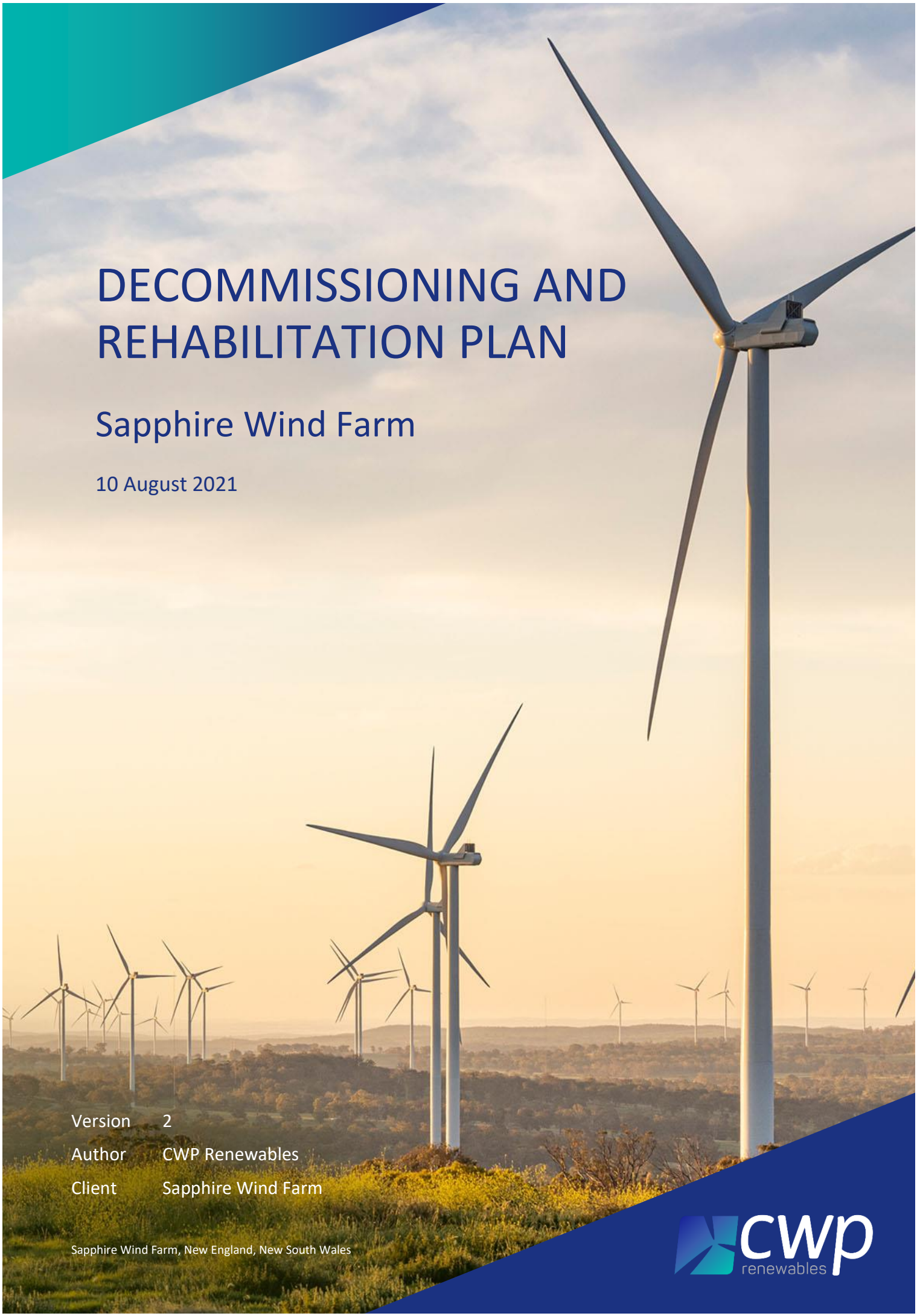
DECOMMISSIONING AND REHABILITATION PLAN

Sapphire Wind Farm

10 August 2021



Version 2

Author CWP Renewables

Client Sapphire Wind Farm

Sapphire Wind Farm, New England, New South Wales

REVISION CONTROL

Revision	Date	Issue	Author	Reviewed	Approved	Milestone
1	22/07/2016	Final/Issued	S Isherwood	M Branson	E. Mounsey	Approved by DPE
2	10/08/2021	Draft	M Henderson	L Cross	J Fortes	Approved by DPIE

CONFIDENTIALITY

DISCLAIMER

Contents

Figures

Tables

1 Introduction

Sapphire Wind Farm (the Project) (SWF) is located 28km east of Inverell and 18km west of Glen Innes, in Northern NSW. The Project is in its operational phase after completing construction in late 2018 and consists of 75 Vestas V126-3.6 wind turbine generators (WTG), installed on 136 metre towers and associated infrastructure. The WTGs are located on moderate to high elevations (870 to 1170m above sea level, Australian Height Datum), across two clusters being the Sapphire and Swan Vale clusters. The total nameplate capacity of the Project is 270MW. Figure 1 below contains an overview of the site.

The Project was constructed in three blocks as shown below in Table 1. These blocks were energised progressively, and the Operational Environmental Management Plan (OEMP) implemented as each stage was completed.

