



Proposed Variation to Consent

Taumatotara Wind Farm Ltd

Landscape and Visual Assessment

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Cover image: Looking northeastwards from the junction of Marokopa Road and Coutts Road towards the southern part of the site for the proposed windfarm.

Image by J. Head 8 August 2019

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1 Introduction

WSP-Opus has been commissioned by Taumatotara Wind Farm Ltd (TWF) to prepare a Landscape and Visual Assessment (LVA) to assess the landscape and visual effects of a proposed variation to the consent regarding a 22-turbine windfarm at Taumatotara West Road, Te Anga (the 'T4' wind farm) (**Attachment 1**).

An assessment of effects is required in order to ascertain any potential adverse effects of the variation on landscape and visual amenity. This assessment responds to TWF's request to reduce the size of the windfarm from 22 to 11 wind turbines¹ and increase the tip height of the remaining eleven turbines from the consented 110m to 172.5m. Twenty-two 110m tall² turbines are to date consented (but unbuilt) at the site

The site is located approximately 6.5km northwest of Te Anga, which is approximately 30km west of the Waitomo Caves area, within the Waitomo District. The Project is situated along a ridge line with turbines being located in a northwest/southeast line, straddling the Taumatotara West Road. In the Waikato Regional Landscape Assessment (WRLA), the site is located within the Western Hill Country landscape type. Within the WRLA the area where the site is located is not categorised as an Outstanding Natural Landscape/Feature (ONLF).

It is considered that the primary issue is whether a windfarm is appropriate in this setting or not. In this regard both landscape and visual effects are relevant. As 22 turbines have been consented to date, the decision regarding the appropriateness of such a proposed change to the setting has been made based on the various assessments provided to date.

It is also noted that the originally consented 110m tall turbines are very large structures. Given the relatively sparsely lived-in and visited receiving³ environment, it is anticipated that an increase in height (within reason) of a substantially reduced number of individual structures is not likely to trigger additional landscape character or visual effects that would be unacceptable given the existing consented setting.

2 The Proposed Activities

The proposal is to increase the maximum height⁴ of the northern eleven turbines beyond what has been consented to the point in which any additional landscape character and visual effects arising from the height increase do not exceed the 'low'⁵ threshold⁶. The acceptability of this change is aided by halving the turbine numbers compared to what is consented, not changing their fundamental design, or substantially altering the individual locations of the retained northern eleven⁷.

In addition to the overall height increase other changes are involved at a design engineering level which have negligible changes in terms of landscape and visual effects over what has been consented. Some changes represent net improvements. These changes are included in **Table 1**.

All eleven turbines will use a 'narrow blade' type, which reduces the extent of any shadow flicker effects. In addition, the proposed turbine blades have a lower rotation frequency. Both of these changes represent positive visual effects over what is currently consented for the northern eleven turbines which is discussed shortly.

¹ 'Turbines' refers to the mast, nacelle, hub and blades (the entire structure).

² It is understood that a recent consent variation was granted to increase the turbine heights from 110m to 121.5m tall for the eleven turbines. However, this assessment is based on the potential visual and landscape effects arising from the increase in height between what is proposed now and the first consent.

³ The receiving environment is a 'study area' considered to be the area where any landscape or visual effects of the proposal will be potentially adverse. The proposal may be visible beyond the receiving environment; however, any effects from here will not be adverse.

⁴ From the ground to the tip of the blade when in a vertical position.

⁵ **Low:** A low level of [additional] effect on the character or key attributes of the receiving environment [which includes the consented but unbuilt wind farm] and/or the visual context within which it is seen; and/or have a low level of effect on the perceived amenity derived from it. (Oxford English Dictionary Definition: Low: adjective-below average in amount, extent, or intensity).

⁶ 'Low' and 'very low' are assessed as equating to 'less than minor' in RMA terms. The terms 'more than minor', 'minor' and 'less than minor', are used in the RMA in Section 95 (notification), and Section 104D (non-complying activities), although the latter is not relevant in this application.

⁷ The locations of the 11 turbines have altered from between 2-86m of their consented locations. See **Figure 1** in Energy3 Services Ltd report.

