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Response to Independent Merit Review

Restart of the Redbank Power Station and use of Biomass (Excluding Native Forestry Residues from Logging) As a Fuel - SSD-56284960

Verdant Earth Technologies Limited

Prepared for Verdant Earth Technologies Limited

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JEP Environment & Planning would like to thank all contributors that have informed this report. All recommendations and views in this report are attributable to JEP Environment & Planning unless otherwise stated.

We declare that
The report contains all available information that is relevant to the assessment of the Site and proposed development, activity or infrastructure to which the report relates, and the information contained in the report is neither false nor misleading.

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Version	Authors	Date	Reviewer	Approved for issue	Date
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Declaration

Project details	
Project name	Restart of Redbank Power Station and Use of Biomass (Excluding Native Forestry Residues from Logging) as a Fuel
Application number	SSD-56284960
Address of the land in respect of which the development application is made	112 Long Point Road West, Warkworth NSW 2330
Applicant details	
Applicant name	Verdant Earth Technologies Limited
Applicant address	GPO BOX 2537, Sydney NSW 2001
Details of persons by whom this RTS Report was prepared	
Name	Erik Larson and Dr Mark Jackson
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Declaration by registered environmental assessment practitioner	
Name	Dr Mark Jackson
Registration number	R80020
Organisation registered with	Environment Institute of Australia and New Zealand (EIANZ)
Declaration	The undersigned declares that this EIS Report: • has been prepared in accordance with the *Environmental Planning and Assessment Regulation* 2021; • contains all available information relevant to the environmental assessment of the development, activity or infrastructure to which the report relates; • does not contain information that is false or misleading; • addresses the Planning Secretary's environmental assessment requirements (SEARs) for the project; • identifies and addresses the relevant statutory requirements for the project, including any relevant matters for consideration in environmental planning instruments; • has been prepared having regard to the Department's State Significant Development Guidelines; • contains a simple and easy to understand summary of the project as a whole, having regard to the economic, environmental and social impacts of the project and the principles of ecologically sustainable development; • contains a consolidated description of the project in a single chapter of the EIS Report; • contains an accurate summary of the findings of any community engagement; and • contains an accurate summary of the detailed technical assessment of the impacts of the project as a whole.
Signature	
Date	28/02/25

Executive Summary

The NSW Department of Planning, Housing and Infrastructure (DPHI) has commissioned an independent merit review (the Review) of the Environmental Impact Statement (EIS) for the Restart Redback Power Station Project. The EIS forms part of the application for approval under the State Significant Development (SSD) provisions (SSD 56284960).

Verdant Earth Technologies Limited (the Applicant) has considered the Review in detail and prepared this document in response (the Response Report). The Response Report fully considers and comprehensively addresses the issues and requests for information that have been raised in the Review.

Purpose of the Merit Review

In response to the request from DPHI, the Review assessed whether the EIS adequately addresses the following key criteria:

1. Adequate woody biomass supply – Assessment of biomass availability and competition for feedstock to meet energy production goals;
2. Processing capacity of the facility – Information on processing rates (typical, maximum, minimum), maximum waste throughput, and waste storage capacity;
3. Compliance with the NSW Energy from Waste Policy Statement – Adherence to policy and guidelines, including the use of residual waste feedstock from resource recovery processes;
4. Proven technologies and handling capabilities – Verification that the proposed technologies are reliable, well-understood, and can handle the intended waste feedstock;
5. Technical fitness and commissioning details – Confirmation that the technology is suitable for its purpose, with adequate details provided for commissioning and proof of performance; and
6. Emission control techniques and monitoring – Compliance with emission control practices, sampling, and monitoring as per the NSW Energy from Waste Policy Statement (EPA, 2021).

Key Issues Identified in the Merit Review

The Review used a “Red, Amber, Green” status system to classify the risk associated with each item evaluated. None of the items were classified as “Green” or “Red”. All the items in the Review were classified as “Amber” which represents the following:

> *Moderate risks that, based on the information provided, indicate partial fulfilment of requirements. These issues have the potential to impact process operations and significantly affect correct functioning in the short to medium term if not adequately addressed.*

The Review noted some potential risks to the Proposal related to operational, regulatory, and technical challenges and invites Verdant to provide their considered response to the DPHI.

The Review included a request for information (RFI) covering each of the six key areas evaluated. The Review also requests that the Applicant:

- *Evaluate the potential impacts of legislative changes on biomass supply, including preparation of adaptive management strategies to respond effectively to these changes; and*
- *Develop a risk assessment and a contingency plan to address potential risks associated with supplier variability and inconsistencies in feedstock quality.*

Applicant Response to the Review

The Response Report (this document) has been prepared to comprehensively address all the matters raised in the Review and to allow the determination of the SSD-56284960 application.

The Response Report provides information in response to the RFI in each of the six key areas evaluated in the Review. In recognition of the large amount of information provided with the SSD 56284960 application, references have been included to where additional or supporting information can be found in the EIS, RTS or accompanying appendices.

A Risk Assessment has also been prepared and assesses the risk items identified in the Review and provides adaptive management strategies and contingencies to de-risk operations. The Risk Assessment reviews the following:

- Adequacy of the fuel supply, including all proposed eligible waste fuels and standard fuels proposed;
- Compliance and operational risks associated with variability in feedstock characteristics;
- Natural disaster events such as drought, flood and fire; and
- Pending legislative updates and changes that could affect operations.

Conclusions

The biomass fuel to be used at Redbank will comprise only standard fuels and eligible waste fuels as listed in Part 3 of the *NSW Energy from Waste Policy Statement* and defined in the *Eligible Waste Fuels Guidelines*.

The application for SSD-56284960 has provided reasonable assumptions and demonstrated that there is a biomass fuel supply in the proposed quantities required to operate the Redbank Power Station at full capacity over the life of the plant. Further evidence has been provided in this Response Report.

The Applicant has worked over multiple years to identify and develop a range of supply options (excluding Native Forestry Residues from Logging), to ensure the commercial operation of Redbank on 100% biomass fuel. This includes developing options for purpose grown energy crops and securing Memorandums of Understanding (MOUs) for the supply of existing biomass. Various sources of supply have been identified and Verdant has shown that there are sufficient commercial quantities available to provide 100% of Redbank's biomass fuel requirements. Obtaining adequate biomass fuel volumes is a commercial issue that has been addressed in detail and Verdant will finalise contracts and manage this post-approval.

Verdant will diversify and scale up fuel sourcing and operations over time through implementation of the Fuel Supply and Characterisation Study (Appendix M of the EIS). A multi-pronged approach to source fuel from different locations is supported by a regional fuel cropping strategy that will reduce the risk of supply disruptions. Verdant are also targeting at any given time to have 25% more biomass fuel available to make up for potential shortfalls in any one biomass fuel source.

The Redbank FiCirc boilers are a unique design incorporating a deep bubbling fluidized bed and fines recirculation from large cyclones above the furnace. The plant is fit-for-purpose and allows efficient stable combustion of biomass with a wide range of moistures (up to 50% by weight) and particles sizes as given in biomass fuel specification.

Biomass is highly suitable for use in circulating and deep bubbling fluidised bed technologies. This has been researched extensively and is widely known and demonstrated in peer reviewed literature, which is cited in this report.

Senior management staff at Verdant are very familiar with the plant technology at Redbank with experience ranging from being lead project manager on the build of Redbank in 2001 through to the latest operational experience including placing Redbank in care and maintenance and currently maintaining the plant to date. Verdant also works with leading local consultants, global firms and process technology and automation services for the energy industries such as Valmet which has been producing biomass boilers and operating for over 300 years and Andritz a leading biomass engineering firm operating for 140 years. See Appendix C for a summary list of Verdant staff personnel and experience.

Verdant will operate the plant within the design range of the Biomass Design Fuel Specification and in compliance with relevant Specific Resource Recovery Orders and Exemptions (SRROEs) issued by the NSW EPA. Verdant employ staff highly experienced in the use of engineered fuels and waste timber biomass to assess technologies, including plant and equipment alternatives. The Applicant will work directly with contractors and will ensure all biomass feedstock delivered to the power station meets all the required specifications prior to delivery.

A Quality Assurance and Control Procedure for Receipt and Use of Biomass (Appendix E of the Fuel Supply and *Characterisation Study*) will be implemented, reviewed and updated to control fuel quality, manage risk and avoid potential issues, including those related to meeting the requirements of the Biomass Fuel Specification and any SRROEs.

With the implementation of strategies and contingencies identified in the Risk Assessment, all identified risks have been assessed as low and tolerable with the following exceptions (considered to be moderate risks):

- Natural disaster such as a bushfire, drought or flooding event destroying biomass supplies or limiting access to fuel supply for significant periods of time;
- EPA approval to use Domestic Biomass Fuel (DBF) as a biomass fuel and reducing available biomass fuel;
- Biomass with no higher order uses arising from agricultural waste or residues (excluding INS) consistency and quality non-compliance with the Biomass Fuel Specification and/or a Specific Resource Recovery Order and Exemption; and
- The ability to obtain suitable feedstock in relevant quantities to create and deliver Domestic Biomass Fuel to meet the consistency and quality required to comply with the EPA requirements and Biomass Fuel Specification and/or a SRROE.

These moderate risks are already well understood, and Verdant's broad strategy for reducing the risk of undersupply is to diversify and scale up fuel sourcing and operations over time.

Verdant are also targeting at any given time to have 25% more biomass fuel available than required to make up for possible shortfalls of any one biomass fuel source.

As an additional contingency, in the event of an unplanned fuel shortage, there is the ability for the plant to be turned down or a boiler can be taken out of service. The plant consists of two FiCirc Fluidised bed boilers and one Turbine. The plant is designed to be operated between 70 and 100% steam flow. It is a base load plant and operates at 151MW however it has a minimum turndown capability of 110MW and can be operated at this minimum of 110 MW with two boilers, if load needs to be reduced further then one boiler can be taken off service and stored in hot condition. The minimum load with one boiler in operation is 55MW. This would reduce the amount of fuel required to 40 tonnes per hour, or approximately half the amount of fuel required when operating at 100% for full capacity.

Overall, the Risk Assessment concludes that the risks to successful operation of the Redbank Power Station using biomass (excluding native forestry residues from logging) have been assessed as LOW and tolerable.

The EIS provides a detailed assessment demonstrating the suitability of recommissioning Redbank Power Station with biomass fuels. It is recommended that DPHI support the approval of the Proposal, subject to the implementation of the revised mitigation and management measures outlined in the Response to Submissions report.

CONTENTS

1. Introduction

The NSW Department of Planning, Housing and Infrastructure (DPHI) has commissioned an independent merit review (the Review) of the Environmental Impact Statement (EIS) for the Restart Redbank Power Station Project. The EIS forms part of the application for approval under the State Significant Development (SSD) provisions (SSD 56284960).

Verdant Earth Technologies Limited (the Applicant / Verdant) have considered the Review and prepared this document in response (the Response Report). The Response Report fully considers and comprehensively addresses the issues and requests for information that have been raised in the Review.

1.1. Background to the Proposal

Verdant are seeking approval to restart the Redbank power plant using biomass (excluding native forestry residues from logging) as a sustainable fuel to produce near net zero CO_2 emissions and enable the power station to continue to produce “green” electricity on an ongoing basis (the Proposal).

The Proposal is located in the Singleton Local Government Area, within the Hunter Valley, NSW. The Site, located at 112 Long Point Road West, Warkworth (Lot 450 DP 1119428), is positioned in a suitable location in the Hunter Valley approximately 10 km to the west of Singleton, 10 km northeast of Bulga and about 8 km northwest of Mount Thorley. Four open cut coal mines are within 2.2 to 7 km of the Site. The surrounding region also includes rural and agricultural properties and industrial areas.

The Redbank Power Station is an existing and approved baseload power station located at the Site. Originally commissioned in July 2001, the Redbank Power Station was designed to use beneficiated dewatered coal tailings (BDT) left over from coal processing to create electricity. The power station uses FiCirc® fluidised bed combustion technology and a single 151MW steam turbine and associated equipment. The power station is designed to burn low value fuels such as coal tailings and is a preferred technology for energy generation from biomass. The technology has demonstrated excellent performance and a low emissions profile.

The power station was approved in 1994 (DA183/93) and the development consent was modified in 1997. Tailings were transferred by conveyor from the Warkworth mine to the power station as a source of fuel. The power station also relied on supplementary fuel in the form of Run of Mine (ROM) coal to assist in electricity generation. Due to the unavailability of coal tailings from Warkworth mine, the power station has been in care and maintenance since October 2014.

To address concerns expressed by the community in relation to the use of native forestry residues as fuel, the Applicant decided to expressly exclude from the approval the use of Native Forestry Residues from Logging as a feedstock and developed an alternative biomass fuel strategy that specifically excludes this fuel source.

On approval to use biomass as an alternative fuel source, the Applicant will also relinquish the use of coal tailings as a fuel as permitted under the existing development consent (DA183/93).

The area of land occupied by the power station infrastructure has been previously disturbed and cleared. The Site currently contains existing power station infrastructure and technology to support the Proposal including:

- Multiple buildings including offices, warehouses, and turbine hall;
- Road access and carparks;
- Stockpile area and conveyor belts;
- Sediment basin, detention basin and wastewater storage basin;
- Two separate existing access points to the Site from Long Point Road West; and
- Power generation infrastructure (Boiler, cooling tower, stack and turbo generator).

When fully operational the Proposal will supply the grid with approximately 1 million megawatt hours of 24/7 dispatchable or baseload electricity per year, equivalent to supplying the annual needs of around 500,000 people or 200,000 homes[1]. The Proposal will also drive significant progress towards the NSW Government’s *Net Zero Plan*

[1] Ausgrid 2023-2024 Local Council Community Electricity Report. Web: https://www.ausgrid.com.au/-/media/Documents/Data-to-share/Average-electricity-use/Ausgrid-average-electricity-consumption-by-LGA-FY24-pdf.pdf?rev=6ca572d2606741799e179415f1220222

Stage 1: 2020-2030, the foundation for NSW's action on climate change and goal to reach net zero emissions by 2050.

1.2. Assessment Status of SSD 56284960

Public exhibition of the EIS for SSD-56284960 concluded on 11 April 2024. A number of submissions were received from government agencies, organisations and the general public.

An initial response to submissions report (Response to Submissions Report #1) was submitted on 5 July 2024 that identified issues requiring further clarification and addressed the comments received during the exhibition period. Public and agency submissions received during the EIS exhibition period were considered and addressed in detail in the RTS. No significant changes were considered required for the Proposal although some minor discrepancies were fixed and adjustments and additions to the mitigation measures were made to ensure the impacts of the Proposal are minimal or negligible.

DPHI received a specific request for further information from Heritage NSW. Singleton Council and NSW EPA separately provided their comments and recommended draft approval conditions. DPHI also requested that Verdant Earth provide additional information regarding the status of the Voluntary Planning Agreement (VPA) with Singleton Council.

A second Response to Submissions report (RTS #2) was prepared to address the additional comments received from agencies regarding RTS report #1.

All of the government agencies review comments on the Proposal have been addressed by the Applicant and satisfied, including comments from the EPA.

DPHI have now commissioned an independent merit review of the EIS for SSD-56284960 to assist them in assessing the Proposal. The Review was published on the Major Projects Portal on 13 December 2024.

The Applicant has considered the Review and has prepared this Response Report to comprehensively address the issues and requests for information raised in the Review.

1.3. Focus Areas of the Independent Merit Review

In response to the request from DPHI the Review aims to assess whether the EIS adequately addressed six key criteria. The focus of the Review is to evaluate the following critical project elements:

1. **Adequate woody biomass supply** – Assessment of biomass availability and competition for feedstock to meet energy production goals;
2. **Processing capacity of the facility** – Information on processing rates (typical, maximum, minimum), maximum waste throughput, and waste storage capacity;
3. **Compliance with the NSW Energy from Waste Policy Statement** – Adherence to policy and guidelines, including the use of residual waste feedstock from resource recovery processes;
4. **Proven technologies and handling capabilities** – Verification that the proposed technologies are reliable, well-understood, and can handle the intended waste feedstock;
5. **Technical fitness and commissioning details** – Confirmation that the technology is suitable for its purpose, with adequate details provided for commissioning and proof of performance; and
6. **Emission control techniques and monitoring** – Compliance with emission control practices, sampling, and monitoring as per the NSW Energy from Waste Policy Statement (EPA, 2021).

The Review focused on review of a number of documents prepared for the EIS and RTS, most notably the main EIS document, RTS report, Plant Conversion Report (EIS Appendix F). Fuel Supply and Characterisation Study (EIS Appendix M) and Life Cycle Assessment (EIS Appendix N).

Advice from the NSW EPA and five public organisations was also considered as part of the Review.

The Review used a "Red, Amber, Green" status system to classify the risk associated with each item evaluated. None of the items were classified as either "Green" or "Red". All the items were classified as "Amber" in the Review, which represents the following:

> *Moderate risks that, based on the information provided, indicate partial fulfilment of requirements. These issues have the potential to impact process operations and significantly affect correct functioning in the short to medium term if not adequately addressed.*

The primary set of comments identified in the Review are in the form of a request for information (RFI) for the Applicant to provide related to each of the six key areas evaluated in the Review.

This Response Report directly addresses the RFI and provides supporting information and peer reviewed literature where relevant.

1.4. How this Response Report has been Prepared

The purpose of the Response Report is to comprehensively address all matters to allow the determination of the SSD-56284960 application.

The Response Report provides information in response to the RFI in each of the six key areas evaluated in the Review. In recognition of the large amount of information provided with the SSD 56284960 application, references have been included to where additional or supporting information can be found in the EIS, RTS or accompanying appendices.

A Risk Assessment has also been prepared and included that assesses the risk items identified in the Review and provides adaptive management strategies and contingencies to de-risk operations. The Risk Assessment reviews the following:

- Adequacy of the fuel supply, including all proposed eligible waste fuels and standard fuels proposed;
- Compliance and operational risks associated with variability in feedstock characteristics;
- Natural disaster events such as drought, flood and fire; and
- Pending legislative updates and changes that could affect operations.

This Risk Assessment has been prepared in accordance with AS/NZS ISO 31000:2018, the recognised standard for risk assessments and risk management in commercial and business operations. The standard provides a framework and guidelines to help identify, assess, and manage risks in a systematic, consistent and transparent manner.

The Applicant also has provided a separate table of detailed responses to each of the comments within the main Review report (see Appendix B). The table of responses includes each comment from the Review, a corresponding response by the Applicant and any relevant references to associated documents that contain further or supporting information.

Additional peer review literature have also been cited where relevant supporting that biomass is recognised as highly suitable for use in circulating and deep bubbling fluidised bed technologies and is widely known and demonstrated around the world.

2. Response to Request for Information

The primary set of comments identified in the Review are in the form of a request for information (RFI) for the Applicant to provide related to each of the six key areas evaluated in the Review.

Each of these six areas are identified below, along with the specific RFIs from the Review and a detailed response to each. In recognition of the large amount of information provided with the SSD 56284960 application. References have been included to where in the EIS, RTS or accompanying appendices to this Response Report that additional or supporting information can be found.

2.1. Feedstock Availability

1) *Proponent to provide verified data to demonstrate what suitable agricultural land the organisation can realistically secure for feedstock production and supply.*

The *Fuel Supply and Characterisation Study* (Appendix M of the EIS, Section 4.3) details the proposed use of biomass from invasive native species control, scaling up the growing of fuel crops, biomass from approved infrastructure project clearing and other sources where available and that meet the required specifications of the power plant and any SRROE.

This information is demonstrated and cited in the EIS, which provides realistic estimates for all biomass fuel sources enough to supply Redbank's use of biomass as fuel for the foreseeable future. This includes potential sources for INS and areas to grow and harvest specifically grown fuel crops.

This multi-pronged approach sourcing biomass fuel from different locations and supported by a regional fuel cropping strategy with landowners will reduce the risk of supply disruptions.

Based on the information provided in the *Fuel Supply and Characterisation Study* (Appendix M of the EIS), there would be more than the annual 700,000 tonnes (dry) tonnages of biomass fuel available to run the Redbank Power Station at full capacity for the proposed life of the Proposal (30 years until refurbishment is required). The total available biomass is between 250% and 300% of the total annual fuel requirements including standard fuels and eligible waste fuels.

The independent market research prepared by Arche (Higher Order Use Study in RTS Appendix H) concluded that the available amount eligible waste fuels with no other higher order uses or markets including INS is significant (estimated 2.8 million per year) (see Table E1-2).

Verdant has obtained letters of support from landowners committing in principle to supplying biomass. Examples are included in the Risk Assessment (Appendix A). Note that Verdant already has letters of support for 400,000 tonnes from two suppliers and are in the process of establishing a contract for supply of biomass for a minimum of five (5) years from commissioning (see Appendix A of the Risk Assessment). These landowners are actively seeking a solution for their INS waste biomass rather than burning it in their fields onsite (see Figure 2.1).

Figure 2.1 Verdant photo of uncontrolled burning invasive native species onsite at Nicholsons of Nymagee (May 2024).

The Applicant's fuel strategy also includes the use of purpose grown fuel (potentially in mine buffer zones) which is a de-risking strategy to provide 'standard fuels' (as defined in the *Protection of the Environment (Clean Air) Regulation* 2022) as part of the long-term supply for the power station. The Applicant has maintained keen interest in the NSW DPI cropping trials using native Mallee and other appropriate short-rotation species, and has attended harvesting and coppicing trials at Scone, Tamworth and Trangie.

The NSW Department of Primary Industries (DPI), in conjunction with CSIRO's Australian Tree Seed Centre, have been conducting Woody Biomass Crop Trials to examine the suitability of a range of native woody species for short-rotation woody crop biomass production across NSW[2]. More than 50,000 trees have been planted across NSW as far north as Glen Innes and as far south as Yanco. These studies are included in Appendix B of the *Fuel Supply and Characterisation Study* (EIS Appendix M).

The research indicates that by year four, 35 tonnes of above-ground dry biomass per hectare of planted area can be obtained. To meet the total required biomass demand of 490,000 tonnes per year, a minimum total planted area of 56,000 hectares would be required (assuming native mallee species are used). Note that Verdant are also planning for an additional 25% of biomass fuel to maintain an overall buffer in fuel supply, which in part may be from additional fuel crops.

Part 2 of the DPI and CSIRO assessment found that within 100km of the Redbank Power Station there is an estimated 795,753 hectares of land that could produce short-rotation woody crops as fuel.

A recent independent report identified that within the Hunter Valley Region alone there is an estimated 130,000 hectares of coal mining lands[3] that can be repurposed for future businesses generating new employment opportunities, including renewable energy. Verdant has also had discussions with major mining groups in relation to using mine buffer lands to contract grow energy crops. Verdant will work with landowners to either contract grow or to lease or purchase suitable areas to supply suitable purpose grown energy crops to Redbank.

The Applicant acknowledges that securing adequate biomass fuel volumes will require an ongoing, diligent, and targeted approach. To address this, Verdant has developed a multi-pronged fuel strategy, outlined in Appendix M of the EIS. Obtaining the required fuel supply is a commercial matter for Verdant to manage post-approval. The Applicant has provided reasonable assumptions regarding the availability of INS and land areas for fuel crops and has demonstrated that a sufficient biomass fuel supply, along with capable suppliers, exists to ensure the proposed quantity supply necessary to operate the Redbank Power Station at full capacity over the plant's lifespan

2) *Proponent to provide further details of feedstock chemical characterisation to demonstrate eligibility under the NSW Energy from Waste Policy and Eligible Waste Fuels Guidelines.*

The biomass fuel to be used at Redbank will comprise only standard fuels and eligible waste fuels as listed in Part 3 of the *NSW Energy from Waste Policy Statement* and defined in the *Eligible Waste Fuels Guidelines* Facilities. This is discussed in Section 4.5.1 of the EIS. Chemical characterisation of the proposed fuel has been provided in Section 5 and Appendix D of the *Fuel Supply and Characterisation Study* (Appendix M of the EIS).

Under clause 142 of the *Protection of the Environment Operations (General) Regulation* 2022, eligible waste fuels do not meet the definition of 'waste' and therefore the Proposal does not meet the definition of 'thermal treatment'. Therefore clause 143 (Prohibition on energy recovery from thermal treatment of waste) does not apply to the Proposal.

Note that although approval from EPA is still needed, a SRROE is not required to be obtained prior to the use of 'standard fuels', which form a large part of Verdant's long-term fuel strategy. This is described in detail in Section 3.3.1 of the EIS and in Section 4.4 of the *Fuel Supply and Characterisation Study* (Appendix M of the EIS).

Suppliers will be required to adhere to strict requirements, as outlined in Section 3.3.1 of the EIS and the *Quality Assurance and Control Procedure for Receipt and Use of Biomass* (Appendix E of the *Fuel Supply and Characterisation Study*). All biomass fuel material delivered to the power station will be required to:

- Meet the approved specification required for the power station, prior to delivery to the power station;
- Meet all requirements under any relevant SRROE issued by the NSW EPA (for all eligible waste fuels); and
- Adhere to Verdant Earth's quality control and assurance program requirements.

[2] NSW Department of Primary Industries, Woody Biomass Crop Trial 2023. Web: https://www.dpi.nsw.gov.au/forestry/science/forest-carbon/biomass-for-bioenergy/biomass-crops
[3] Lock the Gate Alliance (26 May 2022). Diversification and growth Transforming mining land in the Hunter Valley.

Regardless of the approved fuel types to be used, no non-compliant biomass fuel will be accepted at the power station whatsoever. This is to ensure that the power station operates satisfactorily at all times and remains within regulated emissions limits as set out in its EPA licence.

Further chemical characterisation of fuels at this point is considered unreasonable and will done as part of the fuel supply chain development work and in consultation with the environmental regulator (NSW EPA) as part of the SRROE assessment process post-approval.

The Proposal has been demonstrated to be consistent and comply with the *NSW Energy from Waste Policy and Eligible Waste Fuels Guidelines.*

3) *Proponent to provide further information to verify the credibility and current operational status of potential feedstock suppliers, along with evidence of their capacity and operational capability to provide the expected feedstock quantities.*

Verdant will (and can only) finalise and enter binding arrangements with biomass fuel suppliers once approval is obtained and there is a scheduled commissioning date. During commissioning the plant, Verdant will build fuel inventory ready for year 1 operations. Supply agreements for significant amounts of INS and other eligible waste fuels are pending an approval.

Landowners are very familiar with preparing Property Vegetation Plans (PVPs) and seek certificates (60Y certification) confirming that their proposed clearing of native is compliant with the *Native Vegetation Code* 2018. Landowners clear paddocks and pile up the INS to burn onsite as current practice. Verdant have visited farmer sites to discuss and review how to provide support and resources to enable landowners to manage their INS. There are contractors that currently provide this service. Contractors are used to complete restoration in compliance with and in accordance with the EPA and LLS requirements and have a proven track record of successfully restoring the native grasses and removing INS.

The Higher Order Use Study (Appendix H of the RTS report) confirms and identifies that there is significant opportunity for securing eligible waste fuel biomass for use at the power station. The study concluded that there are no other higher order uses for an estimated 2.8 million tonnes per annum (tpa) (see Table E1-2 of EIS Appendix H) specific to the fuel biomass sources proposed to be used at Redbank. Of this, INS accounts for an estimated 1.5 million tpa with no higher order uses or markets available.

Based on the updated Public Information Register - Certificates Under Section 60Y[4] there are 184 certificates issues to clear invasive native species in the Central West and 78 certificates issues for the Western LLS districts between 09/03/2018 and 4/12/2024. This totals 686,371 hectares of treatment area.

Note that Verdant has letters of support for 300,000 tonnes from one supplier over five (5) years, and 100,000 tonnes per year from another supplier. In 2023, Western Regeneration Pty Ltd signed an MOU for 500,000 tonnes per year chipped to the agreed specification. Whilst Western Regeneration has been disbanded, they consisted of several landowners Verdant are still in discussions with individually to form supply contracts once the Proposal is approved.

Verdant are in the process of establishing contracts for supply of biomass for a minimum of five (5) years from commissioning (see Appendix A of the Risk Assessment). These landowners are actively seeking a solution for their INS waste biomass rather than burning it in their fields onsite. Landholder 1, for example, has provided a signed letter of support indicating 10,320 hectares of land is adversely affected by INS and that they intend to enter into a supply agreement with the applicant for 100,000 tonnes of INS annually post approval of the Proposal.

It is noted that Western Regeneration Pty Ltd has deregistered. However, the group of members still exists and are actively seeking a solution for their INS waste biomass rather than burning it in the field/onsite.

Western Regeneration Pty Ltd was registered in 2012 to explore beneficial reuse options for INS. However, as a satisfactory outcome could not be achieved, the company was deregistered in 2018. Despite this, the group's members remain active and continue to seek solutions for their INS waste biomass, aiming to avoid burning it in the field or onsite. The Applicant acknowledges that it will take time to work with suppliers to build constant supply to specification for the quantities needed by the power station and has developed a network of potential suppliers. This will be a big focus of the Applicant post-approval, during the recommissioning stage Verdant will secure up to 50% of

[4] NSW Local Land Services Public Register. Web: https://www.lls.nsw.gov.au/help-and-advice/land-management-in-nsw/public-register.

the feedstock requirements as a buffer while a long-term supply of this fuel that meets the required specification is secured. This is also true for other eligible waste fuel and standard fuel sources.

Where appropriate, Verdant can assist to provide specialised equipment including grinders/chippers, screening systems, stockpiling, and loading equipment where required to support the required volumes of fuel needed that meets specifications.

Verdant is and will continue to engage landowners and Local Land Services to establish contacts with potential INS suppliers, which supports landowners recognised efforts at management and restoration of their properties.

Verdant's strategy is ongoing and includes continued engagement with landowners and Local Land Services to establish connections with potential INS suppliers. This approach supports landowners' recognized efforts in managing and restoring their properties. Suppliers that will be engaged by the Applicant have many years of experience in clearing INS and restoring native grasslands and landscapes. Many of these contractors/suppliers were former members of the Western Regeneration group.

4) *Proponent to develop a comprehensive risk assessment to evaluate the potential impacts of legislative changes on biomass supply, including preparation of adaptive management strategies to respond effectively to these changes.*

Planning proposals must deal strictly with current legislation and policy, and future changes to legislation are uncertain. As discussed in Section 4.5 of the RTS, whilst these legislative reviews are important and provide an avenue for public input to the legislative review process, these are outside of the scope of the Proposal and any risk of future regulatory changes or updates to legislation that could affect future operations of the Proposal must be borne by the Applicant.

However, the Applicant has prepared a comprehensive Risk Assessment to identify and evaluate the risks to securing sufficient supply of biomass fuel to power the plant. The Risk Assessment, provided in Appendix A, provides measures and adaptive management strategies Verdant will take to ensure risks to the power station's fuel supply from changes to legislation are minimised.

Verdant have reviewed the relevant government review documents, including the NSW Government's response[5] and discussed these changes with Local Land Services. Based on this review, Verdant have determined these pending upcoming amendments would have minimal effect on the supply of INS biomass.

Whilst the NSW Government's response includes consideration of INS clearing under Part 2 of the *Land Management (Native Vegetation) Code* 2018, the recommendation involves developing a protocol for treatment area specificity for Part 2, Division 2 as well as a landholder guide for assessing whether INS are acting invasively (under Part 2, Division 1 of the Code). Verdant support development of protocols and guidelines as this supports sustainable sourcing of biomass.

Risks related to the reduction of available INS through policy amendments is considered low and will be managed via clear communications with LLS and landowners, and through following pending changes to policies and guidelines as recommended by the NSW Government review.

Verdant supports sustainability and biodiversity conservation. Any discussions with landowners and LLS will include considerations of policy, regulation and sustainable land management as part of developing contracts for harvesting INS.

At this stage Verdant believes these changes may affect procedures for obtaining INS as fuel but will not adversely affect the supply of INS to Redbank.

In terms of land clearing for approved infrastructure projects, the NSW Government review recognises that some impacts are unavoidable. For this reason, the NSW Government is committed to supporting transparent, rigorous offsetting and a functioning biodiversity credit market. This will be needed to support clear government priorities for housing, renewable energy and critical infrastructure. These are the types of projects that Verdant will be targeting for potential biomass sources from land clearing. Biodiversity and vegetation clearing will already have been

[5] NSW Government (July 2024). NSW plan for nature NSW Government response to the reviews of the Biodiversity Conservation Act 2016 and the native vegetation provisions of the Local Land Services Act 2013. Web: https://www.nsw.gov.au/sites/default/files/noindex/2024-07/NSW%20plan%20for%20nature%20NSW%20Government%20response%20to%20the%20reviews%20of%20the%20Biodiversity%20Conservation%20Act%202016%20and%20the%20native%20vegetation%20provisions%20of%20the%20Local%20Land%20Services%20Act%202013.pdf

assessed in detail, and approved where relevant, prior to approval and construction. These assessments will need to be reviewed and considered on an ongoing basis in terms of timing, volumes, location and potential higher order uses on an ongoing basis by Verdant.

As part of their fuel strategy, Verdant are including purpose-grown fuel crops (standard fuels) which would be a very stable fuel source for the Redbank Power Station, which will minimise these risks and help to provide a consistent, quality supply of biomass fuel to the power station.

Fuel crops form a significant percentage of Verdant's planned biomass fuel strategy. By year five (5) of operations, 70% of biomass fuel used at Redbank is estimated to be in fuel crops, equating to approximately 490,000 tpa. Fuel crops are considered a 'standard fuel' and do not require a SRROE but do still require approval from the EPA to be used. Note that standard fuels, like eligible waste fuels, need to strictly comply with fuel specifications in order to ensure suitability for the power station and to ensure the power station performs in strict compliance with air emissions limits in the EPA licence.

By year five (5) of operations and beyond, INS accounts for an estimated 13% of the biomass fuel requirements of the power station. Verdant have estimated 150,000 (dry) tonnes of biomass would be used from approved land clearing the first year of operations, scaling down to 50,000 tonnes by year three (3) of operations and 20,000 tonnes by year four. See Table 4.1, page 40 of the *Fuel Supply and Characterisation Study* (Appendix M of the EIS).

The *Fuel Supply and Characterisation Study* (Appendix M of the EIS) clearly outlines the proposed strategy to diversify and scale up fuel sourcing and operations over time. Changes proposed to legislation, as identified in the Review, are considered a low risk to the Proposal.

5) *Proponent to develop a risk assessment and a contingency plan to address potential risks associated with supplier variability and inconsistencies in feedstock quality.*

A Risk Assessment has been prepared by the Applicant that identifies and evaluates risks associated with variability and inconsistency in biomass fuel quality and provides measures and contingencies Verdant will implement to reduce or eliminate these risks to the Proposal (Appendix A).

Work undertaken by Boiler & Power Plant Services Pty Ltd (EIS Appendix F) on behalf of Verdant assessed the required biomass fuel physical characteristics. A specification has been developed that must be met in order to prevent deterioration (e.g. corrosion), maintain the performance of the plant and its various components.

Additionally, all eligible waste fuels proposed for use at Redbank will need to meet the requirements under a SRROE issued by the EPA. The *Eligible Waste Fuels Guidelines* (EPA 2022) specifies strict standards for biomass fuels to minimise risks to human health and the environment.

The primary risks around biomass fuel quality are include the following:

- Biomass fuel does not meet Redbank's Biomass Specification and is unfit for use in the plant; and
- Biomass fuel does not meet SRROE requirements and therefore is not approved for use.

All fuel biomass fuel proposed for use at Redbank Power Station will need to meet stringent specifications, operational requirements of the Redbank Power Station plant and equipment, and the requirements of relevant SRROEs.

This is outlined in a robust strategy for sourcing biomass fuels, and a comprehensive Quality Assurance/Quality Control (QA/QC) program provided Appendix E in the *Fuel Supply and Characterisation Study* (Appendix M of the EIS). The QA/QC program will control fuel quality, manage risk and avoid potential issues, including those related to meeting the requirements of any SRROEs and the Biomass Specification.

The Applicant will establish contracts with suppliers to provide biomass fuel that meets all required specifications. Non-compliant biomass will not be accepted at the power station. Verdant will take an active management role with each supplier to ensure that only compliant materials are sent from each fuel source to Redbank.

Testing requirements of a SRROE issued post approval are inherently part of the QA/QC Procedures. Post approval requirements for testing under any SRROE will be included in the QA/QC and contractual requirements.

Note that although approval from EPA is still needed, a SRROE is not required to be obtained prior to the use of 'standard fuels', which form a large part of Verdant's long-term fuel strategy. This is described in detail in Section 3.3.1 of the EIS and in Section 4.4 of the *Fuel Supply and Characterisation Study* (Appendix M of the EIS).

All biomass fuel for Redbank will be processed to precise specifications prior to its use as fuel. These procedures will be followed, reviewed and updated to control fuel quality, manage risk and avoid potential issues related to meeting the requirements of the Biomass Fuel Specification and SRROEs issued by the EPA.

This approach is designed to maintain optimal operational efficiency and environmental compliance. Given the rigorous processing protocols in place in the QA/QC program, Verdant has assessed the risk of failing to meet the required biomass fuel specifications as low and unlikely.

Adaptive management strategies are built into the QA/QC process to ensure quality biomass fuel is consistently being produced. Verdant are confident this process can be managed in a way to meets all regulatory, safety and environmental requirements.

In addition to the ongoing sampling and testing outlined in Appendix 1 of the QA/QC program for any new Biomass type introduced to the Redbank Power Station , a series of representative samples will be collected from the new Biomass sources for characterisation of the fuel in terms of its composition and variability. This characterisation will allow the Applicant to assess whether the fuel conforms to the fuel specification prior to its use.

Sampling will include at minimum twenty composite samples collected and analysed for all parameters specified in the Biomass Specification using the corresponding test methods (or equivalent) for the purposes of characterisation and undertaken in compliance with EN14780:2011 "*Solid Biofuels – Methods for sample preparation*".

Verdant are also targeting to have at any given time 25% more biomass fuel available than required to make up for possible shortfalls of any one biomass fuel source. For example, additional hectares of fuel crop hectares may be established to provide part of this buffer in supply in standard fuels.

Finally, the plant consists of two FiCirc Fluidised bed boilers and one Turbine. The plant is designed to be operated between 70 and 100% steam flow. It is a base load plant and has minimum turndown capability to 110 MW with two boilers, if load needs to be reduced further then one boiler can be taken off service and stored in hot condition. The minimum load with one boiler in operation is 55MW. This would reduce the amount of fuel required to 40 tonnes per hour, or roughly half the amount that is required for full capacity.

These adaptive management measures and contingencies described above will address potential risks associated with supplier variability and inconsistencies in biomass fuel quality.

6) *Proponent to provide information on feedstock availability and composition that matches the specified quality standards, as the feedstocks currently provided indicate levels of moisture content, chlorine, and potassium that exceed the developed fuel specifications for optimal facility operation.*

The results of the testing completed for the Applicant by HRL indicate that biomass types generally comply with the fuel specification as provided in the *Biomass Fuel Characterisation and Specification Proposed for use at the Redbank Power Station* (Appendix D of the *Fuel Supply and Characterisation Study*). Further biomass fuel test data is not supplied in this Response Report as ultimately all biomass fuels will need to meet the required specification for the power station. If they do not meet the specification, they simply will not be received.

Nevertheless, it is noted that the Redbank FiCirc boilers are a unique design incorporating a deep bubbling fluidized bed and fine recirculation from large cyclones above the furnace which allows efficient stable combustion of biomass with a wide range of moistures (up to 50%), particles sizes and components as given in fuel specification Figure 20 of EIS Appendix F. The testing provide tolerances to low levels of chemical contaminants which are typically found at trace levels in biomass.

Verdant are well aware of the importance of biomass fuel quality as described in Sections 6 and 7 of the *Fuel Supply and Characterisation Study* (EIS Appendix M) and the importance of appropriate preparation, receival and quality control management.

Verdant are confident that biomass fuel sources are available that meet the requisite specification. Biomass is highly suitable for use in circulating and deep bubbling fluidised bed technologies has been researched extensively and is widely known and demonstrated in peer reviewed literature. Several peer reviewed scientific papers are referenced in this report describing how this type of technology is appropriate for biomass application and is considered world best practice.

The Applicant notes the degree of risk that biomass fuel does not meet the specification varies for each standard fuel and eligible waste fuel type. Fresh hardwood material sourced from approved clearing, removal of INS and coppicing of fuel crops (e.g. native mallees), for example, are well-understood to have qualities that are fit-for-purpose in the

Redbank FiCirc boilers. The risk of not meeting specification for these types is low. Existing technologies are readily available to size and grade this material to meet both a biomass specification and SRROE requirements.

Wood waste (particularly post-consumer) and annual / perennial crops are more challenging to manage and process so that it meets specification. However, meeting specifications with more difficult source material is limited mostly by process and cost of technologies.

Note that although approval from EPA is still needed, a SRROE is not required to be obtained prior to the use of 'standard fuels', which form a significant part of Verdant's long-term fuel strategy. This is described in detail in Section 3.3.1 of the EIS and in Section 4.4 of the *Fuel Supply and Characterisation Study* (Appendix M of the EIS).

Senior management staff at Verdant are highly experienced in the use of biomass fuel to assess technology, including plant and equipment alternatives, and will work directly with contractors to ensure required specifications are met.

Extensive additional testing will be undertaken post approval as part of applying for SRROEs and for Verdant's own commercial due diligence. Verdant are confident these processes can be managed in a way that meets all regulatory, safety and environmental requirements and that allows for optimal and efficient plant operations.

2.2. Processing Capacity of the Facility

1) *Proponent to provide on-site management strategies for controlling moisture content in feedstock, beyond solely relying on 100% supplier compliance, as this may also impact feedstock availability, given that not all available suppliers will be willing or able to meet the required feedstock quality standards.*

The QA/QC program provided Appendix E in the *Fuel Supply and Characterisation Study* (Appendix M of the EIS) outlines how the specification will be achieved, including compliance with the relevant SRROE prior to the biomass fuel being used at the power station. Each biomass fuel manufacturer will be contractually required to maintain an appropriate quality control/quality assurance (QA/QC) (see EIS Section 3.3.1) procedure to ensure that fuels supplied to the power station meet the requirements of the Biomass Specification.

Logistics will play a central role in meeting moisture requirements. HRL Technical Laboratories on behalf of Verdant have assessed moisture loss over time and suggest fresh cut or harvested materials should be at least 6 weeks from cutting in the summer months and 8 weeks from cutting in the winter months prior to chipping to the above specification. These types of details are being incorporated into the commercial fuel planning for Redbank. Note that there is also testing equipment at the power station in an existing on-site lab that tests specifically for moisture content.

To reduce these risks, Verdant are developing a logistics plan with local transport contractors and potential biomass fuel producers to build up an inventory of biomass fuel at the source production end and a potential facility (requiring a separate approval) within a short distance to Redbank. This will allow flexibility to meet the required biomass fuel volumes without compromising fuel quality.

Verdant will also deploy management staff experienced in the use biomass fuels to assess technology, plant and equipment, and take a management role alongside contractors to ensure required specifications are met. If necessary, Verdant will also provide technology transfers including specialized equipment including grinders/chippers, screening systems, stockpiling, and loading equipment where required to support the required volumes of fuel needed that meets specifications.

Additional onsite processing at the power station is unnecessary as the biomass fuel will be fully processed to specification prior to approval to delivery to the power station.

The Redbank Power station stockpiling facility will receive already prepared biomass fuel in size meeting moisture and limited fines specifications. The plant is already equipped for dust control and management as this was essential for the coal fines previously used. The stockpile area is already equipped with dust suppression and fire protection system as well as all transfer chutes and bunkers are equipped with dust collection and monitoring as well as thermal detection for combustion.

The scope of changes required to handle biomass at the Redbank plant is detailed in the Redbank Power Station – Description of Proposed Modifications for Conversion to Fire Biomass fuels (EIS Appendix F). A full risk assessment will be done during the detailed design phase to ensure dust collection and suppression equipment comply with latest Australian safety requirements.

As per the Quality Assurance and Control Procedure for Receipt and Use of Biomass (Appendix E of the Fuel Supply and Characterisation Study), for any new Biomass type introduced to the Redbank Power Station, a series of representative samples will be collected from the new Biomass source for characterisation of the fuel in terms of its composition and variability. Sampling and characterisation will allow for an assessment of the Biomass and its ability to conform to the fuel specification prior to its use.

In addition, ongoing sampling and testing will be undertaken in accordance with any Specific Resource Recovery Order (for eligible waste fuels) and the Biomass Specification by analytical laboratories accredited by the National Association of Testing Authorities (NATA) in accordance with the guidance provided in EN14780:2011 “Solid Biofuels – Methods for sample preparation.

This comprehensive sampling and testing program will accurately assess moisture content so the risk of non-compliant fuel batches received at the power station will be low.

Verdant have a commercial and compliance interest in managing biomass fuel quality and will not rely 100% on supplier compliance, but will provide management support, technology knowledge transfer, sampling guidance and will conduct audits to ensure the required quality standards are met at all times.

2) *Proponent to provide evidence that feedstock storage in open air will not adversely affect the feedstock quality or the process. This should be supported by examples of facilities currently operating under similar conditions, without on-site pre-treatment or processing, and relying on third-party suppliers for feedstock QA/QC. This should include details of equipment used, operational conditions of the combustion process, and acceptable moisture content levels.*

It is not standard practice in Australia to use covered and climate-controlled facilities for biomass storage. Examples of uncovered storage for biomass fired boilers is given in Section 5.2 of EIS Appendix F. The following list provides examples of facilities employing uncovered woodchip stockpiling.

- Visy Tumut, NSW Australia;
- Rocky Point, Gold Coast QLD;
- Maryvale Paper Mill, Maryvale, Victoria;
- Bell Bay Smart Fibre, Bell Bay Tasmania;
- Port Albany Western Australia;
- Portland, Victoria; and
- QLD commodity exports, Port of Brisbane.

Concern over wood chip degradation, bacteria/fungi, temperature increases and changes in moisture content are typical for extended term stockpiling (i.e. longer than 2 months). Research has shown that mitigation of these risks is accomplished via practices such as “first-in/first-out” inventory management, larger and consistent chip sizes (i.e. screening of fines) and pile rotation[6].

The fuel consumption rate for the power plant does not promote fuel quality changes or deterioration. The continuous use and replenishing of the stockpiles will be ongoing, thus preventing fuel deterioration. The stockpile area accommodates a maximum of three (3) days storage capacity. This rapid turnover of the biomass minimises the time biomass fuel is spent in stockpiled conditions.

The Applicant is very familiar with the plant technology at Redbank which is explained in detail in both the B&PPS reports included in Appendix A of the *Fuel Supply and Characterisation Study* (Appendix M of the EIS) and the *Redbank Power Station – Description of Proposed Modifications for Conversion to Fire Biomass fuels* (EIS Appendix F).

The Redbank FiCirc boilers are a unique design incorporating a deep bubbling fluidized bed and fine recirculation from large cyclones above the furnace which allows efficient stable combustion of biomass with a wide range of moistures (up to 50%), particles sizes and components as given in biomass fuel specification.

Biomass is highly suitable for use in circulating and deep bubbling fluidised bed technologies. The type of technology at Redbank has been researched extensively and is widely known and demonstrated in peer reviewed literature to

[6] Slaven, I., Haviarova, E. and D. Cassens (2011). Properties of wood waste stored for energy production. Purdue University, Department of Forestry and Natural Resources / Agricultural Communication.

be fit-for-purpose. For example, Ianello *et al.* (2020)[7] notes that fluidised bed systems are highly flexible and can handle a wide range of biomass fuel qualities (varying in moisture, particle size, and calorific value) without extensive pre-treatment. Another published and peer reviewed paper (Peña, 2011)[8] notes that the technology can burn "difficult" fuels, including biomass and fuel mixtures with variable quality conditions with lower emissions compared to traditional boilers. This adaptability is crucial for using locally and regionally waste-derived biomass material at the power station.

Note that Redbank is unique in that it additional has bed depth control process by removing and reintroducing bed material whilst the plant is in operation. This is something the power plant operators understand and can use for additional performance control in the case of varying moisture and/or fuel variability.

Verdant will operate the plant within the design range of the Biomass Design Fuel Specification with fuel moisture design targeted at 25%, as provided in Figure 20 of the Redbank Power Station – Description of Proposed Modifications for Conversion to Fire Biomass fuels (EIS Appendix F).

3) *Proponent to provide information supporting the assumptions regarding the volume and quality of ash production and evaluate the impact of changes in fuel type composition on ash generation over time, considering potential annual variations.*

In the EIS we indicate the worst scenario of ash content is 5%, which is a conservative number. In fact, the ash content identified from the various fuels been tested indicate vales between 0.5 and 4% ash content. Management of ash is detailed in Section 3.3.4 of the Waste Management Plan prepared for EIS (EIS Appendix L).

As explained in Section 2 of the *Redbank Power Station – Description of Proposed Modifications for Conversion to Fire Biomass fuels* (RTS Appendix F) the percentage of ash from biomass as compared to BDT is low.

It is not expected that ash content in biomass to be higher than 5% and the average ash content is expected to approximately 2%.

When considering the plant was designed for ash content up to 20% when handling coal by using Biomass the plant is substantially over designed for Biomass ash.

4) *Proponent to provide a sensitivity analysis considering a variance of 10% to 50% above or below the 25% moisture content to evaluate its impact on air quality, greenhouse gas emissions, ash production, feedstock requirements, and the station's reliability as a power source for the National Electricity Market, supported by evidence to define an acceptable moisture content range.*

The design moisture content is provided in the Biomass fuel specification in Figure 20 of the *Redbank Power Station – Description of Proposed Modifications for Conversion to Fire Biomass fuels* (EIS Appendix F), as duplicated in Appendix M of the EIS. The Applicant will work with suppliers to ensure an optimised moisture content in fuels is consistently supplied to the power station. The design moisture content of fuel is 25% for the technology at Redbank. However, the range or limit of moisture content in the biomass fuel is between 10% and 50%. The report also notes that while it is convenient to compare Biomass fuel on an oven dry basis, woody biomass fuel in nature contains moisture ranging from about 15% to 25% for seasoned air-dried logs to over 50% for freshly cut green timber.

A report prepared by B&PPS titled *FiCirc Boiler Performance for Bush Fire Damaged Tree Trunk Sample at Various Moisture Levels* (B&PPS Report C12148-01) (see Appendix D) provides the model outputs in Table 3 of the report. Increased moisture content in the biomass fuel above 25% is undesirable. Whilst it would not impact the units' ability to operate within its capability and design parameters there would be a marginal increase in CO_2 and other emissions when comparing a higher moisture content fuel against a lower moisture content fuel and the plant running at the same megawatt (MW) output. This is not expected to affect the air quality or greenhouse gas assessment conclusions because of the following reasons:

- The expected case emissions scenario in the AQIA, the design fuel amount at 25% moisture, equating to 850,000 tpa. Dry wood equivalent of 700,000 tpa, we would have returned lower emissions;

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[7] Iannello, S., Morrin, S. and M. Materazzi (2020). Fluidised Bed Reactors for the Thermochemical Conversion of Biomass and Waste. *KONA Powder and Particle Journal*, 37: 114–131.

[8] Pascual Peña, J.A. (2011). Bubbling fluidized beds: When to use this technology. In: *Luckos, A. and den Hoed, P. (eds.) Industrial Fluidization South Africa*, Johannesburg, South Africa, 16–17 November 2011. Johannesburg: Southern African Institute of Mining and Metallurgy, pp. 57–66.

- The same assumption was made for the original GHG assessment, however EPA requested that the dry equivalent (700,000 tpa) be used with an updated calorific value, which lowered the estimated emissions in the RTS report addendum; and
- Verdant is targeting 25% or less moisture content in the biomass fuel because the plant runs more efficiently and produces more power with less fuel. Though the plant can still successfully operate on higher moisture content fuel, this is not desirable.

Note that Verdant will be required to monitor compliance with applicable limits during through a rigorous sampling campaign to verify the modelling and assumptions in the assessments. This will be done as a matter of course post-approval and under the Applicant's Environment Protection Licence.

Redbank FiCirc boilers operate with a deep bed and in-bed cooling tubes; the bed temperature can be adjusted by changing the bed depth or altering the quantity/size of in-bed tubes. A live bed storage silo exists and forms part of the operating process where bed material is stored and reused during operation to maintaining efficient combustion. The operators are trained in how to manage the bed to achieve the required outputs when to moisture levels vary. This was a design requirement when consuming high moisture BDT often above 40% moisture, hence this is the most suitable furnace design for managing varying moisture fuels.

A high moisture range of biomass fuels will impact typical bubbling fluidized bed temperature. A bubbling bed in-bed cooling surface is usually only designed by heat balance for a limited fuel moisture content range – as a large range may result in defluidisation problems with low bed temperatures.

However, unlike normal bubbling bed technology, the Redbank FiCirc boilers operate with a deep bed and in-bed cooling tubes; the bed temperature can be adjusted by changing the bed depth or altering the quantity/size of in-bed tubes. To manage the bed depth and temperature the plant is equipped with an existing bed material silo where bed material is stored and reused as needed to control furnace combustion.

At moisture levels above the 25%, the boiler output would be reduced due to the inability of the ID fan to cope with the higher flue gas flows. For example, at 45% moisture, the boiler output is restricted to 85% load. This is clearly shown in Figure 9 of the *Redbank Power Station – Description of Proposed Modifications for Conversion to Fire Biomass fuels* (EIS Appendix F).

Verdant have in house capabilities to efficiently and safely operate and manage the plant and will operate the plant within the design range of the Biomass Design Fuel Specification.

In terms of emissions, the Air Quality Impact Assessment (EIS Appendix O) modelled a Regulatory Worst Case (RWC) scenario, which derived constant emission rates from the applicable NSW EPA POEO emission concentration limits that would apply to the Redbank Power Station. The results of the RWC modelling, independent of fuel moisture content and using conservative assumptions, showed that air quality impacts in the surrounding environment would comply with applicable NSW EPA impact assessment criterion.

Verdant will be required to operate continuous in-stack emissions monitoring and testing program to review air pollutant emission concentrations against the limits under an EPA issued Environment Protection Licence.

