In the matter of the Ararat Wind Farm

Planning Panels Victoria

Proponent: RES Australia Pty Ltd

Expert Witness Statement of David Tilley

Expert of RES Australia Pty Ltd

1 Name and address

David Michael Tilley

68 Brighton Street Richmond Victoria 3121

2 Area of expertise

1 I hold diplomas in Geology and Engineering Geology from RMIT and Monash University.

2 For the past 30 years I have been involved in investigations for roads, road design and assessment of road building materials.

3 My qualifications and experience are detailed in Annexure A.

3 Scope

3.1 Instructions

I have been commissioned on behalf of RES Australia Pty Ltd ("RES") to independently assess the Geology and Hydrology Assessment Report ("RES Report") carried out by RES for the proposed Ararat Wind Farm, carry out an independent assessment of geology and hydrology issues raised in the submissions and provide expert witness evidence. RES has also specifically requested that I consider and address in this statement:

- how mitigation measures can be employed during construction to prevent or control erosion; and
- the fact that some sub-surface site investigation works have been carried out by Douglas Partners (in the report on proposed borrow areas) at a number of locations throughout the proposed wind farm in order to determine whether the excavated materials will be suitable and readily available to minimize off-site stone requirements and the outcomes of that investigation.

3.2 Process and Methodology

This statement contains the findings of a review of the relevant reports on both hydrology and geology carried out previously. The main reports reviewed are listed below although background reading of the area and issues to be addressed was also carried out.

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3.3 Reports Reviewed to Prepare Initial Study or Statement

1 RES Ararat Wind Farm Geology and Hydrology Assessment Report August 2009.

2 Douglas Partners Report on Proposed Borrow Areas Ararat Wind Farm Ararat, Victoria. Report 71133, July 2009 ("DP Report"), which is attached as Annexure B to my statement.

3.4 Persons assisting with this work

I am the only person who has worked on preparing this statement.

4 Findings

4.1 Background to the site

(a) Geology

The geology of the area consists of Cambrian to Ordovician age sandstone, siltstone and mudstone. These sediments have been affected by metamorphism, both regional and contact, often resulting in the development of higher strength rock. The rocks of the area are also characterized by tight folding.

(b) Topography

The area of the proposed wind farm is the southwestern end of "The Great Dividing Range". The site is dominated by relatively steep and narrow crown ridges falling to rolling plains and moderate to low hills. The ridge tops have generally been cleared of their original native vegetation and sown with pasture grasses. The land is primarily used for agricultural purposes, grazing and cropping.

(c) Hydrology

The subject site drains northeast in to the Wimmera River, via Mount Cole Creek and south in to the Hopkins River.

The plans provided by the Glenelg-Hopkins and the Wimmera Catchment Management Authorities show that there are no identified wetlands/lakes on site. There are however two small private dams 50m in diameter.

The ridgeline of the Great Dividing Range and Telegraph Hill on which the subject site is based represents the catchment boundary between the Wimmera River to the north and the Hopkins River to the south.

4.2 RES Geology and Hydrology Assessment Report

A peer review of the RES Report was carried out by Douglas Partners as set out in a letter of 16 June 2009. Although I was not the person who undertook that review, I confirm that I have reviewed the RES Report and agree with the proposed RES methodology for the design, construction and maintenance of the site from a geology and hydrology perspective.

A summary of the pertinent issues discussed in the RES Report is presented below.

(a) Design Criteria

Access tracks and hardstandings

The RES Report addresses design considerations that are aimed, in part, at mitigating the sedimentation and erosion risks associated with the construction of the access tracks and hardstandings. It notes that the preliminary access track and layout design has been undertaken taking account of factors such as:

- Minimising the length of on-site track and position where possible on ridge crest to minimise catchment areas above cuttings and filled areas;
- land tenure constraints;
- vehicle manoeuvrability;
- safe sight distances;
- gradients to meet turbine delivery and installation requirements;
- contours and cross slopes; with respect to drainage requirements and minimising cut and fill volumes;
- avoidance of water courses.

The key point in minimising the impact of roads is to reduce the accumulation and channelling of water by dispersing it back into the usual catchment system at as many points as possible.

On-site tracks

In relation to on-site tracks, RES proposes to consider the following design measures in the layout and detailed design to mitigate sedimentation and erosion risks:

- avoid scouring caused by significant velocities by minimising collected water flows and designing low velocity swale drains;
- minimise the exposure of soil, especially on non-trafficked areas such as batters and drains by minimising the construction footprint;
- discharge run-off regularly from table drains through turn out drains in to sheet flow across well vegetated ground so that it does not have direct access to drainage lines;
- where necessary, use surface or sub-surface drains to redirect water flow away from any identified areas of instability, relict or ongoing, by the construction of small diversion drains;
- minimise the number of watercourse crossings and maximise the distance between tracks and parallel existing streams;
- maximise length of routes confined to already disturbed areas;
- protect batters with uphill catch drains; and
- intercept subsurface flows where these seep from cut batters, and direct flow with safety to the table drain.