Table 1 OEMP Operational Dates

Block	Collector Group	Wind Turbine Generator ID	OEMP Operational Date
1	1, 2, 3	1 – 28	1 May 2018
2	4, 5, 6, 7	29 – 62	17 August 2018
3	8	63 – 75	29 September 2018

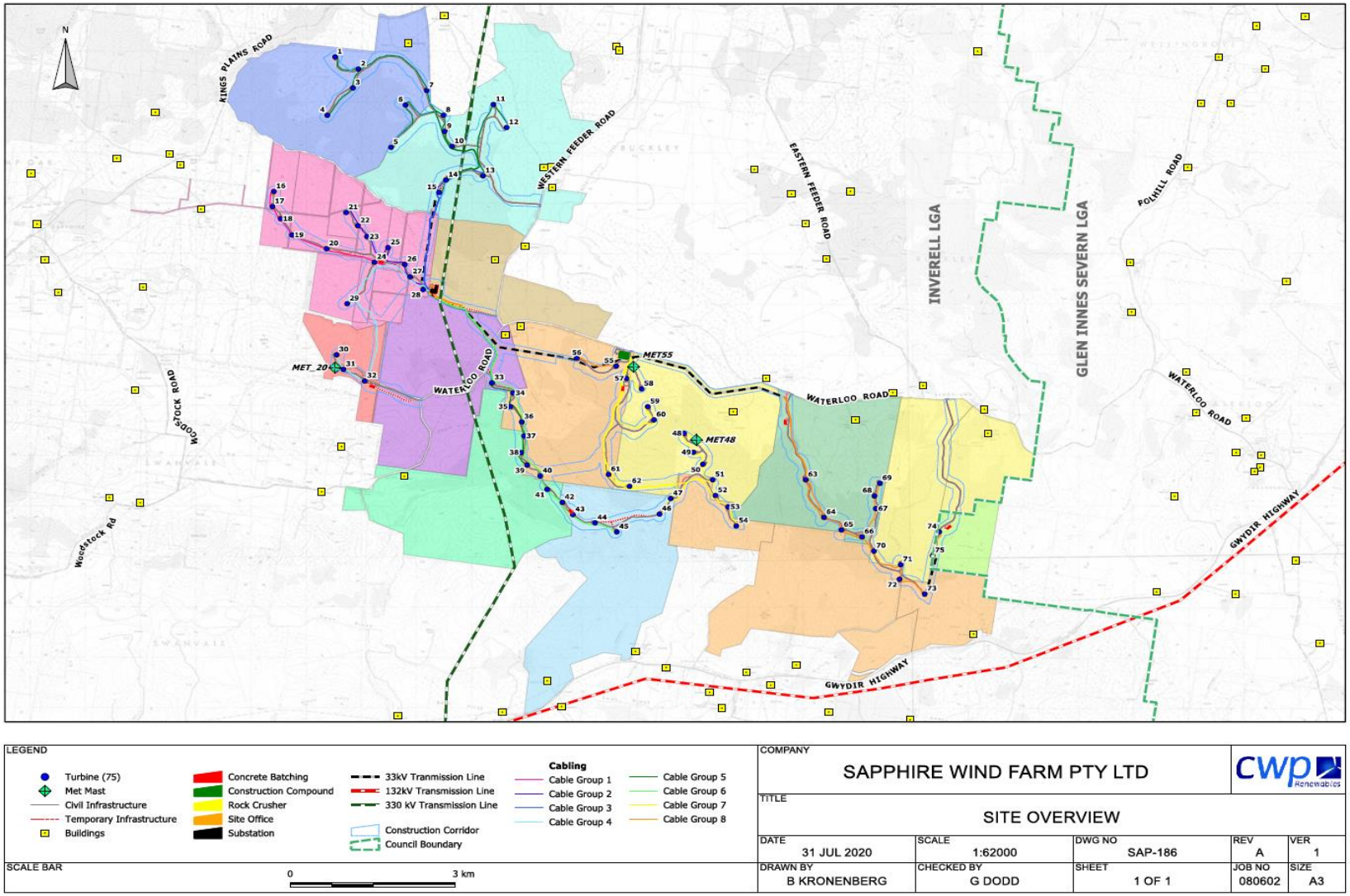


Figure 1 Site Overview

1.1 Purpose

The purpose of this Decommissioning and Rehabilitation Plan (DRP) is to outline a current methodology that may be used to decommission all infrastructure associated with the project and rehabilitate the land at the end of the Project's economic life. The DRP also outlines procedures for individual wind turbine generators that may be decommissioned during the Project's operational phase in accordance with Condition B7 of the Project Approval MP 09_0093. The DRP will be updated every five years in accordance with Condition G11.

1.2 Project Operational Lifespan

The Vestas V126 3.6MW wind turbine generator has an expected design life of 25 to 30 years depending on site conditions, and therefore project has been designed around an equivalent operational period. Construction was completed in late 2018 and will be followed by 25 – 30 years of operations.

At the end of the operational period, the project could undergo either:

- decommissioning and rehabilitation at the cessation of the Project;
- a program to replace turbine infrastructure on an as-needed basis (subject to necessary approvals); or
- refurbishment of existing infrastructure to prolong turbine life (again, subject to necessary approvals).

The decision on whether to decommission, replace or refurbish the Project will depend on a range of factors including the energy market, advances in wind technology, social and political climate and Project approvals.

This DRP has been developed based on the assumption that the Project will be decommissioned at the end of the anticipated 25 to 30-year operational timeframe. This assumption will be revisited closer to the operational life of the current wind turbines to provide more detailed and reliable plans for the decommissioning phase.

1.3 Conditions of Approval

Table 2 identifies the Project Conditions of Approval (CoA) for MP 09_0093 which are relevant to this DRP.

Table 2 Project Approval Conditions Relevant to the DRP

Condition	Requirement	Addressed
B7	If any wind turbine is not used for the generation of electricity for a continuous period of 12 months, it shall be decommissioned by the Proponent, unless otherwise agreed by the Secretary. The Proponent shall keep independently-verified annual records of the use of wind turbines for electricity generation. Copies of these records shall be provided to the Secretary upon request. The relevant wind turbine and any associated infrastructure is to be dismantled and removed from the site by the Proponent within 18 months of the date that the wind turbine was last used to generate electricity.	Section 1.7 and 3.3
B8	Prior to the commencement of construction, the Proponent shall provide written evidence to the satisfaction of the Secretary that the lease agreements with the site landowners have adequate provisions to require that decommissioning occurs in accordance with this approval, and is the responsibility of the Proponent.	Section 2.1
G9	Unless otherwise agreed by the Secretary, within 18 months of the cessation of operation of the project, the site shall be decommissioned and returned by the Proponent, as far as practicable, to its condition prior to the commencement, in consultation with the relevant landowner(s) and to the satisfaction of the Secretary (and in accordance with the Decommissioning and Rehabilitation Plan required under condition G11). All generating facilities and associated infrastructure (including but not necessarily limited to the substations and transformers, switchyard, operation and maintenance facility, overhead transmission lines and access roads) shall be removed from the site unless otherwise agreed	This DRP will support compliance with this condition at decommissioning

