideration of weather impacts), and no more than 30 minutes in any one day. In the absence of any other guidance, these parameters have been adopted to define the maximum extent of Reflected Light in the Yellow category to achieve an overall *low* rating.

In addition, the SGHAT software outlines specific impact criteria for aviation, which indicates for towers, runways and runway approaches there should be no Red category Reflected Light from a proposal within 20 miles (approximately 30km), and no Yellow category Reflected light within 2 miles (approximately 3.5km).

Software Model Outputs

Project Name: Hinuera Solar Farm

Project Location: Hinuera

Solar Farm Parameters

Feature	Parameters
Type	Monocrystalline silicon photo-voltaic (PV) modules
Mounting structure configuration	PV modules mounted on a horizontal single-axis tracking module. PV modules are facing east-west and run in parallel rows-oriented north-south. Tracker axis height will be approx. 2.2 from ground to midpoint of panels. Proposed ground cover ratio (width of the modules as mounted on the tracker divided by the tracker spacing) is approximately 47% as per provided information.
Module Details	TSM-565DEG19RC - 2384×1134×30mm, AR anti-glare coating on the front glass is included.
Tracking system	The tracking angle will likely range from +60 to -60 degrees to the horizontal each day. Modules are assumed to “backtrack” to prevent row-to-row shading during morning and afternoon when the sun is low.

Accessed Receptor Locations

Refer to map on following page.

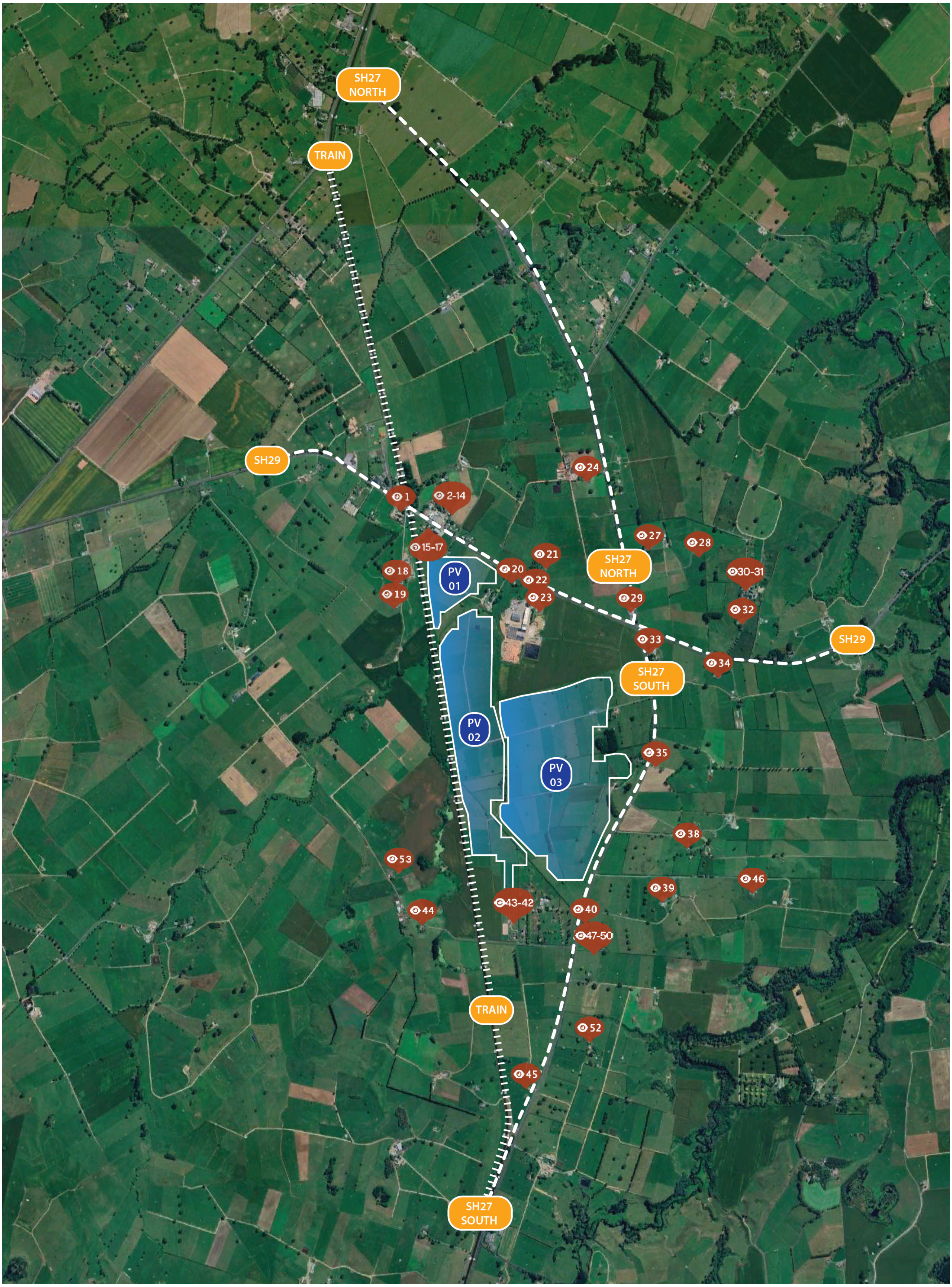
Routes:

- State Highway 27 (SH27) - North of Site, both directions
- State Highway 27 (SH27) – South of Site, both directions
- State Highway 29 (SH29) - both directions
- Railway Track - both directions

Observation Points:

- 1 - 4813 State Highway 29
- 2 - 4798 State Highway 29
- 3 - 4798 State Highway 29
- 4 - 4798 State Highway 29
- 5 - 4792 State Highway 29
- 6 - 4792 State Highway 29
- 7 - 4788 State Highway 29
- 8 - 4784 State Highway 29
- 9 - 4782 State Highway 29
- 10 - 4780 State Highway 29
- 11 - 4774 State Highway 29
- 12 - 4772 State Highway 29
- 13 - 4770 State Highway 29
- 14 - 4768 State Highway 29
- 15 - 4795 State Highway 29
- 16 - 4793 State Highway 29
- 17 - 4791 State Highway 29
- 18 - 4811 State Highway 29
- 19 - 4811 State Highway 29
- 20 - 4735 State Highway 29
- 21 - 4720 State Highway 29
- 22 - 4713 State Highway 29
- 23 - 4711 State Highway 29
- 24 - 8138 State Highway 27

- 25 - 8166 State Highway 29
- 26 - 8164 State Highway 27
- 27 - 8187 State Highway 27
- 28 - 8187 State Highway 27
- 29 - 8224 State Highway 27
- 30 - 4602 State Highway 29
- 31 - 4602 State Highway 29
- 32 - 4602 State Highway 29
- 33 - 8243 State Highway 27
- 34 - 4599 State Highway 29
- 35 - 8309 State Highway 27
- 36 - 8333 State Highway 27
- 37 - 8333 State Highway 27
- 38 - 8351 State Highway 27
- 39 - 8379 State Highway 27
- 40 - 792 State Highway 27
- 41 - 22 Gore Road
- 42 - 32 Gore Road
- 43 - 34 Gore Road
- 44 – 70a Gore Road
- 45 - 677 State Highway 27
- 46 - 8379 State Highway 27
- 47 - 790 State Highway 27
- 48 - 750 State Highway 27
- 49 - 748 State Highway 27
- 50 - 748 State Highway 27
- 51 - 748 State Highway 27
- 52 - 712 State Highway 27
- 53 – 70b Gore Road