A detailed assessment of Section 3.3 of the *Greenhouse Gas Mitigation Plan and Climate Change Adaptation Plan* (EIS Appendix P) outlines the long-term Scope 1 GHG emissions reduction target for the Proposal that represents relative to the emissions reduction objectives of NSW. The Proposal emissions would reduce at a comparable rate to the NSW net zero emissions trajectory. This was revised in Section 2.3 of the *Air Quality Impact Assessment, Greenhouse Gas Mitigation Plan and Climate Change Adaptation Plan Addendum* (RTS Appendix E).

The Proposal will be a small contributor to GHG emissions in NSW. Under the 'current policy' scenario for NSW, the project would represent 0.02% of state-wide emissions in 2030, and 0.07% in 2050.

A sensitivity analysis in addition to the B&PPS report titled *FiCirc Boiler Performance for Bush Fire Damaged Tree Trunk Sample at Various Moisture Levels* (B&PPS Report C12148-01) (Appendix D) is not required and not warranted as non-compliant fuels with moisture content outside the specification cannot and will not be accepted as fuel for the power station.

2.3. Compliance with NSW Energy from Waste Policy

1) *Proponent to clarify the changes to the composition of the proposed feedstock supply if DBF is not determined to meet the requirements of an eligible waste fuel, as this could have implications for the how the proposal is assessed under the EfW policy framework*

As described in Section 2.3.1 of the EIS, facilities that only thermally treat lower risk ‘eligible waste fuels’ as listed in Part 3 of the *NSW Energy from Waste Policy Statement* and defined in the *Eligible Waste Fuels Guidelines* are not considered an Energy Recovery Facility.

As provided in the Section 3.3 of the EIS and described in detail in Section 4 of the *Fuel Supply and Characterisation Study* (Appendix M of the EIS), the Applicant proposes to use only a combination of ‘standard fuel’ and ‘eligible waste fuel’ biomass to operate the Redbank Power Station.

Under Clause 142 of the *Protection of the Environment Operations (General) Regulation* 2022, eligible waste fuels do not meet the definition of ‘waste’ and therefore the Proposal does not meet the definition of ‘thermal treatment’. Therefore Clause 143 (Prohibition on energy recovery from thermal treatment of waste) does not apply to the Proposal.

Verdant recognise that the EPA has not at this stage approved the use of Domestic Biomass Fuel (DBF) and does not list DBF as an eligible waste fuel. However, included in the EIS is a process and strategy towards enabling the use of DBF. Verdant Earth Technologies will continue to engage with the NSW EPA to characterise DBF and seek approval for the use of DBF via an approved DBF trial.

Under Part 1 of the *Eligible Waste Fuel Guidelines*, the EPA provide the following note:

- As information about certain waste and waste-derived streams improves, the EPA <u>will review</u> the eligible waste fuels list from time to time.

The Eligible Waste Fuel Guidelines explicitly states that the EPA may review the list of eligible waste fuels from time to time. Verdant do not propose to use DBF at Redbank prior to implementing the trial protocols as described in the EIS and successfully gaining an approval and designation of DBF as an eligible waste fuel by the EPA.

Upon review and listing of DBF produced to the approved specification as an Eligible Waste Fuel for use at Redbank, Verdant will seek a post-approval SRROE application under Clause 93 of the *Protection of the Environment Operations (Waste) Regulation* 2014 for its use.

Verdant are also aware of the challenges in sourcing and processing DBF material so it can meet the Biomass Specification and a SRROE. Verdant will use senior management (with over 35 years of experience in the timber and waste industries and in the use of biomass fuels) to assist in technology and logistics planning to appropriately characterise DBF and provide opportunities to conduct baseline assessments of DBF. Preliminary results have confirmed that the materials can be processed to the required specifications using existing technologies.

DBF constitutes an estimated small portion (7%) of the fuel proposed beginning in Year 3 of operations if DBF meets the fuel specification for the plant at Redbank and also meets the approval requirements of the NSW EPA as an eligible waste fuel. This is outlined in the fuel strategy in Section 3.3.1 of the EIS and in the Section 4.5.4.1 *Fuel Supply and Characterisation Study* (Appendix M of the EIS). However, the Applicant’s fuel strategy will not rely on DBF throughout the operational life of the power plant and this small portion of the fuel strategy can, if necessary, be supplemented by other sources.

Verdant will maintain access to other fuel sources (e.g. INS, fuel crops) in higher amounts than estimated in the fuel strategy to cover shortfalls in the future if required.

2) *Proponent to provide details regarding potential compliance risks arising from feedstock variability and availability, and outline how the facility will manage situations where feedstock eligibility is compromised for these reasons.*

A Risk Assessment has been prepared by the Applicant (see Appendix A) that identifies and evaluates risks associated with variability in biomass fuel quality and availability of compliant fuel to the power station.

A stated previously, the primary risks around biomass fuel quality are include the following:

- Biomass fuel does not meet Redbank’s Biomass Specification and is unfit for use in the plant; and
- Biomass fuel does not meet SRROE requirements and therefore is not approved for use.

Biomass sourced from approved clearing, removal of INS and coppicing of fuel crops (e.g. native mallee) are well-understood to have qualities that are fit-for-purpose in the Redbank FiCirc boilers.

The *Fuel Supply and Characterisation Study* (Appendix M of the EIS) details the Proposal's use of biomass from invasive native species control, scaling up the growing of fuel crops, biomass from approved infrastructure project clearing and other sources where available and that meet the required specifications of the plant.

The risk is higher for potential fuels sourced from wood waste (particularly post-consumer) and annual / perennial crops (e.g. grasses). For these types, the Applicant will deploy senior management staff experienced in the use of engineered fuels and waste timber biomass to assess technology, plant and equipment, and work directly with contractors to ensure required specifications are met. In the case of DBF, Verdant are proposing to only accept feedstocks from a prequalified feedstock producer and Verdant may choose to wholly own or have a financial position in DBF feedstock suppliers.

Verdant will also implement a comprehensive strategy to ensure that all biomass fuel for Redbank is processed to precise specifications prior to its use as fuel. This approach is designed to maintain optimal operational efficiency and environmental compliance. Given the rigorous processing protocols in place, Verdant has assessed the risk of failing to meet the required biomass fuel specifications as unlikely. This is because all biomass fuels will be tested to ensure compliance with specifications prior to delivery to the power station. Non-compliant biomass fuels will not be approved for transport or accepted whatsoever at the power station.

This is outlined in a robust Quality Assurance and Control Procedure for Receipt and Use of Biomass (Appendix E of the Fuel Supply and *Characterisation Study*). The procedure will used, reviewed and updated as required to control fuel quality, manage risk and avoid potential issues, including those related to meeting the requirements of the Biomass Fuel Specification and any SRROEs.

Verdant will diversify and scale up fuel sourcing and operations over time via implementation of the Fuel Supply and Characterisation Study (Appendix M of the EIS). This multi-pronged approach sourcing fuel from different locations and supported by a regional fuel cropping strategy will reduce the risk of supply disruptions.

Biomass fuels must meet the Biomass Fuel Specification prior to delivery to Redbank. In the unlikely event biomass fuels delivered to Redbank that does not meet the required specifications they will not be accepted. Again, it is emphasised in no uncertain terms that only pre-tested and fully compliant biomass fuels will be accepted at the power station.

3) *Proponent to provide additional evidence demonstrating higher-order reuse opportunities specifically for the secured feedstock intended for use by the facility.*

A Higher Order Use Study prepared for the Response to Submissions report (Appendix H of the RTS) confirms and identifies that there is significant opportunity for securing eligible waste fuel for use at the power station. The study concluded that there are no other higher order uses for an estimated 2.8 million tonnes per annum (tpa) (see Table E1-2 of EIS Appendix H) specific to the biomass fuel sources proposed to be used at Redbank.

Of this, INS accounts for an estimated 1.5 million tpa with no higher order uses or markets available. Data from the Higher Order Use Study (RTS Appendix H) is provided via interviews ARCHE completed with fifteen (15) stakeholders including a selection of landowners and Local Land Services representatives.

Note that Verdant has letters of support for 300,000 tonnes from one supplier over five (5) years, and 100,000 tonnes per year from another supplier. In 2023, Western Regeneration Pty Ltd signed an MOU for 500,000 tonnes per year chipped to the agreed specification. Whilst Western Regeneration has been disbanded, they consisted of several landowners Verdant are still in discussions with individually to form supply contracts once the Proposal is approved. Verdant are in the process of establishing contracts for supply of biomass for a minimum of five (5) years from commissioning (see Appendix A of the Risk Assessment). These landowners are actively seeking a solution for their INS waste biomass rather than burning it in their fields onsite.

Verdant are aware of the commercial risks of a free market, however, Verdant are confident in the availability of partnerships and biomass in all fuel sources identified in their fuel strategy. Verdant has been and continues to engage with landowners, senior management of the West and Central West LLS, mining companies and multiple other parties regarding MOUs, trial chipping operations and many other aspects to fuel sourcing and operations. This is described in detail in Section 4.5.1 of the EIS.

For all proposed fuel types categorised as eligible waste fuels, Verdant will be required to obtain an SRROE from the NSW EPA. This is described in the EIS Section 4.5.2. These applications will require higher order use studies specific to the proposed source in the application.

In addition, and as described in the EIS Section 7.6. (and forming part of the proposed mitigation measures), the Applicant proposes that prior to the first use of eligible waste fuel sources, and annually thereafter, each potential source will require an independent market study be completed to show whether these materials have higher order uses.

4) *Proponent to provide information regarding feedstock management that addresses contaminants associated with pesticides and fire retardants, as these were not included as part of the quality requirements.*

Verdant are aware of the Eligible Waste Fuel requirements, as described in the EIS Section 4.5.2. For all proposed fuel types categorised as eligible waste fuels Verdant will be required to obtain an SRROE from the NSW EPA. Applications for SRROEs will be made for relevant fuels post approval.

Results of the RROE application/determination will need to be included in any required sampling and monitoring of biomass fuel characteristics.

Where chemicals of concern could impact fuel quality, this will be investigated in detail to inform the SRROE application. No biomass fuels will be used that contain chemicals that could adversely affect the environmental performance of the power station.

In addition, section A1.1.4 of the QA/QC procedure specifically requires that "*The Manufacturer must ensure that any testing of samples required by Verdant Earth's Specific Resource Recovery Order is undertaken by analytical laboratories accredited by the National Association of Testing Authorities (NATA) or equivalent testing standards."*

Therefore, any testing requirements of a SRROE issued post approval are inherently part of the QA/QC Procedure. Post approval requirements for testing under any SRROE will be included in the QA/QC and contractual requirements – once those requirements are known post approval.

2.4. Proven Technologies and Handling Capabilities

1) *Proponent to provide details on the design limits/specifications of the existing CFB furnace with respect to moisture content, calorific value, fuel flow rate and how optimal combustion high moisture/low CV feedstocks will be managed.*

Extensive work has been done by B&PPS and Verdant staff to ensure the power plant can be modified as necessary and a fuel specification has been developed, as provided in the *Redbank Power Station – Description of Proposed Modifications for Conversion to Fire Biomass fuels* (EIS Appendix F).

A report prepared by B&PPS titled *FiCirc Boiler Performance for Bush Fire Damaged Tree Trunk Sample at Various Moisture Levels* (B&PPS Report C12148-01) (Appendix D) provides the model outputs in Table 3 of the report. The table provides technical information as derived from the thermal model comparing increasing biomass moisture content in the biomass fuel to the high moisture BDT and ROM coal. A higher moisture content than 25% would not impact the units ability to operate within its capability and design parameters. There would be a marginal decrease in efficiency (% gross calorific value) and increase in fuel flow when comparing a higher moisture content biomass fuel against a lower moisture content biomass fuel with the plant running at the same megawatt (MW) output.

Verdant understand at moisture levels above the 25% the boiler output would be reduced due to the inability of the ID fan to cope with the higher flue gas flows. Figure 9 in EIS Appendix F provides the derating. For example, at 45% moisture, the boiler output is restricted to 85% load.

The Redbank FiCirc boilers are a unique design incorporating a deep bubbling fluidized bed and fine recirculation from large cyclones above the furnace which allows efficient stable combustion of biomass with a wide range of moistures (up to 50%), particles sizes and components as given in fuel specification as given in Figure 20 of the *Redbank Power Station – Description of Proposed Modifications for Conversion to Fire Biomass fuels* (EIS Appendix F).

However, no additional fuel or energy is required to evaporate the moisture as this is managed in the off-site fuel storage. All preparation including drying, chipping and screening will be performed off site. No material will be accepted at Redbank that has not been pre-validated to show that it meets fuel specifications and the relevant SRROE granted by the NSW EPA. Non-compliant fuels will not be accepted at the power station.

In terms of moisture, HRL Technical Laboratories on behalf of Verdant have assessed moisture loss over time and suggest fresh cut or harvested materials should be at least six (6) weeks from cutting in the summer months and eight (8) weeks from cutting in the winter months prior to chipping to the above specification. These types of details are being incorporated into the commercial fuel planning for Redbank.

Verdant will sample each fuel source and establish moisture content on the first load arrival from each new fuel source and further random tests will be undertaken to monitor ongoing compliance.

The furnace also has the capability to manage spikes in moisture in the fluidised bed process as required.

As discussed above in Section 2.2, the Redbank FiCirc boilers are a unique design incorporating a deep bubbling fluidized bed and fine recirculation from large cyclones above the furnace which allows efficient stable combustion of biomass with a wide range of moistures.

Redbank FiCirc boilers operate with a deep bed and in-bed cooling tubes; the bed temperature can be adjusted by changing the bed depth or altering the quantity/size of in-bed tubes. A live bed storage silo exists and forms part of the operating process where bed material is stored and reused during operation to maintaining efficient combustion. The operators are trained in how to manage the bed to achieve the required outputs when moisture levels vary. This was a design requirement when consuming high moisture BDT often above 40% moisture, hence this is the most suitable furnace design for managing varying moisture fuels.

These challenges have been fully addressed in the *Redbank Power Station – Description of Proposed Modifications for Conversion to Fire Biomass fuels* (EIS Appendix F). The B&PPS report clearly indicates that the plant modifications as proposed are suitable for the use of biomass meeting the specification as proposed.

2) *Proponent to provide evidence that design biomass feed rates can be achieved by the retained belt conveyors (e.g., CV34 and CV35) across the full range of bulk densities for proposed biomass fuels.*

This information has been fully addressed in the *Redbank Power Station – Description of Proposed Modifications for Conversion to Fire Biomass fuels* (EIS Appendix F). The B&PPS report clearly indicates that the plant modifications as proposed are suitable for the use of biomass meeting the specification as proposed. The B&PPS Report C12156-03 "Biomass Handling Plant Concept Study" dated 18 June 2021 was used to assist in the preparation of the subsequent EIS Appendix F.

The density and flow variation between Biomass and BDT and ROM coal have been taken into account as detailed in the B&PPS in their report *Redbank Power Station – Description of Proposed Modifications for Conversion to Fire Biomass fuels* (EIS Appendix F, Section 5.3). The study determined that the existing conveyors are suitable and capable of handling the required volumes at the proposed densities in the fuel specification. The proposed changes are recommended to maximise the use of the existing equipment and provide consistent biomass fuel to the plant at the required rates.

3) *Proponent to provide details on the impact of using standard fuels, including high chlorine and potassium feedstocks such as perennial grasses and energy crops, that do not comply with the key fuel specifications for optimal plant operations listed in Appendix M, Table 5.1. Impacts include excessive corrosion, slagging and fouling, fines particulates, and trace air pollutants.*

Biomass with elevated levels of elements that do not comply with the biomass fuel specification given in Figure 20 of the *Redbank Power Station – Description of Proposed Modifications for Conversion to Fire Biomass fuels* (EIS Appendix F) and are not suitable for Redbank and will not under any circumstances be fired at the power station.

Any potential fuel to be used at the power station will be critically assessed for its suitability, including potential fuel crops. All fuel delivered to the power station will need to meet the fuel specification prior to delivery, including chlorine and potassium limits. This will be confirmed through ongoing analysis as described in the QA/QC program.

The Biomass fuel specification was designed to ensure no unacceptable levels of chlorides are included in the fuel. The fuel specification must be met with strict Quality Control before it can be delivered to the power plant.

The low levels of potassium and chlorine in the biomass fuel specification given in Figure 20 of the *Redbank Power Station – Description of Proposed Modifications for Conversion to Fire Biomass fuels* (EIS Appendix F) is not expected to be an issue as the identified biomass sources are generally low in potassium and chlorine.

The Biomass Fuel specification was developed to minimise the quantity of fines. The fuel is required to be 95% between 20 and 100 mm with 75% between 20 and 50mm in size. To achieve this, screening will be essential and screening on a 20mm bottom deck will ensure little or no fines below 5mm. Biomass specification will be strictly controlled in all stockpiled locations prior to loading into truck for delivery to Redbank.

Note that a variety of fuels have been identified and tested for potential use as fuel crops, and only those fuels that comply to the fuel specification will be used for combustion at Redbank Power station. Verdant have been working on trials for the use of indigenous species including various mallees to be grown as fuel. Many native species are well-understood to have qualities that are fit-for-purpose in the Redbank FiCirc boilers and the risk of not meeting specification is very low for these species.

Verdant will continue to research and test potential fuel crop biomass from a variety of sources to find species that are suitable for use at the power station. Existing technologies are readily available to size and grade this material to meet both a biomass specification and SRROE requirements. For example, the NSW Department of Primary Industries (DPI), in conjunction with CSIRO's Australian Tree Seed Centre, have been conducting Woody Biomass Crop Trials to examine the suitability of a range of native woody species for short-rotation woody crop biomass production across NSW[9].

In terms of emissions, the power station is expected to operate at or below emission limits set by the applicable in-stack concentration limits from the *Protection of the Environment Operations (Clean Air) Regulation* 2022, which would be confirmed post-approval through data recorded by the installed continuous emissions monitoring system (CEMS) and periodic emissions sampling campaigns.

The existing monitoring requirements for Redbank are outlined in condition P1 and M2 of EPL 11262. A new EPL or variation to the existing EPL will be required post approval inclusive of continuous monitoring conditions to meet predicted and regulated air quality requirements for the power station as outlined in the *Air Quality Impact Assessment* (EIS Appendix O).

Biomass within the specification range is suitable and will not have excessive corrosion, slagging and fouling, fines particles, and trace air pollutants.as per B&PPS Report "Biomass Performance Risk Review" dated 30-11-2020. This has been provided as Appendix A in the EIS Appendix M as referenced in Section 5.1.

2.5. Technical Fitness and Commissioning Details

1) *Proponent to provide information or an assessment on the operation of the bed material from biomass fuels containing ash-forming elements with reactive and fluxing properties, such as potassium and chlorine compounds*

The Redbank FiCirc boilers are a unique design incorporating a deep bubbling fluidized bed and fine recirculation from large cyclones above the furnace which allows efficient stable combustion of biomass with a wide range of moistures (up to 50%), particles sizes and components as given in the fuel specification shown in Figure 20 of the *Redbank Power Station – Description of Proposed Modifications for Conversion to Fire Biomass fuels* (EIS Appendix F).

The deep bubbling bed consisting of ~200 tons of bed inert material and ~2% of combusting material gives a thermal flywheel allowing large variations in the biomass characteristics. The fines recirculation ensures high efficiency under all conditions.

The bed temperature is maintained by adjusting the bed height making the bed tubes effective. The boilers are fitted with an external bed storage silo into which bed material is moved in or out of during operation as needed to suit the fuel characteristics.

Redbank FiCirc boilers operate with a deep bed and in-bed cooling tubes; the bed temperature can be adjusted by changing the bed depth or altering the quantity/size of in-bed tubes. A live bed storage silo exists and forms part of the operating process where bed material is stored and reused during operation to maintaining efficient combustion. The operators are trained in how to manage the bed to achieve the required outputs when fuel has variable characteristics.

The biomass fuel will be provided within the Biomass specification designed specifically to avoid and eliminate operational problems caused by defluidisation in the plant.

Biomass with the specified maximum ash content of 4% will require bed make-sand to be added. This is chemically inert washed river sand and possibly limestone if SOx emissions dictate.

[9] NSW Department of Primary Industries (2023). Woody Biomass Crop Trial. Web: https://www.dpi.nsw.gov.au/forestry/science/forest-carbon/biomass-for-bioenergy/biomass-crops

The low levels of potassium and chlorine in the biomass fuel specification given in Figure 20 of EIS Appendix F will ensure these elements do not impact the operations of the bed or resulting air emissions. It is further noted that ash fusion occurs at a temperature of 1,200°C. The bed operating temperature at Redbank is 900°C, meaning the risk of ash fusing in the bed is negligible.

The operating personnel are well trained in managing the FiCirc technology and ensuring efficient and reliable operation.

2.6. Emission Control Techniques and Monitoring

1) *Proponent to provide additional details of air emissions resulting from combustion of feedstocks with elevated levels of volatile inorganic species, such as perennial grasses and agricultural residues.*

Combustion of biomass fuels with elevated levels of volatile inorganic species, such as perennial grasses and agricultural residues, will not be used when it does not meet the Biomass Specification and/or a SRROE.

When testing shows that the biomass fuel considered meets the specification it can be used at Redbank. Where the specification is not met, it will not be used, as described in the EIS Section 3.3 and in the *Redbank Power Station – Description of Proposed Modifications for Conversion to Fire Biomass fuels* (EIS Appendix F).

The Applicant has prepared a comprehensive Risk Assessment (see Appendix A) that identifies and evaluates the risks to securing biomass fuel that does not meet the required specifications.

Verdant will diversify and scale up fuel sourcing and operations over time by implementing a robust and comprehensive fuel strategy as described in section 4 of the Fuel Supply and Characterisation Study (Appendix M of the EIS).

When testing shows that the biomass fuel considered meets the specification it can be used at Redbank. Where the specification is not met, it will not under any circumstances be used.

Note that the fuel strategy estimates that no agricultural residues would be used at Redbank in the first year, and at year 2 and onwards 50,000 tpa would be used, which is 7% of the total (dry) biomass full capacity requirements.

Verdant will continue to test biomass to find suitable fuel from agricultural residue biomass sources prior to its use at the power station, including natural organic fibrous materials and organic residues from harvest activities including fibres, roots, stalks, stubble, leaves, seed pods, nut shells cotton and cane trash.

Similarly, perennial grasses are only one type of possible fuel crop that Verdant will continue to test for potential fuel suitability at the power station if they meet the required standards.

At this time, coppicing of native Australian species for fuel crops (e.g. native mallees) are well-understood to have qualities that are fit-for-purpose in the Redbank FiCirc boilers. The risk of these types of fuel not meeting specification is low as there are existing technologies readily available to size and grade this material to meet both a biomass specification and SRROE requirements.

The Air Quality Impact Assessment (EIS Appendix O) modelled a Regulatory Worst Case (RWC) scenario, which derived constant emission rates from the applicable *Protection of the Environment Operations (Clean Air) Regulation* 2022 emission concentration limits that would apply to the Redbank Power Station. The results of the RWC modelling, independent of fuel moisture content and a highly conservative emissions situation, showed that air quality impacts in the surrounding environment would comply with applicable NSW EPA impact assessment criterion.

Note that the Air Quality Impact Assessment (EIS Appendix O) in Table 7.10 lists the emissions control technology employed at the power plant. The existing FiCirc fluidised bed boiler is especially suited for burning biomass, has reduced thermal NOx formation due to combustion temperatures of 800-900°C, whilst avoiding low temperatures associated with volatile organic compounds and polycyclic aromatic hydrocarbons formation and conditions conducive to the formation of dioxins. The technology includes high efficiency cyclones to capture fines and return them to the combustion bed, and bag filters to control fine particulates.

Verdant will be required to operate continuous in-stack emissions monitoring to review air pollutant emission concentrations against NSW EPA POEO limits, and commit (for confirmation) to a commissioning phase emissions testing program to verify real-world emission concentrations relative to fuel moisture contents and the emission rates modelled in the AQIA.

2.7. Additional Considerations

1) *Proponent to provide additional evidence to support the claim that bottom ash could displace fertiliser use.*

It is not assumed that ash would be used on its own as a fertiliser. If ash is blended with other fertilisers, this would still reduce the need for the fertilisers which normally provide the nutrients contained in the ash. Displacements are calculated based on potassium, phosphorous and calcium contents in the ash, and it is assumed to only displace equivalent amounts of these same chemicals.

This is shown in Table 2, and Table 10 of the *Use of Biomass Fuel at Redbank Power Station – Life Cycle Assessment* (EIS Appendix N).

Only emissions associated with upstream production of fertilisers are assumed to be displaced. i.e. no direct emissions are offset. Excluding the fertiliser production displacement increases emissions in the biomass scenario by less than 0.2% in the Lifecycles report.

2) *Proponent to remove of statement referring to carbon monoxide not having an impact.*

It is agreed that this is disputable. A small edit could be made to text in the text of the *Use of Biomass Fuel at Redbank Power Station – Life Cycle Assessment* (EIS Appendix N) to clarify that CO is not counted as a greenhouse gas in the LCA impact method applied (IPCC GWP100 2013).

However, this would not change the results as the method applied (IPCC GWP100 2013) do not include CO as a greenhouse gas.

3) *Proponent to confirm to what extent the biomass pulverisation has been modelled.*

The literature source used for chipping in the *Use of Biomass Fuel at Redbank Power Station – Life Cycle Assessment* (EIS Appendix N, Reference #13) did not contain a particle size, though equated to approximately 0.54MJ diesel per kg of chips at 25% moisture content.

Note that Redbank uses fluidised bed technology (FiCirc boilers) and does not require pulverised materials. Using pulverised fuel is not compatible with the technology. The fuel specification size as provided in Figure 20 of the *Redbank Power Station – Description of Proposed Modifications for Conversion to Fire Biomass fuels* (EIS Appendix F) does not allow fines (i.e. pulverised fuel) into the bed due to the updraft from the fluidised sand bed.

The Biomass Fuel specification was developed to minimise the quantity of fines. The fuel is required to be 95% between 20 and 100 mm with 75% between 20 and 50mm in size. To achieve this screening will be essential and thus it is unlikely that fines below 20mm can be retained by the screens. Biomass specification will be strictly controlled as described in the EIS and the Quality Assurance/Quality Control (QA/QC) program provided Appendix E in the *Fuel Supply and Characterisation Study* (Appendix M of the EIS).

The mechanical processes used to achieve the required size specification will reduce and remove fine particulates prior to the material being used at Redbank.

The majority of the fuel should be 50mm minus and preferably between 30 and 45mm chip to enable combustion in the furnace bed with little or no fines below 5mm.

Biomass may require pulverisation if it is replacing coal in the traditional coal fire power station where the coal is pulverised and blown into the boiler, which is clearly a different technology than the FiCirc fluidised bed technology employed at Redbank.

3. Conclusions

The biomass fuel to be used at Redbank will comprise only standard fuels and eligible waste fuels as listed in Part 3 of the *NSW Energy from Waste Policy Statement* and defined in the *Eligible Waste Fuels Guidelines*.

The Applicant acknowledges that securing adequate biomass fuel volumes will require an ongoing, diligent, and targeted approach. To address this, Verdant has developed a multi-pronged fuel strategy, outlined in Appendix M of the EIS. Obtaining the required fuel supply is a commercial matter for Verdant to manage post-approval. The application for SSD-56284960 has provided reasonable assumptions and demonstrated that there is a biomass fuel supply in the proposed quantities required to operate the Redbank Power Station at full capacity over the life of the plant. And further evidence has been provided in the Response Report.

Verdant will diversify and scale up fuel sourcing and operations over time through implementation of the Fuel Supply and Characterisation Study (Appendix M of the EIS). A multi-pronged approach to source fuel from different locations is supported by a regional fuel cropping strategy that will reduce the risk of supply disruptions. Verdant are also targeting at any given time to have 25% more biomass fuel available than required to make up for potential shortfalls in any one biomass fuel source.

The Redbank FiCirc boilers are a unique design incorporating a deep bubbling fluidized bed and fines recirculation from large cyclones above the furnace. The plant is fit-for-purpose and allows efficient stable combustion of biomass with a wide range of moistures (up to 50%), particles sizes and components as given in biomass fuel specification.

Biomass is highly suitable for use in circulating and deep bubbling fluidised bed technologies. This has been researched extensively and is widely known and demonstrated in peer reviewed literature, which is presented in the report.

Senior management staff at Verdant are very familiar with the plant technology at Redbank and have experience ranging from being lead project manager on the build of Redbank in 2001 through to the latest operational experience including placing Redbank in care and maintenance and maintaining the plant to date. Verdant also works with leading local consultants, global firms and process technology and automation services for the energy industries such as Valmet which has been producing biomass boilers and operating for over 225 years and Andritz a leading biomass engineering firm operating for 140 years. See Appendix C for a summary list of Verdant staff personnel and experience.

A Quality Assurance and Control Procedure for Receipt and Use of Biomass (Appendix E of the Fuel Supply and *Characterisation Study*) will be implemented, reviewed and updated to control fuel quality, manage risk and avoid potential issues, including those related to meeting the requirements of the Biomass Fuel Specification and any SRROEs.

With the implementation of strategies and contingencies identified in the Risk Assessment, <u>ALL</u> identified risks have been assessed LOW and tolerable with the following exceptions (considered to be MODERATE risks):

- Natural disaster such as a bushfire, drought or flooding event destroying biomass supplies or limiting access to fuel supply for significant periods of time;
- EPA approval to use Domestic Biomass Fuel (DBF) as a biomass fuel and reducing available biomass fuel;
- Biomass with no higher order uses arising from agricultural waste or residues (excluding INS) consistency and quality non-compliance with the Biomass Fuel Specification and/or a Specific Resource Recovery Order and Exemption; and
- The ability to obtain suitable feedstock in relevant quantities to create and deliver Domestic Biomass Fuel to meet the consistency and quality required to comply with the EPA requirements and Biomass Fuel Specification and/or a SRROE.

These MODERATE risks are already well understood, and Verdant's broad strategy for reducing the risk of undersupply is to diversify and scale up fuel sourcing and operations over time.

Verdant are also targeting at any given time to have 25% more biomass fuel available than required to make up for possible shortfalls of any one biomass fuel source.

As a contingency, the plant consists of two FiCirc Fluidised bed boilers and one Turbine. The plant is designed to be operated between 70 and 100% steam flow. It is a base load plant and has minimum turndown capability to 110 MW with two boilers, if load needs to be reduced further then one boiler can be taken off service and stored in hot condition. The minimum load with one boiler in operation is 55MW. This would reduce the amount of fuel required to 40 tonnes per hour, or roughly half the amount for full capacity.

Overall, the Risk Assessment concludes that the risks to successful operation of the Redbank Power Station using biomass (excluding native forestry residues from logging) have been assessed as LOW and tolerable.

The Proposal is considered a highly suitable project for the Redbank Power Station. It is recommended that DPHI recommend approval of the Proposal with the implementation of the (revised) mitigation and management measures as exhibited in the Response to Submissions report.

Appendix A Risk Assessment

JEP
ENVIRONMENT & PLANNING

Risk Assessment of Biomass Fuel Supply

Restart of the Redbank Power Station and use of Biomass (Excluding Native Forestry Residues from Logging) As a Fuel - SSD-56284960

Verdant Earth Technologies Limited

Prepared for Verdant Earth Technologies Limited

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Acknowledgements
JEP Environment & Planning would like to thank all contributors that have informed this report. All recommendations and views in this report are attributable to JEP Environment & Planning unless otherwise stated.

We declare that
The report contains all available information that is relevant to the assessment of the Site and proposed development, activity or infrastructure to which the report relates, and the information contained in the report is neither false nor misleading.

Version	Authors	Date	Reviewer	Approved for issue	Date
Draft	E. Larson	14/02/2025	Dr M. Jackson	Dr M. Jackson	16/02/2025
Final	E. Larson	26/02/2025	Dr M. Jackson	Dr M. Jackson	27/02/2025

Executive Summary

Purpose and Background

This Risk Assessment report has been prepared on behalf of Verdant Earth Technologies Limited (Verdant) (the Applicant) as part of its application to restart the Redbank Power Station using biomass (excluding native forestry residues from logging) at 112 Long Point Road West, Warkworth (Lot 450 DP 1119428) (the Site).

Public exhibition of the Environmental Impact Statement for this state significant development (SSD-56284960) concluded on 11 April 2024. In response to public and government comments, a Response to Submissions report was prepared for the NSW Department of Planning, Housing and Infrastructure (DPHI) and submitted on 5 July 2024. Verdant supplied additional information upon request to DPHI along with a second response report on 23 August 2024.

At the request of DPHI, an Independent Merit Review (the Review) of the Environmental Impact Statement (EIS) for the Restart Redbank Power Station (SSD 56284960) was provided on 13 December 2024 to assist in the review and determination of SSD-56284960.

The Review specifically requests that a risk assessment be provided for the following:

- *Proponent to develop a comprehensive risk assessment to evaluate the potential impacts of legislative changes on biomass supply, including preparation of adaptive management strategies to respond effectively to these changes.*
- *Proponent to develop a risk assessment and a contingency plan to address potential risks associated with supplier variability and inconsistencies in feedstock quality.*

Other risks identified that have also been considered in this Risk Assessment include the potential for a shortage of biomass and natural disasters.

Verdant has prepared this Risk Assessment to provide a detailed evaluation of these issues. This Risk Assessment has been prepared generally in accordance with AS/NZS ISO 31000:2018, the recognised standard for risk assessments and risk management in commercial and business operations. The standard provides a framework and guidelines to help identify, assess, and manage risks in a systematic, consistent and transparent manner.

This Risk Assessment has comprehensively assessed the items requested in the Review in detail, and provides adaptive management strategies and contingencies for proposed work and operations under SSD 56284960, including the following aspects:

1. Adequacy of the fuel supply, including all proposed eligible waste fuels and standard fuels proposed;
2. Compliance and operational risks associated with variability in feedstock characteristics;
3. Natural disaster events such as drought, flood and fire; and
4. Pending legislative updates and changes that could affect operations.

Results of the Risk Assessment

Following provides an overview of the Risk Assessment results, and a summary of adaptive management strategies and contingencies proposed.

1. ***Adequacy of the fuel supply, including all proposed eligible waste fuels and standard fuels proposed***

Following are sources of biomass fuel proposed to be used for energy generation at Redbank, as they are listed in the EIS:

Standard Fuels:

- Purpose grown energy plantations;
- Perennial grasses; and
- Energy crops.

Eligible Waste Fuels:

- Biomass with no higher order uses arising from invasive native species control on agricultural land[1];
- Biomass with no higher order uses from approved land clearing activities such as major infrastructure developments for approved civil infrastructure, road clearing works, right of ways and related approved projects[2];
- Agricultural waste biomass products or residues with no higher order uses;
- End of life waste woody biomass manufactured and produced into a fuel to specification ("Domestic Biomass") (subject to EPA approval as an eligible waste fuel)[3]; and
- Other sources of eligible waste fuels with no higher order uses.

Each proposed biomass fuel source comes with its own set of risks related to Verdant's objective of supply Redbank up to 700,000 (dry) tonnes per annum (tpa) of biomass fuel to generate electricity at full capacity.

Verdant's broad strategy for reducing the risk of undersupply is to diversify and scale up fuel sourcing and operations over time. This is outlined in the Fuel Supply and Characterisation Study (Appendix M of the EIS). Verdant are also targeting at any given time to have 25% more biomass fuel available than required to make up for possible shortfalls of any one biomass fuel source.

As a contingency, the plant consists of two FiCirc Fluidised bed boilers and one Turbine. The plant is designed to be operated between 70 and 100% steam flow. It is a base load plant and has minimum turndown capability to 110 MW with two boilers, if load needs to be reduced further then one boiler can be taken off service and stored in hot condition. The minimum load with one boiler in operation is 55MW. This would reduce the amount of fuel required to 40 tonnes per hour, or roughly half the amount for full capacity.

Whilst there are specific risks to individual proposed biomass fuel types, the overall risk has been assessed as LOW and tolerable with the implementation of the strategies and contingencies provided above.

Risks related to the individual biomass fuel types has also been assessed, and adaptive management strategies provided for each, as summarised below.

Fuel crops

Fuel crops form an estimated 70% of the annual requirements by year 5 of operations. If this amount of fuel crops is unavailable or lower in volumes than expected, it could lower energy production at Redbank, assuming the fuel cannot be replaced with other types of approved biomass.

The risk of not meeting supply estimates could be due to a variety of factors such as inadequate land, lack of suppliers, or lower than expected production. These and other risks have been assessed as LOW and tolerable with the implementation of the following strategies:

- Verdant will continue active strategic engagement with the relevant community, landowners and businesses including Hunter Valley mines to develop a network of opportunities that can be employed post approval;
- Verdant are in and will continue to be in discussions with regional farmer groups and consultants to use quick rotation biomass crops on degraded / less productive lands;
- Verdant will continue to assess and identify the suitability of various native woody species for biomass production across NSW;
- In cooperation with the NSW Department of Primary Industries (DPI), and in conjunction with CSIRO's Australian Tree Seed Centre, Verdant will continue to examine the suitability of a range of native woody species for short- rotation woody crop biomass production across NSW[4];
- Verdant will use the expertise and data available (e.g. Woody Biomass Crop Trials) to leverage the infrastructure and knowledge base within the nursery and farming industry to support large-scale production of fuel crops; and

[1] The *Land Management (Native Vegetation) Code* 2018 under the *Local Land Services Act* 2013 sets out permitted clearing and thinning of native vegetation on agricultural land, such as invasive native species where a compliance certificate has been issued by Local Land Services NSW.
[2] Requires notification by the NSW EPA in the New South Wales Government Gazette under Section 140 of the *Protection of the Environment Operations (General) Regulation* 2022.
[3] Domestic Biomass Fuel (DBF) is not currently prescribed as an 'eligible waste fuel' under current EPA guidelines, though the applicant will seek to demonstrate this prior to its use through a post-approval Specific Resource Recovery Order and Exemption application under Clause 93 of the *Protection of the Environment Operations (Waste) Regulation* 2014.
[4] NSW Department of Primary Industries, Woody Biomass Crop Trial 2023. Web: https://www.dpi.nsw.gov.au/forestry/science/forest-carbon/biomass-for-bioenergy/biomass-crops

- Verdant will continue to actively engage with the relevant industries in Australia and overseas where necessary, to proactively prepare and contract with suppliers of seedlings and rootstock and appropriate technologies, plant and equipment suited to establishing, maintaining and harvesting fuel crops in a sustainable manner.

Invasive Native Species

Invasive native species (INS) account for an estimated 71% of the required biomass fuel in the first year of operation, scaling down to 13% in year 5.

The Review identifies that there is a risk that suppliers may not be able to provide sufficient INS due to discrepancies in yield estimates from landholders, fewer contracts established or the inability to provide labour or equipment needed to supply the material. These and other risks have been assessed as LOW and tolerable with the implementation of the following strategies.

- Verdant will continue to undertake outreach to landowners and Local Land Services to establish contacts with potential suppliers;
- Verdant will work with Local Land Services, supply contractors and landowners to establish and/or provide plant/equipment technologies required direct to the landowners;
- Verdant will provide labour and capabilities through technology transfers, if necessary, including specialized equipment including grinders/chippers, screening systems, stockpiling, and loading equipment where required to support the required volumes of fuel needed that meets specifications; and
- Verdant will establish supply contracts with landowners committing to supply biomass of a minimum amount per year to specification. Note that Verdant has letters of support for 300,000 tonnes from one supplier over five (5) years, and 100,000 tonnes per year from another supplier. In 2023, Western Regeneration Pty Ltd signed an MOU for 500,000 tonnes per year chipped to the agreed specification. Whilst Western Regeneration has been disbanded, they consisted of several farmers Verdant are still in discussions with individually to form supply contracts once the Proposal is approved (see 0).

Because of the significant amounts of INS available in the western areas of NSW and its suitability for Redbank, INS can also support shortfalls in other fuel sources during the ramp of fuel crops.

Land Clearing

Verdant's fuel strategy includes biomass with no higher order uses from approved land clearing activities such as major infrastructure developments for approved civil infrastructure, road clearing works, right of ways and related approved projects. Verdant have estimated 150,000 (dry) tpa of waste biomass would be used from approved land clearing the first year of operations, scaling down to 50,000 tpa by year 3 of operations and 20,000 tpa by year four.

The Review identified the risk of reinforced restrictions and oversight on land clearing activities that could affect the pool of accessible biomass. There is also the variability of infrastructure project approvals, their locations and the unpredictable nature of clearing involved in each project, including whether there are higher order uses for the materials.

These risks have been assessed as LOW and tolerable with the implementation of the following strategies.

- Verdant Earth have been and will continue to develop supply agreements with companies that have commercial volumes of waste biomass available from approved clearing activities;
- Verdant will continue to assess fuel sources as market conditions and contractors change in response to ongoing project approvals and developments to determine where and how much material is available on an ongoing basis;
- Verdant will be required under a Specific Resource Recovery Order and Exemption (SRROE) to undertake an appropriate Higher Order Use Study for any approved infrastructure project where waste biomass may be sourced; and
- In the first two years of Redbank operation, in the event of a shortfall in this area, Verdant will supplement the tonnage in the first two years with INS or other sources to fill the supply gap.

Agricultural Residues

Biomass from agricultural residues is considered biomass waste directly resulting from agricultural production. This waste may include fibres, roots, stalks, stubble, leaves, seed pods, nut shells and some waste from agricultural processing such as cotton trash.

The quantities of agricultural material potentially available to Redbank within a 300 km radius of Singleton is estimated to be 1,023,172 tpa, as identified in the EIS. The Higher Order Use Study (RTS Appendix H) estimates that 675,294 tpa of this is currently being disposed with no higher order use.

The fuel strategy estimates that no agricultural residues would be used at Redbank in the first year, and at year 2 and onwards 50,000 tpa would be used.

- Verdant will be required under a SRROE to undertake an appropriate Higher Order Use Study for any agricultural residue waste biomass sourced; and
- Verdant will continue to assess agricultural markets and producers to ascertain where and how much material is available on an ongoing basis.

Verdant have identified the risks to supply of agricultural residues as LOW and tolerable.

Domestic Biomass

Verdant recognise that the EPA has not at this stage approved the use of Domestic Biomass Fuel (DBF) and does not list DBF as an eligible waste fuel. However, included in the EIS is a process and strategy towards enabling the use of DBF.

The Review identifies challenges with the proposed use of DBF from sources such as Construction and Demolition (C&D) and Commercial and Industrial (C&I) waste due to existing regulatory restrictions and commercial barriers, including competitive gate fees and contamination risks.

The risk that EPA does not list DBF as an eligible waste fuel because of the potential for contamination and the inconsistency or heterogeneity of the biomass fuel composition – and does not approve DBF for use at Redbank – has been assessed as HIGH. However, because Verdant does not estimate DBF will be used at Redbank in the first two (2) years of operations at Redbank, and 7% (50,000 dry tpa) of the fuel requirements is estimated beginning in year 3 of operations, the impact of this reduces the risk to MODERATE, for both pre and post-treatment and mitigation.

Similarly, the risk of DBF not meeting the Biomass Fuel Specification or a Specific Resource Recovery Order and Exemption requirements is MODERATE, however, the impact is low and therefore post-treatment and mitigation the risk has been assessed as LOW and tolerable.

- Verdant Earth Technologies will continue to engage with the NSW EPA to characterise DBF and seek approval for the use of DBF via an approved DBF trial;
- Verdant will not rely on DBF the first two (2) years of operations and will maintain access to other fuel sources (e.g. INS, fuel crops) in higher amounts than estimated in the fuel strategy to cover shortfalls in the future if required;
- Verdant will use senior management (with over 35 years of experience in the timber and waste industries and in the use of engineered fuels and waste timber biomass) to assist in technology and logistics planning for the use of DBF at Redbank; and
- Verdant will continue to conduct baseline assessments of DBF. Preliminary results have confirmed that the materials can be processed to the required specifications using existing technologies.

Transportation and Logistics

Biomass feedstock for Redbank will require B-double heavy vehicles operating 24/7, delivering fuel on a prioritised 16-hour period between 6am and 10pm, 7 days per week (Monday to Sunday). Deliveries of biomass are expected to be approximately 56 trucks over the course of each day.

Transport of up to 700,000 (dry) tpa to Redbank from a variety of source locations may incur higher costs than estimated. There is a risk of logistical failures in the timing or ability of these loads in delivering regularly to Redbank. Significant failures could lead to a shortage of planned feedstock being available in the required quantities over a time period or of processed fuel not being picked up by haulage trucks.

These risks have been assessed as LOW and tolerable with the implementation of the following strategies.

- Verdant is developing a logistics plan to establish biomass feedstock inventory at biomass feedstock source production sites and a potential facility near Redbank;
- Verdant will continue to engage with and develop this strategy with local transport contractors;

- Verdant will coordinate with Local Land Services precincts and land managers in closer precincts to Redbank to reduce transport costs of INS where possible; and
  Verdant will continue to assess the feedstock transport costs per tonne and the supply and processing cost per tonne to ensure financially viability.

2. *Compliance and operational risks associated with variability in feedstock characteristics*

Work was undertaken by Boiler & Power Plant Services Pty Ltd (EIS Appendix F) on behalf of Verdant to assess the required biomass feedstock fuel physical characteristics. A specification has been developed that must be met in order to prevent deterioration (e.g. corrosion) and maintain the performance of the plant and its various components.

Additionally, all eligible waste fuels proposed for use at Redbank will need to meet the requirements under a SRROE issued by the EPA. The *Eligible Waste Fuels Guidelines* (EPA 2022) specifies strict standards for feedstocks to minimise risks to human health and the environment.

The Review requested that Verdant provide details regarding potential compliance risks arising from feedstock variability and availability, and outline how the facility will manage situations where feedstock eligibility is compromised for these reasons. In addition, the Review requested that a contingency plan be developed to address potential risks associated with supplier variability and inconsistencies in feedstock quality.

The primary risks around biomass feedstock quality include the following:

1. Biomass fuel does not meet Redbank's Biomass Specification and is unfit for use in the plant; and
2. Biomass fuel does not meet SRROE requirements and therefore is not approved for use.

The degree of risk is not the same for each standard fuel and eligible waste fuel type.

However, overall and across all fuel types, risks have been assessed as LOW and tolerable with the implementation of the following strategies:

- Implement the Fuel Supply and Characterisation Study (Appendix M of the EIS) to diversify and scale up fuel sourcing and operations over time;
- Implement, and update as necessary, the Quality Assurance and Control Procedure for Receipt and Use of Biomass (Appendix E of the Fuel Supply and Characterisation Study);
- Deploy senior management staff experienced in the use of engineered fuels and waste timber biomass to assess technology, plant and equipment, and work directly with contractors to ensure required specifications are met;
- Implement, review and update as needed the Quality Assurance and Control Procedure for Receipt and Use of Biomass (Appendix E of the Fuel Supply and Characterisation Study); and
- Feedstock must meet the Biomass Fuel Specification prior to delivery to Redbank.

Risks have been assessed as LOW and tolerable for purpose-grown fuel crops, INS, and biomass from land clearing for approved infrastructure project with the implementation of the following strategies:

- Verdant to continue to develop and update the fuel crop strategy in collaboration with relevant stakeholders including DPI, EPA, nurseries, landholders, and contractors;
- Verdant will maintain rigorous control of species selection and testing prior to development of fuel crops at scale;
- Verdant will continue to engage with INS landowners and supply contractors to assess that appropriate technologies are employed to meet the required specifications;
- If necessary, Verdant will also provide technology transfers including specialised equipment including grinders/chippers, screening systems, stockpiling, and loading equipment where required to support the required volumes of fuel needed that meets specifications;
- Maintain QA/QC of processing conditions to lower risk of contaminants from machinery and other construction activities onsite for approved land clearing projects through audits, site visits and rigorous testing requirements; and
- Verdant will continue to, and on an ongoing basis, engage with companies that have commercial volumes available of waste biomass from approved land clearing activities;

Risk have been assessed as MODERATE and as low as reasonably practicable for agricultural waste or residues and DBF, with the implementation of the following strategies.

- Verdant will continue to engage with agricultural landowners and supply contractors to assess appropriate technologies required to meet the required specifications for agricultural residues;
- Verdant will continue to test biomass from a variety of sources including natural organic fibrous materials and organic residues from harvest activities including fibres, roots, stalks, stubble, leaves, seed pods, nut shells cotton and cane trash to find suitable fuel for agricultural residue biomass sources;
- Verdant will continue to conduct baseline assessments of DBF. Preliminary results have confirmed that the materials can be processed to the required specifications using existing technologies;
- Verdant will continue to engage with the resource recovery industry to assess appropriate technologies required to meet the required specifications; and
  Verdant to continue to develop and update a DBF strategy in collaboration with relevant stakeholders including the EPA, industry and technology providers, and the wider community.

3. *Natural Disasters, including Drought, Floods and Bushfire*

Drought, floods and bushfires are a fundamental part of the Australian landscape. Natural disasters could temporarily block main and secondary roads, preventing access to fuel feedstock supplies. There is also risk of significant areas of biomass fuel being destroyed (e.g. bushfire).

These risks have been assessed as MODERATE and as low as reasonably practicable, with the implementation of the following strategies.

- The primary strategy to adapt to these natural hazards is to diversify sources in multiple locations to prevent a large percentage of biomass fuel from being destroyed or inaccessible for long periods. This strategy is outlined in the in the Fuel Supply and Characterisation Study (Appendix M of the EIS);
- Other strategies will be implemented as appropriate such as the use of fire roads, coppicing and fuels management and maintenance to reduce unwanted ladder fuels and buildup can provide some prevention and reduction of hazard; and
  Flooding and surface water will be managed in fuel crop areas through land management techniques and drainage controls.

4. *Pending legislative updates and changes that could affect operations*

The Review notes (Pg 10) that the NSW Government's response to reviews of the *Biodiversity Conservation Act* 2016 (BC Act) and the *Local Land Services Act* 2013 (LLS Act) introduces additional risk related to future biomass feedstock availability, and that upcoming legislative amendments aim to strengthen environmental protections.

The Review requested Verdant to develop a comprehensive risk assessment to evaluate the potential impacts of legislative changes on biomass supply, including preparation of adaptive management strategies to respond effectively to these changes.

Adapting to potential changes in policy, legislation and guidelines is important to ensure adequate fuel feedstock is available to Redbank. Verdant will continue to engage with stakeholders and government, and implement adaptive management strategies.

The risks have been assessed as LOW and tolerable with the implementation of the following strategies:

- Verdant will continue to engage directly with senior staff at Local Land Services and with landowners regarding changes to policies and guidelines as recommended by the NSW Government review;
- Verdant will update their fuel strategy as outlined in the Fuel Supply and Characterisation Study (Appendix M of the EIS) and the Quality Assurance and Control Procedure for Receipt and Use of Biomass (Appendix E of the Fuel Supply and Characterisation Study) to incorporate any relevant changes that could affect availability and operations around INS and biomass from approved infrastructure land clearing projects;
- Verdant will review contractual arrangements with landowners and contractors to incorporate these changes; and
- Review upcoming approvals for infrastructure construction projects in consideration of timing, volumes, location and potential higher order uses on an ongoing basis.

Conclusions and Recommendations

A comprehensive Risk Assessment has been prepared that evaluates in detail the potential impacts and risks associated with potential shortages of biomass fuel, variability in supply, ability of biomass sourced to meet fuel specifications and regulatory requirements, and potential legislative changes on the supply of biomass.

The Risk Assessment also identifies adaptive management strategies and contingencies Verdant will use to respond effectively to these risks.

With the implementation of these identified strategies and contingencies, all identified risks have been assessed low and tolerable with the following exceptions (considered to be moderate risks):

- Natural disaster such as a bushfire, drought or flooding event destroying biomass supplies or limiting access to fuel supply for significant periods of time;
- EPA approval to use Domestic Biomass Fuel (DBF) as a feedstock fuel and reducing available biomass fuel;
- Biomass with no higher order uses arising from agricultural waste or residues (excluding INS) consistency and quality non-compliance with the Biomass Fuel Specification and/or a Specific Resource Recovery Order and Exemption; and
- The ability to obtain suitable feedstock in relevant quantities to create and deliver Domestic Biomass Fuel to meet the consistency and quality required to comply with the EPA requirements and Biomass Fuel Specification and/or a SRROE;

These moderate risks are already well understood, and Verdant's broad strategy for reducing the risk of undersupply is to diversify and scale up fuel sourcing and operations over time. This is outlined in the Fuel Supply and Characterisation Study (Appendix M of the EIS). Verdant are also targeting at any given time to have 25% more feedstock available than required to make up for possible shortfalls of any one biomass fuel source.

As an additional contingency, in the event of an unplanned fuel shortage, there is the ability for the plant to be turned down or a boiler can be taken out of service. The plant consists of two FiCirc Fluidised bed boilers and one Turbine. The plant is designed to be operated between 70 and 100% steam flow. It is a base load plant and operates at 151MW however it has a minimum turndown capability of 110MW and can be operated at this minimum of 110 MW with two boilers, if load needs to be reduced further then one boiler can be taken off service and stored in hot condition. The minimum load with one boiler in operation is 55MW. This would reduce the amount of fuel required to 40 tonnes per hour, or approximately half the amount of fuel required when operating at 100% for full capacity.

Overall, this Risk Assessment concludes that the risks to successful operation of the Redbank Power Station using biomass (excluding native forestry residues from logging) have been assessed as low and tolerable.

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1. Scope of the Risk Assessment

This Risk Assessment report has been prepared on behalf of Verdant Earth Technologies Limited (Verdant) (the Applicant) as part of its application to restart the Redbank Power Station using biomass (excluding native forestry residues from logging) at 112 Long Point Road West, Warkworth (Lot 450 DP 1119428) (the Site).

Public exhibition of the Environmental Impact Statement for this state significant development (SSD-56284960) concluded on 11 April 2024. In response to public and government comments, a Response to Submissions report was prepared for the NSW Department of Planning, Housing and Infrastructure (DPHI) and submitted on 5 July 2024. Verdant supplied additional information upon request to DPHI along with a second response report on 23 August 2024.