	by the Secretary. Project related infrastructure (including access roads) may only be retained on site, where the Proponent has demonstrated to the satisfaction of the Secretary prior to the commencement of decommissioning, that these components: are permissible under the site's statutory landuse provisions in force upon commencement of the decommissioning; would not pose an ongoing impediment to permissible landuse at the properties; and their retention has been agreed to in writing (with evidence provided to the Secretary) by the relevant landowners. This condition does not apply to any infrastructure which, as at the relevant date, is owned by a network operator under the Electricity Supply Act 1995 (NSW) (or any equivalent provisions which are in force as at the relevant date).	
G10	Any individual turbine that ceases operating for a period of more than 12 consecutive months shall be dismantled within 18 months after the 12 month period.	Section 3.3
G11	The Proponent shall prepare a Decommissioning and Rehabilitation Plan, which shall be submitted for the approval of the Secretary prior to the commencement of construction. The Plan shall be consistent with the requirements of the draft NSW Planning Guidelines – Wind Farms (December 2011), as updated. The plan shall be made publicly available. The Plan shall be updated every five years from the date of preparation, until decommissioning and rehabilitation is completed, and a copy of the updated versions provided to the Secretary and made publicly available. The plan shall include estimated costs of and funding arrangements for decommissioning, including provision for a decommissioning bond or other funding mechanisms, where the plan concludes that estimated costs and funding arrangements are inadequate.	This plan. Section 1.4 Section 5
G12	Unless otherwise agreed by the Secretary, the Proponent shall commission an independent, qualified person or team to undertake the following in consultation with the relevant road authority: • prior to the commencement of decommissioning, review the proposed route and existing access provisions to the Wind Farm Site to determine whether the route and existing provisions allow for safe access of decommissioning vehicles associated with the project (including appropriate site distances and provisions for over-mass or over-dimensional transport and safety with other road users). Where improvements, temporary upgrades or changes to the proposed route are required, the Proponent shall implement these in consultation with the relevant road authority, prior to the commencement of decommissioning and at the full expense of the Proponent; • assess all roads proposed to be used for over-mass and/ or over-dimensional transport (including intersections, bridges, culverts and other road features) prior to the commencement of decommissioning to determine whether the existing road condition can accommodate the proposed over-mass and/ or over-dimensional haulage. Where improvements are required, the Proponent shall implement these in consultation with the relevant road authority, prior to the commencement of decommissioning and at the full expense of the Proponent; and Upon determining the haulage route(s) for decommissioning vehicles associated with the project, and prior to decommissioning, an independent and qualified person or team shall undertake a Road Dilapidation Report. The report shall assess the current condition of the road(s) and describe mechanisms to restore any damage that may result due to traffic and transport related to the decommissioning of the project. The Report shall be submitted to the relevant road authority for review prior to the commencement of haulage. Following completion of decommissioning, a subsequent report shall be prepared to assess any damage that may have resulted from the decommissioning of the project. Measures undertaken to restore or reinstate roads affected by the project shall be undertaken in a timely manner, in accordance with the reasonable requirements of the relevant road authority, and at the full expense of the Proponent.	Section 3.2
G13	Prior to the commencement of decommissioning, or as otherwise agreed by the Secretary, the Proponent shall prepare and implement (following approval) a Decommissioning Environmental Management Plan for the project. The Plan shall outline the environmental management practices and procedures that are to be followed during decommissioning, and shall be prepared in consultation with the relevant agencies and in accordance with the Guideline for the Preparation of Environmental Management Plans (Department of Infrastructure, Planning and Natural Resources, 2004). The Plan shall include, but not necessarily be limited to:	Section 3.1

- a description of activities to be undertaken during decommissioning of the project (including staging and scheduling);
- statutory and other obligations the Proponent is required to fulfil during decommissioning, including approval/consents, consultations and agreements required from authorities and other stakeholders under key legislation and policies;
- a description of the roles and responsibilities for relevant employees involved in the decommissioning of the project, including relevant training and induction provisions for ensuring that employees, including contractors and sub-contractors are aware of their environmental and compliance obligations under these conditions of approval;
- an environmental risk analysis to identify the key environmental performance issues associated with the decommissioning phase; and
- details of how environmental performance will be managed and monitored to meet acceptable outcomes, including what actions will be taken to address identified potential adverse environmental impacts (including any impacts arising from the staging of the decommissioning of the project). In particular, the following environmental performance issues shall be addressed in the Plan:
    i. compounds and ancillary facilities management;
    ii. noise and vibration;
    iii. traffic and access;
    iv. soil and water quality and spoil management;
    v. air quality and dust management;
    vi. hazardous material and waste management; and
    vii. hazard and risk management, including bushfire risk.

The Plan shall be submitted for the approval of the Secretary no later than one month prior to the commencement of decommissioning, or as otherwise agreed by the Secretary. The Plan may be prepared in stages, however, decommissioning works shall not commence until written approval has been received from the Secretary.

1.4 NSW Wind Energy Guideline

The Department of Planning, Industry and Environment (DPIE) released the Wind Energy Guideline in December 2016. Section 4.3.4 of the Guidelines relates to the refurbishment and decommissioning of wind farms and states:

'Once installed, wind turbines typically have an expected operating life of around 20 to25 years, at which point they are usually refurbished or decommissioned. Some turbines may be decommissioned or refurbished earlier."

The NSW Government's policy requires that the proponent/wind farm owner rather than the "host" landowner should be responsible for decommissioning and rehabilitation at the end of life of a wind energy project or a particular turbine.

