Point. Advisory

# CarbonCare: Co-benefits assessment and valuation study

## Yarra Yarra Biodiversity Corridor Reforestation Project – Case Study

Prepared for:

**Carbon Positive Australia**

**November 2020**

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# CONTENTS

# GLOSSARY/DEFINITION OF KEY TERMS

| Term | Definition |
|---|---|
| **Biodiversity offsets** | Biodiversity offsets are measurable conservation outcomes designed to compensate for adverse and unavoidable impacts of projects (e.g. land clearing for road construction). |
| **Carbon offsets** | A reduction in GHG emissions (e.g. via sequestering carbon dioxide in replanted forests) to compensate for or to offset GHG emission made elsewhere. |
| **Co-benefits** | Benefits resulting from restoration and reforestation activities, including biodiversity, water and soil quality, local employment and indigenous benefits, which are beyond those associated with carbon sequestration and carbon storage. |
| **Standard** | A standard provides a set of rules that can be followed but doesn't provide quantification approaches. Examples include the National standards for the practice of ecological restoration in Australia, Accounting for Nature Standard, etc. Most standards will have methods attached but not always. |
| **Method** | The specific Activity/Outcome requirements and procedures used to calculate, monitor and report on a given outcome that may lead to the issuance of a certified product.<br>A method provides a set of instructions that are followed to estimate the value of a benefit and is underpinned by data. |
| **Quantification method** | A method for estimating the quantum of a specific type of benefit associated with an intervention (in this case the Yarra Yarra Biodiversity Corridor project). This typically refers to a unit of benefit delivered by the intervention. |
| **Valuation method** | A method for putting a monetary value on a benefit or a unit of benefit. The dollar value thus obtained can be nominal, that is it will not necessarily be recognised on a market or give rise to a cash transaction. The valuation in dollar terms is a practical way of making benefit value explicit or visible.<br>It should be noted that there can be significant overlap between quantification and valuation methods, as quantification can be integrated into valuation. |
| **SDG impact** | A direct, positive contribution to a Sustainable Development Goal generated by a project. |

| | |
|---|---|
| **Restoration** | Restoration is the practice of reviving degraded landscapes by identifying and implementing practices that restore a balance of the ecological, social and economic benefits of forests and trees within a broader pattern of land uses. |
| **Sequestration (biogenic)** | Is the formal term used to describe the biological removal of atmospheric carbon dioxide by living biomass (e.g. trees, shrubs) and soils. |
| **Regulated markets** | A regulated market is where supply and demand are controlled, and market participants are governed by official rules. Examples includes compliance and voluntary carbon markets. |
| **Non-regulated markets** | A non-regulated market is where supply and demand are not controlled, and market participants are not governed by official rules. Examples include results-based finance and impact investing. |
| **Stapling** | Projects can also employ 'stapling', whereby a verified non-carbon unit (e.g. a biodiversity unit) is stapled to a carbon offset to achieve both local co-benefits and carbon neutrality. |

# EXECUTIVE SUMMARY

## Foreword[1]

The carbon price has been established within Western Australia in line with the Emissions Reduction Fund (ERF) and the price of an Australian Carbon Credit Unit (ACCU). The price of an ACCU does not take into account the value of the other benefits that can accrue through the restoration of previously cleared and degraded land. These other benefits collectively termed co-benefits have a value that when determined enable investors to assess the impact of delivering environmental, socio-economic and cultural outcomes in line with the UN Sustainability Goals (SDG's)

It is believed that Environmental and Social benefits are something that investors will pay a "premium" for when investing in carbon projects. In the Western Australian Wheatbelt, the development of intensive agricultural land-use systems has profoundly changed the landscape. Natural vegetation was cleared and converted to agricultural land and only small patches of natural habitat remain. Planting and reforestation projects that restore the natural landscape and that provide economic benefits are of interest to a wide range of stakeholders.

