T4 Wind Farm

Response to Mansergh Graham Project Memorandum 2nd December 2019

Report Prepared For:
Ventus Energy
M338 Private Bag 300987
Albany
Auckland
New Zealand

By:
Energy3 Services Limited
P.O. Box 17563
Sumner
Christchurch, 8830
New Zealand

Document Control Record

Document prepared by:

Energy3 Services Limited
PO Box 17563
Christchurch, New Zealand

Telephone	**+64 3 376 5539**
Email	info@energy3.co.nz
WWW	www.energy3.co.nz

Report Title		Response to Mansergh Graham Project Memorandum 2nd December 2019				
Document ID		T4	***Project Number***		T40012	
File Path		P:\CUSTOMERS\Ventus Energy\T4\T4 Application				
Client		Ventus Energy	***Client Contact***		Glenn Starr	
Rev	**Date**	**Revision Details/Status**	**Prepared**	**Author**	**Verifier**	**Approver**
0	22 June 2020	Revision 0, draft, discussion document	TC	TC	MB	MB
1						
2						
3						
4						
Current Revision		**0**				

Approval			
Author Signature		***Approver Signature***	
Name		***Name***	
Title		***Title***	

Introduction

Ventus Energy requested that Energy3 Services Limited (E3) undertake a revised ZVI analysis and photomontage exercise for the proposed amendment of the T4 wind farm project. As part of this process, Ventus Energy has requested that E3 respond to questions posed in the *Landscape and Visual Effects Reporting Memo* prepared by Mansergh Graham Landscape Architects, dated 2nd December 2019.

The revised T4 project consists of 11 proposed wind turbine locations, a reduction from the original 22 consented sites. The revised turbine locations are spatially suitable for large scale wind turbines.

The following tables summarises the originally consented turbine dimensions relative to the new turbine proposal.

Parameter	Hub Height (m)	Rotor Diameter (m)	Tip Height (m)
Originally Consented Turbine Specifications	95	155	172.5
Revised Proposal Turbine Specifications	60	100	110.0

Table 1: Wind turbine sizing

The software programme WindFarm was used to process the supplied contour and GIS data, photographic files, and perform the required analysis. The software package QGIS has been used to manipulate the files derived from WindFarm analysis for presentation and further analysis provided in the reports.

List of Figures

E3 RESPONSES TO QUESTIONS POSED

All questions raised by Mansergh Graham Landscape Architects in the project memorandum are replicated below, only the questions directly applicable to E3's work scope have been answered.

a. All landscape and visual effects assessment must follow a recognised and accepted methodological approach.

Photomontages of the proposed T4 Wind Farm were formulated using "WindFarm", development software (Release 4.2.2.1) written by ReSoft, a specialist wind farm software development company (http://www.resoft.co.uk/English/).

WindFarm is an integrated software package, which combines the ability to formulate turbine site layouts, assess potential turbine energy yields, and also has the ability to analyse various turbine layouts for both noise emissions and visual impacts.

To accurately position turbine layouts and locations, topographical contour information and turbine position coordinates are required. This data has been provided by Ventus Energy, sourced from LINZ Data Services, and Ventus Energy's agents.

The broader area vector height data has a resolution of 20m, and the vector data provided for the general site of the proposed wind farm has a resolution of 5m.

The shapefiles were imported into the T4 project in WindFarm; the input files are ordered so that the high-resolution data takes precedence over the lower resolution underlying data. The data files are thus merged, and the contour attributes coalesced to form one continuous terrain file. Prospective turbine sites are also inputted into the model, the existing wind mast sites, photographic viewpoints, and terrain location markers. As a check, the original vector data is sampled and compared with the turbine heights calculated by WindFarm to ensure accuracy is preserved.

WindFarm uses the compiled terrain height data and layout information for turbine energy yield calculations, and of particular importance, to create the wireframe terrain mesh for Photomontage formation.

The basis of the photomontage creation is the loaded topographical data. This data is used to create a three-dimensional wireframe model, on which its accuracy and resolution is based on that of the loaded topographical data. This is a combination of both 5m resolution raster data of the wind farm site, and 20m contours in the case of the data set used for the wider area. When the vector contour files are loaded into WindFarm, the data is converted into a specific grid file format to enable the wireframe rendering.