At the request of DPHI, an Independent Merit Review (the Review) of the Environmental Impact Statement (EIS) for the Restart Redbank Power Station (SSD 56284960) was provided on 13 December 2024 to assist in the review and determination of SSD-56284960.

The Review specifically requests that a risk assessment be provided for the following:

- *Proponent to develop a comprehensive risk assessment to evaluate the potential impacts of legislative changes on biomass supply, including preparation of adaptive management strategies to respond effectively to these changes.*
- *Proponent to develop a risk assessment and a contingency plan to address potential risks associated with supplier variability and inconsistencies in feedstock quality.*

Verdant has considered this request and prepared this Risk Assessment to provide a detailed evaluation of these issues. This Risk Assessment has been prepared generally in accordance with AS/NZS ISO 31000:2018, the recognised standard for risk assessments and risk management in commercial and business operations. The standard provides a framework and guidelines to help identify, assess, and manage risks in a systematic, consistent and transparent manner.

This Risk Assessment has comprehensively assessed the items requested in the Review in detail, and provided adaptive management strategies and contingencies for proposed work and operations under SSD 56284960, including the following aspects:

- Adequacy of the fuel supply, including all proposed eligible waste fuels and standard fuels proposed;
- Compliance and operational risks associated with variability in feedstock characteristics;
- Natural disaster events such as drought, flood and fire; and
- Pending legislative updates and changes that could affect operations.

2. Risk Aspects Review

2.1. Adequacy of Fuel Supply

The following sources of biomass fuel are proposed to be used for energy generation at Redbank, as they are listed in the EIS:

Standard Fuels:

- Purpose grown energy plantations;
- Perennial grasses; and
- Energy crops.

Eligible Waste Fuels:

- Biomass with no higher order uses arising from invasive native species control on agricultural land[5];
- Biomass with no higher order uses from approved land clearing activities such as major infrastructure developments for approved civil infrastructure, road clearing works, right of ways and related approved projects[6];
- Agricultural waste biomass products or residues with no higher order uses;
- End of life waste woody biomass manufactured and produced into a fuel to specification ("Domestic Biomass") (subject to EPA approval as an eligible waste fuel)[7]; and
- Other sources of eligible waste fuels with no higher order uses.

Each proposed biomass fuel source comes with its own set of risks related to Verdant's objective of supply Redbank up to 700,000 (dry) tonnes per annum (tpa) of biomass fuel to generate electricity at full capacity.

Whilst there are specific risks to individual proposed biomass fuel types, the overall risk has been assessed as LOW and tolerable with the implementation of the Fuel Supply and Characterisation Study (Appendix M of the EIS). This is meant to reduce the risk of undersupply in any one source, and to diversify and scale up fuel sourcing and operations over time. Verdant are also targeting at any given time to have more biomass fuel available than required to make up for possible shortfalls of any one biomass fuel source.

Risks related to the individual biomass fuel types are summarised below.

2.1.1. Fuel Crops

Fuel crops form a significant percentage of Verdant's planned biomass feedstock strategy. Fuel crops are considered a 'standard fuel' and do not require a Specific RROE, but do still require approval from the EPA to be used as fuel. By year 5 of operations, 70% of the 700,000 tonnes required annually at Redbank to achieve full generation capacity is estimated to be in fuel crops.

If this amount of fuel crops is unavailable or lower in volumes than expected, it could lower energy production at Redbank, assuming the fuel cannot be replaced with other approved biomass.

Specifically grown fuel crops include such sources as annual crops, perennial grasses, and quick rotation native plant materials (e.g. coppice crops), sourced as seasonally and/or regionally available. Based on the research undertaken by Verdant to date, native woody species appear to be the most suitable option including a selection of mallees, other eucalypts and acacias. Other potential crop species will continue to be assessed for suitability.

The NSW Department of Primary Industries (DPI), in conjunction with CSIRO's Australian Tree Seed Centre, have been conducting Woody Biomass Crop Trials to examine the suitability of a range of native woody species for

[5] The *Land Management (Native Vegetation) Code* 2018 under the *Local Land Services Act* 2013 sets out permitted clearing and thinning of native vegetation on agricultural land, such as invasive native species where a compliance certificate has been issued by Local Land Services NSW.

[6] Requires notification by the NSW EPA in the New South Wales Government Gazette under Section 140 of the *Protection of the Environment Operations (General) Regulation* 2022.

[7] Domestic Biomass Fuel (DBF) is not currently prescribed as an 'eligible waste fuel' under current EPA guidelines, though the applicant will seek to demonstrate this prior to its use through a post-approval Specific Resource Recovery Order and Exemption application under Clause 93 of the *Protection of the Environment Operations (Waste) Regulation* 2014.

short-rotation woody crop biomass production across NSW[8]. More than 50,000 trees have been planted across NSW as far north as Glen Innes and as far south as Yanco.

The research indicates that by year four, 35 tonnes of above-ground dry biomass per hectare of planted area can be obtained. To meet the total required biomass demand of 490,000 tonnes per year, a minimum total planted area of 56,000 hectares would be required (assuming native mallee species are used).

Part 2 of the DPI and CSIRO assessment assessed that within 100km of the Redbank Power Station there is an estimated 795,753 hectares of land that could produce short-rotation woody crops as fuel.

A recent independent report identified that within the Hunter Valley Region alone there is an estimated 130,000 hectares of coal mining lands[9] that can be repurposed for future businesses generating new employment opportunities, including renewable energy.

Importantly, growing and harvesting biomass crops is undertaken across many areas of Europe, North America and Canada. Verdant, for example, have identified equipment that will plant up to 27,000 plants per hour. Similar harvesting strategies and technologies can be used to meet the production and harvesting needs of Redbank.

To manage risks around this fuel strategy, Verdant is taking steps to find adequate land areas and develop partnerships for establishing, maintaining and harvesting the fuel crops:

- Verdant will continue to seek and use the expertise and support of the Department of Primary Industries and the CSIRO to study the viability of various potential fuel crops and maximising the productivity of suitable species in a sustainable and efficient manner;
- Verdant will engage with an existing robust infrastructure and knowledge base within the nursery industry to support the planting of seedlings and rootstock for large-scale biomass projects; and
- Verdant will work with regional farmers groups (e.g. Industry Beef Contracting and Doyle Rural Services), Hunter mines and specialist consultants to use, purchase and/or lease the most appropriate land available (degraded and less arable) for rotational biomass crops. This which presents opportunities for increasing soil health and reducing carbon footprints via offsets whilst securing a sustainable source of biomass feedstock.

Verdant consider that the known risks around establishing significant areas of fuel crops LOW and tolerable.

2.1.2. Invasive Native Species

Invasive native species (INS) account for an estimated 71% of the required biomass fuel in the first year of operation, scaling down to 13% in year 5. INS management is regulated by the *Land Management (Native Vegetation) Code* 2018 (Native Vegetation Code) and clearing of INS can be carried out under the two Divisions that comprise Part 2 of the Native Vegetation Code.

The Review identifies that there is a risk that suppliers may not be able to provide sufficient INS due to discrepancies in yield estimates from landholders in the Higher Order Use Study undertaken for the Response to Submissions (RTS Appendix H). This may be due to a fewer number of contracts established or the inability to provide labour or equipment needed to supply the material.

Based on the updated Public Information Register - Certificates Under Section 60Y[10] there are 184 certificates issues to clear invasive native species in the Central West and 78 certificates issues for the Western LLS districts between 09/03/2018 and 4/12/2024. This totals 686,371 hectares of treatment area.

HRL Technical Laboratories, in work undertaken for Verdant, show positive results with high calorific values between 20MJ/kg and 23.9MJ/kg with an ash content of about 3% for INS.

Because of the significant amount of INS available in the western areas of NSW and the suitability for Redbank, INS could also support shortfalls in other fuel sources during the ramp of fuel crops.

To mitigate risks in shortfalls of INS, Verdant are actioning the following:

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[8] NSW Department of Primary Industries, Woody Biomass Crop Trial 2023. Web: https://www.dpi.nsw.gov.au/forestry/science/forest-carbon/biomass-for-bioenergy/biomass-crops

[9] Lock the Gate Alliance (26 May 2022). Diversification and growth Transforming mining land in the Hunter Valley.

[10] NSW Local Land Services Public Register. Web: https://www.lls.nsw.gov.au/help-and-advice/land-management-in-nsw/public-register.

- Verdant is and will continue to engage landowners and Local Land Services to establish contacts with potential INS suppliers, which supports landowners recognised efforts at management and restoration of their properties.
- Verdant will establish supply contracts with landowners committing to supply biomass of a minimum amount per year to specification. Note that Verdant has letters of support for 300,000 tonnes from one supplier over five (5) years, and 100,000 tonnes per year from another supplier. In 2023, Western Regeneration Pty Ltd signed an MOU for 500,000 tonnes per year chipped to the agreed specification. Whilst Western Regeneration has been disbanded, they consisted of several farmers Verdant are still in discussions with individually to form supply contracts once the Proposal is approved (see 0), and
- Where appropriate, Verdant will provide specialised equipment including grinders/chippers, screening systems, stockpiling, and loading equipment where required to support the required volumes of fuel needed that meets specifications.

Verdant have identified the risks to supply of INS as LOW and tolerable.

2.1.3. Approved Infrastructure Land Clearing

Verdant's fuel strategy includes biomass with no higher order uses from approved land clearing activities such as major infrastructure developments for approved civil infrastructure, road clearing works, right of ways and related approved projects. Verdant have estimated 150,000 (dry) tonnes of biomass would be used from approved land clearing the first year of operations, scaling down to 50,000 tonnes by year 3 of operations and 20,000 tonnes by year four.

The Review identified the risk of reinforced restrictions and oversight on land clearing activities that could affect the pool of accessible biomass. There is also the variability of infrastructure project approvals, their locations and the unpredictable nature of clearing involved in each project, including whether there are higher order uses for the materials.

Data from the NSW government shows more than 74,000 hectares of woody vegetation was cleared between 2009 and 2021 for NSW infrastructure with an average of 5,700 hectares a year. For the Central West, Greater Sydney, Hunter and Western Local Land Services regions, a total of 39,000 hectares of woody vegetation was cleared between 2009 and 2021 for NSW infrastructure, representing 52% of the vegetation cleared for NSW infrastructure. These numbers were identified in the EIS.

Assuming 41.6 (dry tonnes) of biomass residues are potentially available per hectare of clearing. On an annual basis this would equal approximately 27,248 tonnes of dry residues available annually in the Hunter region alone. Including the Central West and Greater Sydney would bring the total dry tonnages of residues available annually to an estimated 64,605 dry tonnes annually available. Including the Western regions would increase the total to 125,799 (dry) tonnes per annum.

Note however that estimates will continue to change based on the approval dates, construction timing, number and locations of infrastructure projects, including the amount of clearing approved and potential higher order uses for the material. This will be assessed on an ongoing basis by Verdant.

For over 3 years, Verdant has and will continue discussions with industry to develop relationships for biomass supply. Verdant have several signed MOU's and verbal agreements with contractors in the industry, including with Advanced Land Clearing and Excavations Pty Ltd, Forest Grind Pty Ltd and JMT Civil Pty Ltd for example. Verdant will negotiate supply agreements during project feasibility and tendering stages.

According to the *Independent market study of eligible waste fuels proposed for use at Redbank Power Station* - Higher Order Use Study (RTS Appendix H), vegetation is often cleared via chain raking and bulldozers. The felled vegetation is raked into piles and chipped or shredded on-site. Once chipped or shredded, the biomass waste is transported for further use or disposal or pasteurised on-site as a landscaping mulch or temporary erosion control. The Higher Order Use Study estimates that approximately 80% of the material available does not have a higher order use and that the spatial dispersion of the resource is in relatively close proximity to Redbank and means that the aggregation and transport costs will be reasonable. It is estimated 20% is either transported to a sawmill (for quality sawlogs) or used on site for mulch, soil amendment and/or erosion control, with a small amount retained for biodiversity. Where no other uses can be identified, the biomass from approved land clearing is disposed through landfill or on-site decomposition.

Verdant will be required under a Specific Resource Recovery Order and Exemption (SRROE) to undertake an appropriate Higher Order Use Study for any approved infrastructure project where waste biomass may be sourced.

Verdant will implement the following strategies.

- Verdant Earth have been and will continue to develop supply agreements with companies that have commercial volumes of waste biomass available of waste biomass from approved clearing activities;
- Verdant will continue to assess biomass fuel sources as market conditions and contractors change in response to ongoing project approvals and developments to determine where and how much material is available on an ongoing basis;
- Verdant will be required under a SRROE to undertake an appropriate Higher Order Use Study for any approved infrastructure project where waste biomass may be sourced; and
- In the first two years of Redbank operation, in the event of a shortfall in this area, Verdant will supplement the tonnage in the first two years with INS or other sources to fill the supply gap.

Verdant have identified the risks to supply of biomass from approved infrastructure land clearing as LOW and tolerable.

2.1.4. Domestic Biomass Fuel (DBF)

Verdant recognise that the EPA has not at this stage approved the use of Domestic Biomass Fuel (DBF) and does not list DBF as an eligible waste fuel. However, included in the SSD application is a process and strategy towards enabling the use of DBF feedstock.

The Review identifies challenges with the proposed use of DBF from sources such as Construction and Demolition (C&D) and Commercial and Industrial (C&I) waste due to existing regulatory restrictions and commercial barriers, including competitive gate fees and contamination risks.

Verdant General Manager of Fuels and Sustainable Energy (Mike Haywood) brings over 30 years of experience in processing waste materials, engineered fuels and waste timber biomass to address these known challenges and risks. This includes 35 years of experience in the timber and waste industries and serving as the president of both the Australian Council of Recycling and the Waste Management Association of Australia.

Verdant, in collaboration with HRL Technology, has conducted baseline assessments to evaluate the suitability of various materials as feedstock for the Redbank project. While not all assessed materials meet the required specifications, the findings suggest that with further processing using existing technologies, compliance with specification requirements can be achieved. Verdant staff have considerable knowledge of processing waste materials and working with specialist technology companies and regulators, which will assist in demonstrating to EPA that once processed appropriately DBF could qualify as an eligible waste fuel;

Verdant has included a comprehensive Quality Assurance/Quality Control (QA/QC) program provided Appendix E in the *Fuel Supply and Characterisation Study* (Appendix M of the EIS), to ensure that all biomass feedstock for the Redbank Power Station is processed to, and must meet, precise specifications prior to its use as a fuel. This approach is designed to maintain optimal operational efficiency and environmental compliance. Given the rigorous processing protocols in place. If the Biomass Fuel Specification is not met, it will not be approved for use at Redbank.

To assess the potential DBF volumes available to Verdant, Verdant commissioned a study by Mike Ritchie and Associates (MRA) to assess the volume of Domestic Biomass that might be available in the Sydney Basin and the regional catchment areas nearby and within the Hunter Valley Region (Appendix C of Appendix M of the EIS).

The analysis found that between 267,000 to 468,000 tonnes of waste timber is landfilled annually, missing the opportunity for a higher order on the waste hierarchy to recover the energy from these materials.

Verdant is actively engaging with existing operators to sublease or acquire processing facilities within the Sydney Basin and the Newcastle area. Several sites have expressed interest in collaborating with Verdant to establish a fuel processing facility. Verdant may also consider in the future the option of purchasing land with no existing waste processing licence to establish a waste processing facility (with associated approvals and licences).

Risks associated with establishing supply contracts, establishing waste facilities and meeting specifications can be managed by Verdant, and are of a commercial nature. Important to note is that Verdant does not estimate DBF will be used at Redbank in the first two (2) years of operations at Redbank, and maintain a minimum estimated requirement of 50,000 dry tonnes beginning in year 3 of operations.

The risk of the NSW EPA not approving DBF for use at Redbank is acknowledged to be high. However, Verdant will continue to engage with the NSW EPA in delivering the relevant studies, procedures and methods that characterise DBF and, where appropriate, establish an approved DBF trial to demonstrate it can be used as an eligible waste fuel and meet requirements under a SRROE.

To reduce risks, Verdant will implement the following strategies:

- Verdant will continue to conduct baseline assessments of DBF. Preliminary results have confirmed that the materials can be processed to the required specifications using existing technologies;
- Verdant will continue to engage with the resource recovery industry to assess appropriate technologies required to meet the required specifications; and
- Verdant to continue to develop and update a DBF strategy in collaboration with relevant stakeholders including the EPA, industry and technology providers, and the wider community.

Verdant have identified the risks to supply of DBF as MODERATE and as low as reasonably practicable.

2.1.5. Agricultural Residues

Biomass from agricultural residues is considered biomass waste directly resulting from agricultural production. This waste may include fibres, roots, stalks, stubble, leaves, seed pods, nut shells and some waste from agricultural processing such as cotton trash.

A distinction can made between field residues, biomass leftover from harvest (i.e. straw, stalks) and processing residues, byproducts from agro-industrial process (i.e. husks, shells). Residues such as straw from cereals crops is not as nutritionally valuable as hay and is generally less expensive than hay. The key distinction is that hay is cut while the plant is still live while straw is the dead stalks of plants after the harvest of grain.

The quantities of agricultural material potentially available to Redbank within a 300 km radius of Singleton is estimated to be 1,023,172 tpa, as identified in the EIS. The Higher Order Use Study (RTS Appendix H) estimates that 675,294 tpa of this is currently being disposed with no higher order use.

The fuel strategy estimates that no agricultural residues would be used at Redbank in the first year, and at year 2 and onwards 50,000 tpa would be used.

- Verdant will be required under a SRROE to undertake an appropriate Higher Order Use Study for any agricultural residue waste biomass sourced; and

- Verdant will continue to assess agricultural markets and producers to ascertain where and how much material is available from multiple suppliers on an ongoing basis.

Verdant have identified the risks to supply of agricultural residues as LOW and tolerable.

2.1.6. Transportation and Logistics

Biomass feedstock for Redbank will require B-double heavy vehicles operating 24/7, delivering fuel on a prioritised 16-hour period between 6am and 10pm, 7 days per week (Monday to Sunday). Deliveries of biomass are expected to be approximately 56 trucks over the course of each day.

Transport of up to 700,000 (dry) tonnes per year to Redbank from a variety of source locations may incur higher costs than estimated. There is a risk of logistical failures in the timing or ability of these loads in delivering regularly to Redbank. Significant failures could lead to a shortage of planned feedstock being available in the required quantities over a time period or of processed fuel not being picked up by haulage trucks.

The timing between initial harvesting of the biomass, processing to specification and transport to Redbank is very important to logistics. Verdant have assessed this extensively. For example, HRL Technical Laboratories on behalf of Verdant have assessed moisture loss over time and suggest fresh cut or harvested materials should be at least 6 weeks from cutting in the summer months and 8 weeks from cutting in the winter months prior to chipping to the above specification. These types of details are being incorporated into the commercial fuel planning for Redbank.

To reduce these risks, Verdant are developing a logistics plan with local transport contractors and potential feedstock producers to build up an inventory of feedstock at the source production end and a potential facility within a short distance to Redbank. This will allow flexibility to meet the required feedstock volumes without compromising feedstock quality.

Verdant have and will continue to assess the feedstock transport costs with local transport companies in relation to the feedstock calorific value to ensure financial viability and commercial success, which is with conservative assumptions financially viable and not a concern for Verdant.

Verdant will continue to engage with and develop a strategy with local transport contractors and suppliers to meet the feedstock requirements of Redbank.

These risks have been assessed as LOW and tolerable with the implementation of the following strategies.

- Verdant is developing a logistics plan to establish biomass feedstock inventory at biomass feedstock source production sites and a potential facility near Redbank;
- Verdant will continue to engage with and develop this strategy with local transport contractors;
- Verdant will coordinate with Local Land Services precincts and land managers in closer precincts to Redbank to reduce transport costs of INS where possible; and
- Verdant will continue to assess the feedstock transport costs per tonne and the supply and processing cost per tonne to ensure financially viability.

2.2. Biomass Fuel Specification Variability

Work was undertaken by Boiler & Power Plant Services Pty Ltd (EIS Appendix F) on behalf of Verdant to assess the required biomass feedstock fuel physical characteristics. A specification has been developed that must be met in order to prevent deterioration (e.g. corrosion), maintain the performance of the plant and its various components.

Additionally, all eligible waste fuels proposed for use at Redbank will need to meet the requirements under a SRROE issued by the EPA. The *Eligible Waste Fuels Guidelines* (EPA 2022) specifies strict standards for feedstocks to minimise risks to human health and the environment.

The Review requested that Verdant provide details regarding potential compliance risks arising from feedstock variability and availability, and outline how the facility will manage situations where feedstock eligibility is compromised for these reasons. In addition, the Review requested that a contingency plan be developed to address potential risks associated with supplier variability and inconsistencies in feedstock quality.

The primary risks around biomass feedstock quality are include the following:

1. Feedstock fuel does not meet Redbank's Biomass Specification and is unfit for use in the plant; and
2. Feedstock fuel does not meet SRROE requirements and therefore is not approved for use.

The degree of risk is not the same for each standard fuel and eligible waste fuel type. Fresh hardwood material sourced from approved clearing, removal of INS and coppicing of fuel crops (e.g. native mallees), for example, are well-understood to have qualities that are fit-for-purpose in the Redbank FiCirc boilers. The risk of not meeting specification because of the material itself is low. Existing technologies are readily available to size and grade this material to meet both a biomass specification and SRROE requirements.

With regards to processing the materials to meet a consistent specification, Verdant have spoken with local and regional contractors at a selection of biomass source locations to discuss how supply and can be undertaken with available equipment. HRL The risk of non-supply to specification of these materials is very low to nil. Samples by HRL Technical Laboratories show positive results with high calorific values between 20MJ/kg and 23.9MJ/kg with an ash content of about 3%.

Wood waste (particularly post-consumer) and annual / perennial crops are more challenging to manage. However, meeting specifications with more difficult source material is limited mostly by process and cost of technologies.

Note that although approval from EPA is still needed, a SRROE is not required to be obtained prior to the use of 'standard fuels', which form a significant part of Verdant's long-term fuel strategy. This is described in detail in Section 3.3.1 of the EIS and in Section 4.4 of the *Fuel Supply and Characterisation Study* (Appendix M of the EIS).

Table 2.1 provides a summary of the degree of compliance risk for each type of fuel proposed to be used at Redbank.

Table 2.1. Compliance risks based on fuel types.

Fuel Type	Compliance Risks		Reason / Notes
	Not Meeting the Biomass Specification	Not Meeting the SRROE	
Purpose grown fuel crops (Standard Fuels are not subject to a Specific RROE).	Low risk	Not applicable	Verdant have full control over species and operational management. Work with DPI and CSIRO, along with fuel analysis results have shown suitability very good, particularly for native hardwood species.
Biomass with no higher order uses arising from invasive native species control on agricultural land	Low risk	Low risk	INS species have been tested and show high suitability for the majority of listed INS species.
Biomass with no higher order uses arising from agricultural waste or residues	Moderate risk	Moderate risk	Preliminary results show higher risk of non-compliance. However, this is not always the case. Further testing and analysis will be required on a variety of these sources.
Biomass with no higher order uses from approved land clearing activities	Low risk	Low risk	Some risk of contaminants from machinery and other construction activities onsite, however this can be minimised through audits, site visits and rigorous testing requirements. Generally low risk.
Domestic Biomass (DBF)*	High risk	High risk	Known challenges with contaminants. Sophisticated technologies required. Continue consultation with EPA through all stages of characterisation.

*Subject to EPA approval as an eligible waste fuel.

Verdant has implemented a comprehensive strategy to ensure that all biomass feedstock for Redbank is processed to precise specifications prior to its use as fuel. This approach is designed to maintain optimal operational efficiency and environmental compliance. Given the rigorous processing protocols in place, Verdant has assessed the risk of failing to meet the required feedstock specifications as unlikely and insignificant.

This is outlined in a robust Quality Assurance and Control Procedure for Receipt and Use of Biomass (Appendix E of the Fuel Supply and *Characterisation Study*). The procedure will used, reviewed and updated as required to control fuel quality, manage risk and avoid potential issues, including those related to meeting the requirements of the Biomass Fuel Specification and any Specific RROEs.

Adaptive management strategies are built into the QA/QC process. Verdant are also implementing the following to ensure quality feedstock fuel is consistently being produced:

All biomass fuel proposed for use at Redbank Power Station will need to meet stringent specifications, operational requirements of the Redbank Power Station plant and equipment, and the requirements of relevant Specific RROEs.

Verdant are confident this process can be managed in a way to meets all regulatory, safety and environmental requirements through implementation of the following strategies:

- Implement the Fuel Supply and Characterisation Study (Appendix M of the EIS) to diversify and scale up fuel sourcing and operations over time;

- Implement, and update as necessary, the Quality Assurance and Control Procedure for Receipt and Use of Biomass (Appendix E of the Fuel Supply and Characterisation Study);
- Deploy senior management staff experienced in the use of engineered fuels and waste timber biomass to assess technology, plant and equipment, and work directly with contractors to ensure required specifications are met;
- Implement, review and update as needed the Quality Assurance and Control Procedure for Receipt and Use of Biomass (Appendix E of the Fuel Supply and Characterisation Study);
- Biomass fuels must meet the Biomass Fuel Specification prior to delivery to Redbank.

Whilst the risk has been assessed as MODERATE and as low as reasonably practicable for agricultural waste or residues and DBF, overall across all fuel types, risks have been assessed as LOW and tolerable.

2.3. Natural Disasters

2.3.1. Flood and Drought

Drought is a fundamental part of the Australian landscape. With one of the most variable rainfall climates in the world, severe drought affects some part of Australia about once every 18 years. During 2017 to 2020, large areas of NSW faced severe water shortages. Between January 2017 and December 2019, NSW temperatures were the warmest and rainfall was the lowest on record[11].

Storms and floods are a natural part of the NSW climate. They bring valuable rainfall and water to parts of the state, yet they can have severe impacts on people, businesses and environments. In June 2016, NSW experienced one of its most damaging east coast lows[12].

With respect to INS, the Cobar Peneplain in New South Wales (NSW) is characterized by a semi-arid climate, making significant flooding events relatively uncommon. Average rainfall is less than 500mm per year, but more than 250mm[13]. Historical records indicate that significant flood events have occurred.

Drought has the potential to affect typical water loving species requirement. However, choosing native mallees and other native species for fuel crops that are resilient under harsh and depleted soil conditions will minimise water supply and maintenance requirements.

Flooding has the potential to temporarily block main and secondary roads, preventing access to fuel feedstock supplies. This could be temporary, or last for a longer period depending on the severity of the event.

To reduce reliance on any one source of waste biomass feedstock, Verdant have developed a *Fuel Supply and Characterisation Study* (Appendix M of the EIS) that outlines the proposed strategy to diversify and scale up fuel sourcing and operations over time.

This includes invasive native species (INS) for biomass feedstock, a long-term strategy to cultivate purpose-grown biomass crops and other sources to ensure a more sustainable and controlled biomass supply.

Verdant will implement the following strategies.

- The primary strategy to adapt to these natural hazards is to diversify sources in multiple locations to prevent a large percentage of biomass fuel from being destroyed or inaccessible for long periods. This strategy is outlined in the in the Fuel Supply and Characterisation Study (Appendix M of the EIS); and
- Flooding and surface water will be managed in fuel crop areas through land management techniques and drainage controls.

Risks to supply associated with drought and flooding have been assessed as MODERATE and as low as reasonably practicable.

2.3.2. Bushfires

Fire is a natural part of the Australian landscape and much of the flora of NSW depends on fire to assist in its reproduction and growth. Development has had a major impact on the integrity and structure of most ecosystems

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[11] State of New South Wales. Drought, floods and extreme events Web: https://water.dpie.nsw.gov.au/our-work/allocations-availability/drought-and-floods or www.nsw.gov.au.

[12] State of New South Wales. Climate change impacts on storms and floods Web: https://www.climatechange.environment.nsw.gov.au/impacts-climate-change/weather-and-oceans/storms-and-floods

[13] NSW Office of Environment and Heritage. Semi-arid woodlands (grassy sub-formation) Web: https://threatenedspecies.bionet.nsw.gov.au/VegFormation?formationName=Semi-arid+woodlands+(grassy+sub-formation).

and has altered fire regimes. The effect of bushfires can vary in extent of the fire and its social impacts and costs. Bushfires in Australia can be extremely destructive and may result in substantial social costs, including the loss of human lives, buildings, infrastructure and livestock[14].

For Verdant, bushfires form part of the risk framework of developing fuel crops and relying on biomass sources such as INS that could be subject to extreme weather and significant fires.

Although relatively rare, the Cobar Peneplain in New South Wales has experienced several significant bushfires over the years. Notable events include 1984 fires that burned approximately 12% of Cobar Shire, and the extensive bushfires across Australia of 1974/75.

The 2019–20 fire season, also known as the Black Summer fires, was unprecedented in its intensity and scale, running for nine months between 1 July 2019 and 31 March 2020. During this season, 11,774 bush/grass fires occurred across NSW, often with numerous fires burning simultaneously burning approximately 7% of NSW.

For Verdant, it is essential to adapt to these natural hazards by diversifying fuel sources and obtaining biomass from multiple locations. Verdant's *Fuel Supply and Characterisation Study* (Appendix M of the EIS) that outlines the proposed strategy to diversify and scale up fuel sourcing and operations over time. This could prevent potentially significant areas of biomass fuel from being destroyed or inaccessible for long periods at the same time.

Other strategies including land management techniques can be used, such as roads, coppicing and fuels management and maintenance to reduce unwanted ladder fuels and buildup can provide some prevention and reduction of hazard.

Verdant will implement the following strategies.

- The primary strategy to adapt to these natural hazards is to diversify sources in multiple locations to prevent a large percentage of biomass fuel from being destroyed or inaccessible for long periods. This strategy is outlined in the in the Fuel Supply and Characterisation Study (Appendix M of the EIS); and
- Other strategies will be implemented as appropriate such as the use of fire roads, coppicing and fuels management and maintenance to reduce unwanted ladder fuels and buildup can provide some prevention and reduction of hazard.

Risks to supply associated with bushfires have been assessed as MODERATE and as low as reasonably practicable.

2.4. Pending Legislative Changes

The Review notes (Pg 10) flagged that the NSW Government's response to reviews of the *Biodiversity Conservation Act* 2016 (BC Act) and the *Local Land Services Act* 2013 (LLS Act) introduces additional risk related to future biomass feedstock availability, and that upcoming legislative amendments aim to strengthen environmental protections and include:

1. Reinforcing Environmental Protections: Measures will focus on reducing the extent of land clearing while increasing areas of native vegetation preserved and permanently managed through set-asides;
2. Improved Management of Invasive Native Species: These changes aim to minimise misuse of invasive species management provisions for clearing purposes; and
3. Eliminating Set-Aside Discounts: Amendments will ensure that areas preserved are greater than those cleared, enhancing environmental offsets.

The Review requested Verdant to develop a comprehensive risk assessment to evaluate the potential impacts of legislative changes on biomass supply, including preparation of adaptive management strategies to respond effectively to these changes.

The NSW Plan for Nature notes (page 24) that LLS is currently making improvements to the landholder guidance and administration of both Part 2, Division 2 (Invasive Native Species) and Part 3, Division 3 (Mosaic Thinning) of the Code. This includes reducing treatment areas for invasive native species by requiring area specificity and providing clear guidance as part of the invasiveness test by LLS officers and improving environmental outcomes

[14] NSW EPA Webpage: https://www.soe.epa.nsw.gov.au/all-themes/land/fire#context

for mosaic thinning by establishing guidelines about the limits of tree canopy opening sizes, a process to improve the selection of retained area locations and requirements for managing those retained areas.

Verdant have reviewed the relevant government review documents, including the NSW government's response[15] and discussed these changes with Local Land Services. Based on this review, Verdant have determined these pending amendments are primarily aimed at improving environmental outcomes and would have minimal effect on the overall supply of INS, which is an acknowledged environmental issue..

Whilst the NSW government's response includes consideration of INS clearing under Part 2 of the *Land Management (Native Vegetation) Code* 2018, the recommendation involves developing a protocol for treatment area specificity for Part 2, Division 2 as well as a landholder guide for assessing whether INS are acting invasively (under Part 2, Division 1 of the Code). Verdant support development of protocols and guidelines as this supports sustainable sourcing of biomass.

Much of the NSW government's response is related to reinforcing environmental protections, however these are primarily protections for Critically Endangered Ecological Communities (CEECs) and retained native vegetation outside of the scope of Part 2. The set-aside discounts also relate to protection in ratios to the areas cleared with ratio requirements for set asides are included in Parts 5 (Divisions 3 & 4) and 6 and Schedule 3 of the Code (not Part 2).

'Nature positive', according to the NSW Government's review, means the environment is being repaired and regenerated rather than traditional sustainability approaches, which have sought to minimise negative impacts by slowing or stabilising the rate of biodiversity loss. Removal of INS is recognised as a valid and proven approach to restoring native ecosystems and will continue to be used as part of a holistic strategy for native vegetation management in NSW.

Local Land Services, part of NSW Department of Primary Industries (DPI), introduced INS as a potential feedstock source to Verdant and recognises the link to assisting landowners reduce maintenance costs and enhance the viability of their properties. DPI's Biomass for Bioenergy Project[16] focuses on opportunities for landowners to use marginal areas of their farms for biomass production, in alignment with sustainable land management practices.

Risks related to the reduction of available INS through policy amendments is considered low and will be managed via clear communications with LLS and landowners, and through following pending changes to policies and guidelines as recommended by the NSW Government review.

In terms of land clearing for approved infrastructure projects, the NSW Government review recognises that some impacts are unavoidable. For this reason, the NSW Government is committed to supporting transparent, rigorous offsetting and a functioning biodiversity credit market. This will be needed to support clear government priorities for housing, renewable energy and critical infrastructure. These are the types of projects that Verdant will be targeting for potential biomass sources from land clearing. Biodiversity and vegetation clearing will already have been assessed in detail, and approved where relevant, prior to approval and construction. These assessments will need to be reviewed and considered on an ongoing basis in terms of timing, volumes, location and potential higher order uses on an ongoing basis by Verdant.

Adapting to potential changes in policy, legislation and guidelines is important to ensure adequate fuel feedstock is available to Redbank.

Verdant will continue to implement the following adaptive management strategies:

- Verdant will continue to engage directly with senior staff at Local Land Services and with landowners regarding changes to policies and guidelines as recommended by the NSW Government review;
- Verdant will update their fuel strategy as outlined in the Fuel Supply and Characterisation Study (Appendix M of the EIS) and the Quality Assurance and Control Procedure for Receipt and Use of Biomass (Appendix E of the Fuel Supply and Characterisation Study) to incorporate any relevant changes that

[15] NSW Government (July 2024). NSW plan for nature NSW Government response to the reviews of the Biodiversity Conservation Act 2016 and the native vegetation provisions of the Local Land Services Act 2013. Web: https://www.nsw.gov.au/sites/default/files/noindex/2024-07/NSW%20plan%20for%20nature%20NSW%20Government%20response%20to%20the%20reviews%20of%20the%20Biodiversity%20Conservation%20Act%202016%20and%20the%20native%20vegetation%20provisions%20of%20the%20Local%20Land%20Services%20Act%202013.pdf

[16] Department of Primary Industries. Web: https://www.dpi.nsw.gov.au/forestry/science/forest-carbon/biomass-for-bioenergy

could affect availability and operations around INS and biomass from approved infrastructure land clearing projects;

- Verdant will review contractual arrangements with landowners and contractors to incorporate these changes; and
- Review upcoming approvals for infrastructure construction projects in consideration of timing, volumes, location and potential higher order uses on an ongoing basis.

The risks have been assessed as LOW and tolerable with the implementation of the strategies listed above.

3. Risk Assessment

3.1. Methodology

The environmental risk assessment has been informed by AS/NZ 31000: 2018 *Risk Management Principles and Guidelines* and *Hazardous Industry Planning Advisory Paper No 6 - Hazard Analysis* (NSW Department of Planning, 2011). The risk management process has been informed by the following elements:

- Establish the context;
- Identify the risks;
- Analyse the risks;
- Evaluate the risks; and
- Treat risks.

3.2. Risk Criteria

The following principles have been adopted to identify and assess risk in this study. This has been informed by the *Hazardous Industry Planning Advisory Paper No. 4 – Risk Criteria for Land Use Safety Planning* (NSW Department of Planning, 2011).

- The avoidance of all avoidable risks;
- A major risk should be reduced wherever practicable, even where the likelihood of exposure is low;
- The effects of significant events should, wherever possible be contained; and
- Where the existing risk is already high, further development should not pose any incremental risk.

3.3. Qualitative measurement of consequence, likelihood and risk

To undertake a qualitative risk assessment, it is useful to describe the levels of consequence of a particular event, and the likelihood or probability of such an event occurring. Risk assessment criteria have been developed in AS/NZS ISO 31000: 2018 which allows the risk assessor to develop risk criteria during the establishment of the context.

In according with AS/NZS ISO 31000: 2018, Table 3.1 and Table 3.2 have been reviewed as part of establishing the context of the Proposal (SSD-56284960. These tables were considered to be consistent with the specific objectives of the fuel supply risk assessment.

Combining the probability and consequence tables, Table 3.3 provides a qualitative risk analysis matrix to assess risk levels.

Table 3.4 provides a summary of the risk identification, scenario, consequence, and a risk rating for pre and post-employment of prevention/treatment measures.

Table 3.1. Qualitative measures of probability.

Event	Likelihood	Description
A	Almost certain	Happens often
B	Likely	Could easily happen
C	Possible	Could happen and has occurred elsewhere
D	Unlikely	Has not happened yet but could
E	Rare	Conceivable, but only in extreme circumstances

Table 3.2. Qualitative measures of maximum reasonable consequence.

Level	Operational Impacts	Economic / Grid Impacts	Asset / Production Costs[1]
1	Permanent shut down of operations.	Extreme economic harm (e.g. widespread catastrophic impact on economy and electricity firming power).	More than $70 million per year loss or production delay.
2	Significant operational shut down time (e.g. 6+ months).	Major economic harm (e.g. widespread substantial impact on economy and electricity firming power).	$35 - $70 million or production delay.
3	Lost operational time and/or long term unplanned reduced operational power generation (e.g. less than 6 months).	Serious economic harm (e.g. widespread and considerable impact on economy and electricity firming power).	$5M - $35M loss or production delay.
4	Intermittent non-maintenance related shut down and/or unplanned reduced power generation operational periods (e.g. 2 – 4 weeks total per year).	Material economic harm (e.g. localised and considerable impact on economy and electricity firming power).	$250K to $5M loss or production delay.
5	Temporary and occasional non-maintenance related shut down and/or unplanned reduced power generation operational periods (less than 2 weeks).	Minimum economic harm (e.g. minor impact on economy and electricity firming power).	Less than $250K or production delay.

Note 1: Estimates are based on the economic / loss production criteria in the Economic Analysis by AEAS (Table 16 of Appendix K in the EIS) amounting to approximately $68.82 M/yr.

Table 3.3. Qualitative risk analysis matrix[1] used in this preliminary hazard analysis and environmental risk assessment.

	Probability					
Consequence		A	B	C	D	E
	1	1 (H)	2 (H)	4 (H)	7 (M)	11 (M)
	2	3 (H)	5 (H)	8 (M)	12 (M)	16 (L)
	3	6 (H)	9 (M)	13 (M)	17 (L)	20 (L)
	4	10 (M)	14 (M)	18 (L)	21 (L)	23 (L)
	5	15 (M)	19 (L)	22 (L)	24 (L)	25 (L)

Note 1: Legend – L: low; M: Moderate; H: high; Risk numbering: 1 – highest; 25 – lowest risk. Colour coding: Green: tolerable risk; orange: ALARP – as low as reasonably practicable; red: intolerable risk.

Table 3.4. Risk identification, scenario, consequence, prevention/treatment measures and risk rating table. Note, P = Probability, C = Consequence.

Risk event	Risk cause / comment	Possible scenarios, results & consequences	P	C	Pre-Risk Rating	Prevention and Adaptive Management Measures	P	C	Post Risk Rating
General Supply of Biomass for Fuel									
Volumes of fuel feedstock predicted to be available in the fuel supply strategy are not met.	The volumes of biomass available to Redbank are less than the amount predicted that would be needed for Redbank to operate at full capacity in the fuel supply strategy.	For various reasons, whether it be supply chain difficulties, challenges with logistics, contracts or unavailable technology, the volumes of biomass outlined in the fuel supply strategy are significantly less than predicted. This could significantly delay or reduce operations and the amount of available energy to the electricity grid, for either short or long term periods.	C	3	13(M)	• Implement the strategy outlined in the Fuel Supply and Characterisation Study (Appendix M of the EIS) to diversify and scale up fuel sourcing and operations over time; • The plant consists of two FiCirc Fluidised bed boilers and one Turbine. The plant is designed to be operated between 70 and 100% steam flow. It is a base load plant and has minimum turndown capability to 110 MW with two boilers, if load needs to be reduced further then one boiler can be taken off service and stored in hot condition. The minimum load with one boiler in operation is 55MW; • Verdant are targeting at any given time to have 25% more feedstock available than required to make up for possible shortfalls of any one biomass fuel source.	D	4	21 (L)
Natural disaster such as a bush fire, drought or flooding event destroys or limits access to fuel supply.	Australia weather patterns are unpredictable, and floods, droughts and bushfire events can destroy vast areas of land, livelihoods, and productivity.	Unforeseen natural events could occur that lead to the destruction of the biomass fuel planned for use at Redbank. Australia is prone to bushfires and flooding, at times causing severe disruptions. Access to areas that contain the biomass could be compromised or unusable for significant periods of time. This could cause delays in delivery of fuel to the facility leading to reduced or held operations.	B	2	5(H)	• The primary strategy to adapt to these natural hazards is to diversity sources in multiple locations to prevent a large percentage of biomass fuel from being destroyed or inaccessible for long periods. • Strategies such as use of fire roads, coppicing and fuels management and maintenance to reduce unwanted ladder fuels and buildup can provide some prevention and reduction of hazard. • Flooding and surface water can be managed in fuel crop areas through	B	4	14(M)

Risk event	Risk cause / comment	Possible scenarios, results & consequences	P	C	Pre-Risk Rating	Prevention and Adaptive Management Measures	P	C	Post Risk Rating
		Inability to access fuel source areas could lead to delays, although this would likely be of relatively short duration, days or potentially weeks.				land management techniques and drainage controls.			
Transport of biomass costs too high or volumes not met.	The projected amounts of feedstock transported to and arriving at Redbank on a regular basis may not be met due to transport costs or other challenges.	Transport of up to 700,000 (dry) tonnes per year to Redbank from a variety of source locations may incur higher costs than estimated, and not meeting Verdant's expected commercial rate. Failures in timing of transport may lead to a shortage of planned feedstock being available in the required quantities over time.	C	2	8(M)	• Verdant is developing a logistics plan to establish biomass feedstock inventory at biomass feedstock source production sites and a potential facility near Redbank. • Verdant will engage with and develop this strategy with local transport contractors. • Verdant will coordinate with Local Land Services precincts and land managers in closer precincts to Redbank to reduce transport costs of INS where possible. • Verdant will continue to assess the feedstock transport costs per tonne and the supply and processing cost per tonne to ensure financially viability.	C	4	18(L)
Supply of INS for Biomass Fuel									
Landowner contracts for supply of INS biomass fall short of expected.	There are too few landowners willing to commit/enter into contracts for supply.	If the initial ramp up of biomass fuel during years 1-4 lack enough INS fuel to achieve maximum power generation, and fuel crops or other viable sources are not yet in place, then full capacity may not be achieved at Redbank.	C	2	8(M)	• Verdant will continue to undertake outreach to landowners and Local Land Services to establish contracts with suppliers; • Verdant will obtain MOU's and/or letters of support from interested landowners committing in principle to supply of biomass. For examples see 0. Verdant have an MOU for 500,000 tonnes per annum from one supplier and are in the process of establishing a take-off agreement for minimum of 5 years from commissioning.	D	4	21 (L)
Landowners lack the capability to supply INS.	Landowners have little or no technology or	If landowners do not have the technology, plant, equipment or labour to harvest, process and supply INS,	C	2	8(M)	• Verdant to work with LLS, supply contractors and landowners to establish and/or provide	D	4	21 (L)

Risk event	Risk cause / comment	Possible scenarios, results & consequences	P	C	Pre-Risk Rating	Prevention and Adaptive Management Measures	P	C	Post Risk Rating
	labour capability to supply biomass.	then low rates of INS could lead to a shortage of planned biomass fuel from INS, particularly in the years 1-4 of operations.				plant/equipment technologies required direct to the landowners. • Verdant to provide labour and capabilities through technology transfers. Verdant can provide specialized equipment including grinders/chippers, screening systems, stockpiling, and loading equipment where required to support the required volumes of fuel needed that meets specifications.			
Supply of Fuel Crops for Biomass Fuel									
Land area unavailable for fuel crops.	Not enough land available to scale up fuel crops as identified in the fuel strategy.	If there is inadequate land available within a reasonable distance to Redbank, it may be too difficult or expensive to meet the volumes expected in the fuel strategy, which could lead to shortfall in available biomass fuel over time. This could be due a shortfall of landowners willing to lease land, sell land or produce fuel crops at a reasonable price, or competition of the land areas for alternative uses that provide higher earnings.	B	3	9 (M)	• Verdant will continue active strategic engagement with the relevant community, landowners and businesses including Hunter Valley mines to develop a network of opportunities that can be employed post approval. • Verdant are in and will continue to be in discussions with regional farmer groups and consultants to use quick rotation biomass crops on degraded / less productive lands.	C	4	18 (L)
Fuel crops plantations not productive.	Fuel crops plantations may not be as productive as expected which causes a shortfall of this fuel.	Fuel crop productivity is influenced by a large variety of variables including soil, climate, weather patterns, care and maintenance and other factors. If these proposed fuel crop plantations do not produce the volumes of biomass expected, or productivity is delayed, this could lead to less than expected amounts available for use at Redbank.	C	3	13(M)	• Verdant will continue to assess and identify the suitability of various native woody species for biomass production across NSW. • In cooperation with the NSW Department of Primary Industries (DPI), and in conjunction with CSIRO's Australian Tree Seed Centre, Verdant will continue to examine the suitability of a range of native woody species for short-	D	4	21 (L)

Risk event	Risk cause / comment	Possible scenarios, results & consequences	P	C	Pre-Risk Rating	Prevention and Adaptive Management Measures	P	C	Post Risk Rating
						rotation woody crop biomass production across NSW[17]. • Verdant will use the expertise and data available (e.g. Woody Biomass Crop Trials) to leverage the infrastructure and knowledge base within the nursery and farming industry to support large-scale production of fuel crops.			
Fuel crop operations (e.g. establishment, production, harvesting) inefficient / not meeting objectives.	If planting is inefficient, seedlings are unavailable, or rotation requirements are not met, Verdant may not get the targeted feedstock volumes required.	If Verdant are unable to plant, harvest the rotation crops in a timely and efficient manner, this may lead to shortfalls in planned volumes of feedstock.	C	3	13(M)	• Verdant will continue to actively engage with the relevant industries in Australia and overseas where necessary, to proactively prepare and contract with suppliers of seedlings and rootstock and appropriate technologies, plant and equipment suited to establishing, maintaining and harvesting fuel crops in a sustainable manner.	D	4	21 (L)
Supply of Approved Land Clearing Biomass Feedstock									
Approved land clearing feedstocks are not available in the quantities Verdant have identified	There are not enough approved infrastructure projects with available biomass to provide a consistent fuel feedstock supply over time to meet fuel strategy estimates.	Infrastructure projects depend on other approvals to begin construction. Delays or locations of projects that do not support existing vegetation approved for clearing could limit biomass availability from this source. If these sources are not available or have competition for higher order uses, then could affect the volumes available to Redbank. Years 1 and 2 are particularly vulnerable as the estimated requirements are during ramp up of the fuel crop strategy.	B	3	9 (M)	• Verdant Earth have been and will continue to develop supply agreements with companies that have commercial volumes of waste biomass available of biomass from approved clearing activities. • Verdant will continue to assess feedstock fuel sources as market conditions and contractors change in response to ongoing infrastructure project approvals and developments. • In the first two years of Redbank operation, Verdant will look for oversupply in other areas (e.g. INS) if deemed necessary to fill any supply gap.	C	4	18(L)

[17] NSW Department of Primary Industries, Woody Biomass Crop Trial 2023. Web: https://www.dpi.nsw.gov.au/forestry/science/forest-carbon/biomass-for-bioenergy/biomass-crops

Risk event	Risk cause / comment	Possible scenarios, results & consequences	P	C	Pre-Risk Rating	Prevention and Adaptive Management Measures	P	C	Post Risk Rating
Potential waste biomass feedstock from land clearing have higher order uses.	Potential waste biomass feedstock from land clearing that has competition from higher order uses could affect that amount available for energy generation at Redbank.	Biomass from major infrastructure developments for approved civil infrastructure, road clearing works, clearing of right of ways and related approved projects can be variable. Clearing may be avoided through project design. The suitability of waste biomass for a variety of uses. Markets may render energy generation a non-compatible use where other higher order uses demand the material. This could lead to shortfalls of biomass fuel feedstock supply in this source.	B	3	9 (M)	• Verdant will be required under a Specific RROE to undertake an appropriate Higher Order Use Study for any approved infrastructure project where waste biomass may be sourced. • Verdant will continue to assess markets and upcoming projects to ascertain where and how much material is available on an ongoing basis. • In the first two years of Redbank operation, Verdant will look for oversupply in other areas (e.g. INS) if deemed necessary to fill any supply gap.	C	4	18(L)
Supply of Agricultural Residues Biomass Feedstock									
Agricultural residues feedstock is not available in the quantities Verdant have identified	Low availability of waste biomass feedstock from agricultural residues could affect that amount available for energy generation at Redbank.	Waste biomass from agricultural residues can be variable. Timing and productivity of the farming community may change, and at least some of the resource is used onsite. There may also be competition from other uses including composting, anaerobic digestion and other soil enhancing technologies into the future. This could lead to shortfalls of biomass fuel feedstock supply in this source.	C	4	18(L)	• Verdant will be required under a SRROE to undertake an appropriate Higher Order Use Study for any agricultural residue waste biomass sourced. • Verdant will continue to assess agricultural markets and producers to ascertain where and how much material is available on an ongoing basis.	C	5	22(L)
Supply of DBF Biomass Feedstock									
Verdant are unable to gain EPA approvals to use Domestic Biomass Fuel (DBF) as a feedstock fuel	Domestic Biomass Fuel (DBF), intended for use at its facility, does not currently qualify as an eligible waste fuel under the Eligible Waste Fuels Guidelines.	NSW EPA has emphasised that DBF is unlikely to be approved as an eligible waste fuel because of the potential for contamination and the inconsistency or heterogeneity of the feedstock's composition. DBF would it’s listing as an Eligible Waste Fuel and require approval by the NSW EPA for it’s use at Redbank.	A	4	10(M)	• Verdant Earth Technologies will continue to engage directly with the NSW EPA to characterise DBF and seek approval for the use of DBF via an approved DBF trial. • Verdant will not rely on DBF the first two (2) years of operations and maintain a minimum estimated requirement of 50,000 dry tonnes beginning year 3 of operations.	A	5	15(M)

Risk event	Risk cause / comment	Possible scenarios, results & consequences	P	C	Pre-Risk Rating	Prevention and Adaptive Management Measures	P	C	Post Risk Rating
						• Verdant will maintain access to other fuel sources (e.g. INS, fuel crops) in higher amounts than estimated in the fuel strategy to cover shortfalls in the future if required.			
DBF does not meet the Biomass Specification and/or requirements under a Specific RROE	Were a DBF trial to be approved, analysis may show that the fuel does not meet minimum requirements and thus cannot be considered for use at Redbank.	If testing shows that DBF does not meet minimum requirements, further testing may not lead to better results. Inadequate contaminant removal or other issues may make meeting the specification difficult or delay approvals farther into the future than the first two years of operations, causing a shortfall of this source in the fuel strategy.	A	4	10(H)	• Verdant will use senior management (with over 35 years of experience in the timber and waste industries and in the use of engineered fuels and waste timber biomass) to assist in technology and logistics planning for the use of DBF at Redbank. • Verdant will continue to conduct baseline assessments of DBF. Preliminary results have confirmed that the materials can be processed to the required specifications using existing technologies. • Verdant will maintain access to other fuel sources (e.g. INS, fuel crops) in higher amounts than estimated in the fuel strategy to cover shortfalls in the future if required.	B	4	14(M)
No supply agreements to establish secure supply of feedstock.	Supply agreements or a facility to process post-consumer for DBF may not be obtainable in the volumes required.	Securing supply agreements for waste biomass in the C&I and C&D industries may prove difficult due to market competition. Establishing a processing facility is a significant commitment of time and resources. Finding enough secure feedstock within the waste recovery industry may not be adequate to establish a significant source of waste biomass for Redbank.	C	3	13(L)	• Verdant will continue to actively engage with existing operators to sublease or acquire processing facilities within the Sydney Basin and the Newcastle area. • Verdant will pursue due diligence and feasibility assessments of existing waste facility purchase and new facility establishment within the Sydney Basin and the Newcastle area.	C	5	22(L)
Feedstock Quality and Consistency									
Feedstock is variable and inconsistent	Biomass feedstock is inconsistent in quality and does not	Feedstocks from different suppliers could be variable and inconsistent, and either not meet the feedstock Biomass	C	2	8(M)	• Implement the Fuel Supply and Characterisation Study (Appendix M of the EIS) to diversify and scale up	D	3	17(L)

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Risk event	Risk cause / comment	Possible scenarios, results & consequences	P	C	Pre-Risk Rating	Prevention and Adaptive Management Measures	P	C	Post Risk Rating
between biomass suppliers.	meet required specifications.	Specification or not meet the SRROE requirements. This may lead to compliance issues relative to plant operations and/or non-approval or regulatory action by the NSW EPA. This could potential reduce output of Redbank, or if significant amounts of the fuel were non-compliant lead to short or long term shutdown of the facility until compliance with specifications are achieved.				fuel sourcing and operations over time; • Implement, and update as necessary, the Quality Assurance and Control Procedure for Receipt and Use of Biomass (Appendix E of the Fuel Supply and Characterisation Study); • Deploy senior management staff experienced in the use of engineered fuels and waste timber biomass to assess technology, plant and equipment, and work directly with contractors to ensure required specifications are met;			
Feedstock not compliant with the Redbank Biomass Specification	Redbank plant and equipment must be operated with biomass fuel that meets the Biomass Specification.	If moisture, fines and analytes in the fuel feedstock results are out of alignment with the Biomass Fuel Specification plant and equipment damage and failures due to agglomeration or other issues may occur. This could lead to plant shutdowns in the short or long term, additional maintenance requirements and higher costs.	C	2	8(M)	• Implement, review and update as needed the Quality Assurance and Control Procedure for Receipt and Use of Biomass (Appendix E of the Fuel Supply and Characterisation Study); • Feedstock must meet the Biomass Fuel Specification prior to delivery to Redbank.	D	3	17(L)

Purpose grown fuel crops not compliant	Fuel crop biomass must meets the Biomass Feedstock Specification. Note that a SRROE is not required.	If the feedstock from fuel crops do not align with the Biomass Feedstock Specification, plant and equipment damage and failures could result, leading to plant shutdowns in the short or long term, additional maintenance requirements and higher costs.	C	2	8(M)	• Verdant to continue to develop and update the fuel crop strategy in collaboration with relevant stakeholders including:
						  ○ DPI
						  ○ EPA
						  ○ Nurseries
						  ○ Landholders
						  ○ Contractors
						• Verdant will maintain rigorous control of species selection and testing prior to development of fuel crops at scale.
							D	3	17(L)

Biomass with no higher order uses arising from invasive	INS biomass must meets the Biomass Feedstock	If the feedstock from INS does not align with the Biomass Feedstock Specification, plant and equipment damage and failures could result,	C	2	8(M)	• Verdant will continue to engage with INS landowners and supply contractors to assess that appropriate technologies are	D	3	17(L)

Risk event	Risk cause / comment	Possible scenarios, results & consequences	P	C	Pre-Risk Rating	Prevention and Adaptive Management Measures	P	C	Post Risk Rating
native species control on agricultural land not compliant	Specification and a SRROE.	leading to plant shutdowns in the short or long term, additional maintenance requirements and higher costs. Additionally, if the feedstock from INS does not meet the requirements of a SRROE, compliance action from EPA could occur, including additional testing costs and/or shut down of operations were other fuel not available at that time.				employed to meet the required specifications. • Verdant will also provide specialized equipment including grinders/chippers, screening systems, stockpiling, and loading equipment where required to support the required volumes of fuel needed that meets specifications.			
Biomass with no higher order uses arising from agricultural waste or residues	Agricultural waste and residues biomass must meet the Biomass Feedstock Specification and a Specific RROE.	If the feedstock from agricultural waste and residues does not align with the Biomass Feedstock Specification, plant and equipment damage and failures could result, leading to plant shutdowns in the short or long term, additional maintenance requirements and higher costs. Additionally, if the feedstock from Agricultural waste and residues does not meet the requirements of a SRROE, compliance action from EPA could occur, including additional testing costs and/or shut down of operations were other fuel not available at that time.	B	3	9(M)	• Verdant will continue to engage with agricultural landowners and supply contractors to assess appropriate technologies required to meet the required specifications. • Verdant will test biomass from a variety of sources including natural organic fibrous materials and organic residues from harvest activities including fibres, roots, stalks, stubble, leaves, seed pods, nut shells cotton and cane trash to find suitable fuel for this type of biomass source;	C	3	13(M)
Biomass with no higher order uses from approved land clearing activities	Biomass from approved infrastructure project land clearing must meets the Biomass Feedstock Specification and a SRROE.	If the feedstock from approved infrastructure project land clearing does not align with the Biomass Feedstock Specification, plant and equipment damage and failures could result, leading to plant shutdowns in the short or long term, additional maintenance requirements and higher costs. Additionally, if the feedstock from approved infrastructure project land clearing does not meet the requirements of a Specific RROE, compliance action from EPA could occur, including additional testing costs	C	2	8(M)	• Maintain QA/QC of processing conditions to lower risk of contaminants from machinery and other construction activities onsite through audits, site visits and rigorous testing requirements. • Verdant will continue to, and on an ongoing basis, engage with companies that have commercial volumes available of waste biomass from approved clearing activities. • If necessary, Verdant will also provide technology transfers including specialized equipment including grinders/chippers,	D	3	17(L)

Risk event	Risk cause / comment	Possible scenarios, results & consequences	P	C	Pre-Risk Rating	Prevention and Adaptive Management Measures	P	C	Post Risk Rating
		and/or shut down of operations were other fuel not available at that time.				screening systems, stockpiling, and loading equipment where required to support the required volumes of fuel needed that meets specifications.			
Domestic Biomass (DBF)* non-compliant.	DBF must be listed as an eligible waste fuel, and must meet the Biomass Feedstock Specification and a SRROE.	If the feedstock from DBF does not align with the Biomass Feedstock Specification, plant and equipment damage and failures could result, leading to plant shutdowns in the short or long term, additional maintenance requirements and higher costs. Additionally, if the feedstock from DBF does not meet relevant eligible waste fuel requirements, and is not listed by EPA as an eligible waste fuel, Verdant will not be able to use the material. If EPA lists DBF as an eligible waste fuel, and if the requirements of a Specific RROE are not met, compliance action from EPA could occur, including additional testing costs and/or shut down of operations were other fuel not available at that time.	A	4	10(H)	• Verdant will continue to conduct baseline assessments of DBF. Preliminary results have confirmed that the materials can be processed to the required specifications using existing technologies. • Verdant will continue to engage with the resource recovery industry to assess appropriate technologies required to meet the required specifications. • Verdant to continue to develop and update a DBF strategy in collaboration with relevant stakeholders including: ○ EPA; ○ Industry and technology providers; and ○ The wider community.	B	4	14(M)
Changes to Legislation Affecting Biomass Supply									
Changes proposed to strengthen the environmental protections in the *Land Management (Native Vegetation) Code*-based clearing	Strengthened prescriptions for managing invasive native species to reduce the risk of misuse of this provision for clearing could make it more difficult for INS to be cleared.	Although there are no known planned or discussed legislative changes that would completely eliminate INS as a potential source of biomass feedstock, there is a risk that the amount of INS available could be reduced by an amount significant enough to cause shortfalls in the expected amount of INS available to Redbank. This is shown in Recommendation 2.1 (page 39) of the NSW Government's *Plan for Nature* to improve	B	4	14(M)	• Verdant will continue to engage directly with senior staff at Local Land Services and with landowners regarding changes to policies and guidelines as recommended by the NSW Government review; • Verdant will update their fuel strategy as outlined in the Fuel Supply and Characterisation Study (Appendix M of the EIS) and the Quality Assurance and Control Procedure for Receipt and Use of Biomass (Appendix E of the Fuel Supply and Characterisation Study)	B	5	19(L)

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Risk event	Risk cause / comment	Possible scenarios, results & consequences	P	C	Pre-Risk Rating	Prevention and Adaptive Management Measures	P	C	Post Risk Rating
		administration and outcomes of authorisations to manage environmental risk and reduce the cleared area for Invasive Native Species (INS) by developing a protocol for treatment area specificity for Part 2, Division 2 as well as a landholder guide for assessing whether INS are acting invasively (under Part 2, Division 1 of the Code).				to incorporate any relevant changes that could affect availability and operations around INS and biomass from approved infrastructure land clearing projects; • Verdant will review contractual arrangements with landowners and contractors to incorporate these changes; and • Review upcoming approvals for infrastructure construction projects in consideration of timing, volumes, location and potential higher order uses on an ongoing basis.			