This Study reviewed the value of co-benefits at a Northern Agricultural Wheatbelt site collectively known as the "Yarra Yarra Biodiversity Corridor". This site is owned by Auscarbon and delivering Gold Standard carbon credits into the voluntary market. The total project area is 13,000 hectares, (4,600 hectares non-Gold Standard) and is located in a biodiversity hotspot. The Southwest Australia Ecoregion that stretches from Shark Bay to Esperance and comprises the project area is one of only 35 globally significant biodiversity hotspots, as recognised by Conservation International, due to high levels of biodiversity and endemism,

The study identified two areas of co-benefits that could be valued: **Environmental** and **Regional economic & Social**. The valuation of these co-benefits is of interest to project developers who are creating biodiverse mixed species carbon plantings in Western Australia, as it can help to form a basis for understanding the value of the co-benefits created, and how those benefits can be communicated to investors. The valuation is also of interest to a wide stakeholder group including landholders, government and restoration groups.

## Context and objective of the project

The CarbonCare co-benefits project objective is to identify, quantify and value the co-benefits of reforestation in the Northern Wheatbelt. Over 90% of the Northern Wheatbelt of South West Australia has been cleared for agricultural planting by European Settlers. Carbon Positive Australia is restoring land through planting native trees and shrubs endemic to the area, particularly on non-productive farmland, and has been supported by Lotterywest to investigate the valuation of co-benefits on mixed species carbon planting.

The *Yarra Yarra Biodiversity Corridor* is located in Western Australia's northern agricultural region approximately 400 km north of Perth and is a mixed species (biodiverse) reforestation project owned by AusCarbon. The project is registered with the International Gold Standard Foundation by Carbon Neutral Pty Ltd. The project generates carbon offsets which are sold into the voluntary market.

## Project Participants

Carbon Positive Australia: Instigated and managed this study with funding provided by Lotterywest. A contributor to the Yarra Yarra Biodiversity Corridor through planting and tree and credit purchase agreements.
Auscarbon Pty Ltd: Land owner and Yarra Yarra Biodiversity Corridor project developer
Carbon Neutral Pty Ltd: Wholly-owned subsidiary of Auscarbon, and registered project holder of the Gold Standard Yarra Yarra Biodiversity Corridor project.

[1] The foreword to the report was written by Carbon Positive Australia

## Approach

This desktop study involved:

- The review of project documents and external literature to identify potential co-benefits and methods to quantify them.
- A review of quantification and valuation methods best suited to value the Yarra Yarra Biodiversity Corridor project's core co-benefits, based on available project data.
- A valuation of co-benefits using economic market and non-market valuation and "benefit transfer" techniques for those areas where valuation was possible
- Reporting and recommendations for Carbon Positive Australia's consideration.

## Results and findings

The review of data, quantification and valuation methods and conversations with internal stakeholders indicated that the core co-benefits of the project (beyond carbon) are associated with biodiversity, water quality, soil quality, local employment and indigenous cultural heritage.

For the purposes of this report only biodiversity, local employment and economic impacts could be explored in sufficient detail to provide a first pass valuation. The results of which are tabled in Section 5. The figures provided are estimates based on data since the "Yarra Yarra Biodiversity Corridor" inception in 2008 up to the end of the fiscal year ending 2020.

- **The biodiversity value of the Hill View property has been estimated at between $2M and $4.5M over the life of the project. Assuming that Hill View is representative of the whole project area, the overall biodiversity value would be between $28M and $63M for the total Yarra Yarra Gold standard accredited 8,700 ha project area (rounded up from 8,699 ha).**
- **The value of co-benefits calculated above can be downscaled to a per carbon tonne offset value. With the caveat that it is not recommended to add together the biodiversity value, and the regional economic value. The biodiversity value per Carbon Offset is estimated at $29 (Low) per Offset, and $65 (high) per offset. The Regional economic impact is $52 (low) and $83 (high).**
- The economic impact, based on an investment of $12.8M in the local economy (exc. land acquisition) is between $18M and $30M, depending on whether the 4 year or 20-year economic impact is considered in the net present value (NPV).
- Improvements in both groundwater and surface water quality are likely and were evidenced. This evidence was anecdotal. Connectivity with receiving environments beyond the boundaries of the projects and potential use and non-use values was not included as part of this report. A separate value on water quality co-benefit (other than that already implicitly included in the biodiversity valuation) is not included in this report.
- Similarly, soil quality, while highly likely to have improved, is unlikely to have any impact off-site and mostly benefits the project vegetation. Additionally, very little data was available, hence no value was put on this co-benefit.
- Monitoring and quantification methodologies – findings and results. In light of the availability and quality of information on biodiversity for the project, the *National Standards for the Practice of Ecological Restoration in Australia* ('the National Restoration Standards') developed by SERA appears to be the most appropriate method to measure biodiversity at this point in time, achieving a good balance between simplicity and transparency.
- The main focus to understand improvements in water quality is to understand connectivity with resources beyond the project area in neighbouring agricultural production areas. That is, understand whether land productivity beyond the project area could be increasing due to improved water quality from reduction in salinity in both ground and surface water. Once this is understood, the potential materiality of co-benefits can be assessed, and monitoring and quantification efforts can be better directed (see recommendations).