The effects considered in this assessment concern only the physical parts of the proposal that exceed what has been consented. It is understood that the reason for the change of conditions sought (turbine number and size) is to respond to recent changes in wind farm technology that have occurred over the last twelve years since the original proposal was consented in 2008. These technical matters are addressed in the overall Assessment of Environmental Effects by Shearer Consulting and are not discussed here.

3 Landscape Description

The following description is taken directly from the Opus International Consultants' Taumatotara Wind Farm LVA for the S92(1) Information Request (February 2012) which assessed an increase in turbine height for 11 of the turbines from 110m tall to 121.5m tall⁸. That assessment is also provided for overall context in the AEE prepared by Shearer Consulting.

"Broader Landscape Character

The broader context in which the Project is located in is the Western Hill Country of the Waikato District.... The landscape is characterised by steep pastoral hill country, inter-dispersed with exotic tree stands and areas of native vegetation.... The Project area is located within the Western Hill Country landscape type as identified in the WRLA. This area encompasses the western hill country located along the west coast of the Waikato and includes both volcanic and sedimentary rocks, which is often overlaid by a thick layer of volcanic ash. Landcover includes areas of pasture, exotic forestry and large tracts of indigenous forest especially to the south of Kawhia.

The WRLA describes the landscape as: "...pastoral farming is the predominant productive rural land use with the majority of farms consisting of hill country. In the Hills west of Otorohanga there is an extensive system of limestone outcrops featuring pinnacles, as well as caves. The limestone forms the karst topography – an amalgamation of caves, underground channels, outcrops, and a bumpy ground surface. The karst landscape and associated caves are a special feature of the Waitomo District."

Overall the character of the area can be described as highly modified with buildings associated with farming development. The area is not identified as an area of high amenity within the WRLA.

Site Context

The topography of the area within the 10km study area.... is characterised by steep sided hills which have well defined ridgelines with narrow valley systems occurring to the north and south of the Project site. The area's topography defines views particularly from the valley areas where ridges or the steep sided hills screen or contain views. The highest local peak (Maungaakohe) to the north of the site is approximately 344m above sea level.

The landcover is predominantly pastoral with areas of remnant native vegetation associated with the hill slopes and valley systems that run off the ridgelines. Isolated areas of exotic tree planting occur across the hilly landscape with the stands generally being located on the hill side slopes particularly to the south of the site. Generally, the ridgelines are exposed with little vegetation occurring along the ridges....

Landuse within the 10km study area is predominantly pastoral with areas of exotic trees scattered across the landscape.... Rural residential buildings and associated farm buildings within the area are generally sparsely located particularly to the north, west and east of the site, with a number of houses well dispersed along the Marokopa Valley... Within the hill country area, rural residential properties are sparsely located and are typically set within sheltered areas in lower lying areas away from the ridgeline and generally with associated vegetation.

To the north of the site the area is highly modified with hilly open pastoral land predominating with small areas of remnant bush or tree planting. To the south of the site the landscape has been highly modified, but the extent of remnant/regrowth native bush and forestry combined with the pastoral areas result[s] in a relatively cohesive appearance [with] a moderate degree of 'natural' appearance. The amenity value varies in relation to each property depending on the orientation of views, degree of screening vegetation and the effects of topography.

⁸ Report prepared by Adrian Morton (Principal Landscape Architect, Opus International Consultants Ltd, Hamilton, 2009 - 2013)

The landscape character has been assessed as having a moderate amenity value, and will be assessed in relation to the consented, yet un-built windfarm.

The above description accords with my own observations of the site and its context which is illustrated in the site images included in the graphic attachments.

4 Methodology

This assessment considers any potential increase in landscape character and visual effects arising from the additional extent of turbine height. This assessment has been carried out via a combination of desktop analysis and first-hand experience of the site, obtained during field work as well as reference to the 2012 WSP-Opus report. With regards to the desktop aspect, technical information has been provided by the applicant⁹. This information includes:

- T4 Wind Farm ZVI Analysis (Energy3 Services Ltd);
- Australasian standards for determining the potential effects of windfarms;
- ‘wire frame’ renderings of the topography, consented and proposed turbines (**Attachments 6-10**);
- visual simulations of the consented and proposed turbines (**Attachments 6-10**);
- zones of theoretical¹⁰ visibility (ZTV) mapping (**Attachments 2-5**);
- the locations and names of potentially affected parties (**Appendix 1**); and,
- the Taumatotara Windfarm Site Plan – version 1.1 (**Appendix 2**).