Additionally, the guidelines requires wind energy project owners or operators to identify and address all relevant issues for decommissioning and rehabilitation in their project EIS and include a commitment that the operator will be responsible for decommissioning and rehabilitation.

1.5 Structure of this Plan

This DRP has been prepared in accordance with Condition G11 which refer to the requirements draft NSW Planning Guidelines – Wind Farms (December 2011) which has since been revised to the NSW DPIE Wind Energy Guideline, December 2016. The information required under the guidelines and Condition G11 is included in the sections as described below in Table 3.

Table 3 DRP Structure

Requirement	Section Addressed

Landowner consultation regarding decommissioning	Section 2.1
Expected operational life of the wind farm	Section 1.2
Proposed approach to dismantle individual turbines and the wind farm as a whole	Section 3.4
Transport and storage of wind turbine components during decommissioning	Section 3.5
The proposed resource recovery strategy in accordance with the EPA Guidelines Assessment, Classification and Management of Liquid and Non-Liquid Wastes	Section 3.6
Restoration and rehabilitation of land	Section 4
Estimated costs and funding arrangements for decommissioning	Section 5
Timeframes for decommissioning	Section 6
Consultation and notification procedures during decommissioning	Section 2
Roles and responsibilities during decommissioning	Section 7

1.6 Review

In accordance with Condition G11 of the Project Approval MP 09_0093, the DRP will be reviewed on a five yearly basis following the commencement of construction. The review will assess the methods proposed for decommissioning in light of emerging technologies, markets for used and scrap materials, costs of contractors, plant and equipment to be used during decommissioning and the underlying assumptions therein.

Additional elements which will be considered during review of the DRP include:

- Modification to the condition of the Project Approval;
- Changes in environmental conditions;
- Changes in legislation and/or guidelines; and
- Improvements in knowledge and/or technology become available.

As operations of the Project progress closer to the operational life of the current turbines, a more detailed financial and project feasibility assessment will be completed to determine the likely pathway of the Project (i.e. decommissioning or refurbishment).

A copy of the revised and updated DRP will be provided to the Secretary for approval and made publicly available on the Project public website.

1.7 Record Keeping

During the operational life of the Project Facility Manager will keep records of electricity generation production. These records will be made available to the relevant government departments on request to identify whether any turbines have ceased operation for a period greater than 12 months in accordance with CoA B7.

2 Consultation

2.1 Consultation with Landowners

The Project was constructed predominantly on freehold land leased from 13 separate landowners. The lease agreements each contain a clause assigning the responsibility for all decommissioning and rehabilitation to the Tenant (the Project owner).

Consultation with landowners regarding decommissioning and rehabilitation commenced when option and lease agreements were presented to landowners for consideration. The provisions contained in the lease agreements have been provided to the Secretary of the Department of Planning, Industry and Environment (DPIE) in accordance with Condition B8, whom advised on 22nd August 2016 that it adequately addressed the condition.

2.2 Consultation with Councils

The Project has been in consultation with the Glen Innes Severn Council (GISC) and Inverell Shire Council (ISC) from the early stages of the project and throughout construction and operation, general discussion have also occurred about decommissioning of the project. The Project occupies three small unformed roads licenced from Inverell Shire Council. The licence agreement contains a clause which apportions the responsibility for all decommissioning and rehabilitation with the licensee (i.e. the Project). The licence agreement was approved by Council at their regular Council meeting in July 2016.

2.3 Consultation Prior to Decommissioning

The Project will undertake further consultation with stakeholders prior to and during the decommissioning process. Key stakeholders to be consulted include (but are not limited to):

- NSW DPIE;
- Glen Innes Severn Shire Council;
- Inverell Shire Council;
- Guyra Shire Council;
- Transport for NSW;
- NSW Rural Fire Service;
- NSW Water;
- Local community members; and
- Relevant network service providers.

The Project Community Consultative Committee (CCC) will remain active throughout the decommissioning phase of the Project. It provides an interface between project activities and the broader community. The CCC will communicate issues raised prior to and during decommissioning works to the community and relevant stakeholders and provide an avenue for feedback to the proponent. Issues raised by the community and stakeholders in relation to decommissioning works will be addressed during CCC meetings and where required, measures discussed to address the issues raised.

The consultation process will be open and transparent, and its objectives will be to (as a minimum):

- Provide the timeline of the proposed decommissioning works;
- Present the nature of the proposed decommissioning works, including the turbine dismantling procedure and the proposed land rehabilitation works and objectives;

- Seek comments from stakeholders on the decommissioning works and address any concerns which may arise (including providing timely and responsive feedback and conflict resolution); and
- Seek ideas to maximise the net benefit to the community during the decommissioning process.

3 Decommissioning Methods

This section of the DRP focuses on current methods that may be used during the decommissioning phase of the Project and decommissioning of individual wind turbines. At the end of the 25 to 30 year Project life, wind farm infrastructure will be dismantled and removed, with the land being rehabilitated in accordance with the Project Approval and Lease agreements, with the following exceptions:

- The 330 kV substation and 330 kV line for the Project will not be subject to decommissioning and rehabilitation under this DRP as it will be an asset of TransGrid, the Transmission Network Service provider.
- Wind farm access road infrastructure on private land may be retained for on-going use by the landowners as agreed during lease negotiations.

Other infrastructure which may be requested by landowners to be retained in the future will be identified in the subsequent revisions to this DRP and evaluated in the Decommissioning Environmental Management Plan (DEMP).

After removal, the wind turbine generators will be either scrapped or transported to another site for resale or reuse. A proposed resource recovery strategy has been identified based on current technology which is expected to improve dramatically as the industry matures in Australia. These methods will be reviewed during five yearly DRP reviews and prior to decommissioning, to ensure the appropriate technology is utilised however a more detailed assessment will be completed closer to the end of the current operational life.