SH27 NORTH
TRAIN
SH29
1
2-14
24
15-17
18
19
PV 01
20
21
22
23
27
28
SH27 NORTH
30-31
29
32
33
SH29
34
SH27 SOUTH
PV 02
PV 03
35
38
53
46
39
44
43-42
40
47-50
TRAIN
52
45
SH27 SOUTH

Assumptions and Limitations

- Height of buildings has been estimated based on publicly available imagery.
- The assumed eye height of the viewer or driver above ground level is 2.5 m for roads (representing the height of a truck driver, i.e., the worst-case scenario), and 1.8 m for single-storey buildings or 3.6 m for double-storey buildings.
- Train driver eye level assessed at 2.7m based on available information
- Topography of the Site and surrounding area has been obtained from publicly available information through the software.

Method/Iterations

In preparing this analysis multiple options of fixed and tracking were tested through the software. This included:

- Mapping the effects of the proposed vegetation – the testing indicated that over time this would have beneficial effects on reducing reflected light if any was generated. The final design iteration includes the removal of panels such that no vegetation is necessary to mitigate the panel layout that has been adopted.
- Mapping different tracking and resting angles, this being how the panels follow the sun, how they back-track to maximise solar yield and how/when they return to an overnight resting angle. The final iteration uses a 10˚ overnight resting angle to avoid any reflected light effects.

What The Reports Show

The report at the end of this appendix provides the core output from the modelling software for the final layout that is proposed. In this, the receptors are referred to as follows:

- Route Receptors – the section of the State Highways and Train tracks that were analysed.
- OP1 to OP53 – the residential/sensitive receptors identified above.

Page 1 of the report provides an overview of the layout parameters and a simple map of the identified sensitive receptors. The site configuration is our own reference that we assign to each analysis. A summary table is then provided which shows the modelled glare outputs – the key numbers being no Annual Yellow Glare and Green Glare.

Pages 4 to 6 provide the co-ordinates and elevations of the mapped array, including identifying for this analysis the overnight resting angle of the panels being placed at 10˚ (further commentary on this is provided in the next section of this report). The layout is drawn to represent the location of the panels and so does not directly align with the site boundary – and shows in the southernmost corner a variegated line because panels have been removed from the proposal in this location to avoid reflected light effects.

Page 7 provides the co-ordinates and elevations of the road, and Page 10 provides the co-ordinates and elevations of the Train.

Page 11 provides the co-ordinates, elevations and height of dwelling observation points.

Page 13 is essentially a copy of the summary tables on Page 1. It indicates that there is no reflected light (or 'glare') identified in the modelled layout if using a 10˚ overnight resting angle, this being the final iteration that matches the proposal for which resource consent is now sought.

Page 16 would typically provide more detail on the reflected light effects for each receptor, but as it notes there are no predicted reflected light ('glare') effects found.

Results

As identified, the graphs and tables from the software output show the final completed model based on numerous iterations that have included removal of solar panels to avoid reflected light effects. The output is that there are no predicted reflected light effects.

Although vegetation mitigation is to be planted along the road boundary, this is not specifically necessary to mitigate any reflected light effects.

It is noted that the model, type and configuration of the solar panels are indicative and will be subject to a detailed design process prior to construction. In addition, the software modelling is based on the use of industry-standard software and best-practice techniques, but does include a number of assumptions (listed in this document and at the end of the Forge Solar output).

On this basis, it would be prudent to ensure that conditions are put in place to manage reflected light effects as the solar farm is developed and becomes operational, as follows:

- Following the detailed design of the solar farm and prior to it being constructed, further reflected light analysis is undertaken on the final layout to ensure that no 'yellow glare' will be generated beyond the boundaries of the site.

FORGESOLAR GLARE ANALYSIS

Project: **Harmony Solar Farm @ Hinuera, Matamata 4731 SH29**
Site configuration: **Single Axis Array DRAFT 10deg**
Calculated via ForgeSolar Radiometric Physics Engine v3.1.3

Created 06 Nov, 2025
Updated 14 May, 2026
Time-step 1 minute
Timezone offset UTC12
Minimum sun altitude 0.0 deg
DNI peaks at 1,000.0 W/m^2
Category >1 GW
Site ID 163985.27445

Ocular transmission coefficient 0.5
Pupil diameter 0.002 m
Eye focal length 0.017 m
Sun subtended angle 9.3 mrad

Summary of Results No glare predicted

PV Array	Tilt	Orient	Annual Green Glare		Annual Yellow Glare		Energy
	°	°	min	hr	min	hr	kWh
PV 01	SA tracking	SA tracking	0	0.0	0	0.0	1,636,000.0
PV 02	SA tracking	SA tracking	0	0.0	0	0.0	1,730,000.0
PV 03	SA tracking	SA tracking	0	0.0	0	0.0	1,701,000.0

Total glare received by each receptor; may include duplicate times of glare from multiple reflective surfaces.

Receptor	Annual Green Glare		Annual Yellow Glare	
	min	hr	min	hr
SH27 North	0	0.0	0	0.0
SH27 South	0	0.0	0	0.0
SH29	0	0.0	0	0.0
TRAIN	0	0.0	0	0.0
OP 1	0	0.0	0	0.0
OP 2	0	0.0	0	0.0
OP 3	0	0.0	0	0.0
OP 4	0	0.0	0	0.0
OP 5	0	0.0	0	0.0
OP 6	0	0.0	0	0.0
OP 7	0	0.0	0	0.0
OP 8	0	0.0	0	0.0

Receptor	Annual Green Glare		Annual Yellow Glare	
	min	hr	min	hr
OP 9	0	0.0	0	0.0
OP 10	0	0.0	0	0.0
OP 11	0	0.0	0	0.0
OP 12	0	0.0	0	0.0
OP 13	0	0.0	0	0.0
OP 14	0	0.0	0	0.0
OP 15	0	0.0	0	0.0
OP 16	0	0.0	0	0.0
OP 17	0	0.0	0	0.0
OP 18	0	0.0	0	0.0
OP 19	0	0.0	0	0.0
OP 20	0	0.0	0	0.0
OP 21	0	0.0	0	0.0
OP 22	0	0.0	0	0.0
OP 23	0	0.0	0	0.0
OP 24	0	0.0	0	0.0
OP 25	0	0.0	0	0.0
OP 26	0	0.0	0	0.0
OP 27	0	0.0	0	0.0
OP 28	0	0.0	0	0.0
OP 29	0	0.0	0	0.0
OP 30	0	0.0	0	0.0
OP 31	0	0.0	0	0.0
OP 32	0	0.0	0	0.0
OP 33	0	0.0	0	0.0
OP 34	0	0.0	0	0.0
OP 35	0	0.0	0	0.0
OP 36	0	0.0	0	0.0
OP 37	0	0.0	0	0.0
OP 38	0	0.0	0	0.0
OP 39	0	0.0	0	0.0
OP 40	0	0.0	0	0.0
OP 41	0	0.0	0	0.0
OP 42	0	0.0	0	0.0
OP 43	0	0.0	0	0.0
OP 44	0	0.0	0	0.0
OP 45	0	0.0	0	0.0
OP 46	0	0.0	0	0.0
OP 47	0	0.0	0	0.0
OP 48	0	0.0	0	0.0
OP 49	0	0.0	0	0.0
OP 50	0	0.0	0	0.0
OP 51	0	0.0	0	0.0