Turbine dimensions and attributes are entered into the WindFarm turbine studio module. The dimensions are accurately based on the turbine that is proposed to ensure the rendered turbines provide a realistic representation. Important dimensions and attributes include:

- Tower height, diameter, and taper
- Blade length, chord, taper, radius, pitch axis, and width
- Hub size and shape
- Nacelle size and shape
- Colour

The following screenshot provides an example of the parameters required for defining a generic blade size in order to produce an accurate representation of the actual turbine proposed. Similar configuration screens are used to define the tower, hub, and nacelle dimensions.

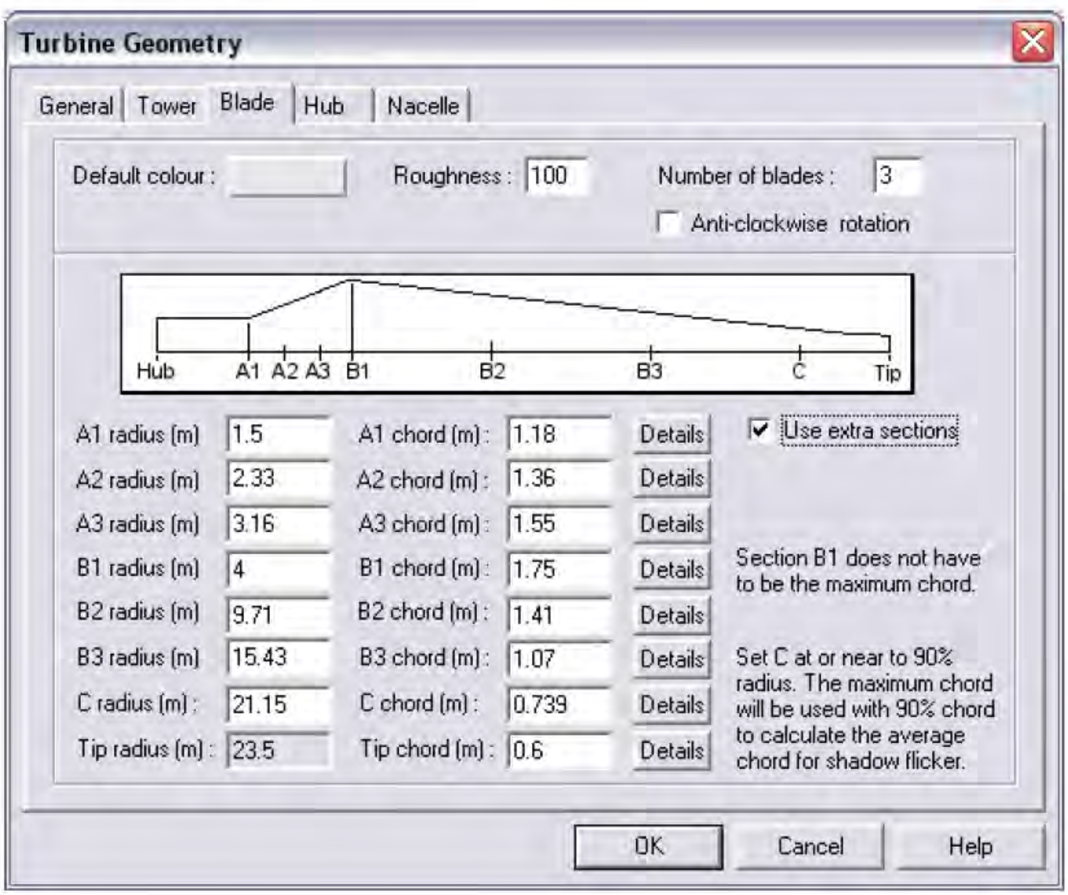

Figure 1 - Blade size definition screenshot

Once the proposed wind farm layout has been entered via entry of the surveyed turbine locations, WindFarm then renderers an outline of the turbines using the previously entered physical dimensions and the three-dimensional wireframe as the ground plane reference.

The following screenshot shows an example of a generated wireframe and rendered turbine representations based on the desired turbine specifications.