Turbine foundations

The RES Report includes discussion of erosion, stability and drainage controls that will affect the final micro-siting of the turbine foundations, including:

- avoid large side slopes which would result in large volumes of cut required to create a level footing;
- avoid areas of potential, ongoing or relict ground instability;
- avoid existing trees and vegetation;
- locate all wind turbines at least 50m from the top of the bank of a CMA recognised waterway (this method has also been suggested by the Glenelg Hopkins Catchment Management Authority and has been incorporated into RES' design of the proposed wind farm);

- consider geological conditions to avoid areas with large depths of overburden and minimise the volume of excavation required; and
- avoid natural low-points which could disrupt natural water flow and/or drainage during wet periods.

(b) Construction mitigation measures

The RES Report addresses in detail mitigation measures to be used during construction to manage the potentially adverse environmental impacts, particularly erosion, potential sedimentation of waterways and impact to soil and landforms, such as:

- continual maintenance of drainage system and track hardstanding surfaces during construction;
- site preparation works and major earthworks activity will be avoided during heavy rain events;
- erosion and sediment control devices (eg. hay bales and swales) will be fitted down slope of construction sites (where required) to prevent erosion events and capture potential sediment wash. These should be regularly maintained;
- areas known to be particularly or potentially prone to erosion will be identified prior to the setting out of access tracks and earthworks, and avoided where possible. Where potential dispersive soils are identified during the site investigation phase of the project, gypsum stabilisation may be nominated as one of the control measures;
- dust suppression regime for all roads and hardstandings be in place for the entire construction period including;
- stabilisation and rehabilitation of batters and cut faces as soon as practicable after works; and
- installation of erosion and sediment controls identified in a Soil and Water Management Plan to be developed for the site.

In the case of construction of the turbine foundations, the RES Report again provides detailed erosion mitigation procedures, such as:

- in area identified as having highly erodible soils, excavation should when practical be only commended during stable, dry weather conditions, operational requirements permitting;
- during excavations for foundations, subsoil should be separated from topsoil for rehabilitation purposes. All topsoil from the excavation sites would be stockpiled and replaced to its original depth for seeding and fertilising;
- landforms would be stabilised and rehabilitated as soon as practicable after works;
- stockpiling of material excavated from turbine bases should be placed outside drainage paths protected with silt fences and covered at the end of the day;
- areas disturbed during turbine installation, and not required to remain cleared, are to be reinstated to their previous condition (as far as practicable), or as agreed by landowners/council; and
- potential surface water contamination is perceived to increase when temporary concrete batching plant/s will need to occur; and suitable bunding arrangements adopted to prevent contamination of the surrounding soils.

(c) Operational mitigation measures

The RES Report outlines the proposed operational mitigation measures, which include:

- development and instigation of a Soil and Water Management Plan;

- monitoring and maintenance of drainage systems and sediment control devices and maintain as required;
- construction mitigation measures listed above be instigated if sizable maintenance works are required; and
- all vehicles on-site shall follow established tracks

The RES Report notes that there is unlikely to be any soil or landform impacts during the operational phase if the above measures are adopted.

4.3 DP Report on proposed borrow areas

DP investigated a number of borrow areas within the proposed infrastructure zone. Six areas were chosen, as indicated within Figure 6.1 “Potential Borrow Pit Areas” within the Planning Application. These areas will include the wind turbine sites, the associated transmission works and roadways.

Testing of each site consisted of excavations and sampling carried out using a tractor mounted backhoe. Logging of the excavations, site mapping, photography, sample and test method selection was carried out by a principal engineering geologist.

I summarise the key points in the DP Report and provide further relevant information regarding the availability of rock on-site as follows:

- The Lab Soaked CBR results of the insitu near surface rock (Greywacke) appear to indicate reasonable quality (Lab Soaked CBR’s 30% - 40%) and this material is likely to be suitable for subbase materials and perhaps even base, limiting the amount of imported material that may be required.
- These harder materials could also be used in creating hard stands, filling gabion baskets (if retaining systems are required) and any other erosion mitigation requirements that would require beaching.
- It is noted that the beds of Greywacke are reported as near vertical and approximately 15m thick which would facilitate selective quarrying.
- Further testing of the proposed sources would need to include wet/dry strength testing. Some mineralization can cause rock that is very strong in the dry state to break down rapidly in the presence of water.
- It also appears that high strength rock is going to be available on site and if this material is to be utilized, an on-site crusher would be required to size the rock.
- The crushing characteristics of the rock needs to be assessed as some rocks with well developed cleavage provide poor rock shape after crushing.
- Generally, the coarser grained rock is likely to provide the better crushed rock.
- There is likely to be sufficient excavated materials for general road construction. I am advised that RES’ preliminary cut and fill assessments indicate that following construction there may be up to 200,000 cubic metres of material excess and that detail design will endeavour to balance and lower this excess material.
- If the site rock is unsuitable for base course, I am advised there is 55km of access tracks with an average of 8m width (includes for bends, junctions and turning areas) and an average thickness of 0.12m and approximately 52800 cubic metres of imported rock would be required. However, should a base course be required for the crane hard standings, substation area and construction compounds, I am advised that this could increase to approximately 73,452 cubic metres. I am also advised this quantity of potentially required imported material has been included within the traffic movement assessments.
- If imported rock is required for the base course it is worth considering sealing these roads as a combination of trafficking and rain would lead to a loss of base

course over time if the road is left unsealed. This is especially important if grades of up to 18% are to be adopted and heavy loads will be accessing the site. I am advised that RES has indicated that certain steep sections of road may have to be sealed and is included within the Planning Application (see Figure 2.2 Infrastructure Drawing in Volume III Figures and Photomontages of RES' Planning Application).

- Unsealed roads also require more on going maintenance with graders and this leads to a loss of the more expensive imported base material.

In summary, I consider that the site investigation carried out by Douglas Partners provides sufficient information to indicate that the majority of the rock required for the site works can be sourced from the site but further analysis will need to confirm its suitability to stand up to trafficking requirements. As such, having a back up of importing a base course is appropriate at this stage. Douglas Partners recommends that further investigations be carried out to confirm the exact amount that can be provided from the infrastructure works.

5 Response to Submission

(a) Submission by Peter Woods

The relevant section of the submission by Peter Woods is given below.

> *As previously mentioned, as one of the properties contributing to the Hopkins River catchment, I have also concerns that any connecting roads constructed within the complex should not interfere with the existing contours for runoffs of water collection and existing dams that are already in place which would if altered, will reduce existing flows for the Hopkins River present catchment as it stands.*

Response

The erosion mitigation measures have been covered in detail in the RES Report and summarised in part 4.2(a) of my statement. However, I have specifically summarised the design criteria to maintain surface water flows as follows:

- minimise length of on-site track and position where possible on ridge crest to minimise catchment areas above cuttings and filled areas.
- avoidance of water courses;
- avoid scouring caused by significant velocities by minimising collected water flows and designing low velocity swale drains;
- discharge run-off regularly from table drains through turn out drains in to sheet flow across well vegetated ground so that it does not have direct access to drainage lines;
- protect batters with uphill catch drains; and
- intercept subsurface flows where these seep from cut batters, and direct flow with safety to the table drain.

The siting of the wind turbines will also consider avoiding natural low-points which could disrupt natural water flow and/or drainage during wet periods.

During construction there will be continual maintenance of drainage system and track hardstanding surfaces.

Further, erosion and sediment control devices (eg. hay bales and swales) will be fitted down slope of construction sites (where required) to prevent erosion events and capture potential sediment wash. These should be regularly maintained.

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Implementation of the above design and construction criteria will ensure that post-construction surface water flows are maintained at pre-construction flow levels. The existing water flows into the abovementioned water catchments will be appropriately managed by a Soil and Water Management Plan within a future Environmental Management Plan to ensure the maintenance of the ongoing surface water flow patterns.

(b) Submission by Glenelg Hopkins Catchment Management Authority ("CMA")

The CMA has indicated that permits are likely to be required for access track and electrical conduit crossings over at least 6 designated waterways.

The CMA has indicated support for the use of box culverts in these situations. However the CMA has indicated that these crossings would be treated on a case by case basis and need to meet the requirements of the CMA in terms of ability to pass storm flows and to withstand erosion under high flow conditions.

Response

Noted.

The Soil and Water Management Plan will need to address the issue of permits that may be required to carry out construction works.

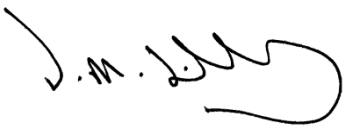
The relevant authority, in this case the CMA, would normally supply the flow data for the various proposed crossings. Using generally accepted standards (which in this case would likely be the Vic Roads Standards), the designers will then be able to provide culvert designs with the size and type of culverts based on storm flows with headwall design and erosion mitigation in the form of creek bank and bed protection also based on these storm flows.