Receptor	Annual Green Glare		Annual Yellow Glare	
	min	hr	min	hr
OP 52	0	0.0	0	0.0
OP 53	0	0.0	0	0.0

Component Data

PV Arrays

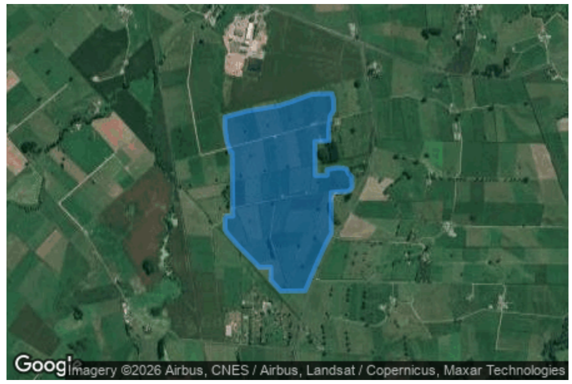
Name: PV 01
Axis tracking: Single-axis rotation
Backtracking: Shade
Tracking axis orientation: 0.0°
Max tracking angle: 60.0°
Resting angle: 5.0°
Ground Coverage Ratio: 0.47
Rated power: 625.0 kW
Panel material: Smooth glass with AR coating

Vertex	Latitude (°)	Longitude (°)	Ground elevation (m)	Height above ground (m)	Total elevation (m)
1	-37.884871	175.764664	80.00	2.20	82.20
2	-37.884890	175.762397	80.00	2.20	82.20
3	-37.884574	175.762392	80.00	2.20	82.20
4	-37.884580	175.761708	80.00	2.20	82.20
5	-37.884895	175.761712	80.00	2.20	82.20
6	-37.884899	175.761414	80.00	2.20	82.20
7	-37.886105	175.761430	79.01	2.20	81.21
8	-37.886804	175.761499	79.00	2.20	81.20
9	-37.888610	175.761882	79.00	2.20	81.20
10	-37.888607	175.762148	79.00	2.20	81.20
11	-37.888307	175.762264	79.00	2.20	81.20
12	-37.887714	175.762256	79.00	2.20	81.20
13	-37.887708	175.762554	79.00	2.20	81.20
14	-37.887387	175.763206	79.00	2.20	81.20
15	-37.886781	175.764272	79.00	2.20	81.20
16	-37.886776	175.764810	78.00	2.20	80.20
17	-37.886221	175.764802	79.00	2.20	81.20
18	-37.886211	175.765996	78.00	2.20	80.20
19	-37.885551	175.765987	79.00	2.20	81.20

Name: PV 02
Axis tracking: Single-axis rotation
Backtracking: Shade
Tracking axis orientation: 0.0°
Max tracking angle: 60.0°
Resting angle: 10.0°
Ground Coverage Ratio: 0.47
Rated power: 625.0 kW
Panel material: Smooth glass with AR coating

Vertex	Latitude (°)	Longitude (°)	Ground elevation (m)	Height above ground (m)	Total elevation (m)
1	-37.887985	175.765697	78.00	2.20	80.20
2	-37.887993	175.764682	78.51	2.20	80.71
3	-37.887607	175.764677	78.00	2.20	80.20
4	-37.887609	175.764410	79.00	2.20	81.20
5	-37.887987	175.763461	79.00	2.20	81.20
6	-37.888617	175.763469	79.00	2.20	81.20
7	-37.888621	175.763051	79.00	2.20	81.20
8	-37.888923	175.762697	79.00	2.20	81.20
9	-37.889524	175.762228	79.00	2.20	81.20
10	-37.890133	175.762236	79.00	2.20	81.20
11	-37.897646	175.763770	79.00	2.20	81.20
12	-37.898343	175.764078	78.00	2.20	80.20
13	-37.900541	175.764406	80.00	2.20	82.20
14	-37.900527	175.766018	90.00	2.20	92.20
15	-37.900826	175.766022	91.60	2.20	93.80
16	-37.900821	175.766559	93.00	2.20	95.20
17	-37.902349	175.766580	94.32	2.20	96.52
18	-37.902345	175.767086	100.00	2.20	102.20
19	-37.901041	175.767068	100.73	2.20	102.93
20	-37.901033	175.768023	96.00	2.20	98.20
21	-37.900424	175.768015	100.21	2.20	102.41
22	-37.899611	175.767048	95.95	2.20	98.15
23	-37.899617	175.766332	92.00	2.20	94.20
24	-37.898925	175.766323	90.00	2.20	92.20
25	-37.898334	175.765658	85.00	2.20	87.20
26	-37.897630	175.765649	84.00	2.20	86.20
27	-37.897623	175.766487	86.00	2.20	88.20
28	-37.896963	175.766475	85.00	2.20	87.20
29	-37.896112	175.766523	85.00	2.20	87.20
30	-37.894678	175.766504	85.00	2.20	87.20
31	-37.892701	175.765821	83.75	2.20	85.95
32	-37.892699	175.765641	82.52	2.20	84.72
33	-37.892003	175.765632	83.00	2.20	85.20
34	-37.889805	175.765722	80.00	2.20	82.20

Name: PV 03
Axis tracking: Single-axis rotation
Backtracking: Shade
Tracking axis orientation: 0.0°
Max tracking angle: 60.0°
Resting angle: 5.0°
Ground Coverage Ratio: 0.47
Rated power: 625.0 kW
Panel material: Smooth glass with AR coating