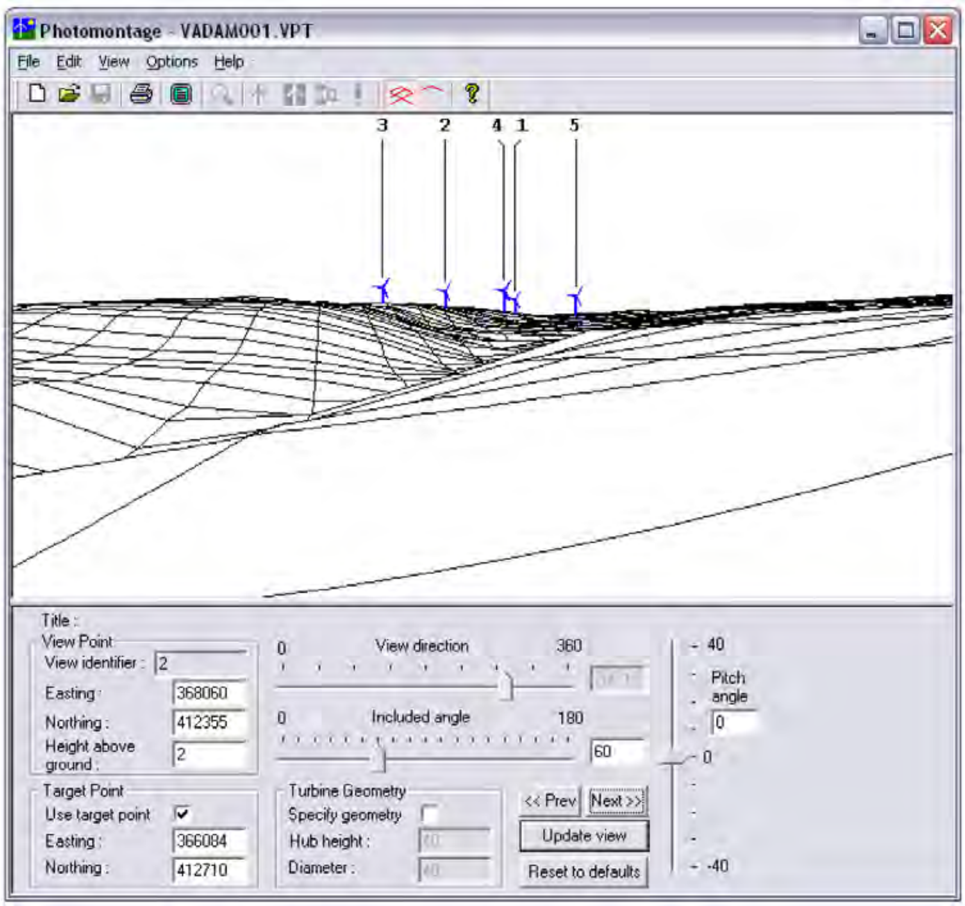

Figure 2 - Wireframe created from contour data

After the turbine rendering process has been completed, viewpoint coordinates must be specified for the photos that are to be used as the montage background. Once the viewpoints are specified, the WindFarm program is able to project a wireframe with scaled turbines, as if viewed from each of the defined viewpoints.

If a wider field of view is required than from a single photograph, a number of photos may be stitched together and then loaded into the photomontage module. Microsoft ICE is used for the stitching procedure; a cylindrical projection is used. It is important to ensure, however, that the total field of view from multiple stitched photographs does not exceed 124° as this is greater than the primary human field of view.

The next step of the photomontage formation is to overlay the individual or stitched photographic image from a particular viewpoint with its corresponding wireframe view. During this process, certain variables must be manipulated by the software operator to ensure the photo closely aligns to the wireframe with particular reference to the horizon.

Variables associated with the manipulation include:

- Height above ground from which the photo was taken
- View direction
- Included viewing angle
- View target coordinates (optional)
- Pitch angle
- Photographic rotation
- Projection

In addition, geographic locators can be specified to accurately align the photographs with the three-dimensional wireframe. These are firstly visually and physically identified on the actual wind farm site and then referenced via a GPS coordinate in the wind farm layout. The markers are subsequently displayed in the wireframe model as a visible reference marker. When the relevant photograph is loaded into the WindFarm software module, the previously listed settings can be manipulated so that the wireframe markers line up with their respective referenced object on the photograph.

Examples of locators used on the T4 Wind Farm site include specific trees, power poles, natural features, and fence lines.