4. Conclusions and Recommendations

A comprehensive Risk Assessment has been prepared that evaluates in detail the potential impacts and risks associated with potential shortages of biomass, variability in supply and feedstock, ability of biomass feedstock to meet fuel specifications and regulatory requirements, and potential legislative changes on the supply of biomass.

The Risk Assessment also identifies adaptive management strategies and contingencies Verdant will use to respond effectively to these risks.

With the implementation of these identified strategies and contingencies, all identified risks have been assessed low and tolerable with the following exceptions (considered to be moderate risks):

- Natural disaster such as a bushfire, drought or flooding event destroying biomass supplies or limiting access to fuel supply for significant periods of time;
- EPA approval to use Domestic Biomass Fuel (DBF) as a feedstock fuel and reducing available biomass fuel;
- Biomass with no higher order uses arising from agricultural waste or residues (excluding INS) consistency and quality non-compliance with the Biomass Fuel Specification and/or a Specific Resource Recovery Order and Exemption; and
- Domestic The ability to obtain suitable feedstock in relevant quantities to create and deliver Domestic Biomass Fuel to meet the consistency and quality required to comply with the EPA requirements and Biomass Fuel Specification and/or a SRROE.

The moderate risks are already well understood, and Verdant's broad strategy for reducing the risk of undersupply is to diversify and scale up fuel sourcing and operations over time. This is outlined in the Fuel Supply and Characterisation Study (Appendix M of the EIS). Verdant are also targeting at any given time to have 25% more feedstock available than required to make up for possible shortfalls of any one biomass fuel source.

As a contingency, the plant consists of two FiCirc Fluidised bed boilers and one Turbine. The plant is designed to be operated between 70 and 100% steam flow. It is a base load plant and has minimum turndown capability to 110 MW with two boilers, if load needs to be reduced further then one boiler can be taken off service and stored in hot condition. The minimum load with one boiler in operation is 55MW. This would reduce the amount of fuel required to 40 tonnes per hour, or roughly half the amount for full capacity.

Overall, this Risk Assessment concludes that the risks to successful operation of the Redbank Power Station using biomass (excluding native forestry residues from logging) have been assessed as low and tolerable.

Appendix A: Letters of Support / MOUs

Bookaloo Aggregation pty ltd

05 February 2025

Mr. Mike Haywood
General Manager Feedstock Fuels and Sustainable Energy
Verdant Earth Technologies Pty Ltd
By Email

Dear Mike,

Re: Confirmation of Proposed Supply Agreement Arrangements for Sustainable Biomass Fuel for use in the Redbank Power Station

I refer to our current discussion in relation to working together to restore our farm and utilise agricultural weeds comprising Invasive Native Species (INS) as fuel for the operation of the Redbank Power Station owned by Verdant Earth Technologies to produce renewable electricity. I confirm the following proposed terms of the supply agreement:

1. ***Ownership***

I am the registered landholder of Bookaloo Station Benlomond road Bourke . Our property comprises a total area of 10,462 hectares.

1. ***Farming Activity***

We undertake a range of farming activities predominately grazing. We are a first generation farmers and our family have managed this property for 16years years.

2. ***Regulatory Approvals***

It is noted that our farm has regulatory approval from Local Land Services for the removal of INS under Certificate No. LMC00489. Our approved treatment area where the removal of INS is permitted comprises a total area of 10,213.40 hectares. We will apply for further certificates in due course, as we move forward with rehabilitating the existing approved treatment areas.

3. ***Capacity & Operational Capability***

We run a full-time farming operation on our property and are planning to work with Verdant Earth Technologies and local contractors to facilitate the removal of INS as approved and onsite processing to produce a material that meets the Biomass Fuel Quality Specification of Verdant Earth Technologies.

We understand that Verdant Earth Technology's contractors will sample and test the biomass fuel material to ensure it meets the required specifications for the duration of the supply agreement.

Verdant Earth Technology's contractors will also coordinate the loading and transport of the biomass fuel that meets the Biomass Fuel Quality Specification to the Redbank Power

Station.

4. ***Feedstock Quantity***

Approximately 10,230 hectares of our property are adversely affected by the presence of INS. I estimated that our farm, with the assistance of Verdant Earth Technology contactors involved in clearing and on-site processing of the waste biomass could supply 100,000 tonnes on an annual basis for use as biomass fuel for the power station.

5. ***Supply Agreement***

We understand that Verdant Earth Technologies has applied for development consent to convert the Redbank Power Station to use sustainable biomass fuel under State Significant Development SSD-56284960.

We acknowledge that we intend to enter a supply agreement with Verdant Earth Technologies once development consent is issued.

Should you require any further information, please contact me as per the details below.

Yours Faithfully,

Allan Clarke

Phone: 0418622640

Email: bookaloostation@outlook.com

Andrew & Megan Mosely
e: info@etiwanda.com.au

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05 February 2025

Mr. Mike Haywood
General Manager Feedstock Fuels and Sustainable Energy
Verdant Earth Technologies Pty Ltd
By Email

Dear Mike,

Re: Confirmation of Proposed Supply Agreement Arrangements for Sustainable Biomass Fuel for use at the Redbank Power Station

I refer to our current discussion in relation to working together to restore our farm and utilise agricultural weeds comprising Invasive Native Species (INS) as fuel for the operation of the Redbank Power Station owned by Verdant Earth Technologies to produce renewable electricity. I confirm the following proposed terms of the supply agreement:

1. ***Ownership***

We are the registered landholders of Etiwanda, 27859 Kidman Way Cobar NSW 2835 & Wirchilleba 1436 Grain Rd Cobar NSW 2835. Our property comprises a total area of 28,172 hectares.

2. ***Farming Activity***

We undertake a range of farming activities including livestock grazing with sheep, cattle & goats, as well as some periodic cropping for land management. We are 3rd generation farmers, and our family have managed land in this area for over 75 years.

3. ***Regulatory Approvals***

It is noted that our farm has regulatory approval from Local Land Services for the removal of INS under Certificate No. PVP00177 Wirchilleba, 23-PVP-00198 Manuka & Etiwanda 23PVP00155. Our approved treatment area where the removal of INS is permitted comprises a total area of 7388 hectares. We will apply for further certificates in due course, as we move forward with rehabilitating the existing approved treatment areas.

4. ***Capacity & Operational Capability***

We run a full-time farming operation on our property and are planning to work with Verdant Earth Technologies and local contractors to facilitate the removal of INS as approved and onsite processing to produce a material that meets the Biomass Fuel Quality Specification of Verdant Earth Technologies.

We understand that Verdant Earth Technology's contractors will sample and test the biomass fuel material to ensure it meets the required specifications for the duration of the supply agreement.

Verdant Earth Technology's contractors will also coordinate the loading and transport of the biomass fuel that meets the Biomass Fuel Quality Specification to the Redbank Power Station.

5. Feedstock Quantity

Approximately 6200 hectares of our property are adversely affected by the presence of INS. I estimated that our farm, with the assistance of Verdant Earth Technology contactors involved in clearing and on-site processing of the waste biomass could supply 300,000 Ton (at a yield of 50ton/ha) over the next 5 years for use as biomass fuel for the power station.

6. Supply Agreement

We understand that Verdant Earth Technologies has applied for development consent to convert the Redbank Power Station to use sustainable biomass fuel under State Significant Development SSD-56284960.

We acknowledge that we intend to enter into a supply agreement with Verdant Earth Technologies once development consent is issued.

Should you require any further information, please contact me as per the details below.

Yours Faithfully,

Andrew Mosely

Andrew Mosely

Phone: 0419 477 983

Email: andrew@etiwanda.com.au

VERDANT
EARTH TECHNOLOGIES

ABN: 65 624 824 791
A: Level 33, 52 Martin Place, Sydney NSW 2000
P: PO BOX 2537, Sydney NSW 2001

17 July 2023

Mr Andrew Mosely
Mr Stephen Nicholson
Mr Mathew Nicholson
Mr Robert Chambers - Chair
Western Regeneration Pty Ltd
Osterley Downs,
Cobar NSW 2835

Dear Sirs,

Biomass Supply Agreement – Cobar

Verdant Earth Technologies is the owner and operator of the 151MW Redbank Power Station (Redbank), located at 112 Long Point W, Warkworth NSW 2330. Verdant is planning to restart Redbank and convert the feedstock from coal tailings to waste wood residues and purpose grown biomass. Verdant is in the process of establishing preferred suppliers for the collection of sustainably sourced waste wood residues.

The Redbank Power Station is an extremely unique asset that operates using a circulating fluidised bed (CFB) boiler. This is different to standard coal fired power stations that typically operate using a sliding grate. CFB boilers are the globally preferred technology for biomass generation, as a result Redbank can be converted to operate on biomass fuel with very minor modifications.

The Redbank Power Station will run on purpose grown biomass, and waste biomass residues sourced from:

- Quick rotation crops
- Agricultural wastes
- Approved land clearing, waste from disaster clean up works or clearing that makes way for major infrastructure developments (roads, transmission lines etc.)
- Invasive species
- End of life Waste Woody Biomass (Domestic Biomass)

The Redbank Project is progressing through the NSW planning system as a State Significant Development and can be operational within 8 months of receiving approval. Verdant is targeting to begin generation at Redbank by December 2024.

Western Regeneration Pty Ltd (“WRG”) is a Cobar based contracting operation established by a group of local business operators to work with local farming groups to manage the removal of invasive species and regeneration of farming properties.

The invasive species issue is being managed in conjunction with Local Land Services (“LLS”). LLS is a regional-focused NSW Government agency charged with delivering services to and assisting farmers, landholders and the wider regional community. LLS helps farmers with Natural Resources management including dealing with invasive species.

WRG estimate there is over 20 million tonnes of native species suitable for use as a fuel at Redbank. WRG have the expertise and capability to clear, chip and produce an estimated 1 million tonnes per annum of such fuel and wish to be a supplier of biomass fuel to Redbank.

In preparation for the targeted restart date, Verdant is requesting potential biomass suppliers to enter a **non-binding Memorandum of Understanding (MOU)**, attached below. The MOU is not legally binding and only commits potential suppliers and VET to deal in good faith to try and reach an agreement on supply, subject to acceptable commercial arrangements.

VERDANT
EARTH TECHNOLOGIES

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Biomass Specification

Biomass must be legally sourced and accompanied by any relevant documentation that supports its legal removal and production. If required, it must be verifiable that the biomass has no higher value use.

The Biomass should be at <25% moisture content and chipped to an approximate grading between +15mm and less than 50mm

Memorandum of Understanding (MOU)

This MOU establishes the agreed intent of the parties to negotiate a supply agreement for the supply of woody biomass from the Cobar land maintenance projects to Redbank Power Station.

The parties agree to work together in good faith and use their best endeavours to enter into a supply agreement on commercial terms over the next 12 weeks, subject to agreement on the types and quantities of residues to be supplied, the initial supply date, and the costs. It is envisioned that VET will enter into an agreement with your group to receive up to 500,000tpa of biomass chipped to the agreed specifications.

Working together it is envisioned that we would develop a load and transport strategy to the Redbank Site at 112 Long Point Road W, Warkworth NSW 2330.

VET shall contact the supplier to commence negotiations within four weeks of this MOU being signed by both parties.

VET will provide regular updates on the expected commencement date for supply, which will be subject to progress on plant refurbishment works.

At our meeting in Cobar you advised that you had been working on this for about 15 years and had several reports in regards to the feedstock and the value that proper management can bring to the land. Upon signing the MOU, VET would ask that these documents be made available so that we can use them in support of the opportunity and use of these fuels.

All negotiations between VET and your group shall be kept in confidence and should you provide any materials to VET, we will seek your approval prior to disclosing them to a third party other than if provided for the purpose of capital raising for Verdant under the terms of a confidentiality agreement protecting such information.

The goal of VET is to develop a long term relationship with your group regarding the supply of biomass feedstock to Redbank, and may ultimately include the development of a new Biomass / Bioenergy plant in Cobar. This will be a long term project and will bring reliable renewable energy, additional jobs and significant economic benefit to the region for many years to come.

VET management team look forward to working with your group and developing a mutually beneficial relationship.

Kind Regards

Mike Haywood
General Manager Feedstock Fuels and Sustainable Energy
Verdant Earth Technologies Ltd

VERDANT
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Memorandum of Understanding

THIS MEMORANDUM OF UNDERSTANDING (the "Document") made as of this 17th day of July 2023 (the "Execution Date"),

BETWEEN:

Verdant Earth Technologies Limited of Level 33, 52 Martin Pl, Sydney NSW 2000, Australia

(the "Purchaser")

- AND –

Western Regeneration Pty Ltd of Osterley Downs Cobar NSW 2835

(the "Seller")

BACKGROUND:

A. The Seller is the owner of certain goods that are available for sale.

B. The Purchaser wishes to purchase the goods from the Seller.

This Document will establish the basic terms used in a future contract for sale between the Seller and the Purchaser. The terms contained in this Document are not comprehensive and it is expected that additional terms may be added, and existing terms may be changed or deleted. The basic terms are as follows:

Non-Binding

1. This Document does not create a binding agreement between the Purchaser and the Seller and will not be enforceable. Only the future contract for sale, duly executed by the Purchaser and the Seller, will be enforceable. The terms and conditions of the future contract for sale will supersede any terms and conditions contained in this Document. The Purchaser and the Seller are not prevented from entering into negotiations with third parties with regard to the subject matter of this Document.

Transaction Description

2. The goods for sale are described as follows:
    - Biomass waste residues, up to 500,000tpa

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Purchase Price

3. The Purchaser will pay to the Seller the amount of $17 AUS Dollars per dry tonne upon collection of the goods (the "Closing Date") from a pre-agreed location as final payment in full for the goods.

Representations

4. The Seller represents and warrants that the goods are free and clear of any liens, charges, encumbrances or rights of third parties which will not be satisfied out of the sales proceeds. If the representations of the Seller are untrue upon the Closing Date, the Purchaser may terminate any future agreement without penalty and any deposits must be refunded.

This Document accurately reflects the understanding between the Seller and the Purchaser, signed on:

this 17th day of July, 2023.

Per: ____________________________

Mike Haywood GM Feedstock Fuels and Sustainable Energy
Verdant Earth Technologies Limited

Per: ____________________________

Robert Chambers Chairperson
Western Regeneration Pty Ltd

Appendix B Detailed Response to the Review

The following table provides a detailed response to each comment raised within the Review report. The table addresses all comments in the report, not just the request for information for each criterion.

In recognition of the large amount of information provided in a relatively unique and complex application, the responses provide information taken from the SSD 56284960 application and a reference to where the information can be found including relevant sections within the EIS, Response to Submissions Report (RTS) and accompanying appendices.

Table 3.1. Response to general comments documented in the report by ARUP (2024) Restart of the Redbank Power Station Project (SSD 56284960) Independent Merit Review of the EIS. Reference: 305102-01, Final Report, 13 December 2024.

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Section 2.1 Feedstock availability				
1	Pg 6	The Redbank Power Station's reliance on 100% biomass as a fuel source places a critical emphasis on the availability of adequate and suitable feedstock. With an expectation of using 700,000 dry tonnes of biomass per year, it is essential that the facility has a steady and reliable supply of suitable feedstock to meet both its operational demands and its regulatory compliance and environmental outcomes.	The Proposal is based on operating with 100% sustainably sourced biomass as a near Net Zero baseload generator which will assist to provide stability into the energy grid and support intermittent solar and wind power generation. It is a green alternative to coal-fired baseload energy. The Applicant has worked diligently over many years to identify and develop a range of supply options to operate Redbank on biomass including developing options for purpose grown energy crops and securing MOU's for existing fuel supply. The Applicant is focussed on biomass fuel supply and is confident that the supply requirements of Verdant can be met. Ultimately sources of supply have been identified and are available, and securing this biomass fuel is an issue for Verdant to finalise and complete post approval. The *Fuel Supply and Characterisation Study* (Appendix M of the EIS) clearly outlines the proposed strategy to diversify and scale up biomass fuel sourcing and operations over time to deliver a steady and reliable supply of suitable biomass fuel . The plant will use 700,000 dry tonnes of biomass per year when the plant is operating at **maximum** capacity. The plant is however also able to continue operations on a single boiler with a corresponding adjustment in fuel requirements and electricity output if required. As documented in the Section 3.2 of the EIS, plant operations can be easily scaled to operate on a single boiler or two boilers simultaneously. Compliance with the fuel specification is critical for every load of biomass fuel delivered to Redbank to ensure the plant is	EIS Appendix M Section 4.3 EIS Section 3.2

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			operated in a manner that complies with all regulatory requirements and environmental/emission limits.	
2	Pg 6	Any disruption in the feedstock supply due to insufficient volumes, delays in delivery, or changes in feedstock quality could significantly impact the facility's ability to generate electricity as planned. Without a consistent flow of biomass that meets the required specifications, the facility may face operational shutdowns, reduced energy output, and higher operational costs, potentially undermining the viability of the project.	The requirement to manage biomass fuel quality is not unique to Redbank and is standard practice in many types of generators. Verdant are aware of the need for reliable biomass fuel supply and have developed fuel sourcing risk strategies. The *Fuel Supply and Characterisation Study* (Appendix M of the EIS) details the Proposal's use of biomass from invasive native species control, scaling up the growing of fuel crops, biomass from approved infrastructure project clearing and other sources where available and that meet the required specifications of the plant. This multi-pronged approach sourcing fuel from different locations and supported by a regional fuel cropping strategy with landowners will reduce the risk of supply disruptions as described in Section 4.4 the *Fuel Supply and Characterisation Study* (EIS Appendix M). Verdant are very familiar with the FiCirc Fluidised bed technology and have developed fuel specification requirements to protect the plant and ensure environmental compliance. A strict Quality Assurance/ and Quality Control (QA/QC) program has been developed to control fuel quality, manage risk and avoid potential issues relating to plant and equipment damage, lower energy output, regulatory breaches and environmental harm. The power station will operate under a strict EPA licence requiring continuous monitoring and reporting.	EIS Appendix M Section 4.3 EIS Appendix M Section 4.4 EIS Section 3.2 EIS Appendix M (Appendix E)

JEP ENVIRONMENT & PLANNING

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			The power station will be supported by a biomass fuel supply chain with sources from multiple locations to reduce risks associated with potential shortages from any one location as outlined in the Fuel Supply and Characterisation Study (Appendix M of the EIS). This will help to ensure continuous operations and stable performance.	
3	Pg 6	Feedstock quality is just as important as its availability, as it directly affects the efficiency and stability of the combustion process. Biomass with inconsistent moisture levels, high contaminant levels, or varying particle sizes can cause both operational issues such as plant and equipment damage or lower energy output, as well as regulatory breaches or environmental harm.	Verdant are well aware of the importance of biomass fuel quality as described in Sections 6 and 7 of the *Fuel Supply and Characterisation Study* (EIS Appendix M) and the importance of appropriate preparation, receival and quality control management. As provided in the QA/QC program (Appendix E of EIS Appendix M), prior to delivery to Redbank Power Station all biomass fuel will be pre-tested and assessed for full compliance with the chemical and physical specifications of a Specific Resource Recovery Order and Exemption as issued by the EPA. Only biomass fuels that have been tested and validated for compliance will be permitted to be received at the power station. The QA/QC program, supported by a comprehensive fuel testing and validation program, will ensure the delivery of consistent quality fuel to Redbank, reliable plant performance and compliance with air quality limits regulated under the EPA licence.	EIS Appendix M Section 6 & 7 EIS Appendix M (Appendix E) EIS Section 4.2 EIS Appendix M Section 3.4.4
4	Pg 6	The following sections highlight the key considerations that have been identified following the assessment of key factors that could impact feedstock availability and, in turn, the operation of the facility.	Noted.	N/a
5	Pg 7	**Uncertainty in biomass supply and credibility of supplier partnerships**	Verdant are confident in the availability of partnerships and biomass fuel sources. Verdant has been and continues to engage with landowners, senior management of the West and Central West LLS, mining companies and multiple other parties	EIS Appendix M Section 4.5.1

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		Verdant has indicated that in year one, 500,000 tonnes of biomass (representing 71% of the total expected feedstock) will be sourced from Invasive Native Species (INS) control on agricultural land, where no higher order uses have been identified. The EIS further states: "Verdant has been working with Western Local Land Services (LLS) and a local business organisation, Western Regeneration Pty Ltd, based in Cobar, to enter into a supply agreement for up to 500,000 tonnes per annum of biomass from their approved INS clearing. Verdant Earth is also in discussions with the Central West LLS about establishing similar supply agreements with local landowners in their area" (Page 64, EIS).	regarding MOUs, trial chipping operations and many other aspects to fuel sourcing and operations. This is described in detail in Section 4.5.1 of the EIS. Additional data from the Higher Order Use Study (RTS Appendix H) prepared for the RTS discusses the results from interviews with 15 stakeholders including a selection of landowners and Local Land Services representatives. The Higher Order Use Study prepared by ARCHE (see Table E1-2 in Appendix H of the RTS) estimated that a significant amount of INS is estimated to be available with no higher order uses (approximately 1.5 million tonnes annually). Verdant will establish supply contracts with landowners committing to supply biomass of a minimum amount per year to specification. Note that Verdant already has letters of support for 400,000 tonnes from two suppliers and are in the process of establishing a contract for supply of biomass for a minimum of 5 years from commissioning (see Risk Assessment in Appendix A). Verdant will (and can only) finalise and enter binding arrangements once approval is obtained and there is a scheduled commissioning date. During commissioning the plant Verdant will build fuel inventory ready for year 1 operations. Supply agreements for significant amounts of INS are pending a planning consent for the Proposal.	RTS Appendix H
6	Pg 7	However, no supporting evidence has been provided to confirm the ability of these parties to reliably deliver the stated biomass volumes or whether they are engaged in other projects that might impact the availability of this feedstock. Additionally, there is no publicly available information to substantiate	The Higher Order Use Study (RTS Appendix H) provides direct market evidence for the availability of INS and concludes that there are no other higher order uses or other market uses or demand for this material. The interviewed 15 stakeholders to assess higher order use opportunities for the eligible waste fuels proposed, and a selection of landowners and LLS representatives regarding INS. A significant amount of INS estimated to be available with no higher order uses or market applications (approximately 1.5 million tonnes annually). See Table E1-2 in Appendix H.	RTS Appendix H

COMMENT NO.	REVIEW PAGE	ISSUE	APPLICANT RESPONSE	REFERENCE TO WHERE ADDRESSED IN APPLICATION
		the capacity or operations of Western Regeneration Pty Ltd to facilitate the procurement of the required 500,000 tonnes of biomass. Notably, it appears that Western Regeneration Pty Ltd has been deregistered by the Australian Securities and Investments Commission (ASIC) since 2018. However, it is worth mentioning that the Department has received a redacted Memorandum of Understanding (MOU) between Verdant and Western Regeneration Pty Ltd, dated 17 July 2023.	Note that Verdant has letters of support for 300,000 tonnes from one supplier over 5 years, and 100,000 tonnes per year from another supplier. In 2023, Western Regeneration Pty Ltd signed an MOU for 500,000 tonnes per year chipped to the agreed specification. Whilst Western Regeneration has been disbanded, they consisted of several landowners Verdant are still in discussions with individually to form supply contracts once the Proposal is approved. Verdant are in the process of establishing contracts for supply of biomass for a minimum of five (5) years from commissioning (see Appendix A of the Risk Assessment). Verdant will continue to work with this group of landowners as individuals or in whatever legal entity is preferred by them. The Applicant acknowledges that it will take time to work with suppliers (whether the landowners themselves, or contractors) to build constant supply to specification for the quantities needed by the power station. Work to date has shown that there is existing operational capability to build on whilst restarting Redbank. This will be a big focus of the Applicant post-approval and during the pre-start period.	
7	Pg 7	The independent market study of eligible waste fuels proposed for Redbank Power Station indicates that the landholders interviewed expressed in-principle agreement to supply Verdant with INS waste material, estimating a total of 4,200,000 tonnes available for management and supply from areas with high INS density (Page 22,	INS is a significant issue impacting large areas of central and western NSW, posing a formidable threat to the health and wellbeing of the landscape and agricultural productivity[10]. It is a recognised environmental problem, and the NSW government has been working to resolve it for well over 50 years.	NA

[10] State of NSW, Local Land Services (2014). A Best Management Practice Guide for the Central West and Western Regions.

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		ARCHE 2024 Higher Order Use Study).		
8	Pg 7	The figure of 4,200,000 tonnes is based on information from three landholders: Landholder 1 (29%), Landholder 2 (14%), and Landholder 3 (57%) (Table 4-1, Page 23, Independent market study of eligible waste fuels proposed for use at Redbank Power Station).	Verdant has reviewed available information on INS which includes some estimates stating that there is 24 million tonnes of INS within 75km of just Cobar[11]. These landowners are examples of only three landowners used in the Higher Order Use Study. There are a significant number of other landowners not incorporated into the study. Whilst the following up-to-date information is supplied, Section 4.5.1.2 of the *Fuel Supply and Characterisation Study* (Appendix M of the EIS) discusses the previously published information. Based on the Public Information Register - Certificates Under Section 60Y[12] there are 184 certificates issues to clear invasive native species in the Central West and 78 certificates issues for the Western LLS districts between 09/03/2018 and 4/12/2024. This totals 686,371 hectares of treatment area. Up to December 2021, approximately 16,541 hectares of authorisations were cleared for the management of INS. The limited extent of activating these authorisations is in part due to the relative expense of undertaking vegetation management[13] and little market options for the biomass material except for onsite disposal via burning. In addition, the average annual area of INS authorisations is less than 145,000 hectares under the current Land Management Framework.	RTS Appendix H EIS Appendix M Section 4.5.1.2

[11] ABC News (2021). Web: https://www.abc.net.au/news/2021-01-20/cobar-biohub-proposal-stalls-without-investment-western-nsw/13072476.

[12] NSW Local Land Services Public Register. Web: https://www.lls.nsw.gov.au/help-and-advice/land-management-in-nsw/public-register.

[13] NSW Local Land Services (LLS 2023). Statutory Review of the native vegetation provisions (Part 5A and Schedule 5A and Schedule 5B) of the Local Land Services Act 2013. Web: https://www.lls.nsw.gov.au/help-and-advice/land-management-in-nsw/statutory-review-of-the-native-vegetation-provisions-of-the-local-land-services-act.

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			INS is a pervasive, ongoing and well-documented issue[14] also recognised by Landcare Australia[15]. Verdant's Proposal would provide assistance to landowners in appropriately managing INS on lands, especially in the Cobar region. INS have either 'regenerated thickly following disturbance or encroached on vegetation communities where they previously didn't occur' (Central West and Western Catchment Management Authorities, 2010[16]). Section 4.5.2 of the *Fuel Supply and Characterisation Study* (Appendix M of the EIS) discusses the proposed use of INS and the landowner problems associated with INS.	EIS Appendix M Section 4.5.2
9	Pg 7	However, discrepancies arise when these estimates are compared with publicly available information. For instance, Landholder 2's operations span 34,000 hectares of owned and leased land and involve a white dorper stud, commercial meat sheep operations, a red angus stud, commercial beef operations, and a meat goat enterprise. The report attributes 600,000 tonnes of INS to Landholder 2. Back-calculating using a yield of 25 tonnes/hectare as stated in the study suggests that 24,000 hectares—approximately 70% of their land— would need to be dedicated to INS supply, which	The Higher Order Use Study reports that "landholders contacted as part of this study estimated 150 tonnes of INS per ha on average was a reasonable estimate of available volumes on their properties" (RTS Appendix H, Section 4.1.1, page 17). Tonnes per hectare at this average would require less land than the Review indicates. Whilst Verdant is aware that the tonnes per hectare will vary based on density, species and age of INS, Verdant will target the most appropriate areas based on discussions with landowners and LLS. Market research evidence from the Higher Order Use Study (RTS Appendix H) suggests significant quantities of INS are available that exceed the Redbank's requirements. A report funded by the Western Management Catchment Authority in 2013 (Green, 2013) (see Appendix E) was prepared to determine how much woody biomass may be	RTS Appendix H (Section 4.1.1) Appendix E

[14] NSW Local Land Services. Web: https://www.lls.nsw.gov.au/regions/western/articles,-plans-and-publications/managing-invasive-native-scrub-to-rehabilitate-native-pastures-and-open-woodlands#:~:text=Invasive%20native%20scrub%20(INS)%20is,production%2C%20communities%20and%20the%20environment.
[15] Landcare Australia. Web: https://landcareaustralia.org.au/landcareagriculture/innovationsinag/western-landcare/treating-a-potentially-lethal-condition-invasive-native-scrub/.
[16] Central West Catchment Management Authority and Western Catchment Management Authority (2010). Managing invasive native scrub to rehabilitate native pastures and open woodlands. A Best Management Practice Guide for the Central West and Western Catchments. (145 pp). Web: https://www.lls.nsw.gov.au/__data/assets/pdf_file/0007/685222/managing-invasive-native-scrub.pdf.

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		appears inconsistent with their operational focus.	available for removal under an approved Property Vegetation Plan (PVP) (near Cobar) and used for commercial bio-char and/or bio-energy production. The maximum estimated dry matter yield from the study was 117.2 tonnes/ha for the harvesting of woody species up to a size of 30cm diameter breast height (dbh). For indicative purposes, 'average' results for planning purposes have been calculated across the units as the following: • 37.3 tonnes/ha to 20 cm dbh; • 45 tonnes/ha to 25cm dbh; and • 49 tonnes/ha to 30 cm dbh. INS is a pervasive problem in the central and western areas of NSW. Landowners are keenly aware of this issue and are willing to work with Verdant on this issue. Adequate supply of biomass fuel from this extensive area is not an issue for Verdant.	
10	Pg 7	Similarly, no publicly available information regarding Landholder 1's land availability or operational activities of the organisation. This absence of data raises questions about the feasibility of supplying the 1,200,000 tonnes of INS attributed to them.	Landholder 1 has provided a signed letter of support indicating 10,320 hectares of land is adversely affected by INS and that they intend to enter into a supply agreement with the applicant for 100,000 tonnes of INS annually post approval of the Proposal. The letter is provided in Appendix A of the Risk Assessment.	Appendix A of this Response Report
11	Pg 7	Furthermore, it is uncertain whether the processing centres expected to manage INS can provide feedstock that meets the physical and chemical characteristics required by the Redbank Power Station, such as particle size and moisture content. These processing centres may lack the necessary equipment and ex pertise to process this material. Additionally, it is uncertain whether they are willing to invest in	Verdant is confident in its ability to deliver high-quality fuel for Redbank Power Station, thanks to a strong combination of in-house expertise, specialist consultants, and dedicated suppliers. The specifics of how these fuel standards are met remain a commercial matter for Verdant. The *Quality Assurance and Control Procedure for Receipt and Use of Biomass* (Appendix E of the *Fuel Supply and Characterisation Study*), has been prepared to ensure the following: • All fuel used at the Power Station meet either the definition of a standard fuel under the *Protection of the*	EIS Appendix M (Appendix E)

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		the equipment needed for feedstock preparation. Their willingness to transport the INS to the Redbank facility also remains unverified.	*Environment Operations (General) Regulation* 2022 and/or the *NSW EPA Eligible Waste Fuel Guidelines*; • Fuels supplied to the Redbank Power Station meet the requirements of the Biomass Specification; and • All sampling and monitoring requirements as set forth by EPA under an appropriate SRROE are complied with. Verdant will be working with landholders and fuel suppliers to put in place fuel processing, testing and transport systems so that biomass fuel delivered to the power station is reliable, consistent in quality and meets all required specifications. The Applicant is actively exploring various options and refining processes to ensure that the biomass fuel supplied to Redbank complies with all required specifications. While the final selection of processing plant and equipment has not yet been made, it will be tailored to the characteristics of each targeted fuel type. For example, achieving the necessary volumes of biomass fuel might require large chippers and screens, which Verdant can acquire in collaboration with landowners to efficiently recover and process the material while adhering to environmental regulations. In addition, Verdant will work closely with landholders and fuel suppliers to establish robust systems for fuel processing, testing, and transportation. This collaborative approach is designed to ensure that the biomass fuel delivered to the power station is not only reliable and consistent in quality but also fully compliant with all specifications.	
12	Pg 7	**Challenges in utilising C&D and C&I waste sources as Domestic Biomass Fuel (DBF)** It has been noted that *"The DBF Verdant are targeting as potential fuel includes Construction and*	Verdant Earth are requesting that Domestic Biomass Fuel (DBF) is included as an approved fuel type for use at the Redbank Power Station, subject to a post-approval DBF trial, a SRROE application under Clause 93 of the *Protection of the Environment Operations (Waste) Regulation* 2014 and approval by the EPA as an eligible waste fuel.	EIS Section 1.1 EIS Appendix M Section 4.5.4

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		Demolition (C&D) and Dry Sorted Commercial and Industrial (C&I) waste sourced primarily from industry skip and bulk bin collection, and demolition works, where this material is presently destined for landfill" (Appendix M, page 55). From year three onwards, it is projected that the facility will utilise 50,000 tonnes of Domestic Biomass Fuel annually. Verdant acknowledges that the use of this feedstock is subject to approval from the NSW EPA.	This is outlined in the EIS Section 1.1, Section 4.5.4 of the *Fuel Supply and Characterisation Study* (Appendix M of the EIS).	
13	Pg 8	However, the NSW EPA Eligible Waste Fuel Guidelines define uncontaminated wood waste as excluding *"wood waste extracted from mixed waste streams, such as construction and demolition waste."* The guidelines further state that *"uncontaminated wood waste does not include wood waste recovered from highly variable streams, such as mixed municipal solid waste or construction and demolition waste, due to their potential to contain a large number of chemical and physical contaminants over time."* This definition clearly precludes the proposed C&D feedstock. Furthermore, the MRA report also concludes that C&D waste is ineligible and suggests either excluding C&D waste as a feedstock or going down the EfW	The biomass fuel that will be used at Redbank is proposed to comprise only standard and eligible waste fuel as listed in Part 3 of the *NSW Energy from Waste Policy Statement* and defined in the *Eligible Waste Fuels Guidelines* Facilities This is discussed in Section 4.5.1 of the EIS. It is noted that the EfW Policy also states that, as information about certain waste and waste-derived streams improves, the EPA will review the eligible waste fuels list from time to time. Domestic Biomass Fuel (DBF) currently meets the definition of a waste derived fuel as per Clause 6(1)(b) of *Protection of the Environment Operations (Waste) Regulation* 2014 but is not currently prescribed as an 'eligible waste fuel' under the *Eligible Waste Fuels Guidelines*. It is the intention of Verdant to demonstrate that DBF may be considered an eligible waste fuel through a post-approval DBF trial and Specific Resource Recovery Order and Exemption application under Clause 93 of the *Protection of the Environment Operations (Waste) Regulation* 2014. This is	EIS Section 4.5.1 EIS Appendix M (Section 3.4.6) EIS Appendix M (Section 3.4.6)

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		regulatory pathway as an 'Energy Recovery Facility' as defined under the NSW EfW Policy Statement 2021.	discussed in Section 3.4.6 of the *Fuel Supply and Characterisation Study* (Appendix M of the EIS). The Redbank Power Station is not classified as an 'Energy Recovery Facility' as defined under the *NSW Energy from Waste Policy Statement* 2021. The use of biomass as described in the EIS as a fuel will only be sourced from Eligible Waste Fuels and Standard Fuels as defined in the *Eligible Waste Fuel Guidelines* (EPA 2022). Verdant are well-aware that wood waste from mixed waste streams are not currently approved as an eligible waste fuel and therefore cannot currently be used at the Redbank Power Station. The EIS seeks only to gain approval for Verdant to include the fuel as a potential source of biomass subject to NSW EPA's approval as an eligible waste fuel issue of an appropriate SRROE. Verdant understands there are a significant number of steps involved as outlined in Figure 3.1. of the *Fuel Supply and Characterisation Study* (Appendix M of the EIS), prior to receiving appropriate licensing approval from the NSW EPA to use this fuel type. Verdant anticipates that DBF will not be used at Redbank in the first two (2) years of operations at Redbank, and 7% (50,000 dry tpa) of the fuel requirements is estimated beginning in year 3 of operations. Verdant will maintain access to other fuel sources (e.g. INS, fuel crops) in higher amounts than estimated in the fuel strategy to cover shortfalls in the future if required. Verdant are targeting at any given time to have 25% more biomass fuel available than required to make up for possible shortfalls of any one biomass fuel source. If NSW EPA does not approve the use of DBF, it will not affect the overall operations or commercial viability of the power station.	EIS Appendix M (Figure 3.1)
14	Pg 8	Even if approval for the use of this feedstock is granted by the NSW EPA, an additional commercial challenge has been identified in the C&I and C&D Woody Biomass	Verdant views this as a commercial challenge to manage, and has engaged industry experts to deepen its understanding of the waste woody biomass market. The Applicant must balance adhering to the Waste Hierarchy for highest and best use with	EIS Appendix M

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		Feedstock Review Report by MRA (Appendix M, page 183). The report highlights that *"In order to access the market, Verdant will need to meet, if not beat, the current gate fees offered by their competitors"* and notes that *"Verdant's proposed gate fee is higher than both the existing arrangements and what the interviewees nominated."*	the need to legally source biomass fuel materials and produce an eligible waste fuel — all within the economic framework defined by anticipated or actual achieved gate fees. Verdant has staff with significant experience in the waste industry and is aware of the market pricing. Verdant has alternate biomass fuel supplies and will manage this as a commercial issue upon approval.	
15	Pg 8	Additionally, the independent market study on eligible waste fuels for the Redbank Power Station highlights that Verdant plan to use Uncontaminated Woody Waste (UWW) as an energy source only if it is available and has no other valuable use. However, the study expresses doubt about the availability of this material, given its potential for other uses. As a result, UWW is not assigned a specified tonnage for use at Redbank but may serve as an opportunistic fuel source.	Verdant note that there are a range of other markets and higher order uses for this biomass type. As a consequence, it has not been relied upon as fuel to be used on a regular basis. If required and the opportunity arises, Verdant may seek NSW EPA approval through a SRROE to "opportunistically" use these fuels if and when they arise.	EIS Appendix M
16	Pg 8	**Risks Associated with variable biomass suppliers and feedstock quality** Verdant Earth has stated: *"Verdant Earth have been developing supply agreements with companies that have commercial volumes available of waste biomass from approved clearing activities. It is, however, important to note that suppliers will change from year to year as market*	Engagement with UWW fuel suppliers can only benefit the Proposal by adding fuel options and reducing potential shortfalls in fuel supply to the power station. That is why Verdant will continue engaging with the industry to assess potential operators and suppliers with their capacities to provide UWW, as discussed in Section 4.5.3 of the *Fuel Supply and Characterisation Study* (Appendix M of the EIS).	EIS Appendix M

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		conditions and project development will create opportunities for feedstock fuel sources" (Appendix M, page 53).		
17	Pg 8	To support this claim, Verdant has provided data on woody vegetation clearing rates across adjoining LLS regions. However, the reliance on a dynamic supplier base, with suppliers potentially changing annually, poses significant risks to feedstock availability. This variability may create challenges in securing consistent volumes of biomass needed for operations, as availability will depend on annual market conditions and project developments.	Verdant acknowledges the challenges of consistent supply, however, is confident in the availability of partnerships and biomass fuel suppliers. To manage supply risks, Verdant have proposed and clearly outlines a strategy to diversify and scale up fuel sourcing and operations over time. The *Fuel Supply and Characterisation Study* (Appendix M of the EIS). This strategy includes both Standard Fuels and Eligible Waste Fuels, and assessment of a variety of potential sources and engagement with a variety of potential partners and suppliers at all levels. Verdant will not be relying on a single supplier, but will be working with multiple fuel suppliers, which will help reduce risks to the fuel supply chain.	EIS Appendix M
18	Pg 8	Furthermore, Verdant has emphasised the importance of maintaining high standards for feedstock quality, as indicated in the *Verdant Quality Assurance and Control Procedure for Receipt and Use of Biomass* (Page 223, Appendix M). Frequent changes in suppliers could compromise the consistency and quality of feedstock, potentially disrupting operational processes and impacting the overall efficiency and reliability of the facility. This risk underscores the need for a robust strategy to ensure stable and high-quality feedstock supplies despite the projected fluctuations in supplier arrangements.	Verdant has s a robust strategy to ensure stable and high-quality biomass fuel supplies. A comprehensive *Quality Assurance and Control Procedure for Receipt and Use of Biomass* (Appendix E of the *Fuel Supply and Characterisation Study*) has been prepared to ensure only high-quality biomass fuel supplies meeting strict specifications are combusted at Redbank. There are many reasons for this, including regulatory and commercial, as identified throughout this response table. All eligible waste fuels that form part of the biomass fuel for the Redbank Power Station will be sourced, tested and assessed (prior to delivery to Redbank) to ensure that they meet the following: • The Biomass Fuel Specification as provided in Figure 20 of the *Redbank Power Station – Description of*	EIS Appendix M (Appendix E) EIS Appendix F EIS Section 3.3.1

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			Proposed Modifications for Conversion to Fire Biomass fuels (EIS Appendix F); and • The requirements of the relevant SRROE as approved and issued by the NSW EPA. Note that although approval from EPA is still needed, an RROE is not required to be obtained prior to the use of 'standard fuels', which form a large part of Verdant's long-term fuel strategy. This is described in detail in Section 3.3.1 of the EIS and in Section 4.4 of the *Fuel Supply and Characterisation Study* (Appendix M of the EIS). To reduce risks to supply, fuel crops form a significant percentage of Verdant's planned biomass fuel strategy. By year 5 of operations, 70% of biomass fuel used at Redbank is estimated to be in fuel crops, equating to approximately 490,000 tpa. Fuel crops are considered a 'standard fuel' and do not require a SRROE but do still require approval from the EPA to be used.	EIS Appendix M Section 4.4
19	Pg 8	**Insufficient evidence for Bana Grass yield estimates and potential feedstock risks** The EIS notes that "*Verdant's discussions with local mine sites have revealed the potential for the establishment of an 8,000 ha crop of Bana Grass, which would yield an average of 50 dry tonnes per hectare (approximately 400,000 tonnes per annum), providing over half of the total feedstock requirements for the power station*" (Page 64, EIS). However, the proposed yield estimate lacks independent, publicly available	Bana grass is one of the potential fuel crops Verdant has been considering. Like all candidate fuels, it will undergo a thorough evaluation to ensure it meets the necessary fuel specifications, including chlorine limits, commercial viability, and robust growth rates in the Hunter Valley. If it fails to meet these criteria, it will not be used—a determination that will be confirmed through detailed analysis. Any potential fuel will be assessed for its suitability of any fuel, including any potential fuel crop, will need meet the fuel specification, including chlorine limits. This will be confirmed through analysis. The *Fuel Supply and Characterisation Study* (Appendix M of the EIS) outlines a strategy to diversify and scale up fuel sourcing and operations over time. Verdant does not rely solely	EIS Appendix M (Appendix E) EIS Appendix M (Appendix E, Section 4.4.2)

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		evidence to support this claim. Studies on Bana grass indicate yield variability based on factors such as climate, soil conditions, and agricultural practices. While optimal scenarios can produce high yields, actual results may differ significantly for the NSW scenario, especially when being grown on degraded mine sites with variable soil conditions and profiles.	on Bana Grass and believes further assessment is necessary before it can be considered for a fuel source. Verdant have been working on trials for the use of indigenous species including various mallees to be grown as fuel on these lands. The NSW Department of Primary Industries (DPI), in conjunction with CSIRO's Australian Tree Seed Centre, have been conducting Woody Biomass Crop Trials to examine the suitability of a range of native woody species for short-rotation woody crop biomass production across NSW[17]. The Woody Biomass Crop Trials are investigating biomass production for bioenergy under short rotation cycles (3-4 years) which would target marginal unproductive areas, for example on farming or mining land. In 2023, Verdant Earth commissioned the NSW DPI and CSIRO to assess the potential for establishing short-rotation woody crops to supply biomass for the Redbank Power Station. The reports can be found in Appendix B of The *Fuel Supply and Characterisation Study* (Appendix M of the EIS). Whilst yields of fuel crops will vary with climate, soil conditions and agricultural practices, the fuel strategy aims to secure multiple supplies to ensure consistent and reliable amounts of fuel to specification is delivered at all times.	EIS Appendix M (Appendix B)
20	Pg 8	Without robust data or local field trials confirming that 50 dry tonnes per hectare is consistently achievable in the proposed conditions, there is a risk of lower yields than anticipated. This would directly impact the projected	Robust data and field trials will continue to be an ongoing part of Verdant's operations and is a commercial issue for Verdant to manage. Verdant are actively working on biomass crop trials. In 2023, Verdant Earth commissioned the NSW DPI and CSIRO to assess the potential for establishing short-rotation woody crops	EIS Appendix M (Appendix B and E)

[17] NSW Department of Primary Industries, Woody Biomass Crop Trial 2023. Web: https://www.dpi.nsw.gov.au/forestry/science/forest-carbon/biomass-for-bioenergy/biomass-crops

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		feedstock supply and the facility's operational reliability. Furthermore, potential challenges such as water availability, fertilisation costs, and pest management could further constrain actual yields.	to supply biomass for the Redbank Power Station. The reports can be found in Appendix B of The *Fuel Supply and Characterisation Study* (Appendix M of the EIS). Whilst yields of fuel crops will vary with climate, soil conditions and agricultural practices, the fuel strategy aims to secure multiple supplies to ensure consistent and reliable amounts of fuel to specification is delivered at all times.	
21	Pg 9	**Uncertainty in alternative feedstock sources and operational impact** Verdant has stated: *"Note that these are indicative targets and that actual feedstock mix may vary due to fuel availability, and fluctuations in market conditions. Other potential sources of eligible waste fuels with no higher order uses will also be considered"* (Appendix M, page 62).	This is a commercial issue for Verdant to manage. Note that Verdant will only ever source and use EPA approved Eligible Waste Fuels and Standard Fuels that meet the specifications required for the operation of Redbank. This is outlined in the The *Fuel Supply and Characterisation Study* (Appendix M of the EIS). All eligible waste fuels will be approved through a SRROE, and will be required to meet strict specifications of the SRROE and the Biomass Fuel Specification. Sources of biomass fuel will be secured through multiple suppliers to provide certainty and minimise operational impacts.	EIS Appendix M
22	Pg 9	This acknowledgment highlights the proponent's recognition of potential challenges in securing the required feedstock volumes due to market fluctuations and availability constraints. While Verdant has suggested the possibility of sourcing alternative eligible waste fuels, there is a lack of clarity regarding what specific types of feedstocks are being considered as substitutes.	Verdant acknowledges that market fluctuations may present challenges. Nonetheless, the Applicant is committed to securing the most cost-effective fuels for Redbank while maintaining stringent QA/QC standards for the biomass fuel. For example, a fluctuation might occur when large-scale land clearings — for bypasses, industrial developments, or residential subdivisions — result in an oversupply of waste woody biomass that lacks access to a higher-order use market. This scenario could create a valuable opportunity for sourcing, processing, and supplying fuel to Redbank. Verdant has proposed and has clearly outlined a strategy to diversify and scale up fuel sourcing and operations over time. The *Fuel Supply and Characterisation Study* (Appendix M of the EIS) details the proposed use of biomass from invasive	EIS Appendix M EIS Section 3.3