- There is no recommended method for measuring soil quality until a project has clearly established its monitoring and quantification objectives in the wider landscape., in light of the finding made above on very local benefits from improved soil quality.
- Local employment and economic benefits can be quantified and valued based on employment and spending data from a project and applying benefit transfer using existing economic impact studies. This is demonstrated in Section 5.2. The more detail a project is able to provide, the better it is to assess effects such as distributional impacts.
- Indigenous cultural heritage and any other socio-economic impacts, such as community resilience and wellbeing, are best assessed and valued collaboratively with stakeholders using methods such as Social Return on Investment (SROI), which, unfortunately can be costly.

## Recommendations

Different co-benefits may warrant or require different approaches to quantification and valuation. These approaches depend to a large extent on the nature and robustness of project monitoring. Monitoring is an important step in establishing robust credentials in terms of impact quantification and valuation.

The benefits derived from undertaking such monitoring should be weighed against the associated costs.

For the latter, collecting information and data on baseline (pre-planting) conditions can be invaluable in demonstrating changes in value in the project area. Once a methodology for condition assessment has been chosen, a monitoring strategy should be developed to ensure data is prioritised and collected efficiently, with a clear view on how it is going to be used and what value-add is expected from the exercise. Section 6 elaborates on recommendations to improve project monitoring both for existing and future projects.

- For biodiversity, if the National Restoration Standards is selected for use, data should be collected accordingly (see Section 6.2). A clear view of which sites are similar should be formed to make sure that a strong basis is established to extrapolate information from one site to the entire project.
- For water quality, understanding resource connectivity should be the priority. As this is likely to be a costly exercise, partnership with a local university and/or statement government should be investigated. Then the project developer can consider monitoring groundwater levels and salinity, and potentially using empirical tools such as the Nutrient Tracker Tool (NTT) for surface water.
- With regards to monitoring investment, soil quality does not appear to be a priority area as carbon benefits are already captured through the issuance of soil carbon credits using the Gold Standard Soil Carbon Tool. Additionally, the value of improved soil is likely to mostly benefit the project area (which will remain woodlands).
- Local employment and local economic impacts can be refined relatively easily by collecting more detailed data and engaging with stakeholders
- For Indigenous cultural heritage values, it is recommended to take a stepped approach and engage with traditional land custodians. If high values are identified, SROI can be used.

Finally, the report concludes on some considerations on market access that could inform Carbon Positive Australia's strategy.

# 1 PROJECT OVERVIEW

## 1.1 Background

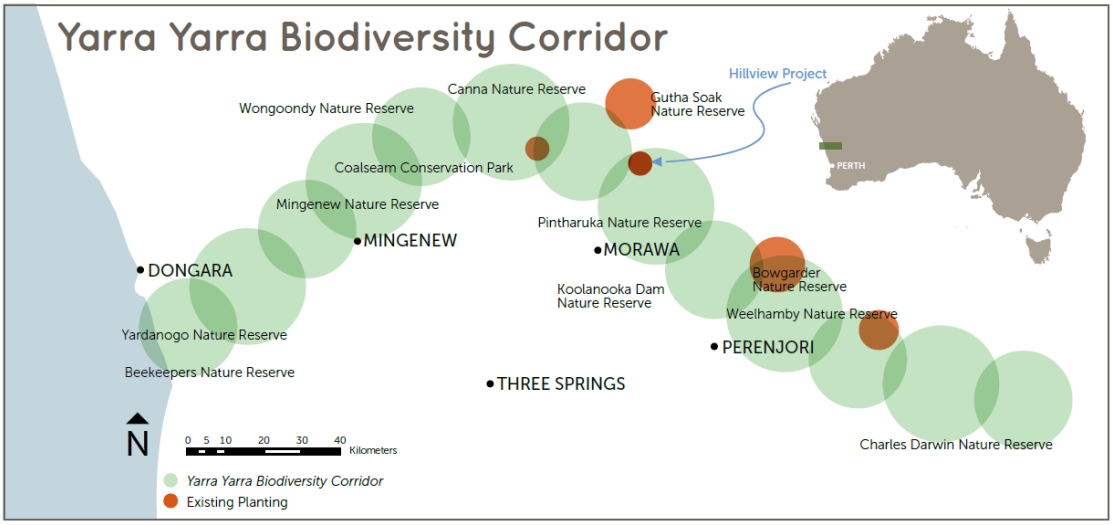
Carbon Positive Australia (CPOS) has established itself as a leading Australian environmental organisation specialising in biodiverse reforestation plantings and carbon sinks, working with the community and organisations to offset greenhouse gas emissions.