The following screenshot from WindFarm shows the process of using markers to align and position the photograph correctly, note that in this case, an existing wind monitoring mast was utilised as a visual marker on the left side of the shot:

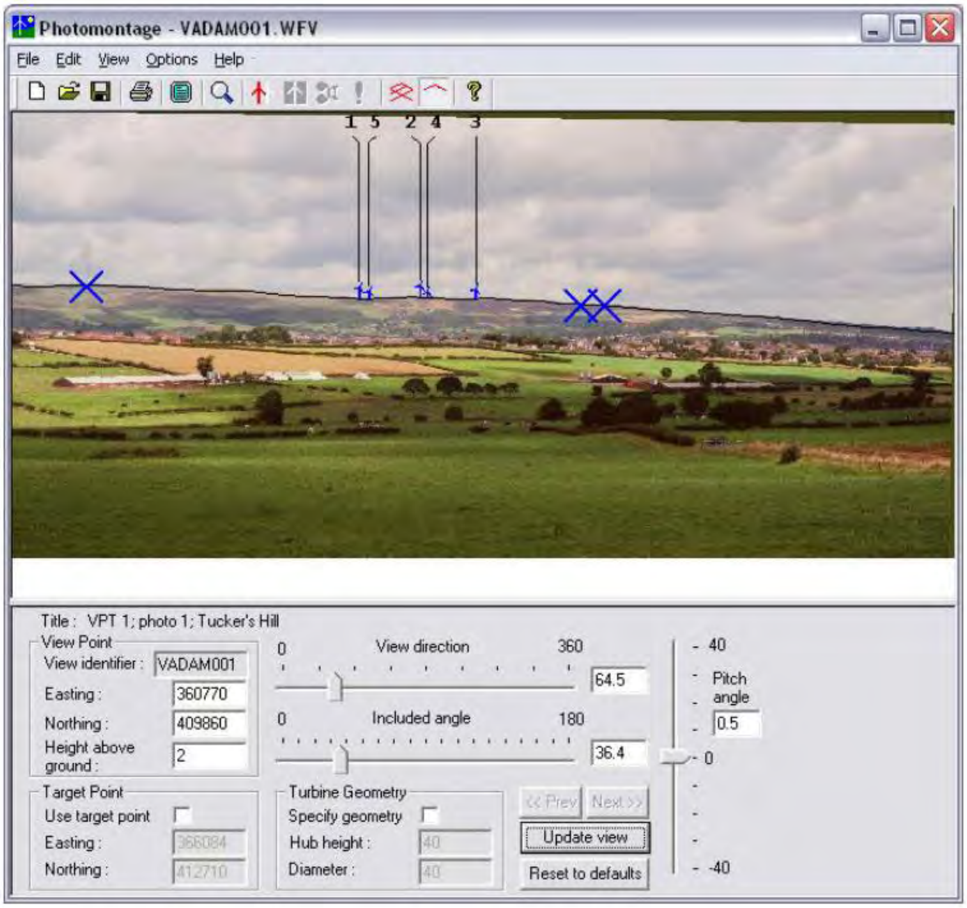

Figure 3- Photograph alignment with geographical markers

Following the correct placement of the photograph relative to the wireframe model, the turbines can be fully rendered to see how they fit in relation to the background photograph.

At this point of the process, the individual turbine positions relative to the foreground of the photograph are taken into account. For example, there may be trees in the foreground that would obscure some of the individual turbines structures. If this is the case, exclusion zones are digitised around foreground objects so that the rendered turbines will appear behind these objects, as opposed to the appearance of being in front of them.

The following screenshot shows the exclusion zone definition process:

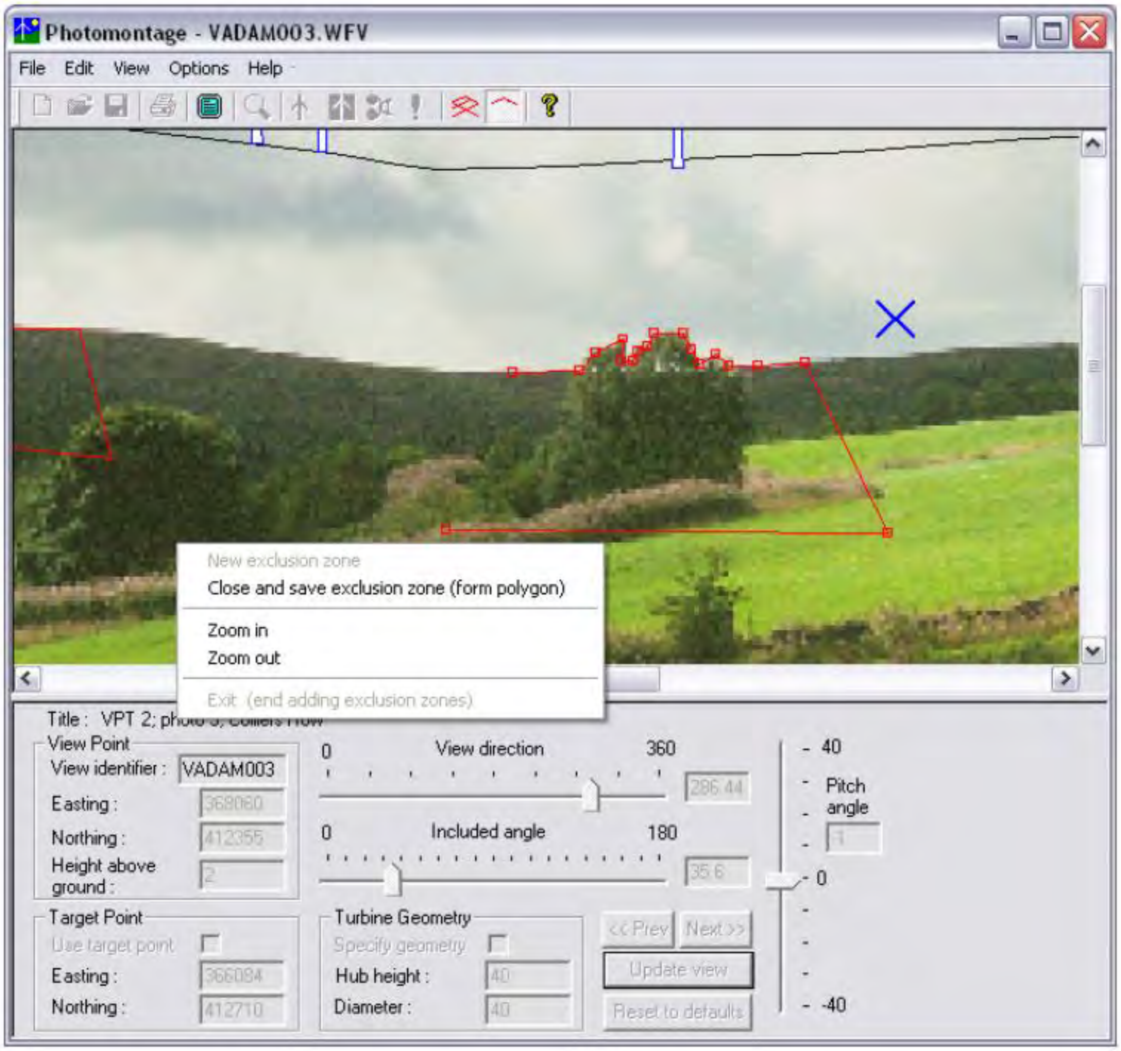

Figure 4 - Digitising exclusion zones

A number of other settings for the display of the turbines are also required to produce realistic simulations. These settings include:

- Lighting model
  - In this module, the Sun's position is specified relative to the wind farm so that realistic shading is factored into the rendered turbines. The position of the turbine nacelles and blades relative to the viewer can also be manipulated depending on requirements.
  - Light intensity is able to be adjusted for the following scenarios:
    - Bright sunlight
    - Weak sunlight
    - Cloudy conditions with no sun
    - Custom control of conditions are also possible

- Colour Shift and Blur
  - The turbine colour is initially set via turbine specifications in the turbine studio module; however; colours may be manually adjusted to allow for a sunrise or sunset reddening effect.
  - Blur may be used when the distant horizon on a photograph appears slightly blurred. In this situation, the rendered turbine will appear to be too sharp in relation to the photograph, and therefore may give a false appearance. Blur reduces the resolution of the rendered turbine giving a more realistic look in these situations.
- Earths Radius
  - The Earths radius is a preset value but can be overridden if necessary.
  - Atmospheric refraction can also be included if necessary or desired.