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			native species control, scaling up the growing of fuel crops, biomass from approved infrastructure project clearing and other sources where available and that meet the required specifications of the plant and EPA approval requirements for the use of eligible and standard fuels. The Applicant and the application clearly sets out all fuel types considered under the Proposal (EIS Section 3.3), including the estimated amounts of each type to be used at the power station.	
23	Pg 9	Moreover, it is unclear how these alternative feedstocks will meet the facility's stringent quality standards, including moisture content and particle size, which are critical for efficient operation. The introduction of alternative feedstocks may also pose risks to the operational process, potentially affecting equipment performance, energy output, or compliance with environmental regulations.	Verdant have prepared a *Quality Assurance and Control Procedure for Receipt and Use of Biomass* (Appendix E of the *Fuel Supply and Characterisation Study*) to ensure a robust program is in place to meet these requirements. Verdant possesses a comprehensive understanding of biomass fuel processing and the specific criteria required for source materials to be considered. Alternative biomass fuel must not only conform to the facility's stringent quality standards — such as moisture content and particle size, which are essential for efficient operation — but they may also introduce risks that could affect equipment performance, energy output, or environmental compliance. As a result, the core criteria for evaluating potential biomass fuel are as follows: • Is the material classified as an eligible waste or a standard fuel? • Can it be processed to meet the required specifications? • Does Verdant's DA, and EPL permit the use of the source material as a biomass fuel? • Can we secure the relevant SRROE? • Can we process it in a manner that produces an economical biomass fuel for Redbank?	EIS Appendix M (Appendix E)

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			All biomass fuels proposed for use at Redbank Power Station will need to meet stringent specifications, operational requirements of the Redbank Power Station plant and equipment, and the requirements of relevant SRROEs. Verdant have developed strategies and processes to manage risks, which will be implemented and commissioned when Redbank Power Station is approved to use biomass as fuel as outlined in the EIS.	
24	Pg 9	The absence of detailed information on the assessment, selection, and integration of these alternative feedstocks raises concerns about the facility's ability to adapt to feedstock variability without compromising operational efficiency or sustainability goals.	Biomass fuel sourcing and processing capabilities are a standard part of any modern biomass to energy facility. This is a commercial issue for Verdant to manage and there is detailed information provided in the EIS and the RTS regarding how Verdant plan to manage and diversify their fuel sources to add stability and certainty to the supply chain. Verdant will operate and aim to deliver the highest possible efficiency using best practice to meet sustainable goals. All fuels will need to meet the required standards no matter where they come from or what source material. Suppliers will be required to adhere to the following requirements, as outlined in Section 3.3.1 of the EIS.: 1) Ensure that the biomass material meets an approved specification required for the power station, prior to delivery to the power station; 2) Meet all requirements under any relevant SRROE issued by the NSW EPA; and 3) Adhere to Verdant Earth's quality control and assurance program requirements. Verdant have prepared a *Quality Assurance and Control Procedure for Receipt and Use of Biomass* (Appendix E of the	EIS Section 3.3.1 EIS Appendix M (Appendix E) EIS Appendix C RTS Appendix C

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			Fuel Supply and Characterisation Study) to ensure a robust program is in place to meet these requirements. Sourcing of eligible waste fuel biomass includes higher order uses undertaken annually to ensure sustainability goals are met, as per the mitigation measures outlined in Appendix C of the EIS, and the revised mitigation measures in Appendix C of the RTS.	
25	Pg 9	**Challenges in biomass sourcing: impact of increased sourcing radius on transport costs, feedstock availability and emissions** According to the EIS, "*potential cropping land increases over fourfold from 100 km to 200 km, and tenfold from 100 km to 300 km, resulting in a total potential land area of 37,278 hectares"* (Appendix M, Page 130). However, expanding the sourcing radius to these greater distances could pose logistical and economic challenges. "*It is estimated that 112 daily movements (56 round trips) using B-double trucks would be necessary to transport the required biomass"* (EIS, Page 68). While the expanded land availability increases the biomass supply options, it also suggests that the facility may need to source feedstock from beyond the 100 km radius, which will lead to higher transportation costs.	The *Fuel Supply and Characterisation Study* (Appendix M of the EIS) includes a fuel strategy encompassing a wider potential area (i.e. 300km). Verdant will be targeting sites that are as close to Redbank Power Station as possible bearing in mind land quality, the land cost and availability for the purpose of growing fuel crops for biomass, with the cost of transport to Redbank. This is a commercial issue for Verdant to manage and there is detailed information provided in the EIS. The Traffic Impact Assessment (Appendix S of the EIS) and the Air Quality Impact Assessment (Appendix O of the EIS) and the Greenhouse Gas Mitigation Plan and Climate Change Adaptation Plan (Appendix P of the EIS) have all assumed that fuels are transported over an average distance of 300km distance (i.e. 600km return) in their estimate of calculations.	EIS Appendix M EIS Appendix S EIS Appendix O EIS Appendix P

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26	Pg 9	Additionally, there is an increased risk of competition for feedstock, as feedstock suppliers may prioritise closer, established facilities, increasing the risk of feedstock competition. This preference could divert feedstock away from the Redbank facility, potentially impacting feedstock availability. Therefore, while the expanded sourcing area offers more land, it also introduces significant risks related to transportation costs and competition from alternative waste management facilities, which could compromise the facility's ability to secure a stable and cost-effective feedstock supply.	The *Fuel Supply and Characterisation Study* (Appendix M of the EIS) clearly outlines the proposed strategy to diversify and scale up fuel sourcing and operations over time. Verdant acknowledge market competition, especially for some eligible waste fuels such as pre-consumer woody wastes. However, research as provided in the *Higher Order Use Study* (Appendix H of the RTS) suggests there is very little to negligible competition, in particular for INS. Verdant as part of the fuel strategy are also including purpose-grown fuel crops (Standard Fuels) which would be a very stable fuel source for the Redbank Power Station, which will minimise these risks and help to provide a consistent, quality supply of biomass fuel to the power station. Furthermore, fuel crops form a significant percentage of Verdant's planned biomass fuel strategy. By year five (5) of operations, 70% of biomass fuel used at Redbank is estimated to be in fuel crops, equating to approximately 490,000 tpa. Fuel crops are considered a 'standard fuel' and do not require a SRROE but do still require approval from the EPA to be used.	EIS Appendix M RTS Appendix H EIS Appendix M (Section 4.4)
27	Pg 9	Energy crops and agricultural residues commonly have very low bulk densities, severely restricting economic transport distances without the use of compaction such as pelletising or baling. The need for compaction, and the responsibility of suppliers to implement this for these feedstocks, has not been clearly addressed or discussed with stakeholders, as it was not mentioned in any of the sections involving stakeholder engagement, such as the report '*Market study of eligible waste fuels*	Verdant acknowledges the costs and challenges involved in pelletising or baling low bulk density fuels. Verdant will continue to monitor these options and should a financially viable option arise, this may be considered an option. Any facilities associated with pelletising or baling would need to be assessed separately as this is not proposed at Redbank and out of scope. This is also a commercial issue for Verdant to manage. The *Fuel Supply and Characterisation Study* (Appendix M of the EIS) clearly outlines the proposed strategy to diversify and scale up fuel sourcing and operations over time. Pellets are noted as a potential form of biomass that could be accepted at the power station, as per Section 3.3.7 of the EIS. Although pelletising is not currently planned for biomass	EIS Appendix M

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		proposed for use at Redbank Power Station'.	processing at this time, it may be conducted by some suppliers if needed to improve transport efficiency and logistics.	
28	Pg 9	Furthermore, it is mentioned that *"Verdant assessed the availability of biomass from Ag Residues within a 300 km radius of Singleton as 1,023,172 tonnes/year"* (Page 25, Appendix H - Higher Order Use Study), however, the emissions modelling considered that the energy crops will be transported over a distance of 50 km to the power station (Page 13, Response to submission, Appendix L - Lifecycle Assessment). This discrepancy indicates that the emissions estimates may underrepresent the real emissions for transporting feedstock over a distance greater than 50 km, or if only a 50 km radius from the facility is selected to collect biomass, the availability of agricultural feedstock is much lower than initially reported.	The Traffic Impact Assessment (Appendix S of the EIS) and the Air Quality Impact Assessment (Appendix O of the EIS) and the Greenhouse Gas Mitigation Plan and Climate Change Adaptation Plan (Appendix P of the EIS) have all assumed 300km distance (i.e. 600km return) in their impact assessment. The results of the Lifecycle Assessment included in the RTS assumes, on average, purpose-grown fuel crops are located 50km from the power station. Biomass fuels from approved land clearing (i.e. INS) is assumed to be 300km from the site of collection to Redbank Power Station. The Applicant believes emission estimates have been correctly assessed and have not been underrepresented.	EIS Appendix S EIS Appendix O EIS Appendix P RTS Appendix L
29	Pg 10	**Land availability vs. feedstock security: gaps in assurance for reliable biomass supply** The EIS and Appendix M frequently mention land availability for growing feedstock. For instance, it is stated that "*Within 300 km of the Redbank Power Station, the NSW Department of Primary Industries determined that there is over 8 million hectares of potential suitable land for growing energy crops*"	Verdant is well aware of and acknowledges the challenges involved in securing reliable supplies of biomass fuel, and this is a commercial issue for Verdant to manage. The *Fuel Supply and Characterisation Study* (Appendix M of the EIS) clearly outlines the proposed strategy to diversify and scale up fuel sourcing and operations over time, including fuel crops. Appendix B of the *Fuel Supply and Characterisation Study* (Appendix M of the EIS) provide extensive details regarding the	EIS Appendix M Section 4.3 EIS Appendix M (Appendix B)

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		(Page 7, Appendix M). While this states that there is a substantial area of land available, it is important to distinguish between land availability and feedstock security. The information provided indicates that Verdant is confident in its ability to secure the necessary feedstock based on land availability. However, this assumption does not inherently ensure the actual accessibility or suitability of the land for feedstock generation. Furthermore, this assumption overlooks critical factors such as the accessibility of essential services required for growing energy crops, such as water, which could be a significant limiting factor to expected crop yield.	NSW Department of Primary Industries fuel crop trials[18] providing extensive data regarding developing native species as short-rotation wood crops. The work was divided into five parts including: • Part 1: Potential carbon abatement of growing short-rotation woody crops; • Part 2: Land use mapping for Singleton (within 300 km); • Part 3: Identification of more desirable areas for biomass crop production; • Part 4: Advice on mix of species most suitable for given areas and situations, and area required to grow around 840,000 tonnes of biomass at 25% moisture content; and • Part 5: Advice on land availability and species mix for expanded generation capacity. For examples, Part 2 developed estimated carbon production of short rotation crops based on the preliminary results from the DPI biomass crop trials and other relevant data. Part 3 estimates the suitability of land based on factors such as: • Access to main roads; • Lot sizes; • 10-year average rainfall; • Soil types; and • Slope and elevation. Verdant are taking seriously the security and availability of biomass fuel crop supply and the EIS has provided extensive details in this area. Verdant's fuel supply strategy involves working with multiple growers and suppliers, which will reduce the risks to supply.	

[18] NSW Department of Primary Industries fuel crop trials webpage: https://www.dpi.nsw.gov.au/forestry/science/forest-carbon/biomass-for-bioenergy/biomass-crops

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30	Pg 10	Similarly, the use of invasive native species (INS) as a feedstock is influenced by land availability that is subject to INS clearance approvals. Despite the approvals, the actual rate of INS clearance can be very low due to practical and economic barriers, including the cost of clearance. Western Local Land Services (WLLLS) has reported estimated costs associated with various INS clearance technologies, highlighting the significant financial challenges that can be faced by landholders in managing INS effectively[2]. For the Redbank facility, it remains unclear how it plans to address these costs and whether it can compete with the lower costs of other technologies. This raises questions about the feasibility and sustainability of relying on INS as a consistent feedstock source.	Verdant acknowledges the difficulties local landholders face in managing INS on large holdings of land. However, as provided in Section 4.5.2 of the *Fuel Supply and Characterisation Study* (Appendix M of the EIS), Verdant proposes the use of INS at scale, in particular through the first several years of operations whilst other biomass fuel sources are developed. INS removal is not a new undertaking in NSW. There is extensive local and regional knowledge via landholders and LLS how this is accomplished. Verdant are confident their ability to obtain INS at a scale sufficient to assist landowners in appropriately managing INS on their land, and supply adequate biomass fuel to the Redbank Power Station as outlined in the EIS. Again, this is a commercial issue for Verdant to manage. The Higher Order Use Study (RTS Appendix H, Table E1-2, page 4) that there is a significant amount of INS and other eligible waste fuels available (estimated 1.5 million tonnes per year) using conservative assumptions. Table 7-1 (page 45) in the study shows that 99.9% of INS is currently disposed of on-farm (via burning) and 0.1% of the material is used for firewood, palletisation and briquettes for domestic heating. As a consequence, from the biomass fuel supply chain development work completed, the Applicant is confident that adequate supplies are available at a viable cost to the power station can be obtained. Furthermore, Section 4.1 of the *Fuel Supply and Characterisation Study* (Appendix M of the EIS) outlines a strategy for transitioning the fuel supply for the power station to purpose grown biomass. By year 5 of operations, 70% of the 700,000 tonnes required annually at Redbank to achieve full generation capacity is estimated to be in fuel crops, equating to approximately 490,000 tpa.	EIS Appendix M Section 4.3 EIS Appendix M Section 4.5.2

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			Note that Verdant has letters of support for 300,000 tonnes from one supplier over 5 years, and 100,000 tonnes per year from another supplier. In 2023, Western Regeneration Pty Ltd signed an MOU for 500,000 tonnes per year chipped to the agreed specification. Whilst Western Regeneration has been disbanded, they consisted of several landowners Verdant are still in discussions with individually to form supply contracts once the Proposal is approved. Verdant are in the process of establishing contracts for supply of biomass for a minimum of five (5) years from commissioning (see Appendix A of the Risk Assessment).	
31	Pg 10	Although the proponent states that it is in, or has had, discussions with entities like Western Local Land Services and Western Regeneration, the information provided lacks details on the reliability and long-term security of these feedstock sources. Most of the documentation refers to land or feedstock availability, but no concrete evidence or assurance is provided regarding the consistency or guaranteed supply of this feedstock. The lack of information on feedstock security presents a potential risk to the facility's ability to maintain a stable and predictable feedstock supply for its operations. Similarly, the Independent Market Study of eligible waste fuels proposed for use at the Redbank	The Higher Order Use Study (RTS Appendix H, Section 7) discusses availability of INS and concludes that there are no other higher order uses for this material. A significant amount of INS estimated to be available with no higher order uses (approximately 1.5 million tonnes annually). See Table E1-2 in Appendix H. The Higher Order Use Study (RTS Appendix H) discusses the results from interviews with 15 stakeholders including a selection of landowners and Local Land Services representatives to inform their results regarding INS. INS is a pervasive, ongoing and well-documented issue[19] also recognised by Landcare Australia[20]. Verdant's Proposal is designed to assist landowners in effectively managing INS on their properties, particularly in the Central West and Western Regions of NSW. For example, the Cobar Peneplain—an area larger than Tasmania—is estimated to have up to 40% of its land (approximately 3 million hectares) is adversely affected by INS. In Verdant's ongoing discussions, landowners have expressed strong support for integrating INS management into	RTS Appendix H EIS Appendix M Section 4.5.2

[19] NSW Local Land Services. Web: https://www.lls.nsw.gov.au/regions/western/articles,-plans-and-publications/managing-invasive-native-scrub-to-rehabilitate-native-pastures-and-open-woodlands#:~:text=Invasive%20native%20scrub%20(INS)%20is,production%2C%20communities%20and%20the%20environment.

[20] Landcare Australia. Web: https://landcareaustralia.org.au/landcareagriculture/innovationsinag/western-landcare/treating-a-potentially-lethal-condition-invasive-native-scrub/.

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		Power Station identifies three landholders as potential contributors to the feedstock supply. However, the security of this feedstock remains unclear, particularly regarding the ability of these landholders to meet the expected quantities and maintain supply consistency over time. Additionally, the study does not provide detailed information about the specific requirements or commitments needed from these landholders to ensure the long-term viability of the feedstock supply. This uncertainty poses further challenges to the reliability and sustainability of the proposed feedstock strategy.	their farming operations and providing Verdant with INS as part of these practices. To mitigate risks associated with the supply of INS biomass fuel (and other fuels), supply contracts will mandate specific commitments from suppliers to ensure that only fuel meeting strict specifications is delivered to the power station. Section 7.1 of the Fuel Supply and Characterisation Study (Appendix M of the EIS) outlines these requirements. These commercial contracts will de-risk the fuel supply, a key focus for the Applicant following approval. In addition, Verdant plans to supply equipment for chipping, screening, and loading materials for transport, recognising that it is unreasonable to expect the farming community to absorb these costs.	
32	Pg 10	**Potential impact of legislative changes on biomass feedstock availability for stage 1 operations** Verdant has outlined that the first stage of its operations at the Redbank Power Station will involve using "*biomass sourced primarily from approved land clearing activities, which currently have no higher order uses"* (Page 5, Appendix M). However, the NSW EPA has flagged as part of its review that recent changes stemming from the NSW Government's response to reviews of the Biodiversity Conservation Act 2016 (BC Act) and the Local Land Services Act 2013 (LLS Act), will	Any planning proposal must strictly comply with the current legislation and policy. While future changes may be considered as part of ongoing risk management, their outcomes remain uncertain. As discussed in Section 4.5 of the RTS, whilst these reviews are important and provide an avenue for public input to the legislative review process, these are outside of the scope of the Proposal. Any risk of future regulatory changes or updates to legislation that could affect future operations of the Proposal must be borne by the Applicant. However, Verdant is well aware of potential future changes. Current advice indicates that any such changes will have minimal impact on the procedures for obtaining INS as fuel and will not adversely affect the supply of INS to Redbank. Verdant supports sustainability and biodiversity conservation. Any discussions with landowners and LLS will include	RTS Section 4.5

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		introduce additional risk related to future biomass feedstock availability. These legislative amendments aim to strengthen environmental protections and include: 1. Reinforcing Environmental Protections: Measures will focus on reducing the extent of land clearing while increasing areas of native vegetation preserved and permanently managed through set-asides. 2. Improved Management of Invasive Native Species: These changes aim to minimise misuse of invasive species management provisions for clearing purposes. 3. Eliminating Set-Aside Discounts: Amendments will ensure that areas preserved are greater than those cleared, enhancing environmental offsets.	considerations of policy, regulation and sustainable land management as part of developing contracts for harvesting INS. INS is a pervasive, ongoing, and historically entrenched issue. Verdant's involvement in managing INS creates opportunities for land restoration and enhanced agricultural productivity in the Central and Western LLS areas. This will be achieved by aligning closely with LLS priorities and adhering to current legislative frameworks, ensuring that all required authorisations and permits are secured. Verdant understands that there is a strict protocol for the removal of INS. Landowners, even with appropriate PVPs and 60Y certificates, cannot simply clear-fell an entire area. Instead, Verdant will work collaboratively with the relevant stakeholders to ensure a reliable supply of INS while maintaining the stringent management criteria. Verdant as part of their comprehensive fuel strategy are also including purpose-grown fuel crops (Standard Fuels) which would be a very stable fuel source for the Redbank Power Station, which will minimise these risks and help to provide a consistent, quality supply of biomass fuel to the power station. Furthermore, fuel crops form a significant percentage of Verdant's planned biomass fuel strategy. Risk of any legislative change in relation to INS or land clearing is significantly reduced as by year 5 of operations as by year five (5) of operations, 70% of biomass fuel used at Redbank is estimated to be in fuel crops, equating to approximately 490,000 tpa. Fuel crops are considered a 'standard fuel' and do not require a SRROE but do still require approval from the EPA to be used. By year five (5) of operations and beyond, INS accounts for an estimated 13% of the biomass fuel requirements of the power station. See Table 4.1, page 40 of the *Fuel Supply and Characterisation Study* (Appendix M of the EIS).	Appendix M of the EIS (Section 4) Appendix M of the EIS (Section 4.4)

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			Verdant are taking seriously the security and availability of biomass fuel crop supply and the EIS has provided extensive details in this area. Verdant's fuel supply strategy involves working with multiple growers and suppliers. This will reduce the risks to supply in case of future legislation changes that may affect the availability of INS. Should these changes drastically affect availability of INS, it would be replaced with other biomass sources including purpose grown fuel crops.	
33	Pg 11	These impending legislative reforms introduce significant risks to the availability of biomass feedstock for Verdant. The reinforced restrictions and oversight on land clearing activities directly affect the pool of accessible biomass, particularly from native vegetation areas that may be classified under stricter conservation requirements. Without clear provisions to accommodate biomass production, the supply chain for Verdant's projected feedstock requirement of 150,000 tonnes for Stage 1 could face substantial disruption.	Verdant does not propose and has never intended to clear protected native vegetation or land set aside under conservation agreements. This is made clear in the EIS that Verdant, to address concerns expressed by the community in relation the use of native forestry residues as fuel specifically excludes this fuel source (EIS Executive Summary and Section 3.1). Biomass from approved land clearing constitutes an estimated 150,000 tpa (21%) in year 1 of operations, scaling down to 20,000 tpa (3%) estimated beginning in year 4 and beyond, as provided in Table 4.1, page 40 of the *Fuel Supply and Characterisation Study* (Appendix M of the EIS). If there is any change in law regarding access to this biomass, it will impact 21% of biomass required for maximum plant operations in year 1 and decline to 3% of biomass required by year 4. Should this occur, the Applicant will continue to work with other fuel suppliers as outlined in the staged fuel approach in Section 4.1 of the *Fuel Supply and Characterisation Study* (Appendix M of the EIS). Furthermore, as outlined in Section 4.2 of Appendix M of the EIS, the power station has the ability to operate using one	EIS Executive Summary, Section 3.1 EIS Appendix M (Appendix E)

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			boiler, which reduces the biomass fuel requirement to 350,000 tpa. This is a short term strategy that can be used if there are sudden and immediate changes to fuel supply from a change in laws.	
34	Pg 11	The scale of the impact is yet uncertain, but if amendments curtail the availability of biomass from land clearing operations, Verdant may need to explore alternative sources or strategies to meet its operational needs. This would likely entail logistical challenges and potential cost increases, compounding the complexities of transitioning to biomass-based operations.	To manage supply risks, Verdant have proposed and clearly outlines a strategy to diversify and scale up fuel sourcing and operations over time – including the use of purpose-grown energy crops – as provided in the *Fuel Supply and Characterisation Study* (Appendix M of the EIS). This strategy includes both Standard Fuels and Eligible Waste Fuels, and assessment of a variety of potential sources and engagement with a variety of potential partners and suppliers at all levels. Further details of management strategies that will be used to reduce the risks associated with potential regulatory amendments to the availability of biomass from land clearing are outlined in Comments 30, 31, 32 and 33.	EIS Appendix M Section 4.3
Section 2.2 Processing Capacity of the Facility				
35	Pg 11	The processing capacity of the facility is closely related to the quality of feedstock, as variations in these characteristics can significantly affect the plant's operational efficiency. Inconsistent feedstock quality, such as fluctuating moisture content, can lead to operational disruptions. Furthermore, variations in feedstock quality can cause wear and tear on equipment, leading to increase in potential downtime, further reducing the facility's overall efficiency and reliability.	Verdant are well-aware of the plant technology at Redbank. See the B&PPS Report included in Appendix A of the *Fuel Supply and Characterisation Study* (Appendix M of the EIS) and the *Redbank Power Station – Description of Proposed Modifications for Conversion to Fire Biomass fuels* (EIS Appendix F). The Redbank FiCirc boilers are a unique design incorporating a deep bubbling fluidized bed and fine recirculation from large cyclones above the furnace which allows efficient stable combustion of biomass with a wide range of moistures (up to 50%), particles sizes and components as given in biomass fuel specification. That biomass is highly suitable for use in circulating and deep bubbling fluidised bed technologies has been researched	EIS Section 3.2 EIS Appendix M (Appendix A) EIS Appendix F

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			extensively and is widely known and demonstrated in peer reviewed literature. The deep bubbling bed consisting of ~200 tons of bed inert material and ~2% of combusting material gives a thermal flywheel allowing large variations in the biomass characteristics. The fines recirculation ensures high efficiency under all conditions. The bed temperature is maintained by adjusting the bed depth making the bed tubes effective. The boilers are fitted with an external bed storage silo into which bed material is moved in or out of during operation as needed to suit the fuel characteristics. Biomass within the fuel specification will not cause additional wear and tear or downtime. Verdant intends to operate the plant within the design range of the Biomass Design Fuel Specification with moisture design at 25%. See Figure 20 of the Redbank Power Station – Description of Proposed Modifications for Conversion to Fire Biomass fuels (EIS Appendix F).	
36	Pg 11	The following sections highlight the key considerations from assessment of the processing capacity of the proposed Redbank Power Station, specifically evaluating whether sufficient information has been provided regarding the facility's processing capabilities and whether feedstock characteristics align with the expected processing capacity of the facility.	Verdant's engineering team is extremely knowledgeable about the plant technology at Redbank. See the B&PPS Report included in Appendix A of the Fuel Supply and Characterisation Study (Appendix M of the EIS) and the Redbank Power Station – Description of Proposed Modifications for Conversion to Fire Biomass fuels (EIS Appendix F). The EIS and in particular the B&PPS Report included in Appendix A of the Fuel Supply and Characterisation Study (Appendix M of the EIS) provide sufficient information regarding the plant and its processing capabilities at Redbank. Verdant intends to operate the plant within the design range of the Biomass Design Fuel Specification. Further to this, Verdant	EIS Appendix M (Appendix A) EIS Appendix F

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			have in house capabilities to efficiently and safely operate and manage the plant. Biomass is highly suitable for use in circulating and deep bubbling fluidised bed technologies. The type of technology at Redbank has been researched extensively and is widely known and demonstrated in peer reviewed literature to be fit-for-purpose. For example, Ianello (2002) notes that fluidised bed systems are highly flexible and can handle a wide range of biomass fuel qualities (varying in moisture, particle size, and calorific value) without extensive pre-treatment[21]. Another published and peer reviewed paper (Peña, 2011[22]) notes that the technology can burn "difficult" fuels, including biomass and fuel mixtures with variable quality conditions with lower emissions compared to traditional boilers. This adaptability is crucial for using locally and regionally waste-derived biomass material at the power station.	
37	Pg 12	**Impact of excessive biomass moisture content on plant performance, emissions, and quality assurance standards** It was stated in Appendix F that "*at biomass fuel moisture levels above about 25%, the plant electrical output is reduced due to flue gas system limitations. The maximum heat input (Gross heat release) occurs at 25% fuel moisture content*" (Page 17, Appendix F). Additionally, the EIS notes that "*general biomass fuel specifications target an expected 25% moisture*	Verdant understand the limitations and opportunities of the plant technology at Redbank Power Station. See the B&PPS Report included in Appendix A of the *Fuel Supply and Characterisation Study* (Appendix M of the EIS). A high moisture range of biomass fuels will impact the bubbling fluidized bed temperature. A bubbling bed in-bed cooling surface is usually only designed by heat balance for a limited fuel moisture content range – a large range may result in defluidisation problems with low bed temperatures. However, unlike normal bubbling bed technology, Redbank FiCirc boilers operate with a deep bed and in-bed cooling tubes; the bed temperature can be adjusted by changing the bed depth or altering the quantity/size of in-bed tubes. To manage the bed depth and temperature the plant is equipped with an existing	EIS Appendix M (Appendix A)

[21] Iannello, S., Morrin, S. and M. Materazzi (2020). Fluidised Bed Reactors for the Thermochemical Conversion of Biomass and Waste. *KONA Powder and Particle Journal,* 37: 114–131.
[22] Pascual Peña, J.A. (2011). Bubbling fluidized beds: When to use this technology. In: *Luckos, A. and den Hoed, P. (eds.) Industrial Fluidization South Africa*, Johannesburg, South Africa, 16–17 November 2011. Johannesburg: Southern African Institute of Mining and Metallurgy, pp. 57–66.

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		content" (Page 66, EIS). This threshold is critical as high moisture content in biomass demands more energy to evaporate water before combustion, decreasing the net heat output. Consequently, the boiler's performance may drop below the 100% Maximum Continuous Rating (MCR) steam load, jeopardising operational efficiency and the ability to meet energy demand.	bed material silo where bed material is stored and reused as needed to control furnace combustion. Verdant understand at moisture levels above the 25%, the boiler output would be reduced due to the inability of the ID fan to cope with the higher flue gas flows. Figure 9 in the *Redbank Power Station – Description of Proposed Modifications for Conversion to Fire Biomass fuels* (EIS Appendix F) provides the derating. For example, at 45% moisture, the boiler output is restricted to 85% load. This does not impact the boiler units ability to operate within its capability and design parameters in infrequent and undesirable high moisture circumstances. This is illustrated in Table 3 of the attached B&PPS report (Appendix D) This is a commercial issue for Verdant to keep the moisture low to maintain load in accordance with the Biomass Fuel Specification. It is not a technical issue.	EIS Appendix F Appendix D
38	Pg 12	The biomass fuel specifications indicate that the moisture content range for the feedstock is "*between 10 and 50%",* which presents a significant variability in moisture levels (Page 237, Appendix M). This broad range introduces operational challenges when optimising the combustion process, as the performance of the combustion system is highly sensitive to moisture content.	Redbank FiCirc boilers operate with a deep bed and in-bed cooling tubes; the bed temperature can be adjusted by changing the bed depth or altering the quantity/size of in-bed tubes. A live bed storage silo exists and forms part of the operating process where bed material is stored and reused during operation to maintaining efficient combustion. The operators are trained in how to manage the bed to achieve the required outputs when to moisture levels vary. This was a design requirement when consuming high moisture BDT often above 40% moisture, hence this is the most suitable furnace design for managing varying moisture fuels. The design moisture content is provided in Figure 20 of the *Redbank Power Station – Description of Proposed Modifications for Conversion to Fire Biomass fuels* (EIS Appendix F), as duplicated in Appendix M of the EIS. The Applicant will work with suppliers to ensure an optimised	EIS Appendix F

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			moisture content in fuels is consistently supplied to the power station. Note that Redbank operated on Beneficiated coal tailings (BDT) regularly with high water content in excess of 40% moisture. At 45% moisture in biomass, output only falls to 85% load. However, Verdant is incentivised to manage biomass fuel to meet specification as this promotes plant efficiency.	
39	Pg 12	Moisture content in biomass directly influences the combustion efficiency of the process and the overall energy output form the facility. Biomass with higher moisture content requires additional energy to evaporate the water, which reduces the heat available for combustion and increases the flue gas volume. Higher moisture levels also lower the effective calorific value of the biomass, thus impacting the stability of combustion, leading to lower combustion temperatures and a potential increase in emissions, such as unburned hydrocarbons and particulate matter. On the other hand, very dry biomass may result in more intense combustion, potentially causing issues such as excessive temperature fluctuations.	The FiCirc boilers can easily handle this variation without impacting on combustion stability or emissions. The Redbank FiCirc boilers are a unique design incorporating a deep bubbling fluidized bed and fine recirculation from large cyclones above the furnace which allows efficient stable combustion of biomass with a wide range of moistures (up to 50%), particles sizes and components as given in fuel specification Figure 20 of the Redbank Power Station – Description of Proposed Modifications for Conversion to Fire Biomass fuels (EIS Appendix F). The deep bubbling bed consisting of ~200 tons of bed inert material and ~2% of combusting material gives a thermal flywheel allowing large variations in the biomass characteristics. The fines recirculation ensures high efficiency under all conditions. The bed temperature is maintained by adjusting the bed height making the bed tubes effective. The boilers are fitted with an external bed storage silo into which bed material is moved in or out of during operation as needed to suit the fuel characteristics. Requiring biomass fuel to be provided to specifications under the QA/QC Program will ensure any variations in moisture content is minimised.	EIS Appendix F

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40	Pg 12	Furthermore, the Best Available Techniques (BAT) Reference Document for Large Combustion Plants highlights that *The risks of explosive dust formation and fires in fuel processing and transportation are normally controlled by keeping the fuel moisture content above 40%*[3]. The facility's *Quality Assurance and Control Procedure for Receipt and Use of Biomass* mentions the inclusion of a "*fuel testing report and compliance certificate*." However, it remains unclear whether this certificate will pertain to each specific delivery or represent a generalised sample. Testing bulk biomass may not accurately represent moisture variability within the load, potentially overlooking non-compliant batches.	The Biomass Fuel specification was developed to minimise the quantity of fines. The fuel is required to be 95% between 20 and 100 mm with 75% between 20 and 50mm in size. To achieve this screening will be essential and thus it is unlikely that fines below 20mm are retained by the bottom screens. Biomass specification will be strictly controlled in all stockpiled locations prior to loading into truck for delivery to Redbank. Redbank Power station stockpiling facility will receive already prepared biomass fuel meeting the required size, moisture and limited fines specifications. The plant is already equipped for dust control and management as this was essential for the coal fines previously used. The stockpile area is already equipped with dust suppression and fire protection system as well as all transfer chutes and bunkers are equipped with dust collection and monitoring as well as thermal detection for combustion. The scope of changes required to handle biomass at the Redbank plant is detailed in the *Redbank Power Station – Description of Proposed Modifications for Conversion to Fire Biomass fuels* (EIS Appendix F). A full risk assessment will be done during the detailed design phase to ensure dust collection and suppression equipment comply with latest Australian safety requirements. As per the *Quality Assurance and Control Procedure for Receipt and Use of Biomass* (Appendix E of the *Fuel Supply and Characterisation Study*), for any new Biomass type introduced to the Redbank Power Station , a series of representative samples will be collected from the new Biomass source for characterisation of the fuel in terms of its composition and variability. Sampling and characterisation will allow for an assessment of the Biomass and its ability to conform to the fuel specification prior to its use. In addition, ongoing sampling and testing will be undertaken in accordance with any Specific Resource Recovery Order (for	EIS Appendix F

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			eligible waste fuels) and the Biomass Specification by analytical laboratories accredited by the National Association of Testing Authorities (NATA) in accordance with the guidance provided in EN14780:2011 “Solid Biofuels – Methods for sample preparation. Verdant staff will closely monitor the production of woodchips destined for delivery to Redbank to ensure that the biomass fuel has undergone the appropriate harvesting and drying period before chipping for transport. To establish a reliable baseline, HRL Labs has been engaged to conduct moisture loss studies on woodchips over time. While weather variations may affect drying times, this factor is just one of several parameters used to determine biomass suitability for chipping and transport. This comprehensive sampling and testing program is designed to accurately assess moisture content, thereby minimising the risk of non-compliant biomass fuel batches arriving at the power station.	
41	Pg 12	Furthermore, while the procedures reference European standards for ensuring biomass quality, there is no alignment provided with relevant Australian standards, such as AS/NZS 1080.1:2012, which outlines methods for testing moisture content in timber. This raises questions about the relevance and adaptability of the stated standards in ensuring the quality and compliance of biomass fuel in an Australian context.	All fuel testing by NATA approved laboratories is done to reputable international standards, currently Verdant have been utilising HRL and SGS laboratories, both NATA certified. Australian standards have now been overtaken by international standards and the ISO standards are now widely used across all testing in all industries in Australia, including biomass. The Redbank power station is well equipped to determine the moisture level of the biomass as and when required by their own staff in the existing laboratory. It is a very simple test routinely done at boiler plants firing biomass. The QA/QC program will need to meet stringent testing requirements under a SRROE prior to the biomass fuel being used at the power station. Each biomass fuel manufacturer will be contractually required to maintain an appropriate quality control/quality assurance (QA/QC) procedure to ensure that	EIS Appendix M (Appendix E)

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			fuels supplied to the Power Station meet the requirements of the Biomass Specification.	
42	Pg 12	**Feedstock Storage** It was noted in EIS that "*All acceptable biomass feedstock received and discharged at the Redbank Power Station will be stored in the existing coal tailings storage area as originally approved*" (Page 73, Appendix M). Additionally, it was indicated that "*Biomass fuel storage will be stored in an uncovered area. Covered storage is more commonly used overseas in colder, wetter climates for protection against the elements and to maintain a more consistent moisture content fuel*" (Page 20, Appendix F).	Biomass fuels will be stored in the existing former Run of Mine coal stockpile area and not the tailings storage bins as this is not possible. From the existing uncovered area biomass will be delivered in the boiler bunkers from where it is feed into the furnace. Storage is addressed in the EIS Section 3.5.2 and in the *Redbank Power Station – Description of Proposed Modifications for Conversion to Fire Biomass fuels* (EIS Appendix F). Consumption rate for the plant does not promote fuel quality deterioration. The continuous use and replenishing of the stockpiles will be ongoing, thus preventing fuel deterioration. The stockpile area accommodates a maximum of 3 days storage capacity. This rapid turnover of the biomass minimises the time fuel is spent in stockpiled conditions.	EIS Section 3.5.2. EIS Appendix F
43	Pg 12	However, biomass presents distinct challenges compared to coal due to its physical and chemical properties. Unlike coal, which is dense and less susceptible to weather impacts, biomass materials are highly vulnerable to moisture. Exposure to rain or high humidity can lead to the absorption of water, causing biomass to swell,	Again, the consumption rate for the plant does not promote fuel quality deterioration. Due to the short duration of stockpiling (maximum of 3 days), the continuous use and replenishing of the stockpiles will prevent fuel deterioration. Storage is addressed in the EIS Section 3.5.2.	EIS Section 3.5.2.

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		disintegrate, and lose its calorific value, rendering it unsuitable for combustion. Furthermore, biomass has a lower energy density than coal, necessitating approximately twice the storage space for equivalent energy production.		
44	Pg 12	These characteristics underscore the importance of adequate storage infrastructure and solutions, such as covered and climate-controlled facilities, to maintain biomass quality and operational reliability. Without proper storage and handling, the risks of fuel degradation and operational inefficiencies are heightened, potentially impacting the plant's performance and environmental outcomes.	It is not standard practice in Australia to use covered and climate-controlled facilities. Examples of uncovered storage for biomass fired boilers is given in Section 5.2 of the Redbank Power Station – Description of Proposed Modifications for Conversion to Fire Biomass fuels (EIS Appendix F). These include • Visy Tumut in NSW • Rocky Point in the Gold Coast, Qld • Maryvale Paper Mill, Maryvale, Victoria • Bell Bay Smart Fibre, Bell Bay Tasmania • Port Albany Western Australia • Portland, Victoria • QLD commodity exports, Port of Brisbane As per Comments 42 and 43, the short stockpiling duration and continuous use and replenishment of the biomass fuel does not promote deterioration. Covering of the biomass fuel stockpiles is therefore unnecessary and unwarranted.	EIS Appendix F Section 5.2
45	Pg 13	**Ash generation from biomass combustion** Figure 7 (below) indicates that projected fuel consumption will increase from 600,000 wet tonnes per year to 835,000 wet tonnes per year. Despite this rise, the report states that ash handling will remain unchanged, utilising either a wet	When the plant was using coal tailings and run of mine coal, the 600 000 wet tonnes per year ash content was over 20%. The existing ash system was designed for those volumes of ash. Biomass has an ash content of less than 1% with a maximum of 4% and the system is more than adequately designed to handle the ash volumes.	EIS Appendix L Section 3.3.4

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		paddle mixer or a dry ash transfer system from a 500m³ silo (Page 18, Appendix F).	Ash content in wet or dry biomass fuel remains a constant. Moisture levels do not change, nor do they generate more ash. When consuming coal, the plant was generating 380T/D of ash When consuming biomass it is estimated to produce between 26T/D for lower ash content and 105T/D with higher ash content which is substantially less than existing plant capacity. Management of ash is detailed in Section 3.3.4 of the Waste Management Plan prepared for EIS (EIS Appendix L). That biomass is highly suitable for use in circulating and deep bubbling fluidised bed technologies has been researched extensively and is widely known and demonstrated in peer reviewed literature. Scientific papers are cited providing details supporting this technology as appropriate for this type of application.	
46	Pg 13	This projection assumes a residual ash production of 3-5% of the feedstock by weight, based on a worst-case scenario of 5% (Page 32, Appendix L). However, this estimate may need to be revised, as the ash generation could increase if combustion efficiency declines, especially if the moisture content exceeds the expected 25%. Such an increase in moisture could lead to higher ash production due to incomplete combustion, potentially requiring modifications to the ash handling system.	Ash production is largely driven by the ash content of the biomass, that is typically low for clean biomass less than 1% with a maximum of 4%. Ash content of biomass does not change with moisture. Note that the *Waste Management Plan* (EIS Appendix L) used 5% ash production as a conservative estimate. The ash content of the BUF/BDT coal that was fired in the Redbank boilers was above 20%, hence the original baghouse inlet particulate design allowances. When firing Design Biomass Fuel with less than 1% it will be well below what is expected when firing coal i.e. easier to maintain stack particulate emissions. As explained in the *Redbank Power Station – Description of Proposed Modifications for Conversion to Fire Biomass fuels* (EIS Appendix F), the Redbank FiCirc technology has a capability of handling higher range moisture fuels more efficiently by controlling the bed depth and hence, we do not	EIS Appendix L Section 3.3.4 EIS Appendix F

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<tr><td></td><td></td><td>Figure 7 – Redbank anticipated performa
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<tr><th></th><th>Units</th><th>1994 Conse</th></tr>
<tr><td>Fuel Type</td><td>-</td><td>Coal tailings</td></tr>
<tr><td>Reference fuel moisture</td><td>%</td><td>dry basis</td></tr>
<tr><td>Net Plant Output (reference)</td><td>MW</td><td>100</td></tr>
<tr><td>Fuel gross specific energy</td><td>GJ/te</td><td>13 (dry)</td></tr>
<tr><td>Fuel energy consumption (annual)</td><td>GJ/annum</td><td>12.7 million</td></tr>
<tr><td>Approximate fuel consumption[6]</td><td>Te/annum</td><td>975,000 (dry</td></tr>
<tr><td>Approximate fuel consumption</td><td>Te/annum</td><td>975,000</td></tr>
<tr><td>Calculated efficiency (GSE basis)</td><td>%</td><td>22.7% [7]</td></tr>
</table></td><td>expect to have any unburned fuel presenting as ash and the ash system is adequately designed to adequately accommodate the higher biomass as content which is substantially lower than the previously consumed coal. Higher moisture level will not result in poorer combustion efficiency when using FiCirc technology.

The specified biomass has less than 4% ash compared to maximum of ~20% in the coal that was being fired. This means the ash collection, storage and handling system is grossly oversized when firing biomass.</td><td></td></tr>
<tr><td>47</td><td>Pg 13</td><td>Biomass supply thresholds and operational efficiency

It has been indicated that “The plant consists of two fluidised bed combustion steam generator units of FiCirc^{TM} design and a single 151MW steam turbine and associated balance of plant equipment” (Page 5, Appendix F), and the EIS states that the plant will operate using up to 700,000 tonnes of dry equivalent biomass per annum as feedstock fuel. However, no information is provided on the minimum feed rate required for efficient plant operation without resorting to additional external fuel sources, such as diesel.</td><td>The plant consists of two FiCirc Fluidised bed boilers and one Turbine. The plant is design to be operated between 70 and 100% steam flow. It is a base load plant and has minimum turndown capability to 110 MW with two boilers, if load needs to be reduced further then one boiler can be taken off service and stored in hot condition. The minimum load with one boiler in operation is 55MW. This is explained in the EIS Section 3.2.

In the unlikelihood of the bed temperatures drop below 550°C the boiler will automatically trip to a safe position and avoid any damage. Restart requires purging of the furnace followed by diesel firing, in such an event and depending on the temperature of the furnace at the time diesel firing could be a maximum of 2 hours.

The plant design does not allow for diesel firing to maintain minimum load operation. Diesel is only used for starting up to raise the bed temperature to 550°C, at which point biomass is introduced and the boilers are operated at the desired condition and outputs.</td><td>EIS Section 3.2.</td></tr>
<tr><td>48</td><td>Pg 13</td><td>This lack of clarity could have significant implications for the operational feasibility and environmental performance of the</td><td>The plant design is such that it is not possible for diesel support in the unlikely event higher moisture fuels are consumed. The plant is capable of operation on 1 boiler should there be an inadequate supply of biomass fuel, however given the</td><td>EIS Section 3.2.

RTS Appendix E</td></tr>
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		plant. If the biomass supply falls below the efficient threshold, reliance on external fuels like diesel could increase, leading to higher greenhouse gas emissions and operational costs.	significant volumes of biomass fuel available to Verdant we would not see this as anything but a very short-term issue. The use of diesel is purely as a start-up fuel when bringing the bed up to temperature estimated about 8 hours from cold and less than two hours if the bed is warm after a trip. Once bed temperature is achieved the biomass replaces the diesel as you cannot have diesel in service with biomass. Diesel consumption was included in the both the AQIA and GHG Assessment (EIS Appendix O and Appendix P, respectively). The RTS *Air Quality and Greenhouse Gas Addendum* (RTS Appendix E) goes further into discussion of the assumptions made in the use of diesel for initial startup and for additional startups of the plant post shutdown for servicing and maintenance on the basis that diesel burners would be used for approximately 40 hours each year.	
49	Pg 13	This issue was not comprehensively addressed in the Response to Submission Appendix E – AQ and GHG Addendum. While Verdant Earth noted that diesel would be used for an average of 40 hours per year to accommodate two outages (one minor and one major), the response did not account for the potential need for additional diesel usage during unanticipated outages due to insufficient feedstock supply. Furthermore, it failed to consider how supply shortages could result in operational inefficiencies that increase reliance on non-renewable fuels. Understanding this threshold at which the plant can operate efficiently is essential for ensuring	The plant consists of two FiCirc Fluidised bed boilers and one Turbine. The plant is design to be operated as a base load plant at 150MW MCR and has minimum turndown capability to 110 MW with two boilers. If load needs to be reduced further, one boiler can be taken out of service and stored in hot condition. This is clearly explained in EIS Section 3.2. As outlined in Section 4.2 of Appendix M of the EIS, the power station has the ability to operate using one boiler, which has a minimum load during operation of 55MW. as which reduces the biomass fuel requirement to 350,000 tpa. This is a short-term strategy that can be used in the unlikely event of insufficient fuel supply. The plant design and code requirements does not allow for diesel firing to maintain minimum load operation. Diesel is only used for starting up to raise the bed temperature to 550°C, at which point biomass is introduced and the boilers are operated within the desired condition and outputs.	EIS Section 3.2. RTS Appendix E

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		consistent plant operation, minimising disruptions, and maintaining compliance. Additionally, insufficient supply planning could compromise the project's ability to meet its renewable energy generation targets, and the GHG emission assessment will need to be further reviewed.	In the unlikelihood of the bed temperatures drop below 550°C the boiler will automatically trip to a safe position and avoid any damage. Restart requires purging of the furnace followed by diesel firing, in such an event and depending on the temperature of the furnace at the time diesel firing could be a maximum of 2 hours. The allowances made in the RTS *Air Quality and Greenhouse Gas Addendum* (RTS Appendix E) are correct for 40 hours of diesel firing per year which allows for two cold starts (8 hours each) per year and makes allowances for unforeseen events which may include warm and hot starts which require less diesel to achieve the required fuel permissive of 550Deg C.	
Section 2.3 Compliance with NSW Energy from Waste Policy Statement and Eligible Waste Fuel Guideline				
50	Pg 14	The NSW Energy from Waste Policy statement outlines the policy framework and technical criteria that apply to facilities proposing to recover energy from waste in NSW. The policy establishes a 2-door framework for assessment of EfW proposals – those that propose to use low risk waste materials referred to, and defined as, Eligible Waste Fuels, and those that propose to recover energy from any other waste material that is not an eligible waste fuel, which are defined as Energy Recovery Facilities. The supporting Eligible Waste Fuels Guideline provides further details on the types of eligible waste fuels, the requirements for waste	Redbank proposes to only fire ‘eligible waste fuels’ and ‘standard fuels’ as listed in Part 3 of the NSW Energy from Waste Policy Statement and defined in the Eligible Waste Fuels Guidelines, including biomass and residues (also referred to as biomaterial). Redbank is not considered an Energy Recovery Facility as there is no proposal to use any other waste material that is not an eligible waste fuel or is a standard fuel. The EIS has clearly outlined the necessary approvals and requirements associated with both ‘standard’ and ‘eligible waste fuels’ as proposed.	EIS Section 2.3.1 and 4.5.1

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		characterisation, and the regulatory framework for using these fuels. These guidelines must be carefully assessed by any proponent seeking to develop an EfW project to ensure compliance with regulatory and environmental standards. It should be noted that the technical requirements associated with having a proposal assessed as an 'Energy Recovery Facility' under the policy framework are significantly more onerous than a facility proposing to recover energy from only eligible waste fuels.		
51	Pg 14	It is therefore critical that the information provided to validate the type, origin, composition, supply and consistency of eligible waste fuels is rigorous and robust to ensure that its consideration as a low risk to human health and the environment from energy recovery practices is valid. The following sections highlight the key considerations that have been identified following the assessment of compliance with the NSW EfW policy statement and the eligible waste fuel guideline	Verdant intend to apply for the requisite SRROE/s post approval and the EIS provides sufficient documentation to show that there is potential supply of biomass to specification in quantities sufficient to operate Redbank on biomass only. Also note that although approval from EPA is still needed, a SRROE is not required to be obtained prior to the use of 'standard fuels', which form a large part of Verdant's fuel strategy. This is described in detail in Section 3.3.1 of the EIS and in Section 4.4 of the *Fuel Supply and Characterisation Study* (Appendix M of the EIS).	EIS Section 4.4 EIS Appendix M Section 4.4
52	Pg 15	**Ineligibility of domestic biomass fuel under eligible waste fuels guideline** Verdant Earth has acknowledged that Domestic Biomass Fuel (DBF),	Whilst Domestic Biomass Fuel (DBF) is not currently prescribed as an 'eligible waste fuel' under current EPA guidelines, Verdant will seek to demonstrate that DBF may be considered an eligible waste fuel through a post-approval DBF trial and Specific Resource Recovery Order and Exemption application	EIS Executive Summary EIS Section 3.3.1 EIS Appendix M Section 3.4.6

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		intended for use at its facility, does not currently qualify as an eligible waste fuel under the **Eligible Waste Fuels Guidelines**. As stated, *"DBF is not currently prescribed as an 'eligible waste fuel' under the Eligible Waste Fuels Guidelines. DBF fuel will include end-of-life waste woody biomass sourced and prepared to specification and fit-for-purpose at Redbank Power Station (subject to NSW EPA approval as an eligible waste fuel)"* (Page 55, Appendix M). Furthermore, feedback from the **NSW EPA** has further emphasised that Domestic Biomass Fuel is unlikely to be approved as an eligible waste fuel. Concerns raised include the potential for contamination and the inconsistency or heterogeneity of the feedstock's composition. These issues pose significant challenges for maintaining compliance with regulatory standards and ensuring operational reliability at the facility. The NSW EPA also stated that "*Domestic Biomass Fuel is not an eligible waste fuel and the approval pathway to enable it to be an eligible waste fuel is not through a Specific Resource Recovery Order and Exemption. The EPA would like to highlight that the Proposal has been assessed using only standard fuels and eligible waste fuel and*	under Clause 93 of the *Protection of the Environment Operations (Waste) Regulation* 2014. Under Part 1 of the Eligible Waste Fuel Guidelines, the EPA provide the following notes: > As information about certain waste and waste-derived streams improves, the EPA will review the eligible waste fuels list from time to time. The Eligible Waste Fuel Guidelines explicitly states that the EPA may review the list of eligible waste fuels from time to time. Upon review and listing of DBF as an Eligible Waste Fuel, Verdant will seek a post-approval Specific Resource Recovery Order and Exemption application under Clause 93 of the *Protection of the Environment Operations (Waste) Regulation* 2014 for its use. At no time does Verdant propose to use DBF at Redbank prior to approval from the NSW EPA. Verdant will not rely on DBF the first two (2) years of operations and maintain a minimum estimated requirement of 50,000 dry tonnes beginning year 3 of operations. DBF is not included as a target fuel during the first two years of operations. However, beginning in year three—and provided that Verdant can demonstrate its ability to produce biomass fuel with the consistency required by the EPA — Verdant will apply for a Specific RROE to use DBF as an eligible waste fuel at Redbank. This application is contingent upon the EPA declaring DBF an eligible waste fuel for use at Redbank and issuing the appropriate SRROEs. Verdant proposes to target a minimum of 50,000 dry tonnes of DBF. Should the EPA not grant this	