The following sections summarise how the remainder of the wind farm equipment and infrastructure is proposed to be decommissioned. The approach described here including the extent of decommissioning and any associated works will be re-visited and confirmed in detail during the operational phase of the Project, during any revisions of the DRP and during the pre-decommissioning consultation process. This will include discussion with and agreement of landowners. Rehabilitation of the site is described in Section 4.

3.1 Environmental Management

Prior to the commencement of decommissioning, or as otherwise agreed with the Secretary, the Project will prepare and implement a DEMP. The DEMP will specifically address the following issues associated with decommissioning:

- Compounds and ancillary facilities management;
- Noise and vibration;
- rTaffic and access;
- Soil and water quality and spoil management;
- Air quality and dust management;
- Hazardous material and waste management; and
- Hazard and risk management, including bushfire risk.

The DEMP will be prepared in accordance with CoA G13 and will be prepared in consultation with the relevant agencies at the time.

3.2 Road Dilapidation

Consultation with the relevant road authorities regarding transport requirements for decommissioning of the Project will occur prior to the relevant stage of decommissioning. A Road Dilapidation Report, if required, will be prepared in consultation with relevant road authorities prior to haulage of any over-size or over-mass components during decommissioning. The road dilapidation aspect of decommissioning will be undertaken in accordance with condition G12.

3.3 Individual turbines

During the operational period, wind turbine generators are regularly serviced for routine maintenance and can be offline for a few days. In cases of major faults, individual turbines could cease operating for longer periods while parts are sourced from overseas or if complicated repairs are required. In the event that a turbine is inactive (not generating power) for a period in excess of 12 months, the Project Approval (Condition B7 and G10) requires that the turbine will be decommissioned, unless otherwise approved by the Secretary. Decommissioning of individual turbines will be undertaken within 18 months after the 12-month period (i.e. within 30 months of the last date of generation).

The method for decommissioning individual turbines will be generally in accordance with the dismantling method described below and will involve sequential removal of components and transport off site for re-use, sale, or recycling.

3.4 Dismantling the Project

This section describes the dismantling process for the project infrastructure at the end of the Project's anticipated 25 to 30-year life.

3.4.1 Turbines

Each wind turbine will be de-energised and safely disconnected from the Project internal reticulation network prior to its decommissioning. The rotor of each turbine will be locked into position according to the relevant manufacturer's decommissioning instructions. Following the de-energising of the wind turbine, the components will be drained of all liquids (oils, lubricants, coolants etc.). The rotor, nacelle and tower will be disassembled using a crane and other specialist heavy machinery and tools in accordance with the manufacturer's approved decommissioning instructions. External items located near base of the tower including, 33kV transformer and switchgear and, the turbine coolers, will separated from their foundations ready for removal from site. The wind turbine components may be transported to wind farm laydown areas, near Project access points, before being moved off-site in accordance with the TMP for the decommissioning phase of the project.

The wind turbine generators will be dismantled using typical environmental and safety management practices in place at the time, and undertaken in accordance with the DEMP.

Dismantling for Re-use

Critical lift plans will be developed specifically for the turbine dismantling and for handling of each major turbine component. The work sequence for dismantling and decommissioning a particular wind turbine generator will most likely proceed as follows:

- Disconnect electrical connections;
- Drain the turbine of all fluids into appropriate containment vehicles for disposal;
- Assemble and stage crane/s on re-established hardstand at turbine;
- Remove rotor and hub and set on ground;
- Remove nacelle and set on ground;
- Remove turbine tower sections and stage on ground;
- Haul off turbine components either off-site or to marshalling compound for salvage operations;
- Breakup and remove concrete foundation pedestal to 1000mm below ground surface;
- Backfill foundation area;
- Rehabilitate foundation area; and
- Monitor the site in context of soil control and weed growth, in accordance with the landowner agreement.

Dismantling for Recycling

Should the wind turbine generators be recycled as scrap metal, dismantling may involve a controlled collapse sequence for the tower which will then be cut disassembled into scrap for transport to recycling facilities.

A typical recycling process will involve the following steps:

- The hub, blades and nacelle will be broken down and stripped of high value components, including gear-boxes, generators the composite materials of the blades and nacelles will be recycled in accordance with EPA guidelines effective at the time of decommissioning. Refer to current methods in Table 3 below;
- Cabling internals in the towers will be removed and scrapped to recover the high value copper conductor materials;
- Transformers and control panels at the base of the towers will be removed and stripped of high value components; and
- Tower sections may be cut into transportable sections for delivery to a scrap metal recycling company.
- The methods to be used in dismantling for either re-use or recycling will be described within the DEMP, including potential impacts and mitigation measures. Cost estimates for each option are provided in Section 5.

3.4.2 Concrete Foundations

It is anticipated that each wind turbine foundation (involving approximately 500m^3 of reinforced concrete) excluding any protruding sections will be left in situ and covered in clean fill material. The area will be graded to reflect the slope of the surrounding area and revegetated to minimise the risk of soil erosion. Further details on the rehabilitation process for disturbed areas are provided in Section 4.

3.4.3 Operations and Maintenance Facility

Unless required by TransGrid, the operations and maintenance facility will be terminated from the 330 kV transmission line and will be dismantled and removed, including the 33 kV / 330 kV transformer and switchgear. A demolition contractor will remove decommissioning debris to a licensed disposal facility permitted to operate under the current and applicable regulations at the time decommissioning occur.

3.4.4 Electrical Infrastructure

All overhead power line poles and conductors connecting the Project to the substation will be removed from the site. As far as possible, all materials and components (e.g. steel, conductors, switches, transformers, etc.) will be reused, sold as scrap, recycled, or re-purposed to the maximum amount economically practical. At some locations, it may be considered that removing the transmission line poles poses a higher degree of environmental risk. In this instance, the powerline pole may be cut at the base, flush with the ground level.

It is anticipated that underground electrical reticulation cabling and associated infrastructure, which connect the wind turbines to the on-site substation, will be left in situ. It is considered that the process of removing the subsurface infrastructure would pose a higher level of environmental risk as opposed to retaining the cabling. Nevertheless, the value of materials that could be recovered will be assessed relative to costs of leaving the cabling in the ground.