The following screenshot shows a completed photomontage, prior to export:

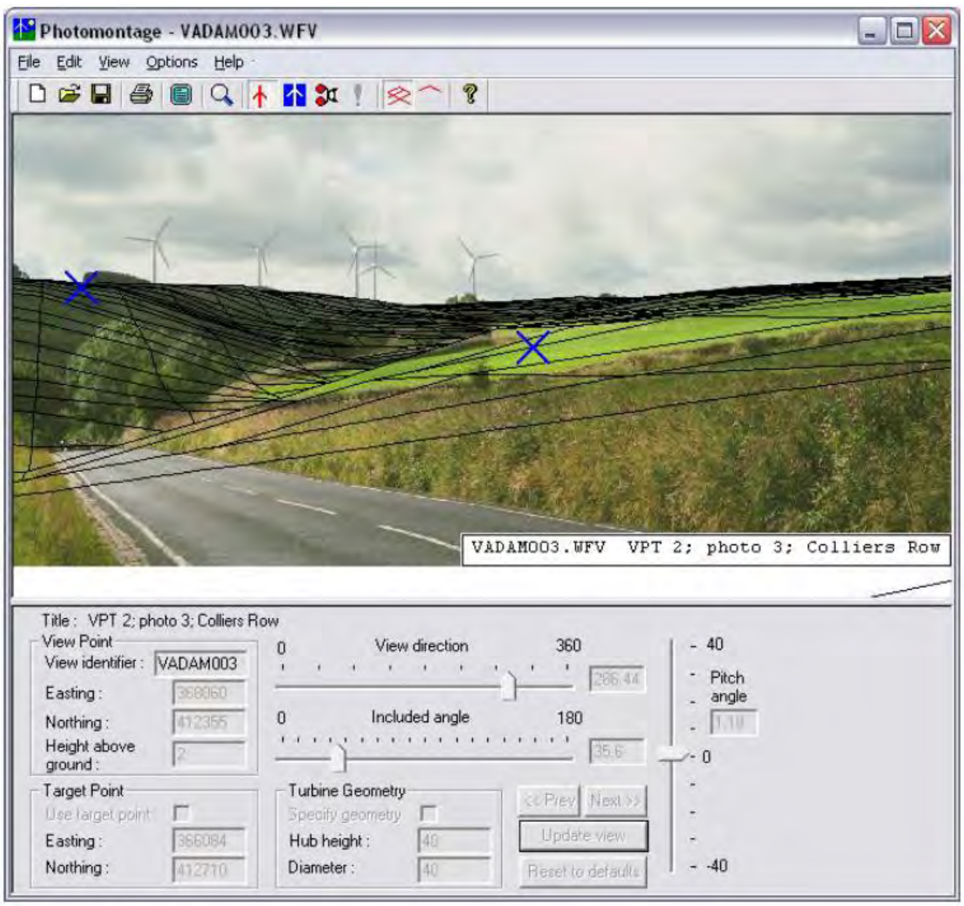

Figure 5 - Completed photomontage prior to export

On completion of the photomontage, the image is exported using the same resolution as the original photograph. When the image is exported, WindFarm calculates the correct viewing distance for a true representation when printed at an A3 scale.

Adjustments are often required to be made to the exported photomontages to better reflect reality; for example where the turbine may be slightly above ground level due to topographical inaccuracies brought about by the resolution of topographical data, or when trees are in the foreground of turbines. There may also sometime be an unnatural transition from the ground or vegetation to the turbine tower which requires some finessing to look realistic. These adjustments are performed with the Photoshop software package and may include refining the transition from ground/vegetation to tower structure. It may also be used to "reorder" more complex vegetation or structures in the foreground so that turbines appear accurately behind semi-porous objects in the foreground, such deciduous trees, power lines, or lattice structures.

Photoshop may also be used to adjust the background light levels so that the turbines can be seen more clearly to illustrate their positions on the landscape. A dual set of images is created in this case so that a viewer may see the unadjusted background image as a comparison.

The following screenshot shows such a situation where the left most turbines tower section intersects with trees, and to be realistic, the tower margins should be blended with the trees to some extent as opposed to a virtual truncation.