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		should not rely on changes to policies or legislation if the proposed feedstock becomes compromised". Similarly, the MRA report included in the Fuel Supply Characterisation Study (Page 184, Appendix M) also reinforces these concerns, explicitly concluding that construction and demolition (C&D) waste, a potential source of Domestic Biomass Fuel, is ineligible under the current guidelines, and suggested as one of their recommendations to exclude C&D waste as a feedstock to align with the regulatory framework.	declaration, Verdant will continue to pursue alternative fuel sourcing programs to ensure supply security. Verdant will maintain access to other fuel sources (e.g. INS, fuel crops) in higher amounts than estimated in the fuel strategy to cover shortfalls in the future if required.	
53	Pg 15	One of the biggest risks associated with producing woody biomass feedstock from processing mixed C&D waste is the inclusion of copper chrome arsenate (CCA) timbers, that are often difficult to identify and/or segregate from other clean timbers, and that can have a significant impact on copper, chrome and arsenic contaminant loading in both bottom ash and air emissions. This could lead to further problems with the proposed reuse of bottom ash from the facility, if increased levels of these heavy metals means that it won't comply with the chemical criteria set out in the NSW EPA *ash from burning biomass order and exemption 2014*.	NSW EPA *ash from burning biomass order and exemption 2014* order applies to ash waste generated by burning biomass from agriculture, forestry and sawmilling residues, uncontaminated wood waste and/or organic residues from virgin paper pulp activities. The order would not apply to ash from DBF. A Specific Resource Recovery Order and Exemption will be sought for ash from use of DBF (post approval by EPA as an Eligible Waste Fuel). This is outlined in the EIS and the Waste Management Plan (EIS Appendix L). Verdant recognises the risks associated with producing woody biomass feedstock from mixed C&D waste, particularly the potential inclusion of copper chrome arsenate (CCA) treated timbers. Although CCA timbers can be challenging to identify and segregate from clean timbers, alternative fuel companies have successfully managed this issue for many years. The identification process for CCA contamination relies on effectively communicating the criteria with supplier customers	EIS Executive Summary and Section 3.6 EIS Appendix L

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			and a well-audited process of identification and elimination. Furthermore, floor spotters at the tipping point will be thoroughly trained to detect non-compliant material, and suppliers who do not adhere to the waste criteria will be banned from the site.	
54	Pg 15	**Challenges in securing domestic biomass fuel through materials recovery facilities** The NSW Energy from Waste Policy Statement views energy recovery as a supplementary waste management solution, specifically for residual waste generated from material recovery processes or source- separated collection systems. In alignment with this policy, Verdant has proposed entering into joint venture partnerships with Materials Recovery Facilities (MRFs) to process waste and recover woody biomass feedstock to meet the required specifications, as outlined in a Specific Resource Recovery Order and Exemption (Page 56, Appendix M). However, Verdant's EIS lacks sufficient documentation to substantiate the existence of established partnerships or to identify MRFs willing to collaborate in this capacity. Additionally, significant challenges are posed by the strict feedstock quality requirements, including a moisture	DBF that meets the fuel specification for the plant at Redbank and also meets the approval requirements of the NSW EPA as an eligible waste fuel constitutes a small portion (7%) of the fuel proposed beginning in Year 3 of operations. This is outlined in the fuel strategy in Section 3.3.1 of the EIS and in the Section 4.5.4.1 *Fuel Supply and Characterisation* Study (Appendix M of the EIS). Verdant recognises the challenges in sourcing and processing waste woody biomass material to meet Redbank's strict biomass fuel specifications. We believe that the current facilities will require a process upgrade to ensure they comply with our stringent standards. Redbank will ensure that only DBF meeting specification is sourced and used at the facility. To accomplish this, Verdant may choose to hold either a sole or partner interest in the operation of these upgraded processes. Agreements with manufacturers is a commercial matter for Verdant to manage. Verdant are not in a position to enter into these agreements until approval is granted for the use of DBF. Modern technologies for achieving quality biomass fuel requirements are available and would be reviewed and assessed by Verdant and potential suppliers for appropriateness. Verdant has been in discussion with waste operators who are interested in assisting Verdant in this area, once the use of DBF has been approved and a Specific Resource Recovery Order and Exemption issued.	EIS Section 3.3.1 EIS Appendix M Section 4.5.4.1

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		content of 25% and precise particle size specifications. The proposed feedstock specification requirements are unlikely to align with the standard operations of most MRFs without significant modifications, which may be financially or operationally impractical. Most MRFs in NSW are designed to sort and recover commingled recyclable materials, typically sourced from household waste, and do not usually include timber or biomass material in their input streams. It would be challenging to utilise this network of facilities to provide suitable feedstock for the Redbank facility without significant changes to collections systems, supply contracts, and plant and equipment.	Note that Verdant will not rely on DBF the first two (2) years of operations and maintain a minimum estimated requirement of 50,000 dry tpa beginning year 3 of operations. Verdant will maintain access to other fuel sources (e.g. INS, fuel crops) in higher amounts than estimated in the fuel strategy to cover shortfalls in the future if required.	
55	Pg 15	MRFs or processing facilities that typically handle timber are C&D waste processing facilities that can sort timber from mixed C&D waste, however, as noted in the section above, this timber is considered higher risk by the EPA due to the heterogeneity of the feedstock composition and the risk of contamination. Without evidence of viable partnerships or a clear strategy to achieve compliance with the feedstock quality standards, the	As noted above, DBF that meets the fuel specification for the plant at Redbank and also meets the approval requirements of the NSW EPA as an eligible waste fuel constitutes a small portion (7%) of the fuel proposed beginning in Year 3 of operations. This is outlined in the fuel strategy in Section 3.3.1 of the EIS and in the Section 4.5.4.1 *Fuel Supply and Characterisation Study* (Appendix M of the EIS). The *Fuel Supply and Characterisation Study* (Appendix M of the EIS) clearly outlines a robust proposed fuel strategy to diversify and scale up fuel sourcing and operations over time. The strategy reduces risks associated with supply and operations associated with the use of DBF.	EIS Section 3.3.1 EIS Appendix M Section 4.5.4.1 EIS Appendix M Section 4

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		feasibility of securing Domestic Biomass Fuel (DBF) feedstock for operational use remains highly uncertain. This uncertainty raises concerns regarding the project's ability to meet both regulatory and operational expectations.		
56	Pg 16	**Potential compliance risks due to feedstock variability from changing suppliers** The issue of feedstock variability due to changes in suppliers, as noted by Verdant, could present a compliance challenge under the NSW EPA's Eligible Waste Fuel Guideline. According to these guidelines, any eligible waste fuel used in energy recovery must consistently meet strict origin, composition, and consistency criteria.	The *Fuel Supply and Characterisation Study* (Appendix M of the EIS) clearly outlines the proposed strategy to diversify and scale up fuel sourcing and operations over time. All biomass fuels proposed for use at Redbank Power Station will need to meet stringent specifications, operational requirements of the Redbank Power Station plant and equipment, and the requirements of relevant SRROEs. This is outlined in a robust strategy for sourcing biomass fuels, and a QA/QC program (Appendix E of EIS Appendix M) to control fuel quality, manage risk and avoid potential issues, including those related to meeting the requirements of any SRROEs. Verdant are confident this process can be managed in a way to meets all regulatory, safety and environmental requirements.	EIS Appendix M EIS Appendix M (Appendix E)
57	Pg 16	The NSW EPA's Eligible Waste Fuel Guideline state, "*The overarching principle of the eligibility of a waste as an eligible waste fuel is that it should pose a minimal risk of harm to the environment and human health due to its origin, low levels of contaminants and consistency over time. The proponent must consider the consistency of the proposed waste fuel to ensure its potential environmental impact will not vary*	Verdant are aware of this as outlined in Section 4.5.2 of the EIS and forms part of the proposed operations.	EIS Section 4.5.2

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		over time"[4]. Additionally, a valid Resource Recovery Order and Exemption must be in place for all eligible waste fuels prior to their use.		
58	Pg 16	Changing suppliers may introduce variability in the feedstock, potentially affecting its compliance with criteria established by the EPA under a specific Resource Recovery Order and Exemption. This could lead to issues with maintaining the required fuel quality or consistency over time, which are critical outcomes for meeting operational performance standards and regulatory outcomes.	Verdant understands the need to develop and implement robust strategies towards ensuring fuel quality and consistency and have developed the *Fuel Supply and Characterisation Study* (Appendix M of the EIS). All eligible waste fuels that form part of the fuel for the Redbank Power Station will be sourced, tested and assessed (prior to delivery to Redbank) to ensure that they meet the following: • The Biomass Fuel Specification as provided in Figure 20 of the *Redbank Power Station – Description of Proposed Modifications for Conversion to Fire Biomass fuels* (EIS Appendix F); and • The requirements of the relevant SRROE as approved and issued by the NSW EPA. Note that although approval from EPA is still needed, a SRROE is not required to be obtained prior to the use of 'standard fuels', which form a large part of Verdant's long-term fuel strategy. This is described in detail in Section 3.3.1 of the EIS and in Section 4.4 of the *Fuel Supply and Characterisation Study* (Appendix M of the EIS).	EIS Appendix M EIS Appendix F EIS Section 3.3.1 EIS Appendix M Section 4.4
59	Pg 16	**Market analysis for higher-order reuse of feedstocks** As part of the eligibility requirements for waste fuel under the **Eligible Waste Fuel Guidelines**, the proponent is required to demonstrate that there are no practical, higher-order reuse opportunities for the waste being proposed. Section 6 of the	Verdant are aware of the commercial risks of a free market. The Higher Order Use Study (RTS Appendix H) has identified that there is significant opportunity for securing eligible waste fuel, particularly around INS. As described in the EIS Section 4.5.2, for all proposed fuel types categorised as eligible waste fuels, Verdant will be required to obtain an SRROE from the NSW EPA. An application for a SRROE will be made for relevant fuels post approval.	RTS Appendix H EIS Section 4.5.2 EIS Section 7.6

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		independent market study on eligible waste fuels examines feasible uses for the anticipated feedstocks. While the report identifies that a significant proportion of the feedstock lacks higher-order reuse options, this analysis is not specific to the secured feedstock intended for the facility. Instead, it evaluates the broader availability of feedstocks across a wide area. There is a potential risk that the feedstock genuinely available for the facility may already have established recycling applications. Furthermore, for uncontaminated woody waste, the study indicates that more than 66% of this feedstock is recyclable. Consequently, this material would not meet the eligibility criteria outlined in the Eligible Waste Fuel Guidelines. It would be beneficial if the proponent could provide additional evidence demonstrating higher-order reuse opportunities specifically for the secured feedstock intended for use by the facility, thereby narrowing the focus to opportunities relevant solely to this feedstock.	The use of UWW is an alternate source and not currently relied on in the fuel strategy. Prior to the first use of eligible waste fuel sources, and annually thereafter, each potential source will require an independent market study be completed to show whether these materials have other potential higher use orders. This is described in the EIS Section 7.6. and forms part of the revised mitigation measures (RTS Appendix C). The Higher Order Use Study (Appendix H of the RTS report) confirms and identifies that there is a great opportunity for securing eligible waste fuels for use at the power station. The study concluded that there are no other higher order uses for a significant amount of eligible waste fuels, estimating 2.8 million per year using conservative assumptions (see Table E1-2 of EIS Appendix H) inclusive of and specific to the biomass fuel sources proposed to be used by the Applicant.	RTS Appendix C RTS Appendix H Table E1-2

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60	Pg 16	**Feedstock quality analysis** The **Eligible Waste Fuel Guidelines** specify that applications to use forestry and sawmilling residues must include information regarding any treatments the waste has undergone, such as sprays or fire retardants, commonly used in bushfire management. Fire retardants are commonly used to manage bushfire risks, particularly in relation to strategic containment efforts. These chemicals, which include but are not limited to ammonium sulphate, diammonium sulphate, and ammonium phosphate can remain in forestry residues and, if not properly accounted for, could introduce contaminants into the biomass feedstock. Similarly, conventional agricultural systems in Australia use a wide range of agricultural chemicals to boost yields and quality of produce, as well as pesticides to control weeds, insect pests, and disease. The NSW EPA Eligible Waste Fuels Guidelines clearly outlines that biomass from agriculture "*may contain pesticide or herbicide residues. The risks presented by these residues will be assessed as part of the resource recovery order and exemption application*"[5]. Most of the commonly used pesticides either containing chlorine (e.g.,	Verdant are aware of the Eligible Waste Fuel requirements, as described in the EIS Section 4.5.2, for all proposed fuel types categorised as eligible waste fuels, Verdant will be required to obtain a SRROE from the NSW EPA. An application for a SRROE will be made for relevant fuels post approval. Where chemicals of concern could impact fuel quality, this will be investigated in detail to inform the SRROE application. No biomass fuels will be used that contain chemicals that could impact on the environmental performance of the power station.	EIS Section 4.5.2

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		atrazine, 2,4-dichlorophenoxyacetic acid, pentachlorophenol dichlorprop, etc.) and/or are embedded with dioxin precursor structures (e.g., dichlorprop, decamethrin, niclosamide, etc.)[6]		
61	Pg 17	Even though Verdant is aware that this is a requirement for feedstock eligibility, the *Quality Assurance and Control Procedure for Receipt and Use of Biomass* does not include specific information regarding chemical analysis to determine that the feedstock is free from pesticides, herbicides, fire retardants and other chemical components. The Verdant *Quality Assurance and Control Procedure for Receipt and Use of Biomass,* only outlines a set of parameters to be analysed by the feedstock supplier, including moisture content and ash (Page 240, Appendix M). The omission of these chemical components from the feedstock analysis raises concerns about potential environmental and operational impacts, as their presence could affect combustion processes and emissions.	Section A1.1.4 of the QA/QC procedure specifically requires that "*The Manufacturer must ensure that any testing of samples required by Verdant Earth's Specific Resource Recovery Order is undertaken by analytical laboratories accredited by the National Association of Testing Authorities (NATA) or equivalent testing standards.*" Therefore, any testing requirements of a SRROE issued post approval are inherently part of the QA/QC Procedure. Post approval requirements for testing under any SRROE will be included in the QA/QC and contractual requirements – post approval once those requirements are known. As per Comment 60, where chemicals of concern could impact fuel quality, this will be investigated in detail to inform the SRROE application. No biomass fuels will be used that contain chemicals that could impact on the environmental performance of the power station.	EIS Appendix M (Appendix E)
Section 2.4 – Proven technologies and handling capabilities				
62	Pg 17	The Redbank facility previously operated using BDT as the primary fuel and run-of-mine coal as a supplementary fuel. Transitioning to a 100% biomass fuel-operated facility introduces operational	These challenges have been fully addressed in the *Redbank Power Station – Description of Proposed Modifications for Conversion to Fire Biomass fuels* (EIS Appendix F). The B&PPS report clearly indicates that the plant modifications as	EIS Appendix F

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		challenges due to the fundamental differences in the chemical and physical characteristics of the feedstock. The following sections highlight the key considerations that have been identified following the assessment and evaluation of key feedstock characteristics (such as moisture content, density, chlorine, and phosphorus), on the facility's operations. It also highlights the core differences between biomass and previous fuel types that need to be carefully considered in the transition.	proposed are suitable for the use of biomass meeting the specification as proposed.	
63	Pg 18	**Impact of feedstock moisture content on operational performance and feedstock quality** Verdant has specified that the Redbank Biomass facility *"is designed to process feedstock with a moisture content of 25%, allowing for a range or limit between 10% and 50%"* (Table 5.1, Page 63, Appendix M). However, during the FiCir Boiler Performance analysis, Boiler & Power Plant Services Pty Ltd identified significant implications of deviations from this design specification[7]. Increased moisture in the feedstock directly results in	These potential issues are known to Verdant, which is why there has been extensive work including that done by B&PPS to ensure the plant can be modified as necessary and a fuel specification has been developed in the *Redbank Power Station – Description of Proposed Modifications for Conversion to Fire Biomass fuels* (EIS Appendix F, Figure 20). The design moisture content is provided in the Biomass Specification The Applicant will work with suppliers to ensure an optimised moisture content in fuels is consistently supplied to the power station. That biomass is highly suitable for use in circulating and deep bubbling fluidised bed technologies has been researched extensively and is widely known and demonstrated in peer reviewed literature. For example, as described by Narnaware *et al.* (2023)[23], bubbling fluidized bed technology is less sensitive to variations in fuel quality than other boilers which helps	EIS Appendix F

[23] Narnaware, S.L., Panwar, N.L., Gupta, T. and K.K Meena (2023). Bubbling fluidized bed gasification of biomass: A review on the effect of selected operational parameters. *Biointerface Research,* 13(5), p.474.

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		higher fuel consumption and diminished overall process efficiency. As detailed in the boiler performance report (Appendix F – Response to submissions), "*increasing the moisture content in fire- damaged tree trunks from 15% to 45% caused a 75% rise in fuel requirements. This was due to both the energy-intensive evaporation of the additional moisture and a decrease in boiler efficiency from 81.5% to 72.1%. The reduction in efficiency arises because more energy is diverted from generating usable heat to evaporating excess moisture*". Additionally, Verdant noted that higher moisture levels elevated flue gas flow, compounding operational challenges (Page 5, Appendix F).	mitigate issues like tar formation and bed agglomeration, promoting cleaner, more efficient energy production from biomass. In addition, Alaudden *et al.,* (2010) notes that fluidized bed reactors provide excellent mixing and uniform temperature distribution. These characteristics enhance gas–solid contact, leading to faster reaction rates and higher conversion efficiencies[24] Redbank FiCirc boilers operate with a deep bed and in-bed cooling tubes; the bed temperature can be adjusted by changing the bed depth or altering the quantity/size of in-bed tubes. A live bed storage silo exists and forms part of the operating process where bed material is stored and reused during operation to maintaining efficient combustion. The operators are trained in how to manage the bed to achieve the required outputs when fuel has variable characteristics. Note that the QA/QC Procedure requires close monitoring of biomass fuel destined for delivery to Redbank. To establish a reliable baseline, HRL Labs has been engaged by Verdant to conduct moisture loss studies on woodchips over time. While weather variations may affect drying times, this factor is just one of several parameters used to determine biomass suitability for chipping and transport. Biomass fuel will undergo a drying period before chipping for transport. The comprehensive sampling and testing QA/QC program is designed to accurately assess moisture content, thereby minimising the risk of non-compliant biomass fuel batches arriving at the power station.	

[24] Alauddin, Z., Lahijani, P., Mohammadi M. and A.R. Mohamed (2010). Gasification of lignocellulosic biomass in fluidized beds for renewable energy development: A review. *Renewable and Sustainable Energy Reviews,* pp. 1-11.

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64	Pg 18	Despite the boiler being designed to accommodate feedstock with a 25% moisture content, the absence of an on-site pre-treatment process to regulate and manage feedstock moisture content poses significant challenges. Elevated moisture levels in feedstock introduces complexities in the operation of fluidised bed boilers. For instance, increasing fuel moisture (at a fixed excess air level), reduces the temperature throughout the fluidised bed volume due to the energy consumed in evaporating water, even when residence time increases, because of the apparent influence of the latent heat of water evaporation[8]. This variability can lead to suboptimal fluidisation, increased risk of agglomeration within the bed material, and impacting residence time to complete fuel combustion.	The Redbank FiCirc boilers are a unique design incorporating a deep bubbling fluidized bed and fine recirculation from large cyclones above the furnace which allows efficient stable combustion of biomass with a wide range of moistures (up to 50%), particles sizes and components as given in fuel specification as given in Figure 20 of the *Redbank Power Station – Description of Proposed Modifications for Conversion to Fire Biomass fuels* (EIS Appendix F). The deep bubbling bed consisting of ~200 tons of bed inert material and ~2% of combusting material gives a thermal flywheel allowing large variations in the biomass characteristics. The fines recirculation ensures high efficiency under all conditions The bed temperature is maintained by adjusting the bed height making the bed tubes more or less effective. The boilers are fitted with an external bed storage silo into which bed material is moved in or out of during operation as needed to suit the fuel characteristics. A fuel specification has been developed in the Redbank Power Station – Description of Proposed Modifications for Conversion to Fire Biomass fuels (EIS Appendix F, Figure 20). The design moisture content is provided in the Biomass Specification and the Applicant will work with suppliers to ensure an optimised moisture content in fuels is consistently supplied to the power station. A strict Quality Assurance/ and Quality Control (QA/QC) program has been developed to control fuel quality, manage risk and avoid potential issues relating to plant and equipment damage, lower energy output, regulatory breaches and environmental harm. Biomass is highly suitable for use in circulating and deep bubbling fluidised bed technologies has been researched	EIS Appendix F

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			extensively and is widely known and demonstrated in peer reviewed literature.	
65	Pg 18	High moisture content in feedstock increases energy consumption requirements. Extra energy is consumed to evaporate the water content, reducing the heat available for practical use. This process also increases the volume of flue gases due to the water vapour and heated combustion air, placing additional strain on the system.	The process is managed as indicated in the previous response statements. No additional fuel or energy is required to evaporate the moisture as this is managed in the off-site storage as well as the furnace has the capability to manage spikes in moisture in the fluidised bed process. Verdant understand at moisture levels above the 25% the boiler output would be reduced due to the inability of the ID fan to cope with the higher flue gas flows. Figure 9 in EIS Appendix F provides the derating. For example, at 45% moisture, the boiler output is restricted to 85% load. Again, extensive work including done by B&PPS on a fuel specification has been developed in the Redbank Power Station – Description of Proposed Modifications for Conversion to Fire Biomass fuels (EIS Appendix F, Figure 20). The design moisture content is provided in the Biomass Specification and the Applicant will work with suppliers to ensure an optimised moisture content in fuels is consistently supplied to the power station. That biomass is highly suitable for use in circulating and deep bubbling fluidised bed technologies has been researched extensively and is widely known and demonstrated in peer reviewed literature. For example, the vigorous solids circulation in the turbulent bed creates a very uniform, well-mixed combustion environment that promotes efficient combustion and heat transfer, boosting the overall energy recovery from biomass. It is also well-known that fluidised beds are tolerant of	EIS Appendix F

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			variable fuel quality promoting complete, stable combustion. [25, 26 27].	
66	Pg 18	During biomass storage and drying, moisture content facilitates chemical precipitation (e.g., chlorides, sulphates, phosphates) and leaching of critical elements like calcium, potassium, and magnesium, while microbial proliferation in moist conditions poses health risks associated with mould and fungus growth[9].	All preparation including drying, chipping and screening will be performed off site. No material will be accepted at the Facility that has not been pre-validated to show that it meets fuel specifications required by Redbank Power Station and that it meets a SRROE granted by the NSW EPA. Non-compliant fuels will not be accepted. The purpose for this is not only to have biomass fuel availability for continuous use but to allow the biomass woodchips to dry out to the required moisture levels. As these stockpiles are reclaimed and restocked monthly there will be no degradation as the feedstock is quickly replenished. From tests undertaken, in wood chipping and stockpiling, the moisture content drops substantially and will adequately meet the required fuel specification. Storage of biomass is common practice for biomass fired boilers in Australia and internationally. Verdant will use existing standard industrial practice. The continuous use and replenishing of the stockpiles will be ongoing, thus preventing fuel deterioration, chemical precipitation and fungal growth, which is expected to be negligible. The stockpile area accommodates a maximum of 3 days storage capacity. This rapid turnover of the biomass minimises the time fuel is spent in stockpiled conditions. Concern over wood chip degradation, bacteria/fungi, temperature increases and changes in moisture content are	EIS Section 3.3.1 EIS Appendix M Section 6

[25] Pascual Peña, J.A. (2011). Bubbling fluidized beds: When to use this technology. In: *Luckos, A. and den Hoed, P. (eds.) Industrial Fluidization South Africa*, Johannesburg, South Africa, 16–17 November 2011. Johannesburg: Southern African Institute of Mining and Metallurgy, pp. 57–66.
[26] Ravelli, S., Perdichizzi, A. and G. Barigozzi (2008). Description, applications and numerical modelling of bubbling fluidized bed combustion in waste-to-energy plants. *Progress in Energy and Combustion Science,* 34, pp.224–253.
[27] Koornneef, J., Junginger, M. and A. Faaij (2006). Development of fluidized bed combustion—An overview of trends, performance and cost. *Materials and Energy,* 31(1), pp.1-16.

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			typical for extended term stockpiling (i.e. longer than 2 months). Research documents that mitigation of these risks is via practices such as "first-in/first-out" inventory management, larger and consistent chip sizes (i.e. screening of fines) and pile rotation[28]. The fuel consumption rate for the power plant does not promote fuel quality changes or deterioration. The continuous use and replenishing of the stockpiles will be ongoing, thus preventing fuel deterioration. The stockpile area accommodates a maximum of 3 days storage capacity. This rapid turnover of the biomass minimises the time biomass fuel is spent in stockpiled conditions.	
67	Pg 18	To address these issues, implementing a robust on-site pre-treatment process, such as drying, is highly recommended. Such measures would help maintain optimal combustion performance, minimise operational inefficiencies, and reduce environmental impacts[10].	On-site (at Redbank Power Station) fuel preparation is not proposed. Fuel preparation to the desired specification will be prepared and tested off site to ensure compliance before it is released for delivery to the power plant. This is explained in detail in the EIS Section 3.3.1 and Section 6 of the *Fuel Supply and Characterisation Study* (Appendix M of the EIS). By supplying fuels to specification to the power station, this avoids the requirement for on-site processing.	EIS Section 3.3.1 EIS Appendix M Section 6
68	Pg 18	**Impact of biomass density on conveyor system design and operation** Verdant has indicated that the proposal "*includes the repurposing of several existing conveyors for transporting the biomass feedstock, specifically the CV76 Existing reclaim conveyor, CV34 Existing tailing/supplementary fuel conveyor,*	The density and flow variation between Biomass and BDT and ROM coal have been taken into account as detailed in the B&PPS in their report *Redbank Power Station – Description of Proposed Modifications for Conversion to Fire Biomass fuels* (EIS Appendix F, Section 5.3). Appendix A of the *Fuel Supply and Characterisation Study* (Appendix M of the EIS) and the *Redbank Power Station – Description of Proposed Modifications for Conversion to Fire Biomass fuels* (EIS Appendix F) clearly indicate that existing conveyors are suitable and capable of handling the required	EIS Appendix F

[28] Slaven, I., Haviarova, E. and D. Cassens (2011). Properties of wood waste stored for energy production. Purdue University, Department of Forestry and Natural Resources / Agricultural Communication.

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		and CV35 Existing supplementary fuel conveyor" (Page 21, Appendix F). These conveyors were originally designed to handle beneficiated dewatered coal tailings (BDT) and run- of-mine coal as supplementary fuels. According to literature, coal and coal tailings typically have a density ranging from 800 to 1500 kg/m³. However, the biomass feedstock expected for use at the facility has a significantly lower density, ranging from 160 to 490 kg/m³ [11,12,13].	volumes. The proposed changes are recommended to maximise the use of the existing equipment and provide a higher availability.	
69	Pg 19	This discrepancy in material densities may present several operational challenges. Lower-density materials like biomass take up more volume for the same mass when compared to denser materials such as coal or coal tailings. As a result, the conveyors, initially designed for higher-density fuels, may face issues with volumetric capacity[14]. Specifically, the conveyors may not efficiently handle the increased volume of biomass feedstock that needs to be transported. This increase in material volume can exceed the conveyors' designed capacity, potentially leading to overloading, inefficiency, and even potential blockages or overheating of the conveyor system due to higher material volumes. Additionally, there is no indication on how	The density and flow variation between Biomass and BDT and ROM coal have been taken into account as detailed in EIS Appendix F. As above, the B&PPS reports clearly indicate that existing conveyors are suitable and capable of handling the required volumes. The proposed changes are recommended to maximise the use of the existing equipment and provide a higher availability.	EIS Appendix F.

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		Verdant plans to meet the feed rate of existing conveyor systems or address the implications of the change in feedstock of their operations.		
70	Pg 19	Additionally, the lower density of biomass can cause an increase in the energy requirement for moving the material. Since biomass takes up more space due to its low density, conveyors will need to move larger volumes of material for the same mass, which in turn requires more energy to operate the belts. The energy needed to move biomass could therefore be significantly higher than that required for coal tailings, demanding additional power or more frequent maintenance to maintain optimal performance. Moreover, the design of the conveyors will need to be evaluated to ensure that they are capable of handling the different material flow characteristics of biomass. Biomass can be more friable, fibrous, or sticky compared to coal, further complicating its movement along the conveyor. Consequently, the repurposed conveyors might require modifications such as increased belt strength, adjusted skirt friction settings, or improved dust control measures to ensure smooth	This is an incorrect statement; the energy is based on weight and not volume. The *Redbank Power Station – Description of Proposed Modifications for Conversion to Fire Biomass fuels* (EIS Appendix F) clearly indicate that the existing conveyors can handle the weight and the volume with no major adjustment necessary. The density and flow variation between Biomass and BDT and ROM coal have been taken into account as detailed in B&PPS in their report *Redbank Power Station – Description of Proposed Modifications for Conversion to Fire Biomass fuels* (EIS Appendix F, Section 5.3).	EIS Appendix F

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		operation and reduce wear and tear.		
71	Pg 19	**Challenges of elevated chlorine and phosphorus content in feedstock** The facility has been designed to manage Beneficiated Dewatered Tailings (BDT) and run-of-mine (ROM) coal as supplementary fuel. With the transition to a 100% biomass feedstock for electricity generation, the proponent has proposed modifications to three key areas (Page 2, Appendix F): • Internal roadways including new weigh bridges • Supplementary fuel receival, storage, and reclaim • Supplementary fuel transport equipment.	NA	NA
72	Pg 19	However, this transition has not fully considered the operational implications of changing from coal to biomass feedstock the fundamental differences between biomass and coal as fuels. Biomass contains larger quantities of alkali and alkaline earth elements (potassium, sodium, calcium, magnesium), phosphorus and chlorine than coal. As all the constituents of the biomass enter the boiler, several technical concerns arise. Higher fuel chlorine	This issue has been fully considered. The effects of the differences in components in biomass compared to coal have been considered in the limits in the biomass fuel specification. This was based on a previous report by B&PPS Report C12163-01 dated 30-11-2020 which is included as Appendix A in EIS Appendix M. Verdant's engineering services team and the reports by B&PPS both confirm that the Redbank FiCirc fluidised bed boilers are suitable for consuming biomass meeting the biomass fuel specification given in Figure 20 of the *Redbank Power Station –*	EIS Appendix F EIS Appendix M (Appendix A)

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		contents can lead to greater high-temperature corrosion in boilers. Accelerated fouling and slagging can occur when fuels containing high levels of potassium are utilised[15].	*Description of Proposed Modifications for Conversion to Fire Biomass fuels* (EIS Appendix F). That biomass is highly suitable for use in circulating and deep bubbling fluidised bed technologies has been researched extensively and is widely known and demonstrated in peer reviewed literature. Several scientific papers are cited in this report that provide details supporting this technology as appropriate for this type of application.	
73	Pg 19	An analysis of the proposed biomass fuel for the Redbank Power Station highlights that "*perennial grasses contain significantly elevated levels of chlorine (1.42 ± 0.46% daf), potassium (37.6 ± 7% db), and phosphorus (8.4 ± 1.2% db). Similarly waste biomass from land clearing activities exceeds the chorine content (0.25 ± 0.17% daf)"* (Page 189, Appendix M). These values far exceed the feedstock specifications set by Verdant. Such elevated levels of alkaline and halogen elements, particularly potassium and chlorine, present a range of technological and environmental challenges during biomass combustion and conversion processes.	Bana grass was one of the potential fuel crops Verdant considered and as with any potential fuel was and will be assessed for its suitability for use as biomass fuel. As with all potential fuel crops currently being evaluated, bana grass would need to meet the fuel specification, including chlorine limits and commercial viability or else it will not be used. This will be confirmed through an ongoing analysis program. The biomass fuel specification was designed to ensure no environmental impact and no harm to the plant and equipment. A variety of fuels have been identified and tested including grasses, only those fuels that comply to the fuel specification will be used for combustion at Redbank Power station. Biomass with elevated levels of elements that do not comply with the biomass fuel specification given in Figure 20 of the *Redbank Power Station – Description of Proposed Modifications for Conversion to Fire Biomass fuels* (EIS Appendix F) and are not suitable for Redbank and will not be used.	EIS Appendix F
74	Pg 20	One major issue is the volatilisation of potassium and chlorine, which leads to the formation of hazardous compounds such as chlorine gas (Cl_2) and hydrogen chloride (HCl). As the flue gases cool in the boiler	The Biomass fuel specification has been designed to address this issue to ensure no unacceptable levels of Chlorides are included in the fuel. The fuel specification must be met with strict Quality Control before it can be delivered to the power plant.	IS Appendix F

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		section, a large portion of these chloride salts condense into solid particles or adhere to surfaces like heat exchangers or fly ash. Investigations have shown that between 40% to 80% of the total chlorine released is embedded in the ash when wood chips or bark are burned For straw or cereals combustion, this figure rises to 80% to 85%, especially when baghouse filters are used to capture particulate matter These compounds are highly corrosive gases, accelerating wear and damage to boiler tubes, heat exchangers, and other critical plant components, leading to increased maintenance costs and equipment downtime.	The low levels of potassium and chlorine in the biomass fuel specification given in Figure 20 of the *Redbank Power Station – Description of Proposed Modifications for Conversion to Fire Biomass fuels* (EIS Appendix F) will not pose an issues. The power station is expected to operate below emission limits set by the applicable in-stack concentration limits from the *Protection of the Environment Operations (Clean Air) Regulation* 2022, which would be confirmed post-approval through data recorded by the installed continuous emissions monitoring system (CEMS) and periodic emissions sampling campaigns. The existing monitoring requirements for Redbank are outlined in condition P1 and M2 of EPL 11262. A new EPL or variation to the existing EPL will be required post approval inclusive of continuous monitoring conditions to meet predicted and regulated air quality requirements for the power station as outlined in the *Air Quality Impact Assessment* (EIS Appendix O).	
75	Pg 20	Similarly, due to the presence of high levels of chlorine, there is a risk that dioxins and furans are generated, which can cause significant environmental and human health impacts due to their toxicity and persistence. These components have high thermal and chemical stability in the environment and can only be destroyed above temperatures of 1,000 ºC. It should be noted that PCDD/F (Polychlorinated dibenzodioxins and dibenzofurans) are not only found in stack gases but also in solid residues from any	Verdant understand that high levels of potassium and Chlorides can cause problems in the Redbank plant. That is why a fuel specification has been developed. The low levels of potassium and chlorine in the biomass fuel specification given in Figure 20 of the *Redbank Power Station – Description of Proposed Modifications for Conversion to Fire* Biomass fuels (EIS Appendix F) will not pose a problem. Biomass with elevated levels of elements including chlorine that do not comply with the biomass fuel specification and are not suitable for Redbank and will not be used. Suppliers will be required to adhere to the following requirements, as outlined in Section 3.3.1 of the EIS.:	EIS Appendix F EIS Section 3.3.1

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		combustion process, such as in bottom ashes, slags, and fly ash[20]. Another critical impact of biomass combustion is the formation of potassium salts, such as potassium chloride (KCl) and potassium sulphate (K_2SO_4), which are often water-soluble. This characteristic increases their leaching potential in combustion residues like ash[21].	1) Ensure that the biomass material meets an approved specification required for the power station, prior to delivery to the power station; 2) Meet all requirements under any relevant SRROE issued by the NSW EPA; and 3) Adhere to Verdant Earth's quality control and assurance program requirements.	
76	Pg 20	Despite Verdant's stringent feedstock specifications to limit such problematic elements, perennial grasses and waste biomass from land clearing often exhibit levels of chlorine and potassium that are two to three times higher than the Verdant acceptable limits included in the *Quality Assurance and Control Procedure for Receipt and Use of Biomass*.	The analysis presented in the HRL report (Appendix D of EIS Appendix M) indicate a limited number of different samples from a variety of sources that have been tested for consideration. Further testing will be required under a SRROE and to ensure the fuel specification is met and to ensure efficient and safe operation of the plant. The results of the HRL testing provide tolerances to low levels of chemical contaminants which are typically found at trace levels in biomass. The results indicate that biomass types generally comply with the fuel specification. As with any potential biomass fuel, including perennial grasses and approved land clearing, each biomass fuel source will be assessed for its suitability for use at the power station. All potential biomass fuel will need to meet the fuel specification, including chlorine limits and commercial viability or else it will not be used. This will be confirmed through analysis prior to acceptance at Redbank. Unless the biomass fuel meets the required specification given in Figure 20 of the EIS Appendix F it will not be considered.	EIS Appendix M (Appendix D) EIS Appendix F Section 5.2
77	Pg 20	While Verdant has placed the responsibility of meeting these specifications on suppliers, the facility itself will bear the operational	The Quality Assurance and Control Procedure for Receipt and Use of Biomass (Appendix E of EIS Appendix F), contractual	EIS Appendix F (Appendix E)

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		and environmental consequences if these elevated levels are not addressed. Implementing effective pre-treatment technologies, such as washing or ash fraction removal, or sourcing alternative feedstocks with lower contaminant levels, may be necessary to mitigate these risks, ensure stable operational performance, and ensure the facility can comply with the *Protection of the Environment Operations (Clean Air) Regulation*.	arrangements and monitoring by Verdant will ensure that the fuel specification is met. Redbank is a multimillion-dollar power station and to protect it Verdant has a commercial responsibility to ensure that only biomass fuel processed to Redbank's specific chemical and physical specification will be used. Verdant will work with landholders and fuel suppliers to put in place fuel processing, testing and transport systems so that biomass fuel delivered to the power station is reliable, consistent in quality and meets all required specifications. The Redbank Power Station will also need to develop and implement an *Air Quality Management Plan* that incorporates the monitoring requirements outlined in the existing EPL 11262 and any other air quality monitoring requirements from associated approvals, permits and licences.	EIS Section 10.5
Section 2.5 – Technical fitness and commissioning details				
78	Pg 21	The technical suitability of the operation is closely linked to the technologies employed, the handling capabilities, and the comprehensive assessment of feedstock characteristics. Ensuring that all systems are technically fit for purpose and undergo proper commissioning is essential for achieving optimal performance. As outlined in sections 2.2, 2.3, and 2.4, there are overlapping considerations that directly impact these aspects, highlighting the importance of incorporating feedstock characteristics and handling capabilities into the operational framework.	Verdant are well-aware of the technology used at Redbank, including opportunities and limitations.	N/A

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		This section further evaluates the impact of feedstock changes on bed material operations, specifically addressing how variations in feedstock composition may affect the efficiency and stability of the combustion process and overall plant performance.		
79	Pg 21	**Impact on bed material due to change in feedstock from coal to biomass** The existing fluidised bed combustion technology is designed to operate with a mean particle size of the bed material in the range of 300 to 600µm. The bed material is fluidised by primary air introduced through air distributors at the bottom of the bed, and by the gas generated during combustion (Page 3, Appendix M). However, the use of biomass as a feedstock, instead of coal, introduces challenges related to bed material agglomeration. Biomass fuels contain a variety of ash-forming elements with reactive and fluxing properties, such as potassium and chlorine compounds. These elements have been shown to promote agglomeration during fluidised bed combustion (FBC) by causing the bed material particles to stick together. Agglomeration can lead to a decrease in fluidisation	As discussed in the EIS Section 3.2, the Redbank FiCirc boilers are a unique design incorporating a deep bubbling fluidized bed and fine recirculation from large cyclones above the furnace which allows efficient stable combustion of biomass with a wide range of moistures (up to 50%), particles sizes and components as given in fuel specification shown in Figure 20 of the *Redbank Power Station – Description of Proposed Modifications for Conversion to Fire Biomass fuels* (EIS Appendix F). The deep bubbling bed consisting of ~200 tons of bed inert material and ~2% of combusting material gives a thermal flywheel allowing large variations in the biomass characteristics. The fines recirculation ensures high efficiency under all conditions. The bed temperature is maintained by adjusting the bed height making the bed tubes effective. The boilers are fitted with an external bed storage silo into which bed material is moved in or out of during operation as needed to suit the fuel characteristics. The biomass fuel will be provided within the Biomass specification designed specifically to avoid and eliminate operational problems in the plant and agglomeration. The operating personnel are well trained in managing the FiCirc technology and ensuring efficient and reliable operation.	EIS Section 3.2 EIS Appendix F

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		quality and, in extreme cases, to complete defluidisation - where the bed stops being effectively fluidised, causing significant operational problems and potentially leading to an unscheduled shutdown of the combustion system[22].	Biomass with the specified maximum ash content of 4% will require bed make-sand to be added. This is chemically inert washed river sand and possibly limestone if SOx emissions dictate. The low levels of potassium and chlorine in the biomass fuel specification given in Figure 20 of EIS Appendix F will not pose an agglomeration problem. The ash fusion temperature of 1,200°C is well above the bed operating temperature which is less than 900°C. That biomass is highly suitable for use in circulating and deep bubbling fluidised bed technologies has been researched extensively and is widely known and demonstrated in peer reviewed literature.	
80	Pg 21	Verdant has not provided any information or assessment regarding the effects of transitioning from coal to biomass on the operation of the bed material. This is an important consideration, as the existing bed material may not be suitable for handling biomass without adjustments, especially when considering the increased risk of agglomeration. Therefore, further evaluation of, and potentially modifications to, the bed material and fluidisation system will be required to ensure the continued and efficient operation of the FBC system with biomass feedstocks.	Verdant's engineering services team and B&PPS in their report *Redbank Power Station – Description of Proposed Modifications for Conversion to Fire Biomass fuels* (EIS Appendix F) both confirm that the Redbank FiCirc fluidised bed boilers are suitable for firing biomass meeting the biomass fuel specification given in Figure 20 of the B&PPS report. There is no "transitioning from coal to biomass" aside from what has been assessed already in the report from B&PPS (EIS Appendix F). New bed material (washed river sand) will be used for the first fill of bed material in preparation for biomass firing. Verdant does not believe there will be an issue with using this bed material with biomass and can make adjustments to the bed material if required. That biomass is highly suitable for use in circulating and deep bubbling fluidised bed technologies has been researched extensively and is widely known and demonstrated in peer reviewed literature. Several scientific papers are cited in this	EIS Appendix F

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			report that provide details supporting this technology as appropriate for this type of application.	
Section 2.6 – Emission control techniques and monitoring				
81	Pg 22	A change in biomass feedstock results in a shift in its chemical composition, which in turn affects the emissions expected to be generated during combustion. An analysis of the impact of this change on emissions associated with the feedstock intended to be used at the facility is provided in section 2.4. This section offers further analysis on the potential impacts of biomass combustion on emissions, including the generation of contaminants and particulate matter, which could have significant implications for environmental compliance and operational efficiency.	The EIS and supporting documentation makes clear that only biomass fuel meeting the fuel specification given in Figure 20 of the *Redbank Power Station – Description of Proposed Modifications for Conversion to Fire* Biomass fuels (EIS Appendix F) will be used. In addition, the Air Quality Impact Assessment (EIS Appendix O) modelled a Regulatory Worst Case (RWC) scenario, which derived constant emission rates from the applicable NSW EPA POEO emission concentration limits that would apply to the Redbank Power Station. The results of the RWC modelling, independent of fuel moisture content and a highly conservative emissions situation, showed that air quality impacts in the surrounding environment would comply with applicable NSW EPA impact assessment criterion.	EIS Section 3.3 EIS Appendix M Section 6 and Appendix E EIS Appendix O

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82	Pg 22	**Impact of biomass combustion on emissions** The properties of biomass fuel differ significantly from coal, leading to distinct particulate matter (PM) emission characteristics during combustion. Compared to coal, biomass combustion, particularly of wood and agricultural residues, produces higher quantities of PM. Additionally, the physical characteristics and elemental composition of the emitted PM vary notably between the two fuels[23]. The biomass fuel characterisation for Redbank Power Station, for example, highlights that "*perennial grasses exhibit elevated levels of chlorine"*, above those expected (Page 189, Appendix M). During biomass combustion, volatile inorganic species such as potassium hydroxide (KOH) and potassium chloride (KCl) are released into the gas phase. These compounds undergo complex chemical and physical reactions, contributing to the formation of fine PM. Studies have shown that PM emissions from agricultural biomass combustion are dominated by particles with diameters of less than 2.5 µm (PM2.5), which have significant implications for air quality and human health[24].	The EIS and supporting documentation makes clear that only feedstock meeting the fuel specification given in Figure 20 of the *Redbank Power Station – Description of Proposed Modifications for Conversion to Fire Biomass fuels* (EIS Appendix F) will be used. Thus concern over variability in the properties of biomass fuel are not applicable. The differences between coal and biomass emissions are not relevant as the Redbank plant will not be burning coal, only biomass. Perennial grasses are only one type of biomass that can be considered for use as fuel. When testing shows that the biomass fuel considered meets the specification it can be used at Redbank. Where the specification is not met, it will not be used. Perennial grasses represent just one category of biomass that is being considered for fuel use. When testing confirms that a biomass fuel meets requisite specifications, it can be used at Redbank. Conversely, if the fuel does not meet these criteria, it will not be used. For example, the bana grass sample tested by HRL did not meet the criteria and would therefore not be acceptable for use at Redbank. Biomass within the specification range is suitable and will not have excessive corrosion, slagging and fouling, fines particles, and trace air pollutants.as per B&PPS Report "Biomass Performance Risk Review" dated 30-11-2020. This has been provided as Appendix A in the EIS Appendix M as referenced in Section 5.1 That biomass is highly suitable for use in circulating and deep bubbling fluidised bed technologies has been researched extensively and is widely known and demonstrated in peer reviewed literature. Several scientific papers are cited in this	EIS Section 3.3 EIS Appendix F) EIS Appendix M Section 6 and Appendix E EIS Section 3.3 EIS Appendix M (Section 5.1 and Appendix A) EIS Appendix F EIS Appendix O

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		Furthermore, the feedstock analysis identified "*elevated levels of specific minerals across different biomass types, such as phosphorus in perennial grass, sodium and calcium in waste biomass from land-clearing activities, and calcium in agricultural wastes"* (Page 189, Appendix M). These minerals contribute to PM formation through two primary mechanisms[25,26]: 1. **Fragmentation of minerals**: Components rich in magnesium (Mg), calcium (Ca), phosphorus (P), iron (Fe), and silicon (Si) form coarse particles as they break down during combustion. 2. **Condensation of alkali vapours and sulphates**: Alkali compounds released into the flue gas condense and nucleate, forming additional coarse particles. The elevated levels of alkali metals and chlorine in biomass also increase the volatilisation of these species, further exacerbating PM emissions and altering the size distribution and composition of the particulate matter.	report that provide details supporting this technology as appropriate for this type of application. Verdant's engineering services team and the report by B&PPS (*Redbank Power Station – Description of Proposed Modifications for Conversion to Fire Biomass fuels* in the EIS Appendix F) both confirm that the Redbank FiCirc fluidised bed boilers are suitable for consuming biomass meeting the biomass fuel specification. In addition, the Air Quality Impact Assessment (EIS Appendix O) modelled a Regulatory Worst Case (RWC) scenario, which derived constant emission rates from the applicable NSW EPA POEO emission concentration limits that would apply to the Redbank Power Station. The results of the RWC modelling, independent of fuel moisture content and a highly conservative emissions situation, showed that air quality impacts in the surrounding environment would comply with applicable NSW EPA impact assessment criterion. The studies provided in the EIS and subsequent RTS have sufficiently shown that the plant at Redbank is suitable for using biomass that meets the required specification. Modification to the fuel delivery systems have been developed specifically for using biomass to specification as fuel.	
Section 2.7 – Additional Items Reviewed				

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83	Pg 23	Understanding the Life Cycle Assessment is essential as it offers a thorough evaluation of the environmental impacts throughout the project's life. The following section provides a summary of the Life Cycle Assessment review for the Redbank Power Station, with key aspects highlighted that require further investigation due to their potential influence on assessment of the project's environmental impacts.	We note the Review included commentary on both Appendix N (November 2023, Lifecycles) of the EIS, which covers all the proposed biomass fuel types and Appendix L (September 2023, Lifecycles) of the RTS, which models solely energy crops and land clearly although provides commentary around bioenergy systems generally.	N/A
84	Pg 23	**Comparative scenario** The LCA compares two scenarios, a biomass scenario (for energy crops and land clearing residues) and a black coal scenario (Figure 5 and 6, Response to submission Appendix L – Lifecycle Assessment). The black coal scenario has been included as this was the original fuel feedstock specified when the facility was first developed. However, the facility has not been operational with black coal as a fuel feedstock since 2014, and so it is incorrect to compare biomass as displacing black coal, but rather it would form part of the national electricity market and form part of the energy mix of NSW. As it would form part of the energy mix of generation in NSW, it is also	Both reports from Lifecycles reports, including the *Use of Biomass Fuel at Redbank Power Station – Life Cycle Assessment* (EIS Appendix N) and *Energy from biomass at Redbank Power Station LCA Results And Commentary On Environmental Effects* (RTS Appendix L) do not assess directly against black coal use at Redbank, as the power station was not using black coal but beneficiated coal tailings (BDT) and has been non-operational since 2014. In choosing a reference scenario, Lifecycles considered which energy technology would most likely be *indirectly* displaced by the conversion of Redbank to a bioenergy facility. The conversion of the power station provides additional energy to the market, and hence production will exceed demand, causing another technology to drop off from the market based on price. The technology in question is known as the marginal supplier. This approach is more in line with how energy markets operate compared to the assumption that the grid mix of technologies is displaced.	EIS Appendix N RTS Appendix L EIS Appendix N

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		incorrect to assume that it is displacing any other form of generation but if it were, it would only displace what is currently in the NEM.	Black coal is still considered the most likely energy source to be ramped down whilst operation of Redbank with biomass fuels prior to 2030. As coal facilities are shut down over the coming years (see report by Marsden Jacob in RTS Appendix O), renewables will increase over Redbank's lifetime. The electricity from Redbank will compete with other firming technologies (electricity used to fill gaps in generation from intermittent renewables). At this point such firming technologies could be residual coal generators, natural gas generation or storage technologies. Note that in the Life Cycle Assessment included in the EIS (Appendix N), a sensitivity analysis was performed using natural gas as the marginal supplier.	
85	Pg 23	Furthermore, since the facility is not slated to be operational for 6 years, the generation it would be displacing would be the energy mix in 2030 rather than now, which would likely be close to 50% renewable. Over a 40 year project life it is feasible that at some point in this time horizon that generation would likely be displacing renewable power and have a net greenhouse gas impact, not benefit.	Upon receiving final approval, it is planned for Redbank to restart within 12 months, subject to long lead items. It is estimated that energy generation would begin as soon as possible (estimated) one year post approval, not in 2030. A provided in the NSW Electricity Supply Gap (EIS Appendix J and updated in RTS Appendix O) Marsden Jacob's concluded that NSW's electricity supply has a projected reliability level (from the late 2020's) below the required standard and the robustness of electricity supply in NSW is subject to unforeseen changes. These issues would be improved if additional firming, dispatchable capacity from Redbank was available in NSW from the mid 2020's. This is critical timing especially since other renewables including solar and wind provide intermittent power to the electricity grid. A detailed assessment of Section 3.3 of the *Greenhouse Gas Mitigation Plan and Climate Change Adaptation Plan* (EIS Appendix P) outlines the long-term Scope 1 GHG emissions	EIS Section 3.3 RTS Section 2.3

COMMENT NO.	REVIEW PAGE	ISSUE	APPLICANT RESPONSE	REFERENCE TO WHERE ADDRESSED IN APPLICATION
			reduction target for the Proposal that represents relative to the emissions reduction objectives of NSW. The Proposal emissions would reduce at a comparable rate to the NSW net zero emissions trajectory. This was revised in Section 2.3 of the *Air Quality Impact Assessment, Greenhouse Gas Mitigation Plan and Climate Change Adaptation Plan Addendum* (RTS Appendix E). The Proposal will be a small contributor to GHG emissions in NSW. Under the 'current policy' scenario for NSW, the project would represent 0.02% of state-wide emissions in 2030, and 0.07% in 2050.	
86	Pg 23	**Reference to Methane Capture in Landfill** The results have been predicated on the assumption there would be 100% methane capture should waste products go to landfill. At best, average methane capture in Australia is circa 70%, and this therefore needs to be accounted for as part of this calculation.	The model for landfill used in the *Use of Biomass Fuel at Redbank Power Station – Life Cycle Assessment* (EIS Appendix N) assumes only a fraction of methane is captured (44%) as documented in the Department of Climate Change, Energy, the Environment and Water's *National Inventory Report*.	EIS Appendix N
87	Pg 23	**Fertiliser Displacement** The results have been predicated on the assumption that the bottom ash could feasibly displace fertiliser use. It would be incorrect to assume that this would be an actual scenario given that at best this would be a product that may be used in conjunction with standard fertilisers to achieve desired agronomic benefit. The majority of emissions associated with fertilisers	It is not assumed in the model that ash would be used on its own as a fertiliser. If ash is blended with other fertilisers, this would still reduce the need for the fertilisers which normally provide the nutrients contained in the ash. Displacements are calculated based on potassium, phosphorous and calcium contents in the ash, and it is assumed to only displace equivalent amounts of these same chemicals. This is shown in Table 2, and Table 10 of the *Use of Biomass Fuel at Redbank Power Station – Life Cycle Assessment* (EIS Appendix N).	EIS Appendix N

COMMENT NO.	REVIEW PAGE	ISSUE	APPLICANT RESPONSE	REFERENCE TO WHERE ADDRESSED IN APPLICATION
		come from nitrogen (circa 70%). It is understood that the potential bottom ash fertiliser replacement would have minimal nitrogen content.	Only emissions associated with upstream production of fertilisers are assumed to be displaced. i.e. no direct emissions are offset. Excluding the fertiliser production displacement increases emissions in the biomass scenario by less than 0.2% in the Lifecycles report.	
88	Pg 23	**Reference to Carbon Monoxide not being a Greenhouse Gas** The LCA makes reference to the carbon monoxide (CO) not being considered as a greenhouse gas or having an impact on, however, this is disputable and while it is not currently accounted for under NGERs, CO does have an impact on global warming potential. Suggest removal of statement referring to carbon monoxide not having an impact.	We note that this is disputable, and a small edit could be made to text in the text to clarify that CO is not counted as a greenhouse gas in the LCA impact. However, this would not change the results as the method applied (IPCC GWP100 2013) in the *Use of Biomass Fuel at Redbank Power Station – Life Cycle Assessment* (EIS Appendix N), which does not include CO as a greenhouse gas in the methodology, although this may change.	EIS Appendix N
89	Pg 24	**Carbon Neutrality Principle of Combustion and Harvesting of Wood Fuel** The LCA seems to imply that the growing of trees for harvest and combustion has a greater net benefit than the combustion of the timber for power. However, it is not entirely clear. The report indicated "the carbon neutrality principle has not been applied" and the growing component and absorption of atmospheric carbon component of the process would outweigh the combustion release of stored carbon during power production. If	The statement 'carbon neutrality principle has not been applied' refers to the modelling approach of counting both biogenic carbon uptake (as a negative emission at plant growth) and biogenic emissions (as a positive emission at combustion) separately. When the carbon neutrality is applied, we would assume all biogenic uptake and emissions are net neutral (using a characterisation factor of 0 for both biogenic absorption and biogenic emissions), as it makes the modelling simpler. The results would not change if the carbon neutrality principle was applied. For the biomass scenario, the biogenic CO_2 absorption does outweigh the biogenic CO_2 emissions slightly, due to the conversion of some carbon to CO. However, this still results in an overall small net detrimental impact, once other combustion emissions, processing and transport are accounted for, as	EIS Appendix N

COMMENT NO.	REVIEW PAGE	ISSUE	APPLICANT RESPONSE	REFERENCE TO WHERE ADDRESSED IN APPLICATION
		this is the case, most literature would suggest that at best it is a carbon neutral (or close to it after accounting for wood processing) process. It is recommended that carbon neutrality principle be applied as well, accounting for the emissions associated with processing, transport etc.	shown in Figure 7 (Climate change contribution analysis) in the *Use of Biomass Fuel at Redbank Power Station – Life Cycle Assessment* (EIS Appendix N). For the reference scenario, there is a small negative component to the impacts. This is due to the current fate of the biomass fuel, some of which was assumed to go to landfill. It is assumed that some methane is captured during this process, and the resulting avoided production of fossil methane results in a negative impact.	
90	Pg 24	**Particle Size of Dry Matter** The quantity of carbon emissions associated with dry matter pulverisation can change dramatically depending on the particle size that the dry matter is processed to. Biomass that is pulverised to 0.1mm as opposed to 0.5 mm could result in a 5.5-fold increase in carbon emissions. Please confirm to what extent the biomass pulverisation has been modelled	The literature source used for chipping in the *Use of Biomass Fuel at Redbank Power Station – Life Cycle Assessment* (EIS Appendix N, Reference #13) did not contain a particle size, though equated to approximately 0.54MJ diesel per kg of chips at 25% moisture content. Note that Redbank uses fluidised bed technology (FiCirc boilers) and does not require pulverised materials. Using pulverised fuel is not compatible with the technology. The fuel specification size as provided in Figure 20 of the *Redbank Power Station – Description of Proposed Modifications for Conversion to Fire Biomass fuels* (EIS Appendix F) does not allow fines (i.e. pulverised fuel) into the bed due to the updraft from the fluidised sand bed. In addition, the mechanical processes used to achieve the required size specification will reduce and remove fine particulates prior to the material being used at Redbank. The majority of the fuel will be processed to 50mm minus and preferably between 30 and 45mm chip to enable combustion in the furnace bed. Screening on a 20mm bottom deck will ensure little or no fines below 5mm. Biomass would only require pulverisation if it is replacing coal in the traditional coal fire power station where the coal is	EIS Appendix F (Figure 20)

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			pulverised and blown into the boiler, which is clearly not the case with Redbank.	