Should removal be required for any reason, cabling will be removed in a way that minimises impacts on the environment. Disturbed areas will be adequately backfilled and graded to match the slope and contour of the surrounding land. The disturbed areas will then be revegetated to prevent soil erosion and reintegrated within the surrounding environment, consistent with the procedures in Section 4.

All waste which cannot be reused shall be classified in accordance with the Waste Classification Guidelines (EPA, 2014), removed from the site and disposed of at a facility that can lawfully accept the waste in accordance with the

Protection of the Environment Operations Act 1997 (POEO) and POEO Waste Regulation. Any ground disturbed as a result of these activities will be rehabilitated in accordance with the procedure in Section 4.

The 330 kV substation and 330 kV line will not be decommissioned as it will remain an asset owned by TransGrid as the Transmission Network Service provider.

3.4.5 Access Roads, Hardstands and Laydowns

Access tracks and access roads may be retained, subject to landowner requests. Hardstand areas will be removed and ground rehabilitated. Crane hardstands and construction laydown areas will consist of an all-weather base and will be constructed in a similar way to access roads. Located next to each wind turbine, crane pads will be cleared and levelled suitable for operating a large crane. Rehabilitation of these will be undertaken consistent with the approach described in Section 4.

3.5 Transportation

All wind turbine generators will be dismantled onsite and broken down into smaller components to allow for easier transportation, either for re-use, or for recycling/disposal. If the pieces cannot be transported off site immediately, they will remain on site on the existing hardstand and/or road areas or a temporary lay down area. If required, the temporary lay down area will likely be at the location of ancillary facility sites used during construction in order to minimise impact to the land. Any ground disturbed by the creation of the lay down area would be temporary and would be rehabilitated following decommissioning. Any impacts associated with storage of components prior to haulage will be described in the DEMP.

Transport of Project infrastructure and components will be undertaken in accordance with the traffic and access assessment undertaken in the DEMP and Transport Management Plan. An assessment of the haulage route(s) will be undertaken and a Road Dilapidation Report prepared as described in Section 3.2. Consultation with the relevant road authorities at the time will be undertaken to ensure that concerns are addressed and agreement reached in relation to any road upgrades or dilapidation requirements.

3.6 Resource Recovery Strategy

After dismantling of the turbines, components will be either be sold and transported to another site for reuse or reduced on site and sold to the scrap metal market. The method for re-using or recycling components, particularly turbine blades, is based on current technology. There is an emerging global wind turbine generator refurbishment industry overseas, however this industry is yet to mature in Australia as most, if not all Australian wind farms, are still within their operational life span. As wind farms are decommissioned across Australia over the coming years there will be a growth in providers tendering to procure, transport and sell wind farm components and scrap metal for future uses. This market is currently competitive in Europe, particularly in Germany and Scandinavia, which forms the basis of the resource recovery strategy adopted in this DRP. These methods will be reviewed during each five yearly review of the DRP to evaluate the reuse and recycling options available and revise the DRP as necessary.

3.6.1 Principles

Decommissioning of the Project will provide an opportunity to recover the cost of assets, which will be used to fund the decommissioning exercise. Any component that can either be reused or salvaged will be available for resale or recycling. It is likely that a tender process will be undertaken to maximise the salvage potential of each turbine and extract value through recycling and reusing its components. This is likely to involve an evaluation of the condition of wind turbine generator and transmission components (to identify reusable components) procurement of decommissioning, salvage, transport and rehabilitation services either individually or in a package, to be undertaken in accordance with the Project Approval. A financial analysis has been undertaken in Section 5 to identify the anticipated costs of decommissioning associated with decommissioning and rehabilitation under this strategy.

3.6.2 Re-use of Wind Turbine Generators

If the wind turbine generators are sold for reuse, the rotor, nacelle and tower sections will be dismantled and transported from the site in a manner similar to that used to deliver the turbines to the site. The methods to be used for dismantling are described in Section 3.4.1.

3.6.3 Recycling of Wind Turbine Generators

If the wind turbine generators are not sold for reuse, they will be broken into smaller components for transport and recycled through a scrap metal recycling company.

Vestas has calculated the average recyclability across the components of a V126-3.3 MW wind turbine to be approximately 87.5%. For estimation purposes this breakdown is representative of the Vestas V126 3.6 MW wind turbine generator models installed in the Project.

Material breakdown of V126-3.3 MW turbine only (% mass):

- Steel and iron materials (88%)
- Aluminium and alloys (1%)
- Copper and alloys (<1%)
- Polymer materials (4%)
- Carbon / glass composites (5%)
- Concrete (0%)
- Electronics / electrics (<1%)
- Fuels and fluids (<1%)
- Not specified (<0.2%)

All large metal components that are primarily single material (e.g. tower sections, cast iron frame in nacelle, etc.) are assumed to be 98% recycled, 2% landfilled.

Other major components, such as generator, gearbox, cables and yaw system parts are 95% recycled, 5% landfilled.

3.6.4 Wind Turbine Generator blades

Wind turbine generator blades are constructed from composite materials including glass fibre, carbon fibre, polyester and epoxy resins. Current technologies for wind turbine generator blades require a complex recycling process for recovery due to their materials. The purpose is to separate the polymer (resin) and fibre composites. Once separated, the resins are usually used for energy production while the fibre composites can be reused or recycled. Currently, Germany has the world's only industrial-scale factory for reprocessing wind turbine blades. The blades are sawn and chopped into chunks then shredded and hammered into 5 cm long fragments. These are mixed with other wet waste material and used as fuel in a cement kiln. The re-processing firm deals with up to 60,000 tonnes of blades per annum.

Five main methods for recycling composite materials currently exist, including mechanical, thermal, oxidation, chemical and cement kiln route processes. These processes are described in Table 4 below.

Table 4 Composite Materials Recycling Process

Composite Material	Recycling Process
Mechanical	Blades materials are crushed to reduce the size of the pieces to 50 micrometres in size (Pickering, 2006). This process 'pounds' the resins out of the fibres. A grading process is then used to separate the finer (resin) and coarser (fibre) materials.