Since 2008, Carbon Neutral Pty Ltd (the project developer) has developed a multi-species native reforestation project named "Yarra Yarra Biodiversity Corridor Project" located on Auscarbon owned properties. CPOS funded a portion of the planting at the Hill View Site and other areas in the project. The total project comprises around 13,300 hectares planted in the Mid-West region of Western Australia and includes areas that are certified by the Gold Standard Foundation and other areas that are uncertified.

### 1.1.1 Project area

The project is established on degraded agricultural land that struggles to support viable farming practices. The project is located in a **National Biodiversity Hotspot**: the North Eastern Avon Wheatbelt of Western Australia[2]. The woodlands dominated by York Gum, Salmon Gum, Casuarina and Wandoo provide habitat for threatened fauna and flora and endemic species. Additionally, the Southwest Australia Ecoregion that stretches from Shark Bay to Esperance and comprises the project area is **one of only 35 globally significant biodiversity hotspots,** as recognised by Conservation International, due to high levels of biodiversity and endemism (Pettit, et al., 2015).

***Figure 1. Yarra Yarra Biodiversity Corridor Vision*** (Carbon Neutral Charitable Fund, n.d.)




As illustrated in Figure 1, the project's vision is to reconnect drier inland habitats with more lush coastal habitats, creating a corridor for species to migrate and propagate. The project connects remnant vegetation through biodiverse plantings in the Western Australian regions Mid-West and the Northern Wheatbelt.

Around 50 native tree and shrub species such as Eucalypts and woody-stemmed Acacia species that are endemic to the region are planted and protected with 100-year carbon rights and carbon covenants registered on the land titles. Seeds and seedlings are hand-planted or seeded directly on private land alongside fragmented remnant vegetation and nature reserves to restore the landscape to what is perceived as its natural condition.

By connecting, protecting and recovering habitat, it aims to create biodiverse rich habitat for endangered and declining woodland and shrubland fauna, such as Malleefowl, Carnaby's Black-Cockatoo, Crested Bellbird,

[2] https://environment.gov.au/biodiversity/conservation/hotspots/national-biodiversity-hotspots#hotspot10

Western Yellow Robin and Western Spiny-tailed Skink. Additionally, the reforestation activities are understood to improve the hypersaline groundwater tables and protect topsoil from erosion.

We note the following project boundaries:

- Carbon producing areas corresponding to the Gold Standard certified project area, including Australian Sandalwood plantings, totalling 8,699 hectares of planted vegetation.

Also part of the project, but considered outside the boundary for this study are:

- Non-Gold Standard biodiverse plantations (approximately 4,600 hectares)
- Irrigated Indian sandalwood plantations
- Farming areas.

The project areas certified under the Gold Standard include seven Auscarbon[3] owned properties that are all located in the Shire of Morawa and the Shire of Perenjori:

- Tomora
- Terra Grata
- Hill View
- Bowgada Hills
- Pine Ridge
- Preston Waters
- Hughes Block

For further details regarding the actual establishment areas, refer to the map in Appendix 1.

### 1.1.2 Carbon offsets

The Yarra Yarra Biodiversity Corridor project ('Yarra Yarra project') is the first premium Gold Standard project in Australia with its initial issuance in 2015 of 166,940 carbon offsets certified by the Gold Standard. It generates Gold Standard Verified Emissions Reductions (VERs) that are sold on the voluntary carbon market. The project is predicted to generate 967,965 VERs over the 50-year crediting cycle from the eligible project area.