Vertex	Latitude (°)	Longitude (°)	Ground elevation (m)	Height above ground (m)	Total elevation (m)
1	-37.892450	175.766257	79.00	2.20	81.20
2	-37.893060	175.766266	79.00	2.20	81.20
3	-37.893759	175.766395	78.00	2.20	80.20
4	-37.894353	175.766641	78.00	2.20	80.20
5	-37.894352	175.766761	78.00	2.20	80.20
6	-37.897801	175.766807	81.85	2.20	84.05
7	-37.897804	175.766390	81.00	2.20	83.20
8	-37.897926	175.766272	81.00	2.20	83.20
9	-37.898536	175.766280	82.00	2.20	84.20
10	-37.898712	175.766402	83.00	2.20	85.20
11	-37.899366	175.767127	86.66	2.20	88.86
12	-37.900565	175.768636	94.00	2.20	96.20
13	-37.900559	175.769412	95.53	2.20	97.73
14	-37.901258	175.769421	97.12	2.20	99.32
15	-37.901849	175.770086	100.00	2.20	102.20
16	-37.901835	175.771785	102.25	2.20	104.45
17	-37.900532	175.772484	101.15	2.20	103.35
18	-37.899314	175.773184	101.00	2.20	103.20
19	-37.898714	175.773593	101.00	2.20	103.20
20	-37.896519	175.773563	100.00	2.20	102.20
21	-37.896456	175.774756	103.00	2.20	105.20
22	-37.896277	175.774993	104.00	2.20	106.20
23	-37.895668	175.774984	103.00	2.20	105.20
24	-37.895488	175.774743	102.07	2.20	104.27
25	-37.895251	175.774621	102.00	2.20	104.20
26	-37.895186	175.774262	101.00	2.20	103.20
27	-37.895189	175.773935	100.83	2.20	103.03
28	-37.895281	175.773280	98.15	2.20	100.35
29	-37.895597	175.773284	99.00	2.20	101.20
30	-37.895605	175.772476	96.00	2.20	98.20
31	-37.894906	175.772467	95.71	2.20	97.91
32	-37.894005	175.772455	95.00	2.20	97.20
33	-37.893756	175.772451	94.63	2.20	96.83
34	-37.893746	175.773406	96.12	2.20	98.32
35	-37.893090	175.773397	96.27	2.20	98.47
36	-37.892383	175.773507	97.00	2.20	99.20
37	-37.892082	175.773742	97.00	2.20	99.20
38	-37.891472	175.773733	96.00	2.20	98.20
39	-37.891175	175.773610	95.00	2.20	97.20
40	-37.891182	175.772746	92.98	2.20	95.18
41	-37.891232	175.772150	91.00	2.20	93.20

Vertex	Latitude (°)	Longitude (°)	Ground elevation (m)	Height above ground (m)	Total elevation (m)
42	-37.891597	175.770902	88.00	2.20	90.20
43	-37.891821	175.770009	83.00	2.20	85.20
44	-37.892140	175.767686	81.00	2.20	83.20

Route Receptors

Name: SH27 North
Path type: Two-way
Azimuthal view angle: 50.0°
Downward view angle: 90.0°

Vertex	Latitude (°)	Longitude (°)	Ground elevation (m)	Height above ground (m)	Total elevation (m)
1	-37.888290	175.775181	87.57	2.50	90.07
2	-37.887960	175.775304	86.00	2.50	88.50
3	-37.887755	175.775342	85.00	2.50	87.50
4	-37.887516	175.775312	84.00	2.50	86.50
5	-37.887060	175.775184	81.45	2.50	83.95
6	-37.884720	175.774536	78.00	2.50	80.50
7	-37.882443	175.773957	77.00	2.50	79.50
8	-37.879347	175.773127	75.00	2.50	77.50
9	-37.876606	175.772386	78.00	2.50	80.50
10	-37.875763	175.772183	78.00	2.50	80.50
11	-37.875479	175.772081	78.00	2.50	80.50
12	-37.874514	175.771458	79.00	2.50	81.50
13	-37.872700	175.770303	78.00	2.50	80.50
14	-37.870803	175.769047	77.00	2.50	79.50
15	-37.868978	175.767888	76.00	2.50	78.50
16	-37.868443	175.767530	76.00	2.50	78.50
17	-37.868007	175.767192	75.00	2.50	77.50
18	-37.867353	175.766552	74.00	2.50	76.50
19	-37.867104	175.766241	75.00	2.50	77.50
20	-37.866028	175.764884	75.00	2.50	77.50
21	-37.865270	175.763929	75.00	2.50	77.50
22	-37.864431	175.762875	75.00	2.50	77.50
23	-37.863688	175.761933	74.00	2.50	76.50
24	-37.862528	175.760477	74.00	2.50	76.50
25	-37.861701	175.759426	73.00	2.50	75.50
26	-37.860748	175.758229	72.00	2.50	74.50
27	-37.860464	175.757907	72.00	2.50	74.50
28	-37.860189	175.757634	72.00	2.50	74.50
29	-37.859937	175.757438	72.00	2.50	74.50
30	-37.859615	175.757232	72.00	2.50	74.50

Name: SH27 South
Path type: Two-way
Azimuthal view angle: 50.0°
Downward view angle: 90.0°

Vertex	Latitude (°)	Longitude (°)	Ground elevation (m)	Height above ground (m)	Total elevation (m)
1	-37.919996	175.764862	89.00	2.50	91.50
2	-37.917000	175.766128	88.15	2.50	90.65
3	-37.914949	175.767132	89.42	2.50	91.92
4	-37.913905	175.767693	90.00	2.50	92.50
5	-37.912743	175.768360	91.00	2.50	93.50
6	-37.911442	175.769120	92.00	2.50	94.50
7	-37.910763	175.769450	92.81	2.50	95.31
8	-37.910012	175.769783	93.37	2.50	95.87
9	-37.908905	175.770198	95.19	2.50	97.69
10	-37.905708	175.771045	102.02	2.50	104.52
11	-37.904530	175.771359	104.00	2.50	106.50
12	-37.903584	175.771618	104.00	2.50	106.50
13	-37.902876	175.771850	104.00	2.50	106.50
14	-37.902170	175.772125	103.00	2.50	105.50
15	-37.901584	175.772367	103.00	2.50	105.50
16	-37.900837	175.772727	102.58	2.50	105.08
17	-37.900078	175.773150	102.00	2.50	104.50
18	-37.899325	175.773625	102.00	2.50	104.50
19	-37.898724	175.774051	102.01	2.50	104.51
20	-37.896925	175.775356	104.38	2.50	106.88
21	-37.896267	175.775769	105.00	2.50	107.50
22	-37.895669	175.776072	104.00	2.50	106.50
23	-37.895001	175.776321	101.89	2.50	104.39
24	-37.894187	175.776527	99.00	2.50	101.50
25	-37.893350	175.776604	99.00	2.50	101.50
26	-37.892487	175.776551	101.24	2.50	103.74
27	-37.891543	175.776391	100.00	2.50	102.50
28	-37.889105	175.775753	92.00	2.50	94.50
29	-37.888851	175.775755	91.00	2.50	93.50
30	-37.888649	175.775861	90.00	2.50	92.50

Name: SH29
Path type: Two-way
Azimuthal view angle: 50.0°
Downward view angle: 90.0°