The February 2012 landscape and visual assessment has also been relied upon. This report itself relies on an earlier landscape and visual assessment prepared in 2005 which was included with the original windfarm AEE. Following a site visit on 8 August 2019 it was confirmed that the appearance of the setting for the proposal has not altered discernibly.

During the site visit, the site was observed from the surrounding roads including Marokopa Road, Coutts Road, Taumatotara West Road and Taharoa Road. The site was observed from viewpoints along Marokopa and Coutts Road near where several existing dwellings were located. Several stops were carried out and a photographic record was taken. The primary purpose of the site visit was to determine the extent of the receiving environment and the locations of any potentially affected parties (**Attachment 1**). While it was not possible to observe the site from the privately-owned dwellings or properties themselves, the site was observed from close by these dwellings on public roads where the proposal will appear similar.

As a desktop exercise, the ZTV maps¹¹ were studied and compared. The purpose of this was to establish whether any views from dwellings or public viewpoints within the receiving environment would potentially see more turbines than what was consented (for example a turbine previously out of sight behind screening topography or vegetation may have its upper extent visible when taller). **Figure 13** in the Energy3 Services report illustrates the nett increase in visibility between the consented and proposed windfarms. In this figure it is demonstrated that there will be no additional turbines visible from within dwellings or public spaces (in this case roads) generated by the proposal compared to what has been consented. It is acknowledged that of the 11 turbines that were visible from within the identified dwellings and public places in the ZTV analysis in the consented scheme, the visual effects of these 11 turbines will increase as the proposal increases their height. **Figure 10** in the Energy3 Services report includes the area where there will be a nett reduction in the visibility of the windfarm due to the southern 11 turbines being surrendered.

From the ZTV analysis and mapping, occupants in dwelling ‘No. 21’ (**Figure 13**, Energy3 Services Ltd report) will no longer be able to see any turbines as the southern 11 turbines have been surrendered. Occupants’ views from all of the remaining dwellings in the receiving environment will experience an increase in the visibility of the 11 remaining northern turbines, however they will also see 11 less turbines than what was consented. It is also acknowledged that

⁸ ‘T4 Wind Farm ZVI Analysis’, prepared by Energy3 Services Ltd, 2020.

¹⁰ Of note ZTV maps are limited to demonstrating an indicative area/extent of potential view. ZTV maps do not account for vegetation cover or structures (that may screen the proposal). ZTV maps are limited to the accuracy of local contour information (5m (plus or minus 2.5m) contour intervals). It is also acknowledged that with distance and variable climatic conditions the visibility of the proposal may be significantly lessened.

¹¹ **Figures 10-13**; Energy3 Services Ltd report and **Attachments 2-5**.

the surrendered southern 11 turbines were closer to the majority of dwellings in the area than the retained taller 11 turbines which are further to the north away from these properties.

The Energy3 Services Ltd report, separate photomontages and photomontage methodology provided by Energy3 Services Ltd is comprehensive and appears sound and has been relied upon in the conclusions reached in this LVA.

This assessment is prepared recognising the statutory framework of the Resource Management Act in accordance with Schedule 4, section 7(1)(b) which seeks that, in any assessment of a proposed activity, consideration is given to landscape and visual effects. The assessment considers both positive and adverse effects.

In preparing this assessment the following matters are addressed:

- A brief summary description of the site and its context in terms of landscape character and amenity, including consideration of levels of naturalness.
- A description of the proposed activities' effects on landscape and visual amenity.
- Brief comment on shadow flicker.

5 Landscape Status

The proposed activity is in the Rural Zone within the Waitomo District Plan. It is understood that the change of consent conditions application is to be assessed as a discretionary activity under section 127 of the Resource Management Act.

6 Assessment of Landscape and Visual Effects

6.1 Landscape effects

Landscape effects concern physical changes to the setting which may or may not be seen but are otherwise understood to exist. Landscape effects are also synonymous with effects on character and amenity and whether a change to the setting is appropriate or not. Landscape character is comprised from a combination of landform, land cover and land use (or cultural patterns). As such, landscape effects are confined to the volume of earthworks to form the access roading and foundations (**Table 1**, page 12).