5.2 Any additional work undertaken since exhibition of Application

None

6 Declaration

I have made all the inquiries that I believe are desirable and appropriate and no matters of significance which I regard as relevant have to my knowledge been withheld from the Planning Panel.



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18 June 2010

Annexure A - Qualifications

QUALIFICATIONS

Diploma Geology, RMIT Melbourne 1971

Diploma Engineering Geology, Monash University, Melbourne 1978

PROFESSIONAL ASSOCIATIONS

Australian Geomechanics Society

EMPLOYMENT HISTORY AND ACHIEVEMENTS

Douglas Partners Pty Ltd, Melbourne	2005 - present
Sinclair Knight Merz	2004 - 2005
VicRoads	1976 - 2004
Transport & Road Research Laboratory, UK	1975 - 1976
Consulting Geologist Capetown South Africa	1973 - 1975
Melbourne & Metropolitan Board of Works	1971 - 1973

KEY PROJECT EXPERIENCE

M1 West Gate Upgrade

- Design of new pavements and pavement widenings
- Materials advice during construction of earthworks and pavements, including concrete pavements

EastLink Project

- Assessment of rehabilitation strategies for major roads intersecting EastLink including Defana analysis of all results provided by VicRoads
- Proof engineering using the mechanistic design procedure Circly of all pavement designs for EastLink
- Provision of extra pavement designs as required
- Project Manager for the Dandenong Southern Bypass alignment investigation including pavement designs
- Assessment of original geotechnical advice provided for EastLink including production of interpretative alignment investigation reports based on the initial investigations
- Research of preliminary reports produced in the 1970s and assessment of information provided by these reports including original seismic investigation interpretation
- Assessment of the foundations for reinforced earth walls
- Assessment and advice on erosion control methods

Dandenong Southern Bypass

- Deep strength asphalt pavement design
- Materials investigations and subgrade analysis
- Construction Phase Services advice, incl. foundations for reinforced soil walls

Sinclair Knight Merz

- Albury Wodonga Bypass: Responsible for tender pavement design and general geological assessment of the Site Conditions Information for the Albury - Wodonga Bypass
- Hobson's Bay Main Sewer Relocation (Project Manager)

VicRoads

Alignment investigations

Princes Highway East

- Tynong Sections A and B
- Drouin Bypass
- Warragul Bypass
- Nilma to Darnum Section
- Trafalgar Section
- Moorooduc Road/Mornington Peninsula Freeway Frankston to Dromana
- Springvale Bypass Springvale Road to Princes Highway
- Greensborough Bypass

Quarry Investigations

- Organizing drilling, seismic and testing programs for potential quarry sites
- Assessing the quality of existing quarries to meet VicRoads requirements

Pavements

- Providing rehabilitation strategies for roads for VicRoads and local councils and shires considering pavement dipping information, pavement strength testing with Defana analysis of the results as well as inspections to allow an assessment of the problems and the most cost effective method of rehabilitation.
- Design of unbound granular pavements for local councils and shires utilizing local materials in the pavement design or mixes of local material sources to provide site specific pavement designs rather than prescriptive designs dictated by VicRoads Standard Specifications.
- Determination of asphalt overlay and granular resheet requirements for main roads, freeways and highways.
- Mechanistic pavement design utilizing the Circly design package with designs provided for numerous main roads and freeways in Melbourne. Eastern Freeway extension and the Westall Road extension as well as designs for sections of the Calder, Hume and Moorooduc Highways.
- Managed pavement testing vehicles consisting of the Pavement Strength Evaluator (PaSE) vehicle for pavement evaluation and the SCRIM vehicle for testing skid resistance.

1 **Other Project Experience**

- Cardinia Reservoir and Upper Thompson Reservoir: Geological and environmental investigation for tunnels and dams. Site engineering geologist on both Projects.
- Cape town Consulting Geologist - alignment investigations for roads as well as searches for suitable road building materials. This included a core orientation exercise for a deep cut with no surface outcrop.
- Tunnels Division of the Transport and Road Research Laboratory -Investigation and reporting on all aspects of tunnelling in the UK.

- Main Roads Department Lesotho, Southern Africa (2 year secondment from VicRoads) - Management of laboratories as well as providing pavement design, pavement rehabilitation, geological and geotechnical advice.
- Ministry of Works Department Fiji - Management of laboratories, quarry and asphalt plant.
- Numerous investigations into road failures and construction problems.

2 **Publications**

- D. Tilley, J.M. Morgan & D.A. Barratt: (1975) The Tunnelling System for the British Section of Channel Tunnel Phase 2 Works TRRL Laboratory Report 734.

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Annexure B – DP Report