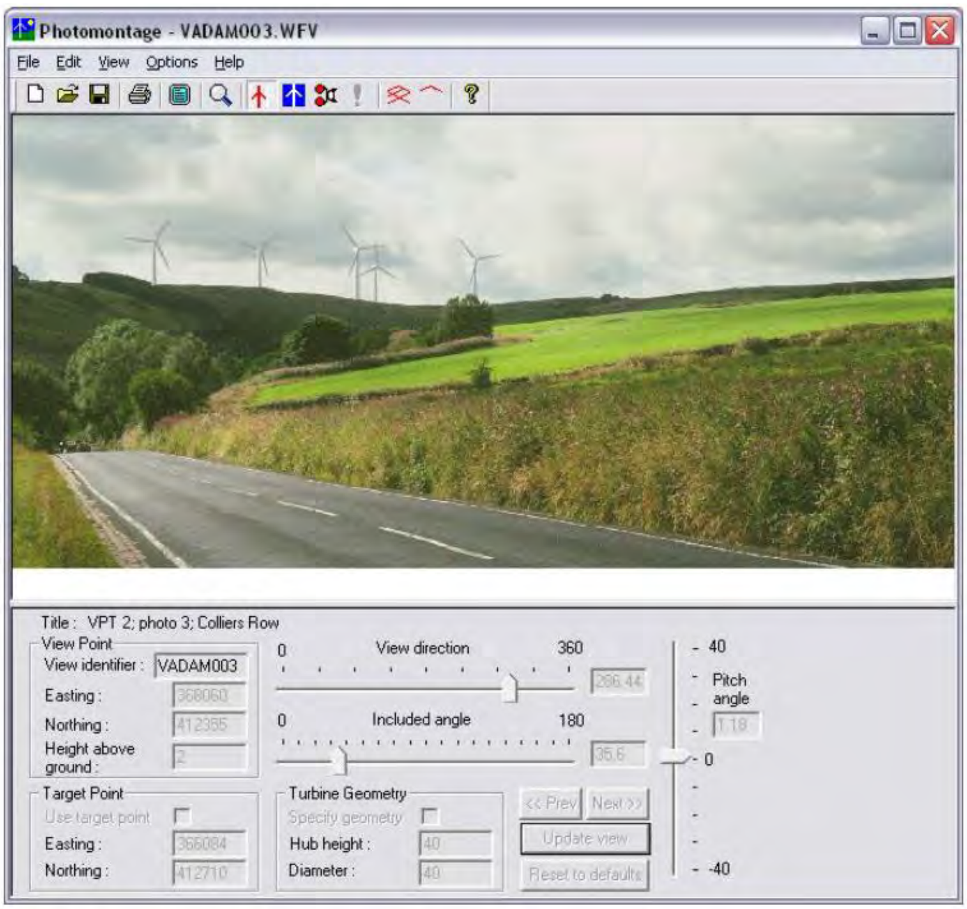

Figure 6 - Photoshop editing required on left most turbines' intersection with surrounding trees

Run Data is available from each photomontage file, and describes critical parameters of the photomontage process to enable auditing and verification.

b. That the existing consented environment is clearly and fully identified

In terms of representing the consented environment, new photomontage's and ZVI's have been created based on the consented turbine numbers, relative positions, and size.

c. That the proposed amendments to the consented activity are clearly identified

Photomontage's and ZVI's have been created based on the proposed amendments to reduce the number of turbines, the proposed revised turbine positions, and increased turbine size.

Identical base data and software settings have been used in WindFarm for the consented and amended sets of analysis to ensure consistency between the two scenarios. Therefore the only variance between scenario representations is the number, placement and size of turbines. The base data and settings of significance include:

- Height Data
- Photographs
- Viewpoint location
- Software settings which include view angles, lighting model, colour shift and blur

d. That the effect of any earthworks associated with the construction of the Windfarm (creation of pads and access roads over and above that already consented is discussed)

Not applicable to the E3 work scope.

e. That the ZTV analysis is provided in a larger format and at a higher resolution so that a comparison can be made between the effects of the consented Windfarm and the proposed amendments;