It is concluded that any permanent changes to the landscape are limited to the following:

- An increase in the footing widths from 14 x 14m (consented) to 18 x 18m.
- An increase in the roading width on corners from 10m wide (consented) to 14m wide.

The landscape effects arising from the proposal include road benching and the formation of cut and fill batters on either side of the road (where required). These are proposed to be rehabilitated to natural grades and revegetated as per the original consent conditions. Most of the site roading occurs along the ridgeline which is at a high point in the landscape limiting its visibility from public places. It is also understood that the location of the roading has avoided highly visible slope faces where roading would generate scarring and visually adverse effects (for example at 'switch backs'). For these reasons, any landscape effects when considering what has been consented are reduced given the halving in the number of turbines proposed and the reduction in the quantum of physical interventions in the landscape to build and provide access to each turbine location.

To summarise, in terms of a comparison of effects with the existing consented environment, the reduction in the number of turbines from 22 to 11 will lead to significantly decreased landscape effects. The roading required for the 11 turbine option will be approximately 40% less in overall length than the 22 turbine consented option (see Site Plan). The number of turbine platforms are also half, albeit they will be larger. The 22 turbines platforms at 14 x 14m equate to 4,312m² of platform, whereas the eleven 18 x 18m platforms equate to 3,564m² - a nett 17% decrease.

With the location of the roading and turbine platforms obscured from public viewing areas and from off-site landholdings, the earthworks effects are assessed as being significantly less than what has been consented.

6.2 Visual effects

On the seven-point scale of effects, the visual effects of the increase in turbine height of the northern eleven turbines will be 'low'¹². This conclusion has been partly informed when examining the visualisations of the proposed versus consented turbines (**Attachments 6-10**). As mentioned in the introduction - the primary issue is whether a windfarm can be appropriately located in this setting or not and this is partly informed by the visibility of the turbines and the sensitivity of the viewing audience. The consented 110m tall turbines are very large structures and so this question has been answered. Or, in other words the primary visual effect is whether there is a wind farm located on the site or not. The turbines are striking features and as such the actual size of the structures becomes less important.

Given the relatively sparsely lived-in and visited receiving environment – particularly proximate to the northern eleven turbines now proposed and the area's remoteness overall, it is concluded that the increase in height sought will not trigger additional visual effects above 'low'. This is primarily due to the consented baseline environment, but also for the following reasons:

- The number of third party¹³ dwellings located within the receiving environment are relatively low in number (11) (**Appendix 1**).
- The closest third party residence from the main viewing area to the south is 3.72 km away (**Appendix 2**).
- The area's remoteness and modified character contributes towards its capacity to absorb further change beyond what has been consented.
- The wind farm's north-south orientation and setback from viewers located on the relatively 'busier' Coutts and Marokopa Roads.
- The incorporation of a narrow blade which reduces the extent of potential shadow flicker effects.
- The slower rotational speed of the turbine blades when compared with the consented wind turbines.
- The number of turbines now proposed is half what has been consented.

Overall, any increase in visual effects and visual dominance generated by an increase in turbine height over what has been consented for the northern eleven turbines is offset by halving the consented turbine numbers. On balance the visual effects generated by the proposal when tested against the consented environment will be 'low' (which can be translated to being 'less than minor' in RMA terms). This conclusion is also informed by the following discussion.

6.3 Visual effects arising from the specifics of the proposal

6.3.1 Zone of theoretical visibility (ZTV) maps

The two ZTV maps (**Attachments 2 and 3**) map the theoretical visibility of the turbines from all points in the landscape within an 8km radius. When the existing consent ZTV and the proposed ZTV were digitally compared by Energy3 Services Ltd (**Attachment 4**), the nett difference in turbine number visibility between the two can be summarised. The conclusion reached from viewing **Attachment 4** is that there will be no additional turbines visible regarding occupants' views or views from public places (roads). **Attachment 5** identifies an area of the receiving environment (green shade) where there will be a nett reduction in the numbers of turbines visible due to the southern 11 turbines being surrendered. Obviously, the 11 proposed turbines are sufficiently tall that they are (potentially) widely visible regardless of their final size. Few areas of 'new' colour is evident. It is acknowledged that this mapping assumes no intervening structures and vegetation occurs within the topographical study environment which would reduce the visibility of the structures – potentially greatly.