Vertex	Latitude (°)	Longitude (°)	Ground elevation (m)	Height above ground (m)	Total elevation (m)
1	-37.889265	175.789808	80.00	2.50	82.50
2	-37.890197	175.786579	84.00	2.50	86.50
3	-37.890333	175.785954	85.00	2.50	87.50
4	-37.890369	175.785397	86.00	2.50	88.50
5	-37.890324	175.784625	89.00	2.50	91.50
6	-37.890070	175.781063	95.31	2.50	97.81
7	-37.890019	175.780593	96.00	2.50	98.50
8	-37.889925	175.780088	96.00	2.50	98.50
9	-37.889798	175.779632	95.90	2.50	98.40
10	-37.889467	175.778637	94.32	2.50	96.82
11	-37.888534	175.775724	89.37	2.50	91.87
12	-37.887633	175.772946	82.88	2.50	85.38
13	-37.886683	175.770038	79.00	2.50	81.50
14	-37.886118	175.768260	77.00	2.50	79.50
15	-37.885788	175.767359	77.00	2.50	79.50
16	-37.885555	175.766809	78.00	2.50	80.50
17	-37.885329	175.766339	78.98	2.50	81.48
18	-37.884564	175.764828	80.00	2.50	82.50
19	-37.883430	175.762618	81.00	2.50	83.50
20	-37.882609	175.761020	80.58	2.50	83.08
21	-37.882192	175.760213	81.00	2.50	83.50
22	-37.881512	175.758772	81.00	2.50	83.50
23	-37.880481	175.756860	80.00	2.50	82.50
24	-37.879927	175.755741	80.00	2.50	82.50
25	-37.879603	175.755064	79.00	2.50	81.50
26	-37.879380	175.754523	80.00	2.50	82.50
27	-37.879263	175.753949	80.00	2.50	82.50
28	-37.879251	175.753233	80.00	2.50	82.50
29	-37.879305	175.752627	80.00	2.50	82.50
30	-37.880661	175.746178	79.00	2.50	81.50

Name: TRAIN
Path type: Two-way
Azimuthal view angle: 50.0°
Downward view angle: 90.0°

Vertex	Latitude (°)	Longitude (°)	Ground elevation (m)	Height above ground (m)	Total elevation (m)
1	-37.864258	175.754734	71.00	2.75	73.75
2	-37.869305	175.756232	75.00	2.75	77.75
3	-37.873041	175.757356	79.00	2.75	81.75
4	-37.877970	175.758786	80.00	2.75	82.75
5	-37.881202	175.759780	81.00	2.75	83.75
6	-37.881973	175.760030	81.00	2.75	83.75
7	-37.882618	175.760203	79.00	2.75	81.75
8	-37.883532	175.760403	80.00	2.75	82.75
9	-37.884502	175.760603	80.00	2.75	82.75
10	-37.885744	175.760853	79.14	2.75	81.89
11	-37.887290	175.761178	79.77	2.75	82.52
12	-37.888233	175.761376	79.00	2.75	81.75
13	-37.889427	175.761639	79.00	2.75	81.75
14	-37.890407	175.761833	79.00	2.75	81.75
15	-37.891591	175.762080	79.00	2.75	81.75
16	-37.892418	175.762250	78.00	2.75	80.75
17	-37.893350	175.762451	78.00	2.75	80.75
18	-37.895284	175.762859	78.00	2.75	80.75
19	-37.898445	175.763521	82.93	2.75	85.68
20	-37.901540	175.764173	94.95	2.75	97.70
21	-37.904534	175.764792	100.00	2.75	102.75
22	-37.908937	175.765711	98.00	2.75	100.75
23	-37.911708	175.766294	92.56	2.75	95.31
24	-37.913352	175.766634	92.00	2.75	94.75
25	-37.913807	175.766712	92.00	2.75	94.75
26	-37.914183	175.766720	91.00	2.75	93.75
27	-37.914655	175.766663	90.99	2.75	93.74
28	-37.915388	175.766446	90.00	2.75	92.75
29	-37.917137	175.765742	89.00	2.75	91.75
30	-37.919960	175.764648	90.18	2.75	92.93

Discrete Observation Point Receptors

Name	ID	Latitude (°)	Longitude (°)	Elevation (m)	Height (m)
OP 1	1	-37.882188	175.759622	81.00	1.80
OP 2	2	-37.881911	175.761768	80.27	1.80
OP 3	3	-37.881975	175.762103	81.00	1.80
OP 4	4	-37.882200	175.761838	81.00	1.80
OP 5	5	-37.882257	175.762531	81.00	1.80
OP 6	6	-37.882455	175.762762	81.00	1.80
OP 7	7	-37.882709	175.762570	81.00	1.80
OP 8	8	-37.883031	175.762787	81.00	1.80
OP 9	9	-37.883286	175.762881	81.00	1.80
OP 10	10	-37.883386	175.763120	81.00	1.80
OP 11	11	-37.883702	175.763706	80.00	1.80
OP 12	12	-37.883814	175.763935	80.00	1.80
OP 13	13	-37.883885	175.764124	80.00	1.80
OP 14	14	-37.883974	175.764302	80.00	1.80
OP 15	15	-37.883180	175.761087	81.00	1.80
OP 16	16	-37.883155	175.761395	81.00	1.80
OP 17	17	-37.883299	175.761626	81.00	3.60
OP 18	18	-37.886083	175.759330	80.00	3.60
OP 19	19	-37.887306	175.759169	80.00	1.80
OP 20	20	-37.885994	175.767022	77.00	1.80
OP 21	21	-37.885226	175.769310	77.00	1.80
OP 22	22	-37.886558	175.768604	78.00	1.80
OP 23	23	-37.887472	175.768870	79.00	1.80
OP 24	24	-37.880645	175.772003	76.00	1.80
OP 25	25	-37.882584	175.772620	76.00	1.80
OP 26	26	-37.882422	175.773670	77.00	1.80
OP 27	27	-37.884252	175.776123	80.00	1.80
OP 28	28	-37.884603	175.779499	83.00	1.80
OP 29	29	-37.887529	175.774955	83.00	1.80
OP 30	30	-37.886462	175.782573	84.00	1.80
OP 31	31	-37.886894	175.782471	84.79	1.80
OP 32	32	-37.888147	175.782353	87.95	1.80
OP 33	33	-37.889698	175.776194	94.00	1.80
OP 34	34	-37.890959	175.780781	98.68	1.80
OP 35	35	-37.895659	175.776605	104.90	1.80
OP 36	36	-37.898763	175.779354	103.00	1.80
OP 37	37	-37.899207	175.780539	102.00	1.80
OP 38	38	-37.899927	175.778721	104.00	1.80
OP 39	39	-37.902775	175.777065	101.30	1.80
OP 40	40	-37.903863	175.771911	104.18	1.80
OP 41	41	-37.904451	175.769036	102.00	1.80
OP 42	42	-37.904126	175.767668	101.00	1.80
OP 43	43	-37.904341	175.767142	101.00	1.80
OP 44	44	-37.903944	175.761049	99.00	1.80
OP 45	45	-37.912549	175.767966	91.94	1.80
OP 46	46	-37.902295	175.783034	100.00	1.80
OP 47	47	-37.905032	175.772975	104.00	1.80
OP 48	48	-37.905566	175.771937	103.00	1.80
OP 49	49	-37.905579	175.773213	103.32	1.80
OP 50	50	-37.906366	175.772988	101.78	1.80
OP 51	51	-37.906336	175.772114	102.00	1.80
OP 52	52	-37.910119	175.772189	90.00	1.80

Name	ID	Latitude (°)	Longitude (°)	Elevation (m)	Height (m)
OP 53	53	-37.901154	175.758883	107.00	1.80

Glare Analysis Results

Summary of Results No glare predicted

PV Array	Tilt	Orient	Annual Green Glare		Annual Yellow Glare		Energy
	°	°	min	hr	min	hr	kWh
PV 01	SA tracking	SA tracking	0	0.0	0	0.0	1,636,000.0
PV 02	SA tracking	SA tracking	0	0.0	0	0.0	1,730,000.0
PV 03	SA tracking	SA tracking	0	0.0	0	0.0	1,701,000.0

Total glare received by each receptor; may include duplicate times of glare from multiple reflective surfaces.