Thermal – Pyrolysis	Blades materials are heated to 450°C to 700°C without oxygen, which converts the resins into gas while the fibres remain inert. The energy generated (gas) can be used in electricity production. Fibres can be later recovered and reused or recycled.
Oxidation in fluidised bed	The fluidised bed process is the most well-known implementation. It consists of combusting the polymeric matrix in a hot and oxygen-rich air flow of 450°C to 550°C. The polymer breaks down and vaporises, releasing the fibres which are carried out into the gas stream. The fibres are separated out and the resin products are fully oxidised in a combustion chamber, where the heat energy can be recovered.
Chemical – Solvolysis	Alcohols (propanol for carbon fibre, methanol for glass fibre) in a supercritical state are used to dissolve the resin from the fibre composites. The polymeric resin is decomposed into oils which free the fibres for collection. This process allows the chemicals in the resin to be reclaimed.
Cement kiln route	Composite materials are fed into a cement kiln. Approximately two-thirds of the material is transferred into raw materials for cement and one third, the organic part (resin) is burnt, generating energy.

Source: Job 2010; Cherrington et al 2011.

The optimal solution for the recycling of wind turbine generator blades will be determined and selected closer to the decommissioning time. It is noted that the technology in wind turbine generator manufacture as well as in recycling processes evolves quickly and the market is expected to expand in Australia as wind farms reach the end of their life expectancy in coming years. If further investigation confirms that this cannot be achieved, the blades will be disposed of at a licensed waste facility.

3.7 Waste Management

As an overarching principle, the waste minimisation hierarchy of avoid/reduce/reuse/recycle/dispose will be applied wherever possible to all decommissioning wastes. Any waste that is unable to be reused, reprocessed or recycled will be disposed of at a facility approved to receive that type of waste.

All waste management will be undertaken in accordance with the NSW EPA's Guideline Assessment, Classification and Management of Liquid and Non-Liquid Wastes (1999), or any other guidelines relevant at the time of decommissioning.

The location of scrap metal merchants and other recycling and disposal facilities to be used will be determined closer to the time of decommissioning. A tender process will be undertaken prior to decommissioning to identity prospective scrap metal merchants to utilise through the decommissioning process.

4 Rehabilitation Methods

4.1 Rehabilitation Objectives

The overall objective of the rehabilitation activities will be to return the site to pre-construction conditions; however specific rehabilitation outcomes will be developed in consultation with the landowners prior to the decommissioning process.

4.2 Areas to be rehabilitated

Any land disturbed during the construction, operation or decommissioning of the wind farm will be rehabilitated, except for parts to remain as agreed with the landowners and TransGrid. It is expected that the following areas will be restored and rehabilitated:

- Land overlying the foundations of each wind turbine (approx. 5m diameter for foundation pedestal removal only);
- Hardstand areas at each turbine site ;
- The O&M compound area (unless required by TransGrid);
- Land disturbed by structures for overhead power-lines; and
- Any remaining laydown areas, stockpiles or other temporary infrastructure required for decommissioning.

4.3 Rehabilitation Process Description

All excavated areas will be filled with clean compatible sub-grade material compacted to a density similar to the surrounding area and contoured to match the surrounding landform. Topsoil would then be replaced and compacted to match the density and consistency of the immediate surrounding area.

Areas which may have become compacted from heavy machinery during the decommissioning works are to be re-established through the restoration of topsoil and graded to reflect the slope and contour of the surrounding area.

Areas to be returned to pasture will be seeded with a seed mix agreed upon with the landowners in order to maintain consistency with the surrounding agricultural uses and to mitigate colonisation of these areas by weed species. Typical species mix will promote species diversity and include legumes.

Revegetation of disturbed areas All areas that are required to be revegetated are to be seeded with native species consistent with the surrounding area. To promote plant establishment, all revegetated areas are to be fertilised at the time of sowing and maintained until adequate coverage (>75%) achieved.

Areas to be returned to trees and shrubs will be seeded with a native species mix promoting species diversity and containing fast germinating species. Where possible, the seeds will be sourced locally. The vegetation to be re-established will be aligned to an endemic ecosystem or local plant communities.

Erosion Control Measures are to be put in place during rehabilitation. This may include but is not limited to:

- Fencing around newly rehabilitated areas to prevent livestock and pest access;
- Mulching around newly established vegetated areas; and
- Adequate levelling and contouring of the rehabilitated areas.

4.4 Monitoring Program

To ensure the rehabilitation activities are successful, periodic monitoring of the rehabilitated areas will be undertaken using methods to be described in the DEMP which is required to be prepared prior to commencement of decommissioning in accordance with CoA G13. It is anticipated that monitoring will be undertaken by the involved landholders in the first instance with any additional rehabilitation works carried out upon assessment of the area. A suitably qualified environmental professional will be engaged at the time where required to oversee the performance of the monitoring program and any additional rehabilitation works that may be required. The DEMP will include provisions for corrective actions to ensure remediation measures are adequate to achieve the objectives.

5 Financing of Decommissioning

The decommissioning funding plan for the project is provided below.

5.1 Decommissioning Costs

Costs estimates have been produced as part of this DRP for the dismantling, rehabilitation and resale of the wind turbines and associated infrastructure, provided in Table 6. Estimates are based on industry examples and using available information from a variety of industry sources using (escalated) 2016 $AUD values of salvage value and removal costs.

The net cost to decommission the Project is equal to the cost to perform the decommissioning tasks described in Section 3 and 4, less the resale value of the turbines (either for reuse or recycling as scrap material). There are currently no examples of previous wind farm decommissioning in Australia to rely on historical data; and therefore every five years, the asset management company will review scrap metal prices and technological advances to keep estimates updated and consistent with the market at the time.