6.3.2 Hub and tower height

The hub height will increase by 58% (60m to 95m) (**Table 1**). The hub height above ground level (measured from the base of the mast), is concluded to be the key determinant of any potential visual effects that may arise. This is because this part of the structure is static and has an obvious upper end-point (hub/nacelle) that clearly defines the upper extent. It is concluded that a 58% increase in height over what is consented will have low adverse visual effects. This conclusion is largely based on the visualisations provided by the applicant (**Attachments 6-10**), which are considered to be accurate and representative, and the fact that the viewing audience is limited.

¹² **Low:** A low level of [additional] effect on the character or key attributes of the receiving environment [which includes the consented but unbuilt wind farm] and/or the visual context within which it is seen; and/or have a low level of effect on the perceived amenity derived from it. (Oxford English Dictionary Definition: Low: adjective-below average in amount, extent, or intensity).

¹³ Understood to Include landowners who do not own land where turbines are proposed to be located.

Any increases in the proposed tower diameters (top and bottom), blade stem chord width, hub and nacelle dimensions above what has been consented are between 22% and 40% (**Table 1**). Any additional visual effects of these increases will be acceptable given what has been consented, as the scale (and change in scale) of these items is relatively small compared with the overall turbine height increase. From the viewing distances involved it will be unlikely that these increases are discernible. Table 1 identifies several changes in the size of the turbine components. The following section assesses the potential visual effects of each of these in turn:

6.3.3 *Blade tip height (overall turbine height)*

The blade tip height will increase by 58% over what is consented. However, while this appears large – particularly in the case of the change from the 110m tall turbine to a 172.5m tall structure, there are two reasons why this increase in tip height will be acceptable relative to the already consented windfarm. The first is due to the ‘narrow’ type blade proposed, with a maximum blade chord width of 4m which reduces the extent of the shadow flicker zone compared to what has been consented.

Secondly, any potential visual effects arising from the increase in overall tip height is mitigated through the rotational speed of the blades. The larger turbines will generate a slower maximum blade rotation speed of 12.5 revolutions per minute (rpm). The consented turbines rotate at a typical 18 rpm. The slower rpm of the proposal will result in a less visually frenetic and more languid rotation which will appear ‘calmer’ and for that reason, less visually intrusive and distracting - particularly in the field of peripheral vision. This goes some way towards compensating for the increased visual effects of the taller structures.

6.3.4 *Changes at ground level*

Changes at ground level include the footings and roading. The footings diameter increases by 28%. It is expected that any increase in footing size will have nil visual effects as these changes will be largely below ground level and out of public view.

Similarly, there are some increases to roading width compared with what has been consented. These increases enable longer components to be trucked around complex topographical change points. It is determined here (on principle) that an increase in road width above what is consented on corners of up to 4m will have acceptable visual effects. This is due to the limited permanent viewing audience, cuts all appear on the top of ridgelines (and not across a slope) and that any increased height of cuttings and fill batters will be required to be revegetated as part of any conditions, should the proposed variation to the consent be granted. It is also acknowledged that overall there will be significantly less changes at ground level included in the proposal compared to what has been consented

6.4 *Shadow flicker zone – small reduction in adverse landscape and visual effects*

The extent of the shadow flicker zone is reduced by approximately 100m compared with the consented turbines as the proposed turbines include ‘narrow width’ blades. Shadow flicker effects are determined by multiplying the maximum blade chord¹⁴ width by a factor of 265¹⁵. The maximum blade chord width is 4m (or a radius of 1,060m centred on each turbine). It is understood that no additional (recently constructed) dwellings are located within the potential shadow flicker zone compared with the consented wind farm. Shadow flicker effects are therefore not addressed further in this LVA.

6.5 *Amenity Values*

Aesthetic coherence of the landscape is derived from all of the senses, although the visual sense is typically pre-eminent¹⁶ for most people where one’s appreciation of the landscape is largely obtained. The visual comes under ‘amenity values’ as defined in the RMA, the other attributes being pleasantness, cultural and recreational.