Receptor	Annual Green Glare		Annual Yellow Glare	
	min	hr	min	hr
SH27 North	0	0.0	0	0.0
SH27 South	0	0.0	0	0.0
SH29	0	0.0	0	0.0
TRAIN	0	0.0	0	0.0
OP 1	0	0.0	0	0.0
OP 2	0	0.0	0	0.0
OP 3	0	0.0	0	0.0
OP 4	0	0.0	0	0.0
OP 5	0	0.0	0	0.0
OP 6	0	0.0	0	0.0
OP 7	0	0.0	0	0.0
OP 8	0	0.0	0	0.0
OP 9	0	0.0	0	0.0
OP 10	0	0.0	0	0.0
OP 11	0	0.0	0	0.0
OP 12	0	0.0	0	0.0
OP 13	0	0.0	0	0.0
OP 14	0	0.0	0	0.0
OP 15	0	0.0	0	0.0
OP 16	0	0.0	0	0.0
OP 17	0	0.0	0	0.0
OP 18	0	0.0	0	0.0
OP 19	0	0.0	0	0.0
OP 20	0	0.0	0	0.0
OP 21	0	0.0	0	0.0
OP 22	0	0.0	0	0.0
OP 23	0	0.0	0	0.0
OP 24	0	0.0	0	0.0

Receptor	Annual Green Glare		Annual Yellow Glare	
	min	hr	min	hr
OP 25	0	0.0	0	0.0
OP 26	0	0.0	0	0.0
OP 27	0	0.0	0	0.0
OP 28	0	0.0	0	0.0
OP 29	0	0.0	0	0.0
OP 30	0	0.0	0	0.0
OP 31	0	0.0	0	0.0
OP 32	0	0.0	0	0.0
OP 33	0	0.0	0	0.0
OP 34	0	0.0	0	0.0
OP 35	0	0.0	0	0.0
OP 36	0	0.0	0	0.0
OP 37	0	0.0	0	0.0
OP 38	0	0.0	0	0.0
OP 39	0	0.0	0	0.0
OP 40	0	0.0	0	0.0
OP 41	0	0.0	0	0.0
OP 42	0	0.0	0	0.0
OP 43	0	0.0	0	0.0
OP 44	0	0.0	0	0.0
OP 45	0	0.0	0	0.0
OP 46	0	0.0	0	0.0
OP 47	0	0.0	0	0.0
OP 48	0	0.0	0	0.0
OP 49	0	0.0	0	0.0
OP 50	0	0.0	0	0.0
OP 51	0	0.0	0	0.0
OP 52	0	0.0	0	0.0
OP 53	0	0.0	0	0.0

PV: PV 01 no glare found

Receptor results ordered by category of glare

Receptor	Annual Green Glare		Annual Yellow Glare	
	min	hr	min	hr
SH27 North	0	0.0	0	0.0
SH27 South	0	0.0	0	0.0
SH29	0	0.0	0	0.0
TRAIN	0	0.0	0	0.0
OP 1	0	0.0	0	0.0
OP 2	0	0.0	0	0.0
OP 3	0	0.0	0	0.0
OP 4	0	0.0	0	0.0
OP 5	0	0.0	0	0.0
OP 6	0	0.0	0	0.0
OP 7	0	0.0	0	0.0
OP 8	0	0.0	0	0.0
OP 9	0	0.0	0	0.0
OP 10	0	0.0	0	0.0
OP 11	0	0.0	0	0.0
OP 12	0	0.0	0	0.0
OP 13	0	0.0	0	0.0
OP 14	0	0.0	0	0.0
OP 15	0	0.0	0	0.0
OP 16	0	0.0	0	0.0
OP 17	0	0.0	0	0.0
OP 18	0	0.0	0	0.0
OP 19	0	0.0	0	0.0
OP 20	0	0.0	0	0.0
OP 21	0	0.0	0	0.0
OP 22	0	0.0	0	0.0
OP 23	0	0.0	0	0.0
OP 24	0	0.0	0	0.0
OP 25	0	0.0	0	0.0
OP 26	0	0.0	0	0.0
OP 27	0	0.0	0	0.0
OP 28	0	0.0	0	0.0
OP 29	0	0.0	0	0.0
OP 30	0	0.0	0	0.0
OP 31	0	0.0	0	0.0
OP 32	0	0.0	0	0.0
OP 33	0	0.0	0	0.0
OP 34	0	0.0	0	0.0
OP 35	0	0.0	0	0.0

Receptor	Annual Green Glare		Annual Yellow Glare	
	min	hr	min	hr
OP 36	0	0.0	0	0.0
OP 37	0	0.0	0	0.0
OP 38	0	0.0	0	0.0
OP 39	0	0.0	0	0.0
OP 40	0	0.0	0	0.0
OP 41	0	0.0	0	0.0
OP 42	0	0.0	0	0.0
OP 43	0	0.0	0	0.0
OP 44	0	0.0	0	0.0
OP 45	0	0.0	0	0.0
OP 46	0	0.0	0	0.0
OP 47	0	0.0	0	0.0
OP 48	0	0.0	0	0.0
OP 49	0	0.0	0	0.0
OP 50	0	0.0	0	0.0
OP 51	0	0.0	0	0.0
OP 52	0	0.0	0	0.0
OP 53	0	0.0	0	0.0