The net cost to decommission the Project has been estimated at $15.8M AUD for the whole Project, based on todays dollar. A breakdown of the estimate is provided in Table 6. It is expected that the 75 Vestas 126 2.6MW turbines will provide significant resale value creating a net surplus of funds used to pay for decommissioning. This is expected to be true in either the resale of turbines and turbine parts of through the resale of the materials as scrap.

5.2 Ensuring Decommissioning Funds

Over the 25 to 30 year operational life of the Project, a review will be completed every five years to review the cost to decommission, recycle and resale.

The review will reassess:

- Dismantling/decommissioning cost estimates;
- New technologies, equipment or methods to be used in decommissioning;
- The likely value of parts and materials to be sold during decommissioning; and
- The influence of inflation and other market forces on the funding plan.

In 2021 a review of the reasonableness of the costs in Table 5 was undertaken and they were escalated by the consumer price index (CPI). These costs are indicative only and will be further refined at each five year review period as the scope and requirements for decommissioning and / or refurbishment is understood. This review demonstrates that at this stage there is unlikely to be a shortfall in funds for decommissioning. These numbers will become clearer over the next 25 years of the operating life.

If a shortfall in funds to decommission the Project is identified during future reviews, then subject to the remaining operational life of the Project, a dedicated decommissioning fund will be established to address the deficit.

Table 5 Decommissioning and Rehabilitation Cost Estimate

Turbine Disassembly and Removal	Units	Daily Cost	Weekly Cost	No. weeks	Cost
Turbine Disassembly and Removal					
Main Crane	1	$19,399	$116,391	30	$3,240,000
Support Crane	1	$8,083	$48,496	30	$1,350,000
Loading Crane	1	$8,622	$51,729	30	$1,440,000

Loading Crane	1	$8,622	$51,729	30	$3,491,737
Telehandler	1	$808	$4,850	30	$1,454,890
Support truck	1	$808	$4,850	30	$1,551,883
Crane Crew	4	$1617	$38,797	30	$1,551,883
Fitters and riggers	20	$135	$16,165	30	$145,489
Electricians	8	$135	$6,466	30	$145,489
Mob/De-Mob	1		$269,424	1	$1,163,912
Site Amenities/Tools/Equipment	1		$129,324	1	$484,963

Switchroom and Compounds	Details	Cost
Isolation (HV & LV)	2 electricians for 1 day	$2,694
Disconnect and remove UPS and batteries	1 electrician and 2 trade assistances for 2 days	$7,005
Disconnect HV cabling	1 electrician and 2 trade assistances for 2 days	$7,005
Disconnect air conditioning ground units	1 electrician for 1 day	$1,347
Disconnect LV cabling external to buildings	2 electricians for 1 day	$2,694
Remove buildings	1 crane for 1 day, 2 riggers, 1 truck and driver	$13,471
Remove building support posts	2 trade assistants 1 day	$2,155
Remove building foundations	Excavator over 4 days	$14,010
Remove waste	Excavator and truck over 6 days	$25,865

Civil Infrastructure	Cost
Hardstands	$2,828,953
Foundations (P/L and Import Material)	$2,020,681
MV Switchroom	$76,247
O&M Compound	$107,770
Rehabilitation and Monitoring	Cost
Grading, re-seeding and monitoring	$107,770
Total Cost	$15,800,648

6 Timeframes for Project Decommissioning

The Project Approval requires that all decommissioning and rehabilitation works outlined in this plan be undertaken within the 18 months of the cessation of the operations phase which is expected to be 25-30 years. The approximate timeframes for decommissioning are identified in Table 6.

Table 6 Approximate Timeframes for Decommissioning

Activity	Anticipated Timing
Disconnection and depowering of infrastructure	2043-48
Disassemble blades, nacelles and fell tower components.	2044-48
Disassemble and remove transmission infrastructure and O&M facility	2044-48
Transport reusable materials off-site	2044-48
Cut and transport materials for recycling and/or scrap market	2044-48
Rip and rehabilitate roads	2044-49
Rehabilitation and monitoring of decommissioned areas	2044-49

7 Roles and Responsibilities

The Project owner at the time of decommissioning will be fully responsible for the decommissioning and rehabilitation of the Project. This is supported by the provisions in the lease agreements which will be executed between owner and the landowners prior to commencement of construction (refer to Section 2.1).

8 References

Peter Garrett & Klaus Ronde; 2013 Life Cycle Assessment of Electricity Production from an Onshore V126-3.3MW Wind Plant- 6 June 2014, Version 1.0. Vestas Wind Systems A/S, hedeager 44, Aarhus N, 8200, Denmark.

R. Cherrington, V. Goodship, J. Meredith, B.M. Wood, S.R. Coles, A. Vuillaume, A. Feito- Boirac, F. Spee, K. Kirwan. Article Title: Producer Responsibility: Defining the Incentive for Recycling Composite Wind Turbine Blades in Europe. 2012

DP&I (2011) Draft NSW Planning Guidelines: Wind Farms, NSW Department of Planning and Infrastructure, December 2011.

Job, S. (2010) Composite Recycling – Summary of recent research and development, Materials Knowledge Transfer Network Report, September 2010.

NSW EPA (1999) Environmental Guidelines: Assessment, Classification and Management of Liquid and Non- Liquid Wastes, NSW Environmental Protection Agency, Chatswood, NSW.

Pickering, S.J. (2006) 'Recycling technologies for thermoset composite materials – current status', Composites Part A 37, pp. 1206-1215.

Yang, Y, Boom, B, Irion, B., van Heerden, D.J., Kuiper, P. and de Wit, H. (2011) 'Recycling of composite materials', Chemical Engineering and Processing, in press, doi: 10.1016/j.cep.2011.09..007

CONTACT

Canberra
Suite 1.01, Level 1
17 Moore Street
Canberra, ACT 2601
Phone: +61 2 6100 2122

Newcastle
Level 2
2 Market Street
Newcastle, NSW 2300
Phone: +61 2 4013 4640

Sydney
Unit 11, Shore 2-3
13 Hickson Road
Dawes Point, NSW 2000

cwprenewables.com