The revised ZVI analysis has been produced in a larger format than the prior consented version, and initial revision. Resolution has been reduced to 20m to provide a more granular visualisation of both the consented wind project and the proposed revision. In addition, a further analysis was carried out using GIS software to ascertain the reduction of visibility bought about by the proposed reduction of turbine numbers and to identify any additional areas of visibility bought about by the proposed larger turbine scale. For consistency identical datasets, visibility quantification, and shading schemes were used for the analysis of both scenarios.

f. Provide further analysis/commentary around the threshold at which all effects fall below the minor threshold (not the low threshold as currently used in the WSP-Opus report)

Not applicable to the E3 work scope.

g. That any difference between the ZTV's is clearly identified and any newly affected properties or person (or properties or persons with increased levels of effect) are clearly identified

GIS software was used to create vector files from the raster ZVI output of Windfarm from both the consented and proposed development scenarios. Thus is was possible ascertain the reduction of visibility bought about by the proposed reduction of turbine numbers, and to identify any additional areas of visibility bought about by the proposed larger turbine scale using vector file manipulation techniques. The initial visibility maps were consequently reduced to clearly present the areas of visibility reduction and any contrary increase. An additional map was created to present properties identified in the prior analysis relative to the areas of potential visibility increase and contained within the ZVI analysis report.

h. That if different turbines heights are to be applied for, greater analysis of the likely effects of seeing two different turbine sizes in proximity is provided. If all turbines are to be the same size and significantly increased, further analysis of the effects around increased prominence and visual dominance (as well as visibility) should be provided

Not applicable to the E3 work scope.

i. That the discussions around hub and tower height be expanded and addressed in further detail

Not applicable to the E3 work scope.

j. All view location photographs and photomontages should be presented in accordance with NZILA best practice note 10.2 and include camera lens and sensor size data, time and location the photographs were taken and recommended viewing distance. This information is required for independent verification of the accuracy of the photomontages.

Note re camera lens and sensor size data, time etc - these are consistent across photos, time was not usually important from prior work. They aren't included in each title block at this point, but can reissue if essential, or provide covering note saying 50mm lense, CMOS sensor etc

In August 2008 the New Zealand Institute of Landscape Architects hosted a Landscape Planning Initiative, from which arose a directive that a series of Best Practice Guide (BPG) documents be prepared. The Technical Guide for Photomontage Simulations was the first of such documents to be published, and as such, has relevance to the formation of the ZVI analysis and the photomontages for the proposed T4 Wind Farm.

The analysis does accurately follow the general principals set out in the NZILA BPG, namely:

- The analysis is performed as accurate as possible with the available data in order to assist in making well-informed judgments.
- The analysis by WindFarm is based on a structured and replicable procedure so that others may test and confirm the accuracy and credibility of the simulations.
- The analysis is carried out by specialist wind farm software, and therefore uses techniques that represent the project in its true environmental context, and in a fair and reasonable manner.
- The presentation provides a clear representation and conveys important information in regards to the analysis for each photomontage.

As part of the presentation process, it is, however; important to ensure that large format printing is carefully managed so that the relationship between picture size and viewing distance is maintained. The prepared images are configured to be printed in the A3 format so that the printed image is 40cm wide. Each photomontage has the appropriate viewing distance noted so as to attain the correct perspective. Often when displayed on a computer monitor, users will zoom in on the image, this distorts the viewed image resolution, and as such no longer reflects a true representation of the potential wind farm.

k. *Photomontages showing the proposed Windfarm (only), should also be included. For comparison purposes photomontages of the consented Windfarm and an overlay of both are useful and may provide some support for any discussion around the level of increase in any effects over and above that already consented*
   Note – Energy3 haven't created an overlay on the same image, it can be done but would be a bit messy, probably better to compare side to side, I think one merged image would be interpreted negatively

Photomontages of both the consented and the proposed project revision have been prepared. In order to present an accurate representation of variance between the two scenarios, all visual aspects between the two scenarios is held consistent. This includes not only the photographic background but also the WindFarm software settings other than those relating to turbine geometry.

l. *That any information, supplied by a third party and relied upon in the VLA, is clearly identified and independently verified by a qualified landscape architect*

Not applicable to the E3 work scope.

m. *Identification of any additional mitigation measure required to be implemented*

Not applicable to the E3 work scope.

n. *If the AEE associated with the existing consent is to be referenced or relied upon then a copy should be provided as an appendix to the VLA.*

Not applicable to the E3 work scope.