Appendix C Verdant Staff CVs

List of personnel already engaged and targeted for the return to service of Redbank Power Station. these experienced personnel have [previous experience in EPC type contracting and were involved in the initial design, construction and commissioning of the power plant.

Key personnel	Title	Years of Experience	Major projects involvement
Costa Tsiolkas	General Manager	48	• Extensive experience in managing EPC contracts in Power plant design, construction, commissioning and operating, with over 48 years of involvement in the power industry. This includes Coal fired power plant, Biomass power plants, Pumped Hydro, Combined cycle Gas Turbines and Energy from Waste. • Previously employed by ABB, Alstom, Downer RCR and other international organisations as a senior project manager/Project Director for projects equivalent of 10GW capacity. • Currently with Verdant Earth Technologies Hunter Valley - Redbank power plant 150 MW. I was the appointed senior project manager for the design, manufacturing,

			construction, commissioning and operation of the plant 1999 to 2001 General Manager with AE&E Australia service and construction Group • Providing construction and commissioning Services for internal new projects and external services support to existing power stations around Australia and Southeast Asia. **Senior Project Manager,** • Redbank Power Station 150 MW plant Hunter Valley • Cape Lambert Power Plant WA, 100 MW 2x GE LM 6000 gas turbines. • Downer, Mt Pleasant, and Mangoola Coal Mines CHPPs • Anaconda Nickel (currently Murrin Murrin) 96 MW Power plant **Project Director** • Mitr Pol Sugar, Thailand 2x40 MW power plants • Ravensthorpe Nickel project 56 MW power plant, • Eskom, Arnot Power station South Africa 3x350 MW Units, return to service after 7 year storage and preservation

			Eskom Electricity Commission of South Africa
			Senior Project Manager,
			• Lethabo Power Station, New 6x620 MW Units, Responsible for the Boilers and Balance of Plant,
			• Duvha Power station – Senior Project Manager, Retrofitting of electrostatic precipitators with Fabric filters and Retrofitting wet ash handling plant with pneumatic air slides for dry handling and disposal
			
			• Duvha Power Station, New 6x620 MW Units
			  ○ Plant Commissioning Engineer,
			  ○ Shift manager Operations
			
			• Various existing power plant retrofits and upgrades to improve efficiency with new technologies.
			  ○ Project Manager/Contracts administrator

Owen Hassall	Engineering and Commissioning Manager	46	• **Start up and commissioning manager** with extensive experience in EPC contracts both locally and oversees in Power and Water • **Current position, Engineering and Re-Commissioning Manager** • Verdant Earth Technologies Hunter Valley - ex Redbank 150 MW power plant

			Owen was involved as a start up and commissioning manager in the following major projects • Commissioning Specialist, AGL, Bayswater Power Station • Commissioning Manager, RCR, Solar Farm Projects • Commissioning Manager Cape Lambert project WA 2x GE LM 6000 gas turbines • Commissioning Manager, UGL, various projects • Commissioning Manager, AE&E, Worsley Alumina expansion project, 114 MW power plant, • Commissioning Manager, AE&E Australia, various projects; ○ Condamine 135 MW Combined Cycle power station ○ - Prony New Caledonia 100 MW power plant ○ -Sembcorp Singapore, 400T/hr gas and oil fired boiler ○ -Kaeng Khoe 4 x HRSGs ○ -Alcan Gove 260 t/h boiler ○ -Ravensthorpe WA 56MW power plant ○ -Savanah Mauritius 45 MW biomass and coal fired Power Plant

			• Commissioning manager, Mitr phol Thailand 40 MW power plant • Commissioning Manager Rocky Point QLD 30MW biomass power plant • Commissioning ManagerRedbank Power station 150MW power plant • Principal Commissioning Engineer Steinmuller Africa, various new power plants from 50 to 620 MW units.
Frank Stewart	Control systems specialist	29	**Control System professional** with extensive experience and involvement in numerous EPC and service projects supporting the commissioning and service teams as required. Frank was involved as a control system specialist in the following major projects. • Currently at Verdant energy Hub Hunter Valley NSW • Leichhardt Power plant NSW • Tablelands Sugar Mill power plant QLD • Mackay Sugar mill power plant QLD • Cargill Newcastle NSW • MOC Rayong power plant Thailand • Worsley Alumina power plant WA

			• Sembcorp VHP boiler Singapore • Savanah Sugar power plant Mauritius • Pioneer Sugar mill power plant QLD • Mitr Phol sugar power plant Thailand • Redbank Power plant NSW • Various process projects PLC installations and programming adjustments
Geoff Marsh	Project and Construction Manager	45	Geoff has extensive experience in **Site management and project management of new build EPC power plant projects** as well as managing Service Projects in the Energy and resource industries. **Project Manager,** - AGL Bayswater, new BCDB Water Return upgrade - Tarong Power Station QLD Installation of a 28 MW package boiler - Integra Mine NSW Installation and commissioning of Coal Gas Flare Project - Redbank Power station Major outage and plant Rehabilitation projects - Rocky point power station QLD Repairs and upgrades - Orica Ammonia plant Construction works

			Site/Construction Manager - Cape Lambert Power Station WA, 100 MW 2x GE LM 6000 gas turbines - BlueScope Steel Airheater tube replacement - Redbank Power Station inbed tube replacement - Condamine Power Station 135 MW combined Cycle power plant - Pioneer Sugar mill - Ravensthorpe Nickel WA, 56 MW power plant - Thiess Australia, construction Superintendent various projects - HIS Engineering, Site manager various projects
Rod Butler	Senior Project Manager/Project Director	40	**Projects director** Hanwha Q Cells Solar Technology Commercial manager Managing European projects and claims **Project Manager RCR** - 150 MW Daydream solar Project and 50 MW Hayman solar Projects - Supply and Commissioning

			2 x steam generators CTIC Corporation Taiwan - 140 MW combined cycle power plant Sriracha Thailand - 180 MW combined Cycle Power plant at Yarnima WA **General Manager Operations AE&E** - Prony 2, 100 MW power plant - Alcan Gove, 260 T/H oil fired boiler - Sembcorp Cogen project - Condamine Combined Cycle power plant - Sino Iron 450 MW Combined cycle power plant - Worsley multi-Fuel power plant **Project director Alstom Power** - Milan Italy - Large HRSG projects Asia **Global Product Manager** GT26, 260 MW gas turbine and HRSG **ABB Australia, Project Manager** - Biomass fired boilers Nghe An Tate & Lyle Sugar Vietnam - Combined cycle power plant New Zealand - Various package boilers Thailand

			- NSW Robotics manager - Projects manager for materials handling division
Alan Hamilton	Commissioning Manager	35	**Lead commissioning Engineer/manager** - Waste to Energy Facility Kwinana WA - Springvale Mt Piper Power Station water treatment Facility - West Angelas Power station Pilbara WA - Diamantina 64 MW Power Station QLD - Worsley multi fuel Cogeneration project - Mortlake 2x 280 MW Gas fired power station Victoria - Prony 2x 55 MW power plant New Caledonia **Project Engineer Steinmuller South Africa,** - Managing power station outage and service work for various Eskom Power stations
Kim Harvey	Maintenance Manager	44	Maintenance Manager/Asset Manager, Verdant Earth Technologies Schedule lead /maintenance Planning - Capital projects, AGL Bayswater Power Station - Outage planning coordination AGL Bayswater and Liddell power stations - BHP Mt Arthur coal

			Construction/mechanical Supervisor - Australian Pressure Testing Services Woodside - BLH Engineering Olympic Dam - Mt Isa servicing Central QLD **IT systems Engineer Liddell and Bayswater Power Stations** **Field Service Technician Kununurra WA** **Aircraft Maintenance Fitter, Royal Australian Air Force**
Grahame Dicker	Operations Manager	37	**Power plant operations** 1. Operations manager Verdant earth Technologies – Redbank Power station. 2. Shift Controller - Queensland Alumina 3. Operations Manager - Redbank Power station 4. Production controller – CS Energy • Nabalco Utilities **Maintenance Supervisor – Ford Timbers**

			Fitter and turner/operations – Royal Australian Navy
Philip Warwick	Electrical Engineering and Construction manager	29	**Commissioning Manager** • Sunraysia Solar farm – 200 MWac NSW • Agon Pacific - 100MW CFB plant Philippines • Mumbida – 55MW Wind farm Geraldton WA **E&I lead and Commissioning Engineer** • Cape Lambert Power station WA • Wheatstone LNG project WA • Condabri Central Water treatment plant – Miles QLD • Yarmina Combined Cycle power plant WA • West Angelas power station WA • Jimblebar Iron Ore Project WA • Kwinana Power Station 2 x 100 MW gas turbines • Condamine combined Cycle Power Plant • Ravensthorpe Nickel project • Alcan Gove expansion NT • Mitr Pohl project Thailand • Quarantine Power Station SA • Redbank Power Station NSW • Anaconda Nickel WA

			Project Engineer • Rockwool Insulation Factory Map Ta Phut Thailand • Guandong Glass Wool Factory China
George Barbu	Project Manager	25	Procurement Specialist – ArcBlue Consulting Program delivery Manager – Department of Agriculture, Water and the Environment **Contracts Manager** – Sydney Water Corporation **Project delivery manager** – Schenk Process Australia **Manager – industrial and power group** – SMEC Australia **Senior Projects/Contracts Manager** – various projects AE&E Australia service group **Senior Projects/Contracts Manager** – various projects – Alstom Power Service division
Angela van der Kroft	OHSE Manager	17	**Health Safety and Environment Manager** – Verdant Earth technologies – Redbank Power Station **Environment and Community officer** • Glencore Coal – United Wambo Joint Venture

			• Centennial Coal – Myuna Colliery • Glencore – Baal Bone Colliery • Glencore – Ulan Coal Colliry • Hunter Enviro Mining operations • Redbank power Station **Chemical Engineer HRL Technologies**
Ronald Pfeiffer	Operations Shift Manager	38	**Senior Operator/ Mechanical Supervisor** - Verdant Earth Technologies Hunter Valley **Operations manager** - Hyrock Fly Ash- Bayswater Power Station **Service and Maintenance Supervisor** - various power stations with Multivalve flow Services **Senior Shift Supervisor** – Redbank Power station **Maintenance fitter/coordinator** – Redbank Power station **Advance class mechanical fitter** - AGL Liddell power station

Christopher Bryant	Operations Shift Manager	33	**Senior Operator/ Mechanical Supervisor** - Verdant Earth Technologies Hunter Valley Workshop Leading Hand – Fitter Welder Service and Maintenance Supervisor various power stations with Multivalve flow Services Senior operator maintainer Redbank Power Station Worksop Supervisor Fitter – Redbank Power Station Fitter Machinist and boilermaker – Northpower power plant
Joseph Barnet	Maintenance supervisor	23	Mechanical maintenance fitter boilermaker – Verdant Earth Technologies Hunter Valley Maintenance Fitter boilermaker • Integra Mining operations • Rus Mining Services • G.A Hayward engineering Construction Supervisor – various projects PPW Engineering
David Sachse	Electrical, Instrumentation and	44	**Outage Commissioning Coordinator**

	controls Technician/supervisor		Chandler Mcleod - AGL Bayswater power station, Boiler, Turbine, Generator, HV and LV Switchboards, DC Supplies, Transformers, and Cooling System **Plant outage maintenance coordinator/Supervisor - Electrical, instruments and mechanical plant** PGSR /Toshiba - Liddell power station Slade Industries Tarong power station QLD Sino Iron Power station WA **Commissioning Supervisor/Coordinator** **Austrian Energy and Environment** Thailand various new projects over 4 years Prony Energy New Caledonia Biomass project at Pioneer sugar mill QLD Savanah Sugar mill power plant Mauritius SembCorp power plant Singapore **Site Engineer/Contract administrator - ABB/Alstom** Various projects Vietnam, Norther Territory, QLD, Biomass and gas fired plants Palmer Electrics, Marine, Commercial and Domestic contracting and services

Joseph Rodrom	Electrical and Instrumentation Supervisor	23	Instrument and Verdant Earth Technologies Hunter Valley Instrument Electrician – Port Macquarie Hastings Council Instrument Electrician and trainee operator – Redbank Power Station Electrician; • Pat Hogan Electrics, Oberon NSW • Interpower Australia, Perth WA • Peak Gold mine, Cobar NSW
Operators Previously employed at Redbank	12 persons	Average 13 years operating experience total of **156** years	The previously employed operators whilst they came from different operating backgrounds they were trained and employed at Redbank from 2000 December 2014. They found jobs in locally existing coal fired power plants but are scheduled for decommissioning. Those operators are very keen to return to Redbank and are awaiting for approvals to be granted prior to us starting with reemployment.
Total Years experience		**711**	

List of personnel already engaged and targeted for the return to Verdant Earth Technologies to source and process Feedstock Fuels

Key personnel	Title	Years of Experience	Major projects involvement
Mike Haywood	General Manager Sustainable Energy and Feedstock Fuels	28	• With 30 years working in the waste management field, Mike has developed a significant network of highly professional waste management peers and legislators. • Mike is recognised as a national leader in the waste and resource recovery field with a capacity to engage with senior and board level management as well as the operational, service and sales divisions. • Mike Haywood's Sustainable Resource Solutions • Currently engaged by Verdant Earth Technologies Ltd. My current role includes: ➢ Managing the planning approvals and licensing process ▪ Gaining the SSD to restart Redbank ▪ Seeking a variation to EPL 11262 ▪ Gaining Resource Recovery Orders and Exemptions

			➢ Feedstock fuels sourcing ▪ Invasive Native Species ▪ Approved Land Clearing ▪ Purpose Grown Biomass Fuels ▪ Once approved DBF ➢ Laboratory Analysis (QA/QC Program) ➢ Feedstock processing ▪ Mobile Plant and Equipment Operations ▪ Site Logistics ▪ Transport Management ▪ Tipping and Feedstock Storage General Manager ResourceCo Pty Ltd **DESIGN AND PROCESS WASTE CONCRETE, BRICKS AND RUBBLE INTO PAVEMENT MATERIALS** ➢ Develop the market for the receipt of Inert C&D waste materials for processing into a wide range of quarry equivalent pavement materials. ➢ Developed and maintained end user markets for a wide range of recycled Pavement materials.

			➢ In conjunction with Transport SA, developed the Part R15 Pavement Material Specifications for Recycled Products. ➢ Undertook trials for the design and development of cement stabilised Pavement materials from recycled crushed concrete. ➢ Undertook trials and developed mix designs for wet mix concrete in conjunction with CSIRO. ➢ Developed and implemented the reuse of crushed asphalt treated with a cold emulsion to produce Bitumix an alternative to stabilised quarry materials, deep lift asphalt and spray seal. **LICENCING AND ENVIRONMENTAL COMPLIANCE** ➢ Gain Development Approvals and EPA Licences for: ▪ Lonsdale Mixed Waste Recycling & Concrete Crushing Plant. ▪ The Alternative Fuels Company. ▪ Lot 202 Clean Fill Land Reclamation Facility. ➢ Develop and implement Environmental Management Plans (EMP) and Environment Improvement Plans (EIP) for all ResourceCo facilities and processes. **THE ALTERNATIVE FUEL COMPANY - ALTERNATIVE FUELS PROJECT**

			➢ The development of the Alternative Fuels project a joint venture between ResourceCo and the Adelaide Brighton Cement Company. ➢ Develop audit protocols to determine composition of Engineered Fuel produced by: ▪ Sorting mixed dry construction, demolition, commercial and industrial waste streams. ▪ Removing the inert and metallic fractions. ▪ Reducing the combustible fraction to a consistent 25mm minus. ▪ Ensuring Ash content <18% and Moisture <20%. ➢ Undertake trials to process sorted waste materials to meet required specification of end user, in this case Adelaide Brighton Cement Company. ➢ Designed and managed the processing and material specifications to produce engineered fuels for use in highly intensive energy processes. ➢ Design and implement small scale processing line for 12-month evaluation trials. ➢ Design best case materials trial for stack emissions testing to ensure environmental compliance at full scale operation.

- Visit similar sites in Europe to determine best practise equipment for full scale processing facility.
- Design and implement full scale processing line to process up to 140,000 tonnes per annum of Alternative Fuel to specification required by end user customer.
- Oversee development and implementation of OH&S Operational Policies and

BOARDS & ASSOCIATIONS

1997 - 2003	Board Member	Keep South Australia Beautiful (KESAB)
2003 – 2023	Member	Waste Management Association Australia
2003 – 2007	SA Branch President	Waste Management Association Australia
2003 – 2007	Inaugural Board Member	Zero Waste SA (Green Industries SA)
2007 – 2011	National President	Australian Council of Recycling (ACOR)
2008 – 2012	Advisory Board Member	Zero Waste SA Research Centre for Sustainable Design and Behaviour (sd+b)

			2012 – 2014 Board Member Keep South Australia Beautiful (KESAB) 2014 – Present Member Australian Industrial Ecology Network (AIEN) 2016 - 2019 Member AIEN Energy from Waste Forum organising Committee 2018 - Present Director Australian Industrial Ecology Network (AIEN)
Gary Roberts	Feedstock Sourcing, Processing and Logistics Manager	25 Years	• Gary is an experienced professional with over 25 years of expertise in the recycling, biomass, and forestry industries. • Proven track record in sales, business development, project management, and operations across the Oceania region, Asia, and North America. • Strong background in managing large-scale projects, optimizing performance KPIs, and driving profitability. • Holds a degree in Logistics and Business Management with hands-on leadership in both corporate and operational environments. **Professional Experience** • Dealer Manager, Oceania Region Major Biomass Company — Asia, Australia, New Zealand

			➢ Managed dealership operations across Oceania, including Asia, Australia, and New Zealand. ➢ Led business development initiatives, increasing market share and revenue. ➢ Provided training and support for biomass equipment operations and maintenance • Owner, National Dealership Major Biomass Company — Australia ➢ Owned and operated a national dealership specializing in biomass equipment. ➢ Oversaw sales, service, and customer support operations. ➢ Built strong relationships with key stakeholders and industry leaders • General Manager Various Companies — Australia & International ➢ Managed budgets, performance KPIs, and operational efficiency for major recycling projects. ➢ Worked closely with forestry contractors to enhance performance and quality outcomes. ➢ Led cross-functional teams in diverse environments.

			• Project Manager Microchip Facilities — Indonesia & St. John, Canada ➢ Successfully project-managed the development of microchip facilities. ➢ Coordinated international teams, vendors, and contractors to ensure timely project completion. ➢ Focused on sustainability and operational efficiency in biomass processing. ➢ Sales Representative & Business Development • Manager Various Machinery Sales and Processing Equipment Companies ➢ Drove sales growth in recycling and biomass sectors. Identified new business opportunities and developed strategic partnerships. ➢ Delivered client-focused solutions to meet industry demands. • Contract Stream Manager Linfox — Australia1986 – 1998 ➢ Started as a Heavy Vehicle Allocator and progressed to Contract Stream Manager.

			➢ Managed logistics operations, fleet coordination, and contract management. ➢ Oversaw performance metrics and improved operational workflows. Key Projects & Achievements ✓ Project management of microchip facilities in Indonesia and St. John, Canada. ✓ Development of major recycling projects for companies such as: • Midway LTD • Australian Native Landscapes, • Suez Environmental, • Forest and Wood Products Australia, • Timber Link, • Solo Resource Recovery, and • C3 Forestry Operations (NZ & AU). ✓ Implementation of performance and quality KPIs with forestry contractors. Education Bachelor’s Degree in Logistics and Business Management Earned through a scholarship University of Victoria 1993. Skills • Project Management & Operations • Business Development & Sales • Recycling & Biomass Industry Expertise • Forestry Performance & Quality KPIs

			• Budget Management & Profitability • Team Leadership & Training • International Market Expansion • Logistics & Supply Chain Management

Appendix D FiCirc Boiler Performance for Bush Fire Damaged Tree Trunk Sample at Various Moisture Levels (B&PPS Report C12148-01)

Boiler & Power Plant Services Pty Ltd

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HUNTER ENERGY
Redbank Power Station
FiCirc Boiler Performance
for
Bush Fire Damaged Tree Trunk Sample
at
Various Moisture Levels

B&PPS Report C12148-01

2	Bone dry to tables 1 and 2 and yearly usage	12 Jun 2020	G Lowry	
1	Issued to Client	10 Jun 2020	G Lowry	
Issue	Description	Date	By	Reviewed

1. Purpose

B&PPS have been engaged by Hunter Energy to investigate the anticipated effect on the performance of the FiCirc boilers when using bush fire damaged tree trunks at various as fired moisture.

The items of interest included:

- Fuel, ash, air & flue gas flows
- Boiler efficiency
- Bed, Cyclone and baghouse flue gas temperatures
- Steam temperature and attemperation
- Emissions - CO2, SOx, ash & dust, and particulates

2. Basis of Performance Runs

The boiler performance runs were based on the boilers operating at MCR and firing wood using an analysis based on the average of three samples taken from the top, middle and bottom from one bush fire damaged tree trunk (See SGS analytical report in Appendix A) and adjusted to four "as fired" moisture levels: 15%, 25%, 35% and 45% as per Table 1. Note that Table 1 also provides comparison with BDT, BUF and a typical Recovered Waste Wood.

Table 1 Base Fuel Analyses

Comparison of analyies of BDT, BUF and Wood		Hunter Energy Tree Sample	Hunter Energy Tree Sample	Hunter Energy Tree Sample	Hunter Energy Tree Sample	Typical Recovered Waste Wood	BDT Ave HRL 2005	BUF Ave HRL 2005
BASIS		As Fired 15%	As Fired 25%	As Fired 35%	As Fired 45%	As Fired 15%	As Fired 33.4%	As Fired 9.7%
C	% Mass	43.94	38.77	33.60	28.43	42.98	39.03	52.24
H	% Mass	5.11	4.51	3.91	3.31	5.07	2.41	3.30
N	% Mass	0.15	0.14	0.12	0.10	0.01	0.89	1.13
S	% Mass	0.04	0.04	0.03	0.03	0.06	0.32	0.42
O	% Mass	35.30	31.15	27.00	22.84	35.69	4.88	7.16
H2O	% Mass	15.00	25.00	35.00	45.00	15.00	33.40	9.70
ASH	% Mass	0.45	0.40	0.35	0.29	1.19	19.08	26.05
TOTAL	% Mass	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Bone Dry Mass	kg/100kg	85	75	65	55	85	67	90
ASH	% Mass db	0.53	0.53	0.53	0.53	1.40	28.65	28.85
Gross CV	MJ/Kg	17.24	15.21	13.18	11.15	16.86	16.01	21.40
Nett CV	MJ/Kg	15.74	13.60	11.46	9.32	15.37	14.66	20.44
GCV daf	MJ/Kg	20.39	20.39	20.39	20.39	20.11	33.68	33.31

Ave HRL 2005 = As fired samples during HRL performance test in 2005. Used in table 2 & 3.
Bone dry = dried in an oven at 100ºC

Depending on the origin, preparation, handling and storage, stored wood chips and pellets can have a moisture level between about 15% to 25%. while freshly hogged wood and logs can have moisture levels up to about 55%.

3. Results

A boiler performance model was run at four "as fired" moisture levels as summarised in Table 2 (columns 16,17,18 &19) and compared to typical existing performance firing 80% BDT and 20% BUF. (Column A).

Table 3 compares the performance with the anticipated boiler performances from an earlier B&PPS report C12116-01 which looked at various combinations of BDT/wood pellets and BUF combinations.

Table 2 Anticipated Performance firing Fire Damaged Trees (note two boilers operating)

Column		16	17	18	19	A
Case		Hunter Tree Analysis SGS 15% H2O	Hunter Tree Analysis SGS 25% H2O	Hunter Tree Analysis SGS 35% H2O	Hunter Tree Analysis SGS 45% H2O	BDT/BUF 80%/20% Warkworth 2005 33.4%/9.7% H2O
% Boiler MCR (261 t/h)		100%	100%	100%	100%	100%
No of Boilers Operating		2	2	2	2	2
Total Steam Flow	t/h	522	522	522	522	522
Steam Press	Mpa	10.60	10.60	10.60	10.60	10.60
Steam Temp	°C	513	513	513	513	513
Feed Temp	°C	189	189	189	189	189
Excess air	%	25	25	25	25	25
Combustion air	t/h	620.1	638.1	663.2	701.6	642.4
	% of Base	96.5%	99.3%	103.2%	109.2%	100.0%
Heat to Steam	MW	376.7	376.7	376.7	376.7	376.7
Boiler Efficiency	% GCV	81.63	79.32	76.32	72.14	83.00
	% of Base	98.3%	95.6%	92.0%	86.9%	100.0%
Fuel						
Total Fuel	MW	461.5	474.9	493.6	522.2	453.9
	% of Base	101.7%	104.6%	108.7%	115.1%	100.0%
		100%	103%	107%	113%	
"As fired" Flow	t/h	96.2	112.2	134.6	168.3	96.8
(8000hrs @ MCR)	t/year	769,752	897,718	1,076,550	1,346,089	774,783
	% of Base	100%	117%	140%	175%	
"Bone Dry" Flow	t/h	81.8	84.2	87.5	92.5	
(8000hrs @ MCR)	t/year	654,289	673,288	699,758	740,349	
	% of Base	100%	103%	107%	113%	
BDT Flow	t/h	0.0	0.0	0.0	0.0	81.6
CO2	kg/h	0.0	0.0	0.0	0.0	113.9
Moisture	% mass	15.0	25.0	35.0	45.0	33.4
Ash	% mass	0.45	0.40	0.35	0.29	19.08
GCV	MJ/kg	17.24	15.21	13.18	11.15	16.01
RWW Flow	t/h	96.2	112.2	134.6	168.3	0.0
CO2	t/h	149.7	154.1	160.1	169.4	0.0
Moisture	% mass	15	25	35	45	15
Ash	% mass	0.45	0.40	0.35	0.29	1.19
GCV	MJ/kg	17.24	15.21	13.18	11.15	16.86
BUF Flow	t/h	0.0	0.0	0.0	0.0	15.3
CO2	t/h	0.0	0.0	0.0	0.0	28.2
Moisture	% mass	9.7	9.7	9.7	9.7	9.7
Ash	% mass	26.05	26.05	26.05	26.05	26.05
GCV	MJ/kg	21.40	21.40	21.40	21.40	21.40
Flue Gas Flow	t/h	714.3	748.2	795.6	867.6	718.3
Flow	% of Base	99.4%	104.2%	110.8%	120.8%	100%
at A/H exit	°C	156	161	168	178	152
Flow	Am3/h	868,509	930,324	1,018,498	1,154,826	862,289
Flow	% of Base	100.7%	107.9%	118.1%	133.9%	100%
Bed SEF		0.99	0.93	0.99	1.00	0.91
Bed Temp	°C	830	830	790	760	851
Cyclone Exit	°C	945	943	918	898	851
Overbed Comb.	%	20	20	20	20	11
Attemp Flow	% Steam Flow	7.7%	10.0%	11.0%	13.6%	0.0%
Limestone flow	kg/h	0	0	0	0	960
	% of Base	0.0%	0.0%	0.0%	0.0%	100%
Sulpur removal	%	0.0	0.0	0.0	0.0	46.5
SOx to Stack	kg/h	81	84	87	92	346
	mg/Nm3*	144	144	144	144	600
CO2 Flow	kg/h	149,746	154,086	160,132	169,405	142,141
Flow	% of Base	105.4%	108.4%	112.7%	119.2%	100%
		100%	103%	107%	113%	
Exclude from Wood	kg/h	0	0	0	0	142,141
Exclude from Wood	% of Base	0.0%	0.0%	0.0%	0.0%	100%
Dust to baghouse	kg/h	1,913	1,968	2,045	2,164	15,085
Dust Stack Exit	mg/Nm3*	<50	<50	<50	<50	<50
Total residue flow	kg/h	2,013	2,072	2,153	2,278	21,550
	% of Base	9.3%	9.6%	10.0%	10.6%	100%

*= dry at 7% O2

Table 3 Anticipated Boiler performance compared with results from Report B&PPS C12116-01 (note two boilers operating

Column		A	B	C	D	E	F	G	H	I	J	K	L	13	14	15	16	17	18	19
Case		BDT/BUF 80%/20% Warkworth 2005 33.4%/9.7% H2O	BDT/BUF 80%/20% Warkworth 2005 30%/9.7% H2O	BDT/BUF 80%/20% Warkworth 2005 25%/9.7% H2O	BDT/BUF 80%/20% Warkworth 2005 17%/9.7% H2O	BDT/BUF 80%/20% Warkworth 2005 10%/9.7% H2O	Pellets/RWW/BUF 60%/20%/20% Warkworth 2005 17%/15%/9.7%H2O	Pellets/RWW/BUF 50%/30%/20% Warkworth 2005 17%/15%/9.7%H2O	Pellets/RWW/BUF 40%/40%/20% Warkworth 2005 17%/15%/9.7%H2O	BDT 100% Warkworth 2005 33.4% H2O	BDT/BUF 50%/50% Warkworth 2005 33.4%/9.7% H2O	BUF 100% Warkworth 2005 9.7% H2O	BDT 100% CDS 30% H2O 8.77% As	BDT 100% Warkworth 2005 17% H2O	Wood (RWW) 100% Typical 15% H2O	Wood/BUF 80%/20% Warkworth 2005 15%/9.7% H2O	Hunter Tree Analysis SGS 15% H2O	Hunter Tree Analysis SGS 25% H2O	Hunter Tree Analysis SGS 35% H2O	Hunter Tree Analysis SGS 45% H2O
% Boiler MCR (261 t/h)		100%	100%	100%	100.7%	101.3%	100%	100%	100%	100%	100%	100%	100%	100.9%	100%	100%	100%	100%	100%	100%
No of Boilers Operating		2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
Total Steam Flow	t/h	522	522	522	525	529	522	522	522	522	522	522	522	527	522	522	522	522	522	522
Steam Press	Mpa	10.60	10.60	10.60	10.60	10.60	10.60	10.60	10.60	10.60	10.60	10.60	10.60	10.60	10.60	10.60	10.60	10.60	10.60	10.60
Steam Temp	°C	513	513	513	507	500	513	513	513	513	513	513	513	504	513	513	513	513	513	513
Feed Temp	°C	189	189	189	189	189	189	189	189	189	189	189	189	189	189	189	189	189	189	189
Excess air	%	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25
Combustion air	t/h	642.4	637.0	630.2	621.2	614.8	620.2	619.5	618.9	649.4	632.1	615.7	644.4	622.8	618.3	617.5	620.1	638.1	663.2	701.6
	% of Base	100.0%	99.2%	98.1%	96.7%	95.7%	96.5%	96.4%	96.3%	101.1%	98.4%	95.8%	100.3%	96.9%	96.3%	96.1%	96.5%	99.3%	103.2%	109.2%
					100%		99.8%	99.7%	99.6%											
Heat to Steam	MW	376.7	376.7	376.7	376.8	376.9	376.7	376.7	376.7	376.7	376.7	376.7	376.7	376.9	376.7	376.7	376.7	376.7	376.7	376.7
Boiler Efficiency	% GCV	83.00	83.69	84.60	85.85	86.76	85.24	84.93	84.61	82.26	84.38	86.07	83.79	85.83	81.46	82.52	81.63	79.32	76.32	72.14
	% of Base	100.0%	100.8%	101.9%	103.4%	104.5%	102.7%	102.3%	101.9%	99.1%	101.7%	103.7%	101.0%	103.4%	98.2%	99.4%	98.3%	95.6%	92.0%	86.9%
Fuel																				
Total Fuel	MW	453.9	450.1	445.3	438.9	434.4	442.0	443.6	445.3	457.9	446.5	437.7	449.6	439.2	462.4	456.5	461.5	474.9	493.6	522.2
	% of Base	100.0%	99.2%	98.1%	96.7%	95.7%	97.4%	97.7%	98.1%	100.9%	98.4%	96.4%	99.1%	96.8%	101.9%	100.6%	101.7%	104.6%	108.7%	115.1%
					100%		100.7%	101.1%	101.4%								100%	103%	107%	113%
Flow	t/h	96.8	92.1	86.0	78.0	72.4	81.1	82.8	84.5	102.9	87.7	73.5	82.5	79.2	98.6	93.2	96.2	112.2	134.6	168.3
	% of Base	100%	95%	89%	81%	75%	84%	85%	87%	106%	91%	76%	85%	82%	102%	96%	99%	116%	139%	174%
					100%		104.0%	106.1%	108.3%								100%	117%	140%	175%
BDT Flow	t/h	81.6	76.8	70.7	62.8	57.1	49.4	42.2	34.6	102.9	50.2	0.0	82.5	79.2						
CO2	kg/h	113.9	112.7	111.2	109.2	107.8	86.1	73.7	60.7	190.5	92.9	0.0	152.7	137.8						
Moisture	% mass	33.4	30.0	25.0	17.0	10.0	17.0	17.0	17.0	33.4	33.4	33.4	30.0	17.0						
Ash	% mass	19.08	20.05	21.49	23.78	25.78	23.78	23.78	23.78	19.08	19.08	19.08	8.77	23.78						
GCV	MJ/kg	16.01	16.82	18.03	19.95	21.63	19.95	19.95	19.95	16.01	16.01	16.01	19.60	19.95						
RWW Flow	t/h						16.5	25.3	34.62						98.6	78.0	96.2	112.2	134.6	168.3
CO2	t/h						25.1	38.5	52.71						150.1	118.7	149.7	154.1	160.1	169.4
Moisture	% mass						15	15	15						15	15	15	25	35	45
Ash	% mass						1.19	1.19	1.19						1.19	1.19	0.45	0.40	0.35	0.29
GCV	MJ/kg						16.86	16.86	16.86						16.86	16.86	17.24	15.21	13.18	11.15
BUF Flow	t/h	15.3	15.3	15.3	15.3	15.3	15.3	15.3	15.3	0.0	37.5	73.5				15.3				
CO2	t/h	28.2	28.3	28.2	28.2	28.2	28.3	28.2	28.2	0.0	69.4	136.1				28.2				
Moisture	% mass	9.7	9.7	9.7	9.7	9.7	9.7	9.7	9.7	9.7	9.7	9.7				9.7				
Ash	% mass	26.05	26.05	26.05	26.05	26.05	26.05	26.05	26.05	26.05	26.05	26.05				26.05				
GCV	MJ/kg	21.40	21.40	21.40	21.40	21.40	21.40	21.40	21.40	21.40	21.40	21.40				21.40				
Flue Gas Flow	t/h	718.3	708.3	695.6	679.0	667.2	684.1	686.7	689.5	731.4	699.0	668.5	718.4	681.9	714.2	704.3	714.3	748.2	795.6	867.6
Flow	% of Base	100%	98.6%	96.8%	94.5%	92.9%	95.2%	95.6%	96.0%	101.8%	97.3%	93.1%	100.0%	94.9%	99.4%	98.0%	99.4%	104.2%	110.8%	120.8%
					100%		100.7%	101.1%	101.6%											
at A/H exit	°C	152	150	149	146	144	148	149	150	154	149	145	152	146	157	154	156	161	168	178
Flow	Am3/h	862,289	844,461	821,832	792,261	771,430	803,797	809,682	816,270	885,536	828,049	774,381	861,585	797,068	869,485	848,785	868,509	930,324	1,018,498	1,154,826
Flow	% of Base	100%	97.9%	95.3%	91.9%	89.5%	93.2%	93.9%	94.7%	102.7%	96.0%	89.8%	99.9%	92.4%	100.8%	98.4%	100.7%	107.9%	118.1%	133.9%
					100%		101.5%	102.2%	103.0%											
Bed SEF		0.91	0.89	0.86	0.87	0.89	0.93	0.95	0.96	0.91	0.89	0.87	1.01	0.87	0.99	1.00	0.99	0.93	0.99	1.00
Bed Temp	°C	851	861	875	880	880	842	830	830	846	860	876	868	880	830	843	830	830	790	760
Cyclone Exit	°C	851	858	869	873	874	877	878	890	841	866	892	851	868	945	926	945	943	918	898
Overbed Comb.	%	11	11	11	11	11	15	16	17	10	12	14	10	10	20	18	20	20	20	20
Attemp Flow	% Steam Flow	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.2%	1.4%	0.0%	0.0%	0.0%	0.0%	0.0%	7.7%	5.4%	7.7%	10.0%	11.0%	13.6%
Limestone flow	kg/h	960	952	941	928	918	647	500	345	966	944	931	772	926	0	0	0	0	0	0
	% of Base	100%	99.2%	98.1%	96.7%	95.7%	67.5%	52.1%	35.9%	100.7%	98.4%	97.1%	80.5%	96.5%						
Sulpur removal	%	46.5	46.5	46.5	46.5	46.5	37.9	32.0	24.5	46.4	46.5	46.8	39.8	46.4						
SOx to Stack	kg/h	346	343	339	335	331	335	335	335	350	340	332	347	335	117	222	81	84	87	92
	mg/Nm3*	600	600	600	600	600	600	600	600	600	600	600	600	600	208	396	144	144	144	144
CO2 Flow	kg/h	142,141	140,952	139,441	137,460	136,056	139,443	140,486	141,614	143,727	139,866	136,145	142,820	137,843	150,063	147,065.9	149,746	154,086	160,132	169,405
Flow	% of Base	100%	99.2%	98.1%	96.7%	95.7%	98.1%	98.8%	99.6%	101.1%	98.4%	95.8%	100.5%	97.0%	105.6%	103.5%	105.4%	108.4%	112.7%	119.2%
					100%		101.4%	102.2%	103.0%								100%	103%	107%	113%
Exclude from Wood	kg/h	142,141	140,952	139,441	137,460	136,056	114,381	101,949	88,900	143,727	139,866	136,145	142,820	137,843	0	28,362	0	0	0	0
Exclude from Wood	% of Base	100%	99.2%	98.1%	96.7%	95.7%	80.5%	71.7%	62.5%	101.1%	98.4%	95.8%	100.5%	97.0%	0.0%	20.0%	0.0%	0.0%	0.0%	0.0%
					100%		83%	74%	65%											
Dust to baghouse	kg/h	15,085	14,959	14,799	14,589	14,440	12,354	11,803	11,159	15,091	14,923	14,966	8,074	14,472	2,615	5,450	1,913	1,968	2,045	2,164
Dust Stack Exit	mg/Nm3*	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50
Total residue flow	kg/h	21,550	21,370	21,141	20,841	20,628	17,648	15,929	14,125	21,558	21,319	21,379	8,972	20,674	2,753	6,412	2,013	2,072	2,153	2,278
	% of Base	100%	99.2%	98.1%	96.7%	95.7%	81.9%	73.9%	65.5%	100.0%	98.9%	99%	42%	95.9%	12.8%	29.8%	9.3%	9.6%	10.0%	10.6%
					100%		84.7%	76.4%	67.8%											

*= dry at [illegible]

4. Discussion of Results

The effect on the performance of the Redbank boilers by varying the moisture in the fire damaged tree trunk between 15% to 45% is given in Table 2 columns 16 to 19 respectively at 100% MCR heat-to-steam.

There was a large increase in fuel fired. It increased by 75% as the moisture level changed from 15% to 45%. This was due to not only higher amount of moisture in the fuel needed to provide the same heat in the fuel but also to a decrease in efficiency from 81.5% to 72.1% due mainly to the energy lost evaporating the additional moisture.

Emissions of CO2, SOx, ash & dust, and particulates are provided in the tables.

The anticipated bed and cyclone temperatures are within operating limits but the flue gas flow increases as the moisture in the wood increases. This will limit the output with moistures above about 25%.

Higher than design attemperation is required to control the steam temperature to design value of 513ºC at the higher moisture levels. This could also limit the output with high moisture wood.

The amount of attemperation is highly dependent on the amount of overbed combustion and the amount of bed heating surface. Reducing the amount of overbed combustion and adding additional bed surface would have the effect of reducing the amount of attemperation. 20% overbed combustion has been used as this is the standard value for biomass but it could be argued that this could reduce as the moisture level increases. Further work would be required to further clarify this as changing the amount of above bed combustion and bed surface also alters other parameters such as the bed and cyclone temperatures.

5. Abbreviations Used in This report

BDT	Beneficiated Dewatered Tailings
db	Dry Basis
MCR	Boiler Maximum Continuous Rating (261 t/h at full steam temperature)
BUF	Backup Fuel
GCV	Gross Calorific Value
RWW	Recovered Waste Wood
SEF	Surface Effectiveness Factor
t/h	Tonnes per Hour

6. Appendix A – SGS Sample Analysis

SGS

ANALYTICAL REPORT

NCM20-01874 R0

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BASIS ANALYSIS

PARAMETER	UNIT	Sample A TOP	Sample B MIDDLE	Sample C BOTTOM	Sample ABC COMPOSITE
Moisture, Total	%	16.2	42.3	49.3	-
Moisture, Lab Sample	%	6.3	6.2	6.6	6.7
Ash, As-Determined	%	0.7	0.4	0.4	-
Volatile Matter, As-Determined	%	77.5	78.3	77.9	-
Fixed Carbon (by diff), As-Determined	%	15.6	15.1	15.1	-
Sulfur, S - As-Determined	%	0.06	0.05	0.03	0.04
Gross Calorific Value, As-Determined	kcal/kg	4441	4624	4549	4534
Carbon, As Determined	%	48.0	48.7	48.5	-
Hydrogen, Corrected	%	5.67	5.62	5.60	-
Nitrogen, As-Determined	%	0.25	0.13	0.13	-

Appendix E Woody Biomass Levels on the Cobar Peneplain Bioregion

WESTERN REGENERATION LTD

Woody Biomass Levels Within the Cobar Peneplain Bioregion.

Daryl Green

May 2013

Funded by the Western Catchment Management Authority

Woody Biomass Levels Within the Cobar Peneplain Bioregion.

Daryl Green

Executive Summary

The study was carried out within the Western Catchment area of the Cobar Peneplain Bioregion. The aim was to determine the woody biomass that may be available for removal under an approved Property Vegetation Plan (PVP). The biomass may then be utilized for commercial bio-char and/or bio-energy production.

The area was stratified into seven broad landscape units, based on the landsystems (Walker 1991). Plots were measured on properties with a completed Property Vegetation Plan (PVP), as approved under the NSW Native Vegetation Act (2003). The species approved to be removed under the PVP were measured using diameter at breast height (tree species) or diameter and height (shrub species).

A minimum of 10 plots per landscape unit were measured, with seventy-six plots being measured in the study. Plots were 0.1ha in size and were selected on a semi-random basis, except for a limited number that were selected to represent a specific species or landscape feature.

Regression equations of weight versus dbh (most using log normal transformation) were developed following the destructive sampling of target tree and shrub species. The measurements produced highly significant regression equations and these can be used with confidence, within the range of the original measurements.

Plot weights were calculated for all plots and for each target species per plot, using the regression equations and the measured vegetation characteristics of each plot. Average weights and standard deviations of plot weights were calculated for each landscape unit. The standard deviations are very large, reflecting the very variable nature of the vegetation communities across the Cobar Peneplain, even within the stratified landscapes. Prior to any consideration for a commercial investment, detailed vegetation community mapping of the specific area, to account for this high level of variation, would be recommended before any investment is implemented.

The **maximum** estimated dry matter yield from this study was 117.2 tonnes/ha for the harvesting of woody species up to a size of 30cm dbh. The plot results were too variable to accurately calculate an 'average' yield for all plots. However for indicative purposes, 'average' results have been calculated across the units: to 20 cm dbh – 37.3 tonnes/ha; to 25cm dbh – 45 tonnes/ha and to 30 cm dbh - 49 tonnes/ha. These figures should only be used for broad planning purposes. The yield results are much lower than those obtained by the Buckwaroon Catchment Landcare Group in their pilot study; however they align well with the limited published data on woody biomass yield levels for semi-arid woodlands.

The plot data, calculated weights per species and two photographs of each plot are available in electronic form (disc) as Appendix 1. A species by weight spreadsheet calculator and a plot recording template are also available in electronic form (disc) as Appendix 2.

Introduction

This report has been prepared by Western Regeneration Pty Ltd, with funding provided by the Western Catchment Management Authority.

The project was designed to provide substantiated estimates of woody biomass levels that could be legally accessed, through a Property Vegetation Plan (PVP), across the various landscapes of the Cobar Peneplain Bioregion of New South Wales. The Property Vegetation Plans that were considered in this study were all Invasive Native Scrub (INS) PVPs. The INS PVPs are carried out to rehabilitate land from a degraded, scrubby state towards a mosaic of open grasslands, timbered areas and scrubby patches as defined under the Environmental Outcomes Assessment Methodology of the Native Vegetation Regulation (Anon, 2011). Research reviewed in Anon (2010) strongly supports the ecological principles behind this methodology. The removal of the defined INS species under the Environmental Outcomes Assessment Methodology (Anon, 2011) is generally limited to small trees/shrubs up to 20cm diameter at breast height (dbh). Within some approved INS PVPs local variations have been applied to allow some species to be removed up to 35 cm dbh. Very few PVPs have variations up to 35 cm dbh; however it is common for variations of 25 or 30 cm dbh to be applied, particularly for bimble box (*Eucalyptus populnea*) and white cypress pine (*Callitris glaucophylla*).

There have been several investigations and trials carried out in attempts to economically utilize the legally removed INS species; these are reviewed in Rogan (2011).

The possible use of woody biomass for the production of bio-char and/or energy production had been initially investigated by the Buckwaroon Catchment Landcare Group and more recently, by Western Regeneration Pty Ltd. There is strong interest from commercial companies for the use of this renewable resource for various purposes but in particular for the possible generation of electricity at mining developments, remote from the grid power system. With the current situation regarding climate change and carbon sequestration opportunities there is an ongoing need to substantiate the amount of carbon stored in the woody biomass of all landscapes.

There is very limited data available in the literature relating to woody biomass levels, not only on the Cobar Peneplain, but across most of the dry rangelands of Australia. Harrington (1979) reported on the estimated biomass of a bimble box woodland with an understory of woody shrubs near Coolabah in Western NSW. The study estimated a woody biomass dry matter of 54.8 tonnes/ha for the above ground biomass. The NSW Soil Conservation Service carried out limited analyses of narrow leaved hopbush (*Dodonaea viscosa subsp angustissima*) weights at 'Lynwood' on the edge of the Cobar Peneplain (Walker and Green Unpub.) in the late 1970s.The Buckwaroon Catchment Landcare Group (Higgins, 2012) carried out a pilot study as a precursor to this project. The Landcare Group developed estimates of woody biomass, albeit from limited measurements and including some root mass, levels averaging 150 tonnes/ha dry matter. In addition, the Landcare Group had commercial laboratories carry out tests of the energy value of the woody biomass and the potential for bio char production (Lau, 2010). The results from this pilot encouraged the Landcare Group to seek support for the current study to be undertaken.

There has been limited additional work done in Queensland in bimble box, mulga (*Acacia aneura*) and white cypress pine landscapes (Burrows et al. 2001). Burrows et al (2001) reported woody biomass levels for white cypress pine in western Queensland of about 58 tonnes/ha of above ground biomass in pine forests, with diameter at breast height (dbh) from 2.4- 43 cm.

A review undertaken by Grierson et al (2000) could not find any woody biomass studies relating to White Cypress pine woodlands in NSW. This study also identified that there is a dearth of knowledge regarding woody biomass in the semi-arid areas of NSW for all other species. However Hayman (2009) measured the amount of woody biomass that would be generated from thinning of dense white cypress pine forests at Baradine, NSW and NSW State Forests have also produced several silvicultural publications on white cypress pine.

Overall there has not previously been any published study that has completed a systematic sampling of the vegetation size classes and structure; nor substantiated the weight relationships for woody species or an estimation of woody biomass levels across the Cobar Peneplain.

<u>Methodology</u>

Moisture Contents

The Buckwaroon Catchment Landcare Group collected a forty litre composite sample of woody material and this was sent to a laboratory for testing of moisture content. The author also collected several samples of woody stem material and dried them to air dry and then oven dry, until a constant weight was obtained, to compare with the laboratory measurements of the composite sample.

Vegetation Structure Plots

The study was undertaken within the Western Catchment portion of the Cobar Peneplain Bio-Region in Western New South Wales. The Bio-Region was stratified into seven land types, based on logical combinations of landsystems as described by Walker (1991) See Table 1.

Table 1. Stratification of landscapes on the Cobar Peneplain Bioregion

Description	Landsystems	Properties with vegetation plots	Benson et al (2006) Numbers
1. Clay loam ridges and flats with bimble box, mulga and shrubby woodlands.	Ironstone (Ir), Cobar (Cz), Boulkra (Bk), Wrightville (Wr) (North of Barrier Highway)	Dijoe, Kergunyah, Lyndhurst, Tindarey, Bundella,	(Benson229) (Benson 108)
2. Clay loam ridges and flats with bimble box, white cypress pine and shrubby woodlands.	Ironstone (Ir), Cobar (Cz), Boulkra (Bk), Wrightville (Wr) (South of Barrier Highway)	The Rookery, Gilbert Park, Osterley Downs, Nullawarra, Killala.	(Benson 103) (Benson229) (Benson 72)

3. Loam and sandy loam plains with mulga and ironwood	Coronga (Cg), Kenilworth (Kw)	Toolooly, Pattison, Glenariff, Tindarey, Lyndhurst, Dijoe.	(Benson125) (Benson 104)
4. Slightly undulating rounded lowlands. Variable landscape with patches of mallee, white cypress pine, red box and bimble box.	Kopyje (Kp), Hartwood (Hw), Yackerboon (Yb)	The Rookery, Glenwood, Yarroma, Lowan, Norma Vale.	(Benson 72) (Benson 104)
5. Extensive plains of alluvial soils with white cypress pine, bimble box and yarran patches	Needlewood (Nw), Belford (Bl)	Lowan, Norma Vale, Kia Ora, Osterley Downs.	(Benson 72) (Benson 77)
6. Broad undulating lowlands with scattered granite outcrops with white cypress pine, bimble box and turpentine	Penshurst (Ph), Killara (Ki)	Bedooba, Etiwanda & Manuka. Norma Vale	(Benson 72) (Benson 77)
7. Texture contrast and calcareous red earth plains with few major creek channels (Buckwaroon Creek). White cypress pine, bimble box, yarran shrubby woodlands	Meadows (Me), Cubba (Cx)	Double Gates, The Meadows, Kia Ora, Pine Ridge	(Benson 229) (Benson 77)

Within the identified landscapes, those properties with a current Property Vegetation Plan, as approved under the NSW Native Vegetation Act (2003), were identified. The species and the size classes for those species that could be legally removed under those PVPs were noted. Approval was obtained from each land owner to collect vegetation community data on the areas identified within the PVPs.

The methodology required a minimum of ten plots per landscape type to be measured. Seventy-six plots were measured in the study.