It is acknowledged and has been discussed throughout that the introduction of eleven fewer and taller turbines to the setting over what is already consented is the key generator of the magnitude of the effects on what is essentially a limited and transient viewing audience. However, on balance the difference between what is consented and what is proposed generates only ‘low’ adverse visual effects. This is primarily due to the halving of the proposed turbine numbers compared to what has been consented. Any potential adverse effects on amenity values were determined at

¹⁴ Point where the blade width is at its maximum.

¹⁵ Table E-2 Summary Modelling Assumptions, EPHC National Wind Farm Development Guidelines – Draft July 2010 (Australia).

¹⁶ Sound and smell are also important as they affect one’s appreciation of the landscape although these attributes are less relevant here.

the initial consenting process on a broader receiving environment compared to now. Turbine height is less important. Nonetheless, the height increases of the proposed 11 turbines will generate 'low' adverse effects on amenity levels above what has been consented to date.

For the foregoing reasons, existing amenity derived from the potentially affected landscape will change little despite the consented more extensive wind farm. Therefore, there will be only 'low' effects in terms of the area's associative attributes. Any effect on amenity values are concluded to be similarly 'low'.

7 Conclusion

It is concluded that regardless of the size of the turbines whether they are 110m, 121.5m or 172.5m tall, all are very large structures. It would be not unreasonable to conclude that anyone looking at a wind turbine would have difficulty in determining its height whether it was 110m tall or 172.5m tall. There is little to compare the height of such structures with.

The purpose of this assessment is to consider the potential landscape and visual effects of the *difference* in the proposal's attributes between what is consented and what is proposed. This is achieved with the benefit of the report prepared by Energy3 Services Ltd. It is found that the difference in effects between the consented twenty-two 110m tall turbines and the proposed eleven turbines at 172.5m tall will have 'low' adverse visual effects. Landscape effects arising from the proposal will be less than what has been consented.

The environment where the site is located is sparsely occupied, or otherwise passed through which provides a sound rationale to locating the wind farm here. Taumatotara West Road appears to be little used other than by locals. The area where the windfarm is proposed is well to the west of the tourist 'terminus' at Waitomo and substantially north of Marokopa Road. It is unlikely that many tourists would venture further west from the Waitomo caves, or onto Taumatotara Road however this can only be assumed.

It is understood that all dwellings inside the shadow flicker zone are on properties owned by those landowners who have agreed to have turbines on their properties.

The site is ideally located to accommodate renewable energy such as a windfarm. The site and setting include substantial modification for farming purposes which includes vegetation clearance practices and drainage works to 'improve' the land. Neither of which have been particularly kind to the landscape. For these reasons, the area is not particularly special with regards to rural amenity values which are concluded to be conservatively 'moderate'.