PV 01 and Route: SH27 North

No glare found

PV 01 and Route: SH27 South

No glare found

PV 01 and Route: SH29

No glare found

PV 01 and Route: TRAIN

No glare found

PV 01 and OP 1

No glare found

PV 01 and OP 2

No glare found

PV 01 and OP 3

No glare found

PV 01 and OP 4

No glare found

PV 01 and OP 5

No glare found

PV 01 and OP 6

No glare found

PV 01 and OP 7

No glare found

PV 01 and OP 8

No glare found

PV 01 and OP 9

No glare found

PV 01 and OP 10

No glare found

PV 01 and OP 11

No glare found

PV 01 and OP 12

No glare found

PV 01 and OP 13

No glare found

PV 01 and OP 14

No glare found

PV 01 and OP 15

No glare found

PV 01 and OP 16

No glare found

PV 01 and OP 17

No glare found

PV 01 and OP 18

No glare found

PV 01 and OP 19

No glare found

PV 01 and OP 20

No glare found

PV 01 and OP 21

No glare found

PV 01 and OP 22

No glare found

PV 01 and OP 23

No glare found

PV 01 and OP 24

No glare found

PV 01 and OP 25

No glare found

PV 01 and OP 26

No glare found

PV 01 and OP 27

No glare found

PV 01 and OP 28

No glare found

PV 01 and OP 29

No glare found

PV 01 and OP 30

No glare found

PV 01 and OP 31

No glare found

PV 01 and OP 32

No glare found

PV 01 and OP 33

No glare found

PV 01 and OP 34

No glare found

PV 01 and OP 35

No glare found

PV 01 and OP 36

No glare found

PV 01 and OP 37

No glare found

PV 01 and OP 38

No glare found

PV 01 and OP 39

No glare found

PV 01 and OP 40

No glare found

PV 01 and OP 41

No glare found

PV 01 and OP 42

No glare found

PV 01 and OP 43

No glare found

PV 01 and OP 44

No glare found

PV 01 and OP 45

No glare found

PV 01 and OP 46

No glare found

PV 01 and OP 47

No glare found

PV 01 and OP 48

No glare found

PV 01 and OP 49

No glare found

PV 01 and OP 50

No glare found

PV 01 and OP 51

No glare found

PV 01 and OP 52

No glare found

PV 01 and OP 53

No glare found

PV: PV 02 no glare found

Receptor results ordered by category of glare

Receptor	Annual Green Glare		Annual Yellow Glare	
	min	hr	min	hr
SH27 North	0	0.0	0	0.0
SH27 South	0	0.0	0	0.0
SH29	0	0.0	0	0.0
TRAIN	0	0.0	0	0.0
OP 1	0	0.0	0	0.0
OP 2	0	0.0	0	0.0
OP 3	0	0.0	0	0.0
OP 4	0	0.0	0	0.0
OP 5	0	0.0	0	0.0
OP 6	0	0.0	0	0.0
OP 7	0	0.0	0	0.0
OP 8	0	0.0	0	0.0
OP 9	0	0.0	0	0.0
OP 10	0	0.0	0	0.0
OP 11	0	0.0	0	0.0
OP 12	0	0.0	0	0.0
OP 13	0	0.0	0	0.0
OP 14	0	0.0	0	0.0
OP 15	0	0.0	0	0.0
OP 16	0	0.0	0	0.0
OP 17	0	0.0	0	0.0
OP 18	0	0.0	0	0.0
OP 19	0	0.0	0	0.0
OP 20	0	0.0	0	0.0
OP 21	0	0.0	0	0.0
OP 22	0	0.0	0	0.0
OP 23	0	0.0	0	0.0
OP 24	0	0.0	0	0.0
OP 25	0	0.0	0	0.0
OP 26	0	0.0	0	0.0
OP 27	0	0.0	0	0.0
OP 28	0	0.0	0	0.0
OP 29	0	0.0	0	0.0
OP 30	0	0.0	0	0.0
OP 31	0	0.0	0	0.0
OP 32	0	0.0	0	0.0
OP 33	0	0.0	0	0.0
OP 34	0	0.0	0	0.0
OP 35	0	0.0	0	0.0

Receptor	Annual Green Glare		Annual Yellow Glare	
	min	hr	min	hr
OP 36	0	0.0	0	0.0
OP 37	0	0.0	0	0.0
OP 38	0	0.0	0	0.0
OP 39	0	0.0	0	0.0
OP 40	0	0.0	0	0.0
OP 41	0	0.0	0	0.0
OP 42	0	0.0	0	0.0
OP 43	0	0.0	0	0.0
OP 44	0	0.0	0	0.0
OP 45	0	0.0	0	0.0
OP 46	0	0.0	0	0.0
OP 47	0	0.0	0	0.0
OP 48	0	0.0	0	0.0
OP 49	0	0.0	0	0.0
OP 50	0	0.0	0	0.0
OP 51	0	0.0	0	0.0
OP 52	0	0.0	0	0.0
OP 53	0	0.0	0	0.0

PV 02 and Route: SH27 North

No glare found

PV 02 and Route: SH27 South

No glare found

PV 02 and Route: SH29

No glare found

PV 02 and Route: TRAIN

No glare found

PV 02 and OP 1

No glare found

PV 02 and OP 2

No glare found

PV 02 and OP 3

No glare found

PV 02 and OP 4

No glare found

PV 02 and OP 5

No glare found

PV 02 and OP 6

No glare found

PV 02 and OP 7

No glare found

PV 02 and OP 8

No glare found

PV 02 and OP 9

No glare found

PV 02 and OP 10

No glare found

PV 02 and OP 11

No glare found

PV 02 and OP 12

No glare found

PV 02 and OP 13

No glare found

PV 02 and OP 14

No glare found

PV 02 and OP 15

No glare found

PV 02 and OP 16

No glare found

PV 02 and OP 17

No glare found

PV 02 and OP 18
No glare found

PV 02 and OP 19
No glare found

PV 02 and OP 20
No glare found

PV 02 and OP 21
No glare found

PV 02 and OP 22
No glare found

PV 02 and OP 23
No glare found

PV 02 and OP 24
No glare found

PV 02 and OP 25
No glare found

PV 02 and OP 26
No glare found

PV 02 and OP 27
No glare found

PV 02 and OP 28
No glare found

PV 02 and OP 29
No glare found

PV 02 and OP 30
No glare found

PV 02 and OP 31
No glare found

PV 02 and OP 32

No glare found

PV 02 and OP 33

No glare found

PV 02 and OP 34

No glare found

PV 02 and OP 35

No glare found

PV 02 and OP 36

No glare found

PV 02 and OP 37

No glare found

PV 02 and OP 38

No glare found

PV 02 and OP 39

No glare found

PV 02 and OP 40

No glare found

PV 02 and OP 41

No glare found

PV 02 and OP 42

No glare found

PV 02 and OP 43

No glare found

PV 02 and OP 44

No glare found

PV 02 and OP 45

No glare found

PV 02 and OP 46

No glare found

PV 02 and OP 47

No glare found

PV 02 and OP 48

No glare found

PV 02 and OP 49

No glare found

PV 02 and OP 50

No glare found

PV 02 and OP 51

No glare found

PV 02 and OP 52

No glare found

PV 02 and OP 53

No glare found

PV: PV 03 no glare found

Receptor results ordered by category of glare

Receptor	Annual Green Glare		Annual Yellow Glare	
	min	hr	min	hr
SH27 North	0	0.0	0	0.0
SH27 South	0	0.0	0	0.0
SH29	0	0.0	0	0.0
TRAIN	0	0.0	0	0.0
OP 1	0	0.0	0	0.0
OP 2	0	0.0	0	0.0
OP 3	0	0.0	0	0.0
OP 4	0	0.0	0	0.0
OP 5	0	0.0	0	0.0
OP 6	0	0.0	0	0.0
OP 7	0	0.0	0	0.0
OP 8	0	0.0	0	0.0
OP 9	0	0.0	0	0.0
OP 10	0	0.0	0	0.0
OP 11	0	0.0	0	0.0
OP 12	0	0.0	0	0.0
OP 13	0	0.0	0	0.0
OP 14	0	0.0	0	0.0
OP 15	0	0.0	0	0.0
OP 16	0	0.0	0	0.0
OP 17	0	0.0	0	0.0
OP 18	0	0.0	0	0.0
OP 19	0	0.0	0	0.0
OP 20	0	0.0	0	0.0
OP 21	0	0.0	0	0.0
OP 22	0	0.0	0	0.0
OP 23	0	0.0	0	0.0
OP 24	0	0.0	0	0.0
OP 25	0	0.0	0	0.0
OP 26	0	0.0	0	0.0
OP 27	0	0.0	0	0.0
OP 28	0	0.0	0	0.0
OP 29	0	0.0	0	0.0
OP 30	0	0.0	0	0.0
OP 31	0	0.0	0	0.0
OP 32	0	0.0	0	0.0
OP 33	0	0.0	0	0.0
OP 34	0	0.0	0	0.0
OP 35	0	0.0	0	0.0