Plot Selection and Layout

Plot selection on each property was done on a standard, semi-random basis by: a) identifying the general area of interest from the Property Vegetation Plan satellite image; b) driving to an identifiable point such as a ground tank, track intersection, gate etc. and selecting a distance (odometer kilometres) that would place the plot in a representative area of the selected landscape; c) plots were alternated between the right hand and left hand sides of direction of travel, unless on a boundary etc. Note: If the location at the designated distance proved to be atypical (eg pushed mulga, small run-on area, burnt etc.) a further 100m was driven to re-locate the plot. d) The plot location for the measurements was done by walking ten paces, perpendicular to the edge of the disturbed area of the road or track, into the vegetation and driving a peg into the ground. e) Vegetation measurement plots were 40x25m (0.1ha) in size, measured from the plot peg; with the 25m side placed parallel to the track and the 40m side running perpendicular to the track. Measuring tapes and squares were used to ensure the correct dimensions were maintained.

Vegetation Plot Measurements

Data collected on each plot were:

- A general site comment regarding the vegetation and soils of the site.
- GPS Location
- Two photographs of the plot – one diagonally across the plot from the site peg and a second photo along the 25m side from the site peg.
- Diameter at breast height (dbh) - over bark at 130 cm high for all target tree species. (Photo 1).
- Tree species recorded were: Mulga (*Acacia aneura*), White Cypress Pine (*Callitris glaucophylla*), Bimble Box (*Eucalyptus populnea*), Red Box (*Eucalyptus intertexta*), Wilga (*Geijera parviflora*), Yarran (*Acacia homalophylla*) and Budda (*Eremophila mitchellii*). Note: trees less than 1cm dbh were not measured.
- Height and diameter of all multi-stemmed target shrub species. Shrub species recorded were Turpentine (*Eremophila sturtii*), Hop bush (*Dodonaea viscosa*) (narrow and broad leaved varieties), Punty bush/silver cassia (*Senna artemisiodes*) and Emu bush (*Eremophila longifolia*). Note: shrubs less than 1m tall were not measured.
- Presence of non-target trees or shrubs on the plot was recorded and for some tree species the dbh was also recorded.

Photo1. Measuring the diameter at breast height (dbh).

Species Weights

A destructive sampling technique was utilized to obtain individual tree/shrub weights for the study. A minimum of twenty individuals of each target species had their dbh or height and diameter recorded and were 'pushed over' by the stick rake attached to a large front end loader; as they would have been in a standard clearing operation. This retained some of the roots attached to the stems but rarely included the total root mass, except for several mulga trees where the root ball was very tightly attached. The amount of dirt included in the root ball was minimized by removing significant amounts manually or by shaking the tree. If this could not be achieved then the tree was weighed as a whole and then the root ball was removed and weighed separately and the percentage root weight estimated for the tree. To help with this estimation a small number of root balls were collected and cleaned using a high pressure hose and then weighed without dirt attached.

Whole trees were weighed using a high lift front end loader, with the tree being suspended from the loader by chains (Photo 2) and then being placed on a platform of (cattle scale) load cells to record the weight. (Photo3) There were some difficulties in ensuring the full weight of the large trees were ‘balancing’ on the platform, (Photo 4) however the operators were very experienced with the machines and the weights are believed to be reasonably accurate. The load cell weights were checked against known weights periodically during the weighing process and following any relocation of the load cells.

Photo 2. Large wilga tree being prepared for weighing

Photo 3. Weighing platform with loads cells located under platform.

Photo 4. Weighing an unwieldy wilga tree.

Results and Discussion

Moisture Contents

Moisture content of the composite woody material collected by the Buckwaroon Catchment Landcare Group and analyzed by Pacific Pyrolysis (Lau, 210) found that the moisture content was at 37%.

A very limited number of small wood samples were also collected during this study, while carrying out plot measurements and are presented below (Table 2). The method used is that described by Hartley and Marchant (1995).

$$\text{Moisture content (\%)} = \frac{\text{Initial mass - Oven-dry mass}}{\text{Oven-dry mass}} \times 100\ (\%)$$

Table 2. Moisture content of wood samples

Species	Weight	Oven dry'	Oven dry' Moisture
Mulga	59	45	31%
Mulga	47	35	34%
Mulga	44	32	38%
Yarran	53	45	18%
Yarran	62	40	55%
Pine	77	57	35%
Pine	50	37	35%
Budda	78	56	39%
Budda	52	35	49%
		Average	37%

The results obtained from the very limited number of samples taken should not be used as conclusive information, as the variability between samples is very high; however the average moisture content equates to that obtained from the composite sample that was analyzed in a laboratory (Lau, 2010). Therefore in calculating the dry weights of the weighed trees the figure of 37% moisture content was used. From the literature this would appear to be a relatively low level of moisture content for standing timber. Anon (2005) stated *'cypress, a softwood that grows in drier areas, may only have average green moisture contents of 45%'*; however Hayman (2009) measured moisture content of 39.7% for white cypress pine in the Baradine area of NSW. The use of 37% moisture content for this study should not be taken as definitive as moisture levels will vary between species, within relative amounts of sapwood versus heartwood and possibly depending on soil moisture content (Chan, et al, 2012). More extensive sampling of all species should be done to substantiate the appropriate level for each species.

Diameter to Weight Relationship

Destructive sampling of trees and shrubs was undertaken to examine the relationship between diameter at breast height (dbh), or diameter by height and dry weight of the target species. Twenty individuals of each species (except mulga) were weighed and their weight and dbh or height by diameter was recorded. These individuals were selected to cover the range of harvestable sizes for each species, although for some species, the smaller size individuals may not be fully represented. The mulga sampling was done in two stages and the second set of data was not usable as the trees that were weighed had significant amounts of damp soil attached to the root ball, therefore an accurate tree weight could not be obtained. It is recommended that, should harvesting of mulga for development purposes be considered, additional weighing of mulga trees be carried out. Mulga trees from the north of the study area, particularly those on sandy loam soils, and a number of trees with dbh sizes below 6cm dbh should be included in any future sampling to ensure that both the geographic distribution and the full range of size classes are included.

Several of the woody species sometimes produce multiple stems and/or branches from below the 130 cm level for standard dbh measurements. This is particularly so for wilga and to a lesser extent for budda and yarran, it also occurs infrequently in other species. To allow for this, the measured weights for multi-stemmed wilga, budda and yarran trees were proportionally distributed between the measured stem dbhs for the analyses. During the plot measurements, multiple stems were recorded and identified in the result sheets.

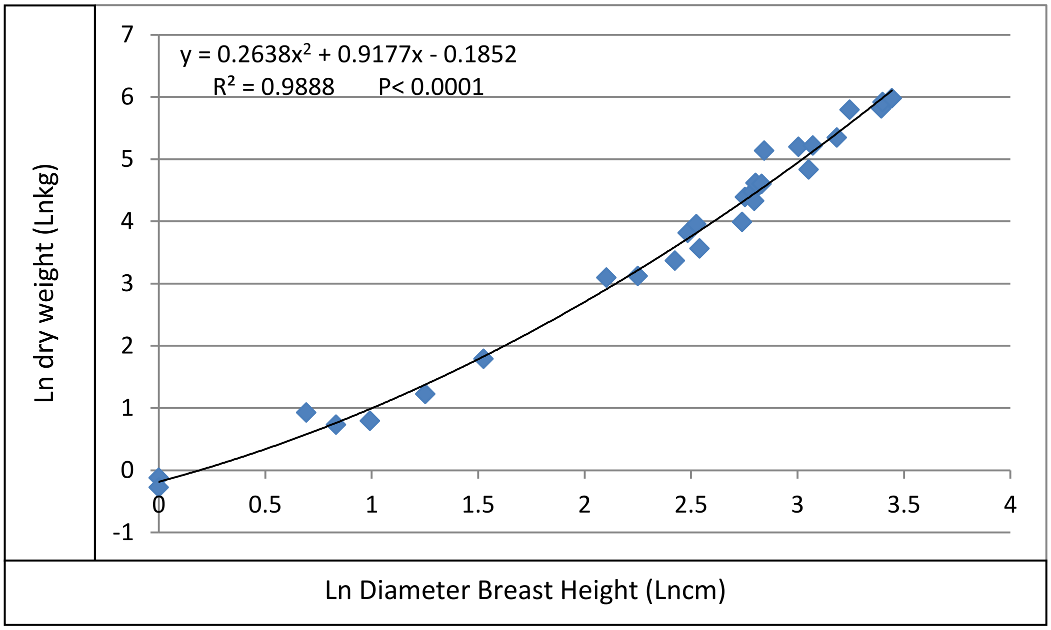
Regression equations were derived and tested to determine the most accurate predictive relationship for each species. Equations were tested against standard dbh (or height by diameter) vs dry weight and lognormal dbh (or height by diameter) vs lognormal dry weight. For all species, except budda the lognormal equation provided the best fit. The use of lognormal transformations for the analysis of biological data is a well-accepted practice, Koen (Pers. com.), Burrows et al (2001), Field (2009).

The regressions with the highest r^2 value were produced by polynomial regression equations as presented below (Graphs 1-8). These were tested for significance by using a spreadsheet tool developed by McDonald (2009) and accessed online. With the assistance of this tool, the most significant value for r^2 was identified for each species.

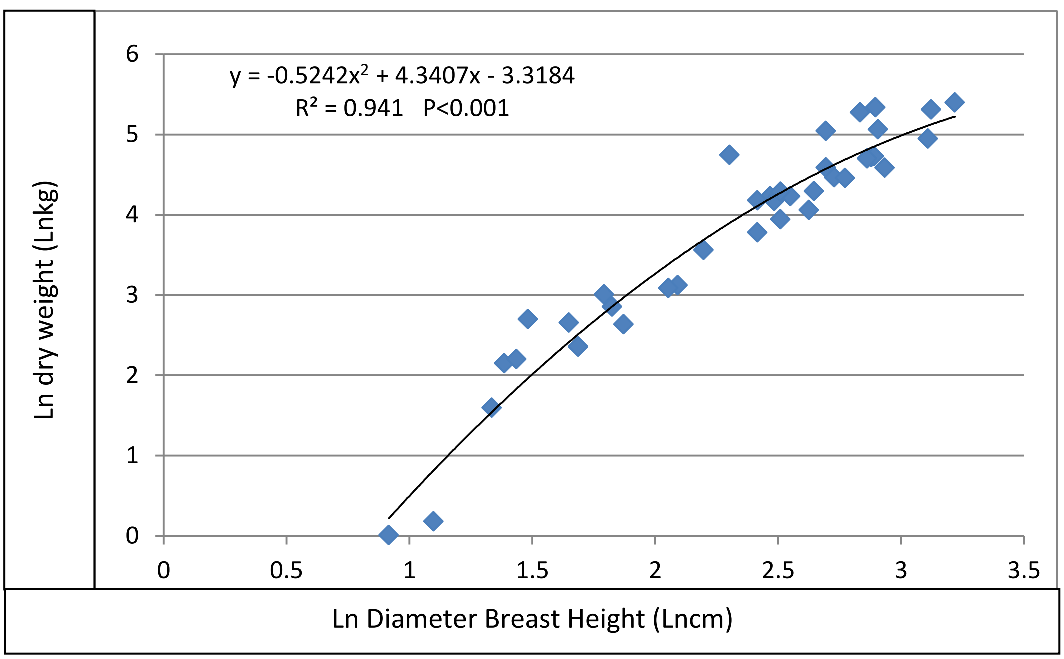
Warning: It is strongly advised that these regression equations are only used for predictive purposes within the original ranges of the data used to develop these equations. Correlations outside the data ranges are likely to generate significant errors, this factor is particularly important at the higher end of the scale as one larger tree will contribute significant extra weight to a measured plot.

The results from this study are presented below, firstly as a set of graphs and regression equations and then a short commentary on each species follows the set of graphs:

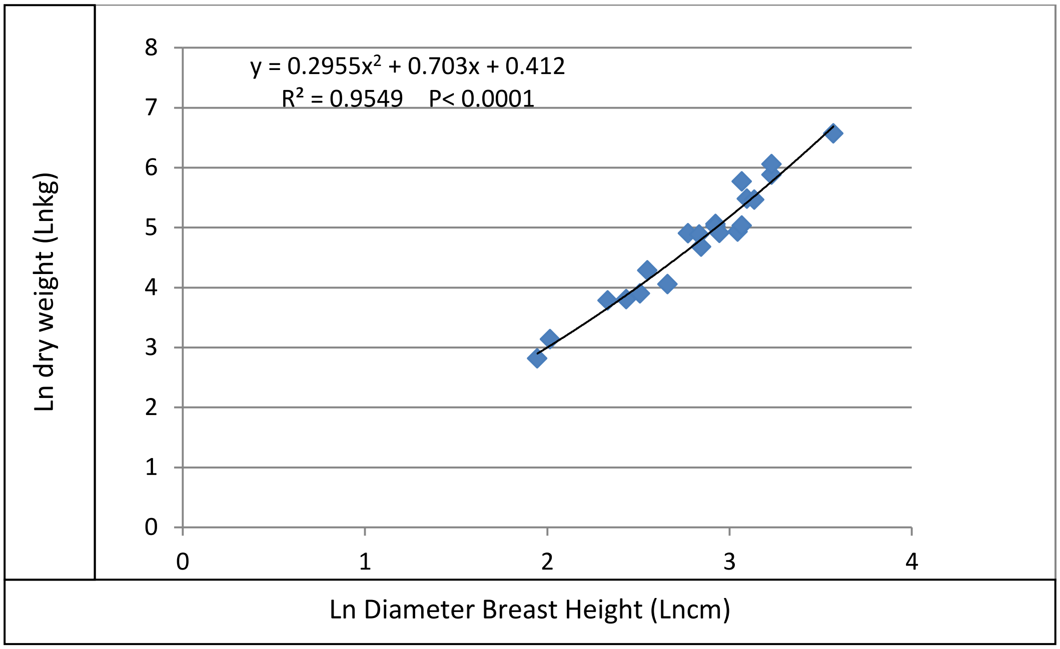
Graph 1. Relationship between log-normal stem diameter (cm) measured at 130 cm above-ground level and log-normal biomass (kg) for white cypress pine *(Callitris glaucophylla).* (Data range: 1 - 31.3 cm dbh)



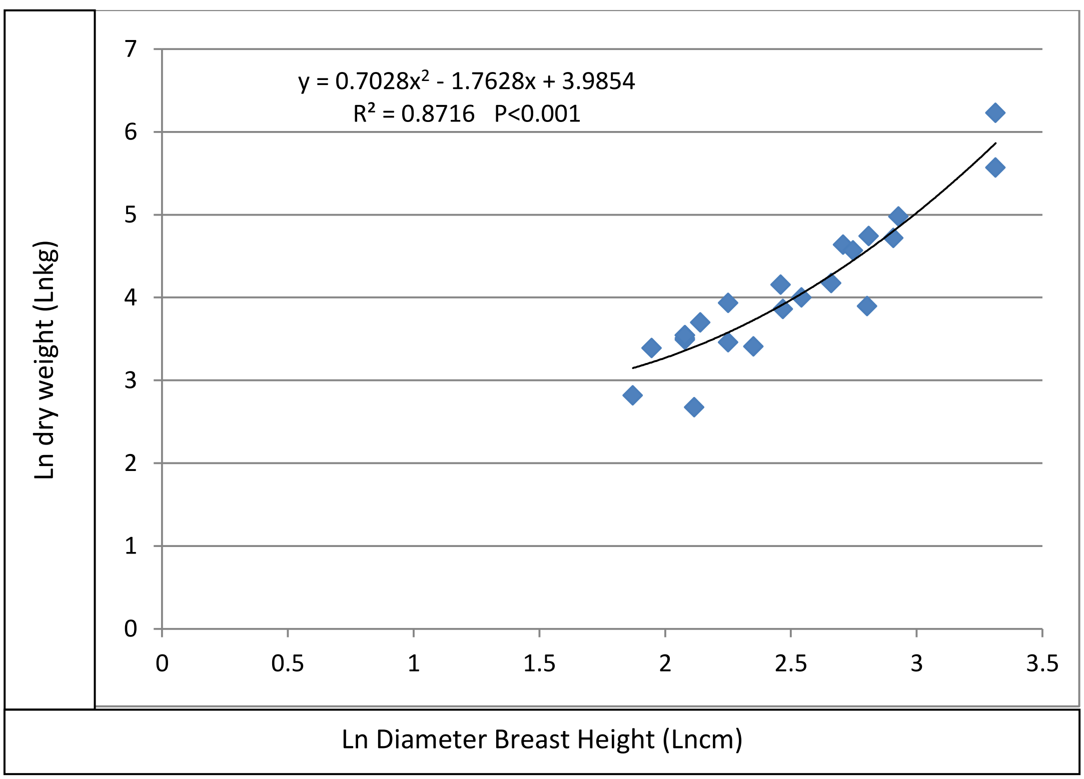
Graph 2. Relationship between log-normal stem diameter (cm) measured at 130 cm above-ground level and log-normal biomass (kg) for Wilga *(Geijera parviflora).* (Data range: 2.5 – 22.7 cm dbh).



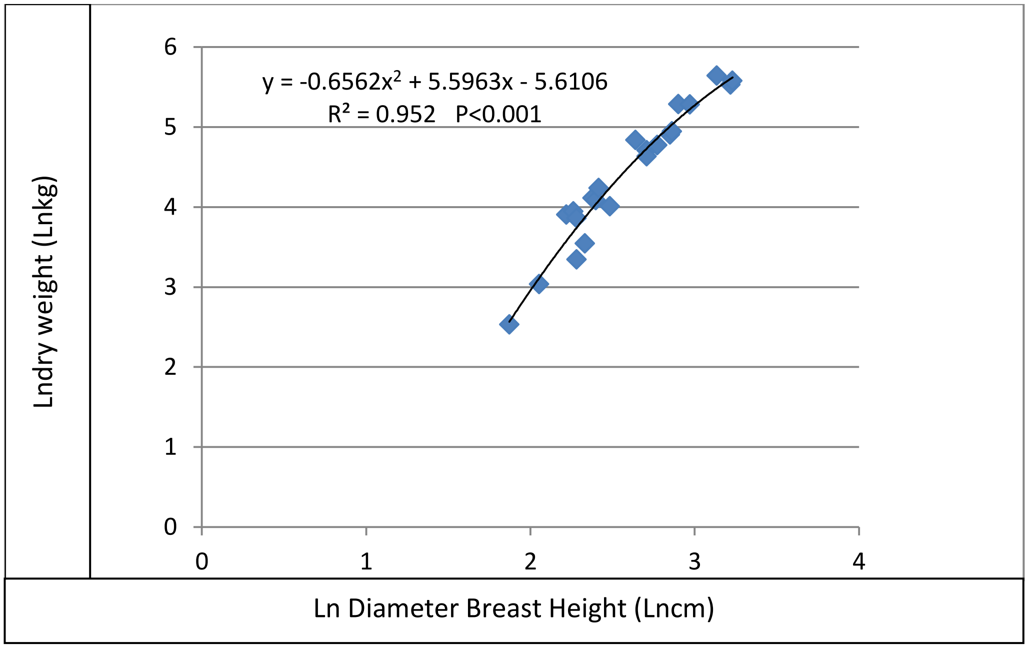
Graph 3. Relationship between log-normal stem diameter (cm) measured at 130 cm above-ground level and log-normal biomass (kg) for Bimble Box (*Eucalyptus populnea*) (Data range: 7 - 35.5 cm dbh)



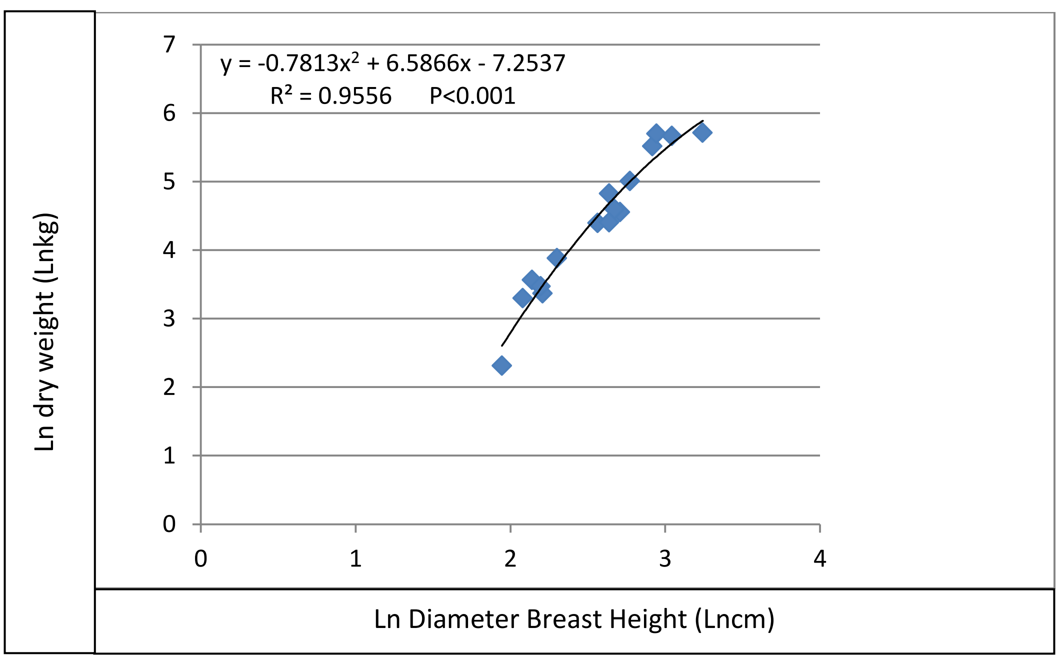
Graph 4. Relationship between log-normal stem diameter (cm) measured at 130 cm above-ground level and log-normal biomass (kg) for Yarran (*Acacia homalophylla*) (Data range: 6.5 - 27.5 cm dbh)



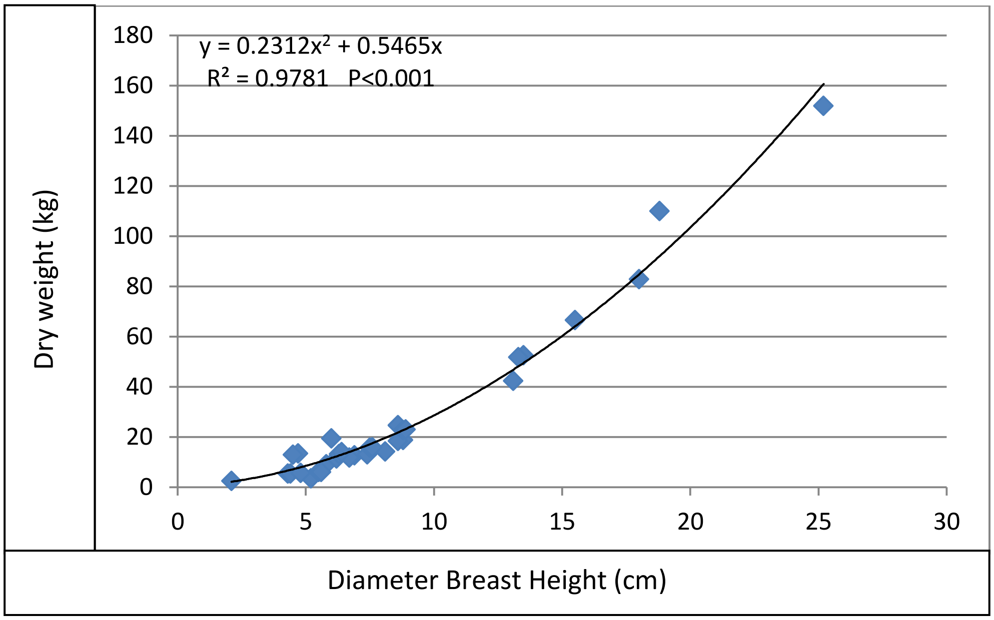
Graph 5. Relationship between log-normal stem diameter (cm) measured at 130 cm above-ground level and log-normal biomass (kg) for Mulga (*Acacia aneura*). (Data range: 6.5 – 25.3 cm dbh)



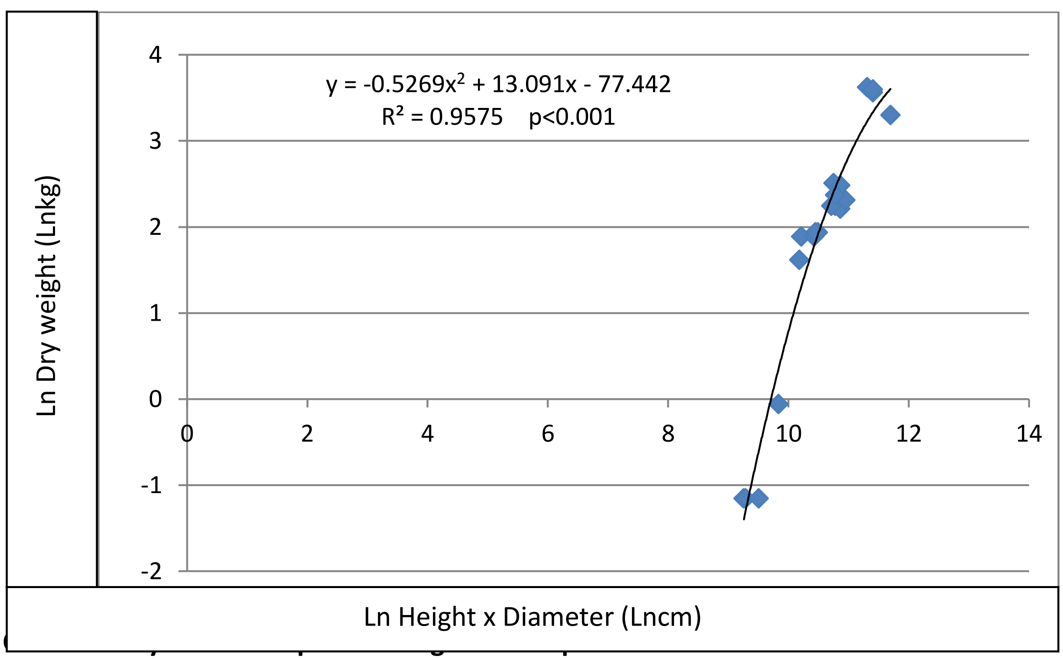
Graph 6. Relationship between log-normal stem diameter (cm) measured at 130 cm above-ground level and log-normal biomass (kg) for Red Box (*Eucalyptus intertexta*). (Data range: 7 - 25.6 cm dbh)



Graph 7. Relationship between stem diameter (cm) measured at 130 cm above-ground level and biomass (kg) for Budda *(Eremophila mitchellii*. (Data range: 2.5 - 25.2 cm dbh) Note: this relationship was also used to calculate biomass of the similar shaped small tree, Emu Bush (*Eremophila longifolia*).



Graph 8. Relationship between log-normal of height x diameter (cm) and log-normal biomass (kg) for Turpentine bush *(Eremophila sturtii). (*Data range: 70-290D &150- 450H cm). Note: This relationship was also used to calculate biomass of similar shrub species – Punty bushes (Senna artemisiodes) and hop bushes (Dodonaea viscosa).



White cypress pine (Graph 1) is a major contributor to the total woody biomass on many of the plots assessed, becoming more dominant on the southern half of the Cobar Peneplain. White cypress pine forests, often associated with ‘whip-stick’ regrowth events, are common south of Cobar. The relationship derived for white cypress pine is very robust, with samples covering a wide range of targeted tree sizes and a very strong r^2 value. This equation can be used with confidence to predict weights for this species, within the measured dbh range.

Wilga (Graph 2) often grows as a spreading, multi-stemmed tree and as such it is difficult to determine the dbh at 130cm above ground level. The results in Graph 2 above indicate a very strong relationship between the measured dbh and the dry weight. This was achieved by allocating the weight of multi-stemmed trees proportionally across the multiple stems. This technique resulted in a much more robust relationship being derived with a highly significant r^2 value. This equation can be used with confidence for the prediction of weights for wilga trees across the range of dbh sizes measured.

Bimble box (Graph 3) trees are one of the iconic species occurring on the Cobar peneplain, often dominating run-on flats across the landscape but also occurring frequently on ridges and low slope country. They can become very large trees, however this study only addressed those that could be removed under an approved PVP and therefore the maximum dbh to be considered was 35 cm. The relationship expressed in the above equation is very robust, with a highly significant r^2 value. As Bimble box trees get larger than 35cm dbh it would be expected that hollows would start to develop in the trunk and branches and it is unlikely that the current equation would be very accurate in predicting tree weights for trees greater than 35 cm dbh.

Yarran (Graph 4) trees are another species that often has stems or branches occurring below the 130 cm height for a standard dbh measurement. The relationship derived for this species, while still very robust, is the weakest for all the species assessed. Additional weighing of trees for this species, particularly for trees below 7cm dbh and between 20-30 cm dbh may assist in producing a more robust equation. Despite this comment the current equation can be used with confidence for predicting weights for this species across the range of dbh sizes measured.

Mulga (Graph 5) is often the dominant tree on the northern half of the Cobar Peneplain and the relationship derived for this species is very robust (within the dbh range) despite the sample number being smaller than for the other species. Confidence in this result would be improved if a larger number of trees had been successfully weighed (see comments above) and if more trees below 7 cm dbh had been included in the sample. It was noted that the equation developed from this sample resulted in trees with a dbh of less than 1.5 cm recording a weight of only a few grams. Often there are very large numbers of small mulga trees occurring on the landscapes assessed and it is believed that a more accurate representation of their weight contributions to the overall woody biomass figure would be useful.

Red box (Graph 6) trees are significant contributors to the total woody biomass on only a few of the landscapes assessed under this study, despite being well distributed across most of the Cobar Peneplain. They do form significant contributions on a few landscapes, particularly the higher and/or stony ridges.

The relationship expressed in Graph 6 is robust, with a highly significant r^2 value and the equation can be used with confidence across the range of the original weights. Should biomass estimates be required for areas with significant red box contributions, additional weights for dbh at the lower end of the scale would be useful to complete the range of sizes. While the above measurements include a 7cm dbh individual tree there is a considerable gap between this and the next lowest dbh figure. Extrapolating weights above the 25cm dbh size should only be done with caution as red box trees are known to develop hollow stems and branches at relatively small sizes.

Budda (Graph 7) is the only species where the direct weight vs dbh relationship was stronger than that tested using the log normal transformation for the other species. Budda is a small tree or large shrub and while it is often multi-stemmed, the stems are generally similar to individual trees, albeit with a common root base. Due to this, the relationship derived in this study is very robust and can be used with confidence. The range of dbh sizes measured will cover virtually all the budda trees that are likely to be encountered on the Cobar Peneplain. The measurement of several more individuals at the higher end of the scale would assist in confirming the relationship, although large budda trees up to 25 cm dbh are not common.

The relationship developed for budda was also used for assessing weights for emu bush as their growth habit and sizes are very similar. Emu bush was an infrequent record across the seventy-six plots measured and the development of a separate regression equation could not be justified.

Bushy woody shrubs such as **turpentine** (Graph 8) are very regular records in the scrubby country of the Cobar Peneplain. The use of height by diameter against dry weight has been successfully used in previous studies (Harrington, 1979 and Walker and Green, Unpublished) to characterize the biomass contribution of woody shrubs. In this study, turpentine was the most common shrub species occurring across the Cobar Peneplain. The relationship determined above is highly significant and can be used with confidence to predict dry weight of this species from the height and diameter measurements.

The equation developed from the turpentine sampling was also used to predict the weights of **hopbush** and **silver cassia/punty bush** species. These species were rarely significant contributors to the total population of trees and shrubs on plots and much less for the total weight contribution. The errors that may have resulted from using the turpentine equation, rather than specifically derived relationships for these species are believed to be small. Despite this, should a further study be undertaken, development of specific equations for these species may be useful.

Woody Biomass Weights

Seventy-six vegetation plots were measured across the Cobar peneplain, with at least 10 plots being allocated to each of the landforms identified in Table 1. For each plot the diameter at breast height (dbh) or the height and diameter for each target species on the plot was recorded and these are included in electronic form on the CD that accompanies this report (Appendix 1 - CD).

A simple spreadsheet calculator, using the regression equations obtained above (Graphs 1-8) was developed and by using the vegetation measurements generated for each of the seventy-six plots the woody biomass (dry weight) for each plot was calculated for each species per plot and the total woody biomass per plot (expressed as kg/ha). The spreadsheet calculator is included in electronic form on the CD that accompanies this report (Appendix 2 - CD). This calculator can be used to calculate the weights of additional plots that may be measured (Note: the calculator should only be used within the limits of the original data that generated the regression equations).

For each plot the woody biomass weight was calculated up to a standard base of 20 cm dbh for all plots. This is the default level for removal of the defined Invasive Native Shrub (INS) species under the Environmental Outcomes Assessment Methodology (Anon, 2011). Within some approved INS PVPs local variations have been applied to allow some species to be removed up to 35 cm dbh. While very few PVPs have variations up to 35 cm dbh it is common for variations of 25 or 30 cm dbh to be applied, particularly for bimble box and white cypress pine. To account for these local variations the total woody biomass was calculated for both 25cm dbh and 30 cm dbh variations for each plot, regardless of the specific approvals under each PVP. This was done to provide comparative figures across the landscape rather than restricting the results to only those approved under the existing PVP for a property.

The results for each plot, within each of the stratified landscapes, are presented below. The relevant land system and short descriptive notes are also included. For each landscape the average weight per plot and the standard deviation of the sample for each dbh level has been calculated, together with the maximum and minimum plot weights for all size classes. Note: due to the small sample size for some of the 25 and 30 cm dbh values the average and standard deviation values should be used with caution.

Table 3. Clay loam ridges and flats with bimble box, mulga and shrubby woodlands.

Plot	Total kg/ha(20)	Total kg/ha(25)	Total kg/ha(30)	Land System	Notes
Dijoe 1	**13,177**	16,506	23,208	Cobar LS	Typical hard red ridge.
Dijoe 2	24,429	-	30,429	Cobar LS	Lower slopes
Dijoe 5	26,225	-	-	Cobar LS	Ridges area
Dijoe 6	53,371	-	-	Cobar LS	Lower area
Lyndhurst 1	25,075	-	-	Cobar LS	Heavily grazed by goats – few under-shrubs
Kergunyah1	25,971	36,557	44,043	Cobar LS	Box/pine/mulga scrubby red ridge.
Kergunyah 2	25,307	32,664	38,774	Cobar LS	Low, scrubby red ridge.
Kergunyah 3	46,460	68,843	**78,320**	Cobar LS	Mature pine/mulga low red ridge.
Tindarey 1	18,974	25,968	29,249	Cobar LS	Bimble box ridge - rung out
Tindarey 3	27,556	-	-	Cobar LS	Mulga ridge few shrubs
Bundella 1	63,767	-	-	Wrightville LS	Yarran area – selected for species.
Average	**31,846**	**36,107**	**40,670**	**Maximum**	**78,320**
Std Dev	**15,614**	**19,816**	**19,863**	**Minimum**	**13,177**

Table 4. Clay loam ridges and flats with bimble box, white cypress pine and shrubby woodlands.

Plot	Total kg/ha(20)	Total kg/ha(25)	Total kg/ha(30)	Land System	Notes
Nullawarra 1	55,081	-	58,718	Ironstone LS	Very broad level area – regrowth pine
Nullawarra 2	35,512	-	-	Ironstone LS	Very broad level area – regrowth pine
Nullawarra 3	36,067	42,118	45,654	Ironstone LS	Slight ridge – pine & mulga
The Rookery 4	32,988	59,965	63,577	Ironstone LS	Small run-on flat – multiple species
The Rookery 5	**7,534**	9,845	-	Ironstone LS	Large trees in run-on flat
Gilbert Park 1	34,746	34,746	41,394	Ironstone LS	White pine regrowth ridges
Gilbert Park 2	38,644	44,596	52,651	Ironstone LS	Broad pine/box run-on area
Gilbert Park 3	36,982	39,333	-	Ironstone LS	Broad flood-out plain – pine/mulga/box
Osterley Downs 1	23,965	33,597	53,961	Ironstone LS	Scrubby pine/box/wilga low ridge
Osterley Downs 2	30,087	43,006	62,889	Ironstone LS	Scrubby pine/box/wilga low ridge
Osterley Downs 7	14,067	16,591		Ironstone LS	Open yarran/red box low ridge
Killala 1	85,138	**92,548**	-	Ironstone LS	Yarran flat – special plot
Average	**35,900**	**41,635**	**53,354**	**Maximum**	**92,548**
Std Dev	**19,698**	**23,535**	**8,928**	**Minimum**	**7,534**

Table 5. Loam and sandy loam plains with mulga and ironwood.

Plot	Total kg/ha(20)	Total kg/ha(25)	Total kg/ha(30)	Land System	Notes
Dijoe 3	34,756	47,986	56,231	Coronga LS	Mulga plains
Dijoe 4	54,998	66,458	**72,512**	Coronga LS	Mulga plains
Toolooly 1	58,538	-	-	Coronga LS	Mulga plains
Toolooly 2	47,108	-	-	Coronga LS	Mulga plains
Toolooly 3	24,557	29,733	32,595	Coronga LS	Mulga plains – heavy goat grazing
Pattison 1	17,311	22,232		Kenilworth LS	Lighter textured mulga country
Pattison 2	40,440	-	-	Kenilworth LS	Lighter textured mulga country
Glenariff 1	**15,678**	30,365	47,542	Coronga LS	Mixed box, pine, mulga scrubby plains
Glenariff 2	30,919	36,507	40,496	Coronga LS	Mixed box, pine, mulga scrubby plains
Glenariff 3	57,600	60,541	64,349	Coronga LS	Mainly mulga scrubby plain
Tindarey 2	16,168	-	-	Yanda LS	Yanda Creek flat – more hard red species
Lyndhurst 2	45,166	-	-	Coronga LS	Mulga plain
Lyndhurst 3	25,819	44,383	-	Coronga LS	Mixed mulga, box, scrub country
Average	**36,081**	**42,276**	**52,288**	**Maximum**	**72,512**
Std Dev	**15,758**	**15,536**	**14,963**	**Minimum**	**15,678**

Table 6. Slightly undulating rounded lowlands. Variable landscape with patches of mallee, white cypress pine, red box and bimble box.

Plot	Total kg/ha(20)	Total kg/ha(25)	Total kg/ha(30)	Land System	Notes
The Rookery 1	**8,308**	30,915	39,933	Kopyje	White pine ridges – some red box
The Rookery 2	73,023	78,798	-	Kopyje	White pine ridges – some red box
The Rookery 3	79,510	86,642	**92,303**	Kopyje	White pine lower area – some red box
Lowan 2	60,129	62,713	-	Yackerboon	Yarran plot – some mallee
Glenwood 1	25,463	25,463	29,003	Yackerboon	White pine and box with scrub species
Glenwood 2	15,080	24,711	33,118	Yackerboon	White pine and box with scrub species
Glenwood 3	73,048	78,392	-	Yackerboon	White Pine country – some red box
Yarroma 1	16,951	-	-	Killala	Old clearing?
Norma Vale 1	39,723	43,265	46,511	Yackerboon	Low ridges to level white pine country.
Norma Vale 2	44,836	-	-	Yackerboon	Very thick regrowth pine (4430 stems/ha)
Average	**43,607**	**57,141**	**48,173**	**Maximum**	**92,303**
Std Dev	**26,687**	**25,833**	**25,555**	**Minimum**	**8,308**

Table 7. Extensive plains of alluvial soils with white cypress pine, bimble box and yarran patches.

Plot	Total kg/ha(20)	Total kg/ha(25)	Total kg/ha(30)	Land System	Notes
Kia Ora 2	15,182	-	-	Meadows	Level pine/ turpentine/ hopbush. Light textured soil.
Kia Ora 3	16,352	-	-	Mulchara	Pine/turpentine/hopbush scrub
Kia Ora 4	9,694	13,860	20,647	Meadows	Sandy Creek- pine regrowth
Osterley Downs 3	16,762	28,946	40,412	Killala	Sandy loam; bimble box pine regrowth - kg/ha(35)= 47719
Osterley Downs 4	**292**	4,741	32,570	Killala	Mature pine; edge of regrowth area - kg/ha(35)=47666
Osterley Downs 5	39,341	91,783	**117,165**	Killala	Thick pine, semi-mature regrowth.
Osterley Downs 6	14,067	16,591	-	Killala	Pine and red-box flats - budda, turpentine and yarran
Norma Vale 3	25,216	25,216	32,071	Needlewood	White cypress pine sandy plain.
Norma Vale 4	9,205	-	-	Needlewood	Turpentine - cleared pine & box
Lowan 1	50,214	55,938	-	Needlewood	Sandy Creek floodplain (sandy)
Average	**19,632**	**33,863**	**48,573**	**Maximum**	**117,165**
Std Dev	**14,930**	**30,242**	**38,986**	**Minimum**	**292**

Table 8. Broad undulating lowlands with scattered granite outcrops with white cypress pine, bimble box and turpentine

Plot	Total kg/ha(20)	Total kg/ha(25)	Total kg/ha(30)	Land System	Notes
Etiwanda 1	20,435	39,716	52,402	Penshurst LS	White pine lower slopes
Etiwanda 2	54,670	70,473	76,513	Penshurst LS	White pine ridges
Etiwanda 3	35,899	77,255	**93,557**	Penshurst LS	White pine ridges
Etiwanda 4	72,611	90,506	-	Penshurst LS	White pine ridges
Etiwanda 5	**19,678**	31,966	45,460	Penshurst LS	White pine lower slope – older trees
Norma Vale 5	38,130	38,130	43,349	Penshurst LS	White pine country
Bedooba 1	29,380	29,380	38,165	Penshurst LS	White pine and some scrub species
Bedooba 2	43,021	44,607		Penshurst LS	White pine ridges
Manuka 1	34,656	43,033	59,482	Penshurst LS	Bimble box and red box country
Manuka 2	26,736	31,715	-	Penshurst LS	Bimble box and red box country
Average	**37,522**	**49,678**	**58,418**	**Maximum**	**93,557**
Std Dev	**16,192**	**21,630**	**20,019**	**Minimum**	**19,678**

Table 9. Texture contrast and calcareous red earth plains with few major creek channels (Buckwaroon Creek).

Plot	Total kg/ha(20)	Total kg/ha(25)	Total kg/ha(30)	Land System	Notes
The Meadows 1	31,833	-	-	Meadows	Budda/turpentine/hopbush scrub. Level clay loam soil
The Meadows 2	39,834	-	-	Meadows	Budda/turpentine plain
The Meadows 3	63,776	**65,381**	-	Meadows	Regrowth pine run-on area
Kia Ora 1	51,932	65,015	-	Meadows	Semi mature pine regrowth
Double Gates 1	67,943	-	-	Meadows	Very scrubby yarran & budda
Double Gates 2	47,946	60,097	65,132	Meadows	Low lying box scrub - loams
Double Gates 3	**11,040**	-	-	Meadows	Mature turpentine; few trees
Pine Ridge 1	26,217	31,187	33,905	Belford	Mulga/Pine/Box/low-lying
Pine Ridge 2	33,032	37,740	41,435	Meadows	Level sandy loam with pine scrub, hopbush & turpentine
Pine Ridge 3	13,519	15,181	25,645	Meadows	Pine flats with belts of mulga
Average	**38,707**	**45,767**	**41,529**	**Maximum**	**65,381**
Std Dev	**19,379**	**20,847**	**17,005**	**Minimum**	**11,040**

Woody Biomass Values

The total woody biomass (dry weight) values for the seventy-six plots that were measured in this study have produced a very high level of variability, both within and between the seven identified landscapes (Tables 3-9). The variability of the average woody biomass values between each landscape was often less than that for the plot measurements within each landscape. The highest average biomass value at

20cm dbh was 43,607 kg/ha for the 'Slightly undulating rounded lowlands' (Table 6) landscape with the lowest average being 19,632 kg/ha on the 'Extensive plains of alluvial soils' (Table 7).

The standard deviation values calculated for each landscape unit are very high. This reflects the highly variable growth of woody species across the landscapes of the Cobar Peneplain and in some instances reflects previous clearing operations, followed by regrowth events. The run-off/run-on nature of the Cobar Peneplain produces favourable and less favourable moisture relationships for plant growth and this fact results in variable woody species growth and density.

The overall values measured for the plots are much less than those estimated in the pilot study undertaken by the Buckwaroon Catchment Landcare Group and reported by Higgins (2012) as being a 'conservative average of 150 tonnes/ha'. The highest estimated woody biomass in this study was 117,165 kg/ha (117 tonnes/ha) for up to 30cm dbh trees on plot 'Osterley Downs 5'.

Photo 5. Osterley Downs 5 - the highest yielding plot of 117,165 kg/ha (for 30cm dbh).

A review of woody biomass estimates carried out by Keith, Barrett and Keenan (2000) estimated that values of around 150 tonnes/ha may be expected in 'Dry Tropical' or 'Subtropical' forests. These areas would be expected to be much wetter, with significantly larger trees, than the 'Semi-arid rangelands' of the Cobar Peneplain. Unfortunately this review did not include any comparative data for the mixed semi-arid woodlands however it did present estimates of 28.9 tonnes/ha for bimble box and 17.1 tonnes/ha for wilga populations.

Harrington (1979) reported a figure of 54.8 tonnes/ha for all wood and leaf material at Coolabah on the Cobar Peneplain (Note: this study included trees of greater size than those allowed to be harvested under a PVP) and Burrows et al (2001), although using somewhat different methodology, estimated that stands of white cypress pine in Central Queensland carried between 50 – 65 tonnes/ha of woody biomass, with tree dbh up to 43 cm. Hayman (2009) measured biomass yields from the thinning of 'whipstick' white cypress pine forests in the Baradine area of NSW. This report estimated total dry biomass yields (for the thinnings) of between 55-96 tonnes/ha, although actual useable yields were assessed at between 40-50 tonnes/ha. These three studies reinforce the validity of the levels estimated in this study and the results for the plots measured can be considered to be representative of the woody biomass levels that may be expected to be harvested under PVPs for the Cobar Peneplain.

Plot Observations

White cypress pine is the dominant tree on much of the southern areas of the Cobar Peneplain. The species was well represented in many of the plots in this area. It was the dominant species in the plot that produced the highest level of woody biomass measured (Photo 5). Conversely, it was also the dominant species on the lowest recorded plot measurement of 292 kg/ha on 'Osterley Downs 4'. This is somewhat misleading as this plot contained mostly mature white pine, many of which had a dbh greater than what is allowed to be harvested under a PVP.

Photo 6. Osterley Downs 4 – the lowest yielding plot (292kg/ha) for 20cm dbh trees.

The dominant tree species on much of the northern areas of the Cobar Peneplain is **mulga**, although it often occurs in mixed stands on the ridge country. Mulga is a very dense timber and often grows in dense stands, therefore it was expected that the mulga country, particularly on the more level areas in the north would carry high levels of woody biomass. The highest estimated biomass for a mulga plot at 72,512 kg/ha, was at the 30cm dbh level on plot 'Dijoe 4'. Most PVPs limit the removal of mulga to a maximum of 20cm dbh and the highest estimated biomass for 20 cm dbh was on Toolooly 1, with a 'yield' of 58,538 kg/ha (Photo 9).

Photo 9. Toolooly 1 plot - with a 'yield' of 58,538 kg/ha for 20cm dbh trees.

Three plots contained significant numbers of **yarran** trees. Yarran may be considered as a target tree due to it being reported as producing high quality bio-char material. The plots were 'Killala 1' (85,138 kg/ha), 'Bundella1' (63,767 kg/ha) and 'Lowan 1' (60,129 kg/ha). Yarran 'flats' occur in run-on locations in the landscape and while infrequent there are several significant stands. Many of the yarran areas have been cleared in the past as they are both in favoured areas of the landscape and often have slightly higher fertility soils.

Photo 7. Killala 1 – Yarran trees with a 'yield' of 85,138 kg/ha.

Two plots were almost exclusively represented by **turpentine** scrub. These plots provide an indication of the expected maximum woody biomass contribution of multi-stemmed shrub species in the landscapes. The plots were ‘Double Gates 3’ (11,040 kg/ha) and ‘Norma Vale 4’ (9,205 kg/ha).

Photo 8. Double Gates 3 – Turpentine scrub with a ‘yield’ of 11,040 kg/ha.

Property/Landscape Woody Biomass Yields

The data presented above, for the seventy-six plots, clearly illustrate the variability of the landscape and the vegetation communities across the Cobar Peneplain. It is because of this variability that any broad statements regarding ‘average’ expected landscape yields for woody biomass should be done with extreme caution. The figures derived in this study provide a guide to the levels that may be expected for various landscapes and vegetation communities.

For broad planning purposes the ‘average’ biomass levels for each maximum size class was calculated using the averages, for six out of the seven landscapes (*Landscape 5*. *Extensive plains of alluvial soils* was excluded from the calculations for 20 and 25cm dbh due to the presence of larger trees on this landscape and subsequent low biomass levels at the smaller dbh levels). The ‘average’ results are: to 20 cm dbh – 37.3 tonnes/ha; to 25cm dbh – 45 tonnes/ha and to 30 cm dbh - 49 tonnes/ha. These figures should only be used for broad planning purposes.

To obtain definitive figures for the development of a commercial use of the woody biomass, a detailed landscape study of the local area of interest would need to be completed, prior to an estimation of the overall ‘yield’ for the development. This may include further plot measurements but once the development area is better defined the results from the plots measured in this study could be used to identify 'benchmark' yields.

On relevant property PVPs several units have been identified, where it is believed that a reasonably accurate average yield could be applied to provide a landscape yield for the property/unit. Note: For the sake of utilizing a common level, only the yields for trees up to 20cm dbh have been used for the calculations, actual yield where local variations have been approved to increase the dbh levels for some species would result in higher yields. The results for these properties are presented below (Table 10).

Table 10. Potential woody biomass yields at the property/landscape unit level for selected properties within the Cobar Peneplain Bioregion. Note: to be used with caution due to local variability.

Property (PVP Unit)	'Average Yield' at 20cm dbh (tonnes/ha)	PVP Unit Area (ha)	Total (tonnes/Property PVP Unit)
Norma Vale (14b)	29.3	8,318	244,106
Nullawarra (14a)	42.2	2,145	90,562
Osterley Downs (14b)	27.2	12,522	340,298
Osterley Downs (14c)	19.7	5,075	100,177
Toolooly (14b)	43.4	4,803	208,455
Dijoe (14b)	29.3	14,552	426,374
Etiwanda (14c)	54.4	3,802	206,803
Glenariff (14b)	34.7	13,784	47,8750

These figures, despite the caution that needs to be applied, identify a very significant resource that could be utilized during the removal of INS on properties with an approved PVP under the Native Vegetation Act (2003).

The data generated in this study will provide a base level for the planning of future commercial possibilities for the use of this woody biomass.

Conclusions and Recommendations

Notes

- The original plot data, calculated weights per species and two photographs of each plot are available in electronic form (disc) attached as Appendix 1.
- A species by weight spreadsheet calculator and a plot recording template are also available in electronic form (disc) as Appendix 2.

The following conclusions and recommendations are made to help direct future activities relating to woody biomass harvesting on the Cobar Peneplain.

Conclusions

The weight to dbh regression equations developed in this study produced high levels of both significance and correlation (r^2) and can be used with confidence to calculate weights from the plot measured dbh levels, provided the sizes are within the range of the figures used to calculate the regression equations.

Woody biomass levels are very variable within and between the landscapes included in this study and the calculation of an average yield across the landscape cannot be accurately predicted without further and much more detailed stratification of the landscapes across the Cobar Peneplain Region.

The woody biomass levels calculated in this study are much lower than that calculated by the Buckwaroon Catchment Landcare Group in their pilot study however the values obtained in this study align with published work produced by several other authors. It is believed that the woody biomass estimates produced from this study better reflect the expected yields from a harvesting operation.

The maximum estimated yield from this study was 117.2 tonnes/ha for the harvesting of woody species up to a size of 30cm dbh. The plot results were too variable to calculate an accurate average yield for all plots however for indicative purposes 'average' results have been calculated across the units per: to 20 cm dbh – 37.3 tonnes/ha; to 25cm dbh – 45 tonnes/ha and to 30 cm dbh - 49 tonnes/ha. These figures should only be used for broad planning purposes.

Recommendations

- While the weighing of the tree species was completed successfully and resulted in a high level of confidence from the regression equations developed, any future studies should consider utilizing a front end loader with integrated weight recording equipment to both reduce workplace safety risks and to improve the ease and accuracy of the weighing of large trees.
- The spatial variability within many vegetation communities, over relatively short distances, means that for an accurate estimate of the woody biomass resource available for harvesting near a particular location is difficult. Detailed vegetation mapping of the area under consideration is recommended before any commercial investment in infrastructure is implemented.
- It is recommended that an actual pilot harvest be carried out, using the preferred harvesting equipment, on plots to obtain a correlation between the estimated woody biomass and the actual harvest biomass before significant investment in infrastructure is implemented.
- The moisture contents of the harvested material should undergo further testing, as the currently measured moisture levels are at the very low end of normal tree moisture levels and this should be substantiated before significant investment in infrastructure is implemented.
- The regression equations developed in this study should not be used to predict weights of trees outside the ranges of 'diameters at breast heights' from which the regression equations were developed. Further weighing of species outside the current sample range must be undertaken prior to use of the regression equations for larger trees.

- The sample of mulga tree weights should be extended to include trees across the full range of sizes measured in the plots and across all the landscapes. This would mean a number of trees with dbh sizes below 6cm dbh should be included in any future sampling and that a selection of mulga trees from the north of the Cobar Peneplain, particularly those on sandy loam soils, be added to the existing data.
- Further data could be collected for both the height and diameter range for turpentine, particularly at the lower end of the range.
- For this study the use of the turpentine regression equation for hopbush and punty bush/silver cassia is valid, as the relative contributions of the shrub layer to the overall woody biomass are generally small; however for more accurate estimates of their respective contributions to the woody biomass, additional individual species regressions should be obtained.
- The measurement of multi-stemmed species at the 130 cm above ground for standard dbh methodology is difficult and consideration should be made to using 'basal area' at 30cm above ground level. Burrows et al (2000) reports on this method.
- Western Catchment Management Authority may wish to produce an interactive GIS for the Cobar Peneplain, using a Spot 5 image underlay, and the GPS coordinates, to locate plots, with a 'pop-up' icon that would display the photographs and plot information (from Appendix 1) for each plot.

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