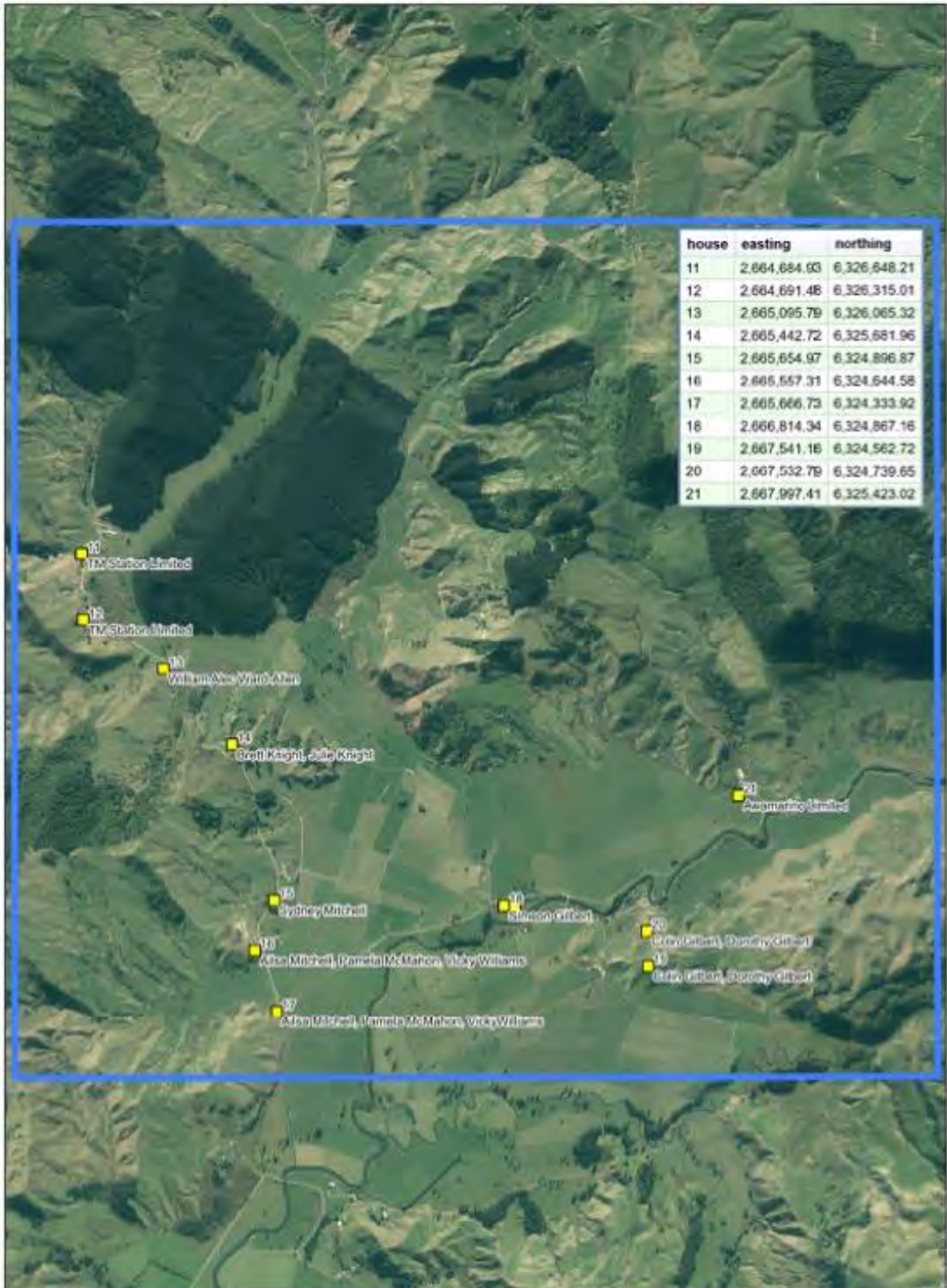
The current proposal seeks to halve the consented turbine numbers. The remaining northern eleven now proposed are in similar consented locations (within 86m at most from their originally consented locations). The slower rotational speed of the proposed narrow type blades is also important in balancing out any additional visual effects of the height increases.

Table 1:**Comparison between proposed and consented turbines and net change**

Design specifics	Proposed (narrow blade)	Consented	Change (%)
Overall height (metres)	172.5	110	+ 58
Hub height (metres)	95	60	+ 58
Blade stem chord (metres)	2.8	2.3	+ 22
Blade chord (widest) (metres)	4	4.4	reduced
Tower diameter (top) (metres)	3	2.3	+ 30
Tower diameter (bottom) (metres)	4.1	3.2	+ 28
Rotor diameter (metres)	155	100	+ 55
Hub diameter (metres)	5.76	4.1	+ 40
Nacelle width (metres)	5.8	4.2	+ 38
Nacelle length (metres)	17.4	12.5	+ 39
Footing dimensions (metres)	18 x 18	14 x 14	+ 28
Roading width (straight sections) (metres)	4	4	same
Roading on corners (metres)	14	10	+ 40
Rotational Speed (RPM)	11.1	18	reduced
Multiplier (for shadow flicker)	265	265	-
Shadow Flicker extent (metres)	1060	1166	reduced
Number of turbines	11	22	reduced

The above comparison table includes technical information provided by the applicant. This information is also relied upon when assessing the landscape and visual effects of the current application to vary the consent.

Appendix 1 – Nearest 3rd Party Houses



T4 Windfarm

Coordinates in NZMG (NZGD1949)
 Cadastral Ref: LandOnline 03/08/19
 Manawatu Aerial Photo Services RN 26/08/19

Scale 1:25 000 (A4)

Appendix 2