Receptor	Annual Green Glare		Annual Yellow Glare	
	min	hr	min	hr
OP 36	0	0.0	0	0.0
OP 37	0	0.0	0	0.0
OP 38	0	0.0	0	0.0
OP 39	0	0.0	0	0.0
OP 40	0	0.0	0	0.0
OP 41	0	0.0	0	0.0
OP 42	0	0.0	0	0.0
OP 43	0	0.0	0	0.0
OP 44	0	0.0	0	0.0
OP 45	0	0.0	0	0.0
OP 46	0	0.0	0	0.0
OP 47	0	0.0	0	0.0
OP 48	0	0.0	0	0.0
OP 49	0	0.0	0	0.0
OP 50	0	0.0	0	0.0
OP 51	0	0.0	0	0.0
OP 52	0	0.0	0	0.0
OP 53	0	0.0	0	0.0

PV 03 and Route: SH27 North

No glare found

PV 03 and Route: SH27 South

No glare found

PV 03 and Route: SH29

No glare found

PV 03 and Route: TRAIN

No glare found

PV 03 and OP 1

No glare found

PV 03 and OP 2

No glare found

PV 03 and OP 3

No glare found

PV 03 and OP 4

No glare found

PV 03 and OP 5

No glare found

PV 03 and OP 6

No glare found

PV 03 and OP 7

No glare found

PV 03 and OP 8

No glare found

PV 03 and OP 9

No glare found

PV 03 and OP 10

No glare found

PV 03 and OP 11

No glare found

PV 03 and OP 12

No glare found

PV 03 and OP 13

No glare found

PV 03 and OP 14

No glare found

PV 03 and OP 15

No glare found

PV 03 and OP 16

No glare found

PV 03 and OP 17

No glare found

PV 03 and OP 18

No glare found

PV 03 and OP 19

No glare found

PV 03 and OP 20

No glare found

PV 03 and OP 21

No glare found

PV 03 and OP 22

No glare found

PV 03 and OP 23

No glare found

PV 03 and OP 24

No glare found

PV 03 and OP 25

No glare found

PV 03 and OP 26

No glare found

PV 03 and OP 27

No glare found

PV 03 and OP 28

No glare found

PV 03 and OP 29

No glare found

PV 03 and OP 30

No glare found

PV 03 and OP 31

No glare found

PV 03 and OP 32

No glare found

PV 03 and OP 33

No glare found

PV 03 and OP 34

No glare found

PV 03 and OP 35

No glare found

PV 03 and OP 36

No glare found

PV 03 and OP 37

No glare found

PV 03 and OP 38

No glare found

PV 03 and OP 39

No glare found

PV 03 and OP 40

No glare found

PV 03 and OP 41

No glare found

PV 03 and OP 42

No glare found

PV 03 and OP 43

No glare found

PV 03 and OP 44

No glare found

PV 03 and OP 45

No glare found

PV 03 and OP 46

No glare found

PV 03 and OP 47

No glare found

PV 03 and OP 48

No glare found

PV 03 and OP 49

No glare found

PV 03 and OP 50

No glare found

PV 03 and OP 51

No glare found

PV 03 and OP 52

No glare found

PV 03 and OP 53

No glare found

Assumptions

"Green" glare is glare with low potential to cause an after-image (flash blindness) when observed prior to a typical blink response time.
"Yellow" glare is glare with potential to cause an after-image (flash blindness) when observed prior to a typical blink response time.
Times associated with glare are denoted in Standard time. For Daylight Savings, add one hour.
The algorithm does not rigorously represent the detailed geometry of a system; detailed features such as gaps between modules, variable height of the PV array, and support structures may impact actual glare results. However, we have validated our models against several systems, including a PV array causing glare to the air-traffic control tower at Manchester-Boston Regional Airport and several sites in Albuquerque, and the tool accurately predicted the occurrence and intensity of glare at different times and days of the year.
Random number computations are utilized by various steps of the annual hazard analysis algorithm. Predicted minutes of glare can vary between runs as a result. This limitation primarily affects analyses of Observation Point receptors, including ATCTs. Note that the SGHAT/ ForgeSolar methodology has always relied on an analytical, qualitative approach to accurately determine the overall hazard (i.e. green vs. yellow) of expected glare on an annual basis.
The analysis does not automatically consider obstacles (either man-made or natural) between the observation points and the prescribed solar installation that may obstruct observed glare, such as trees, hills, buildings, etc.
The subtended source angle (glare spot size) is constrained by the PV array footprint size. Partitioning large arrays into smaller sections will reduce the maximum potential subtended angle, potentially impacting results if actual glare spots are larger than the sub-array size. Additional analyses of the combined area of adjacent sub-arrays can provide more information on potential glare hazards. (See previous point on related limitations.)
The variable direct normal irradiance (DNI) feature (if selected) scales the user-prescribed peak DNI using a typical clear-day irradiance profile. This profile has a lower DNI in the mornings and evenings and a maximum at solar noon. The scaling uses a clear-day irradiance profile based on a normalized time relative to sunrise, solar noon, and sunset, which are prescribed by a sun-position algorithm and the latitude and longitude obtained from Google maps. The actual DNI on any given day can be affected by cloud cover, atmospheric attenuation, and other environmental factors.
The ocular hazard predicted by the tool depends on a number of environmental, optical, and human factors, which can be uncertain. We provide input fields and typical ranges of values for these factors so that the user can vary these parameters to see if they have an impact on the results. The speed of SGHAT allows expedited sensitivity and parametric analyses.
The system output calculation is a DNI-based approximation that assumes clear, sunny skies year-round. It should not be used in place of more rigorous modeling methods.
Hazard zone boundaries shown in the Glare Hazard plot are an approximation and visual aid based on aggregated research data. Actual ocular impact outcomes encompass a continuous, not discrete, spectrum.
Glare locations displayed on receptor plots are approximate. Actual glare-spot locations may differ.
Refer to the Help page at **www.forgesolar.com/help/** for assumptions and limitations not listed here.

Default glare analysis parameters and observer eye characteristics (for reference only):

- Analysis time interval: 1 minute
- Ocular transmission coefficient: 0.5
- Pupil diameter: 0.002 meters
- Eye focal length: 0.017 meters
- Sun subtended angle: 9.3 milliradians

This analysis was conducted using the best available radiometric modeling at the time of generation. Future updates to the modeling methodology may yield different results.