### 1.1.3 Co-benefits

In addition to its primary environmental objective, this project also delivers other environmental benefits and socio-economic and cultural outcomes. While the processes to create and monetise carbon credits are now well established, the situation is different for the non-carbon benefits, and markets for non-carbon benefits are sparse and usually localised.

Co-benefits can be defined as positive outcomes resulting from restoration and reforestation activities, including biodiversity, water and soil quality, local employment and Indigenous benefits, arising from the Yarra Yarra project in addition to carbon sequestration and carbon storage.

Co-benefits are often discussed and referred to, but rarely quantified rigorously. In the future, it is likely that investors will ask for more rigorous demonstration of the co-benefits to pay for a premium on carbon credits. Valuing co-benefits will inform better decisions for CPOS, but also for potential investors, which could create additional value for society, the economy and the environment.

[3] We note that Carbon Neutral Pty Ltd is part of the Auscarbon group.

## 1.2 Project objectives and approach

CPOS engaged Point Advisory in March 2020 to identify, quantify and value the co-benefits associated with the Gold Standard Yarra Yarra Biodiversity Corridor reforestation project.

Throughout this report we refer to the co-benefits of the Yarra Yarra project. Carbon benefits were not the focus of the work undertaken in this study.

This objective was realised through four stages of work:

- **Stage 1. Information collection and review**, including:
    - A desktop review of the context of the project and the associated drivers of value
    - The identification of relevant references and studies on co-benefits
    - The conduct of interviews with key internal and external stakeholders to better understand the project, project boundaries and associated information
    - The identification of how the benefits delivered can be linked to the UN Sustainable Development Goals (SDGs)
- **Stage 2. Identification of core co-benefits related to the project**
    - The collaborative identification of co-benefits with Carbon Neutral Pty Ltd staff and partners
    - The prioritisation of key co-benefits and the identification of evidence to support this classification
- **Stage 3. Assessment of quantification and valuation methods**, including:
    - The assessment of the most suitable methods to quantify and value each of the core co-benefits identified in Stage 2
    - The valuation of the environmental and socio-economic outcomes based on the available project data and research
    - The markets and potential investors (at a high level) for benefits in the form of offsets, units or other
- **Stage 4. Reporting** through this document, and its appendices, including recommendations for next steps for CPOS consideration and the project owners Auscarbon.

## 1.3 This Document

This document is the technical summary report outlining our scope and methodology, data analysis, key findings, assumptions and uncertainties and recommendations for better data collection in the future.

# 2 IDENTIFICATION AND PRIORITISATION OF CORE CO-BENEFITS AND LINKAGE TO THE SUSTAINABLE DEVELOPMENT GOALS

This section presents:

- The preliminary identification and mapping of co-benefits related to the Yarra Yarra project in collaboration with the project owners (Section 2.1)
- The assessment and justification of core co-benefits (Section 2.2)
- A linkage of the core co-benefits to the UN Sustainable Development Goals (SDGs) (Section 2.3) to demonstrate the project's contribution to these overarching goals.

## 2.1 Preliminary Identification and mapping of co-benefits

Co-benefits were identified and mapped based on the review of project documentation, external literature, and conversations with key stakeholders.

Point Advisory performed a co-benefits mapping exercise to establish a preliminary list of co-benefits. The exercise was conducted based on:

- The review of Yarra Yarra Project documentation and external literature
- The combined experience of our team
- Discussions with relevant stakeholders

Generally speaking, co-benefits associated with reforestation activities are: conservation of biodiversity, increase in soil and water quality, (agricultural) productivity increases, economic and cultural services for indigenous communities (Baumber, et al., 2019).

A long list of possible co-benefits was first established, though discussions with stakeholders:

- Creating large-scale habitat for flora and fauna and connecting remnant vegetation
- Halting and reversing land degradation through reducing soil salinity, saving and restoring water quality and providing windbreaks to prevent soil erosion
- Improving soil and water erosion control
- Local climate regulation
- Disaster risk reduction
- Creating new industry in rural areas and expenditure with local contractors
- Local employment, including Indigenous people
- Consultation and liaison with Indigenous communities
- Recognising Indigenous heritage sites registered with the Department of Indigenous Affairs Registry and preserving them
- Providing opportunities for scientific research, eco-tourism and community education

For further details regarding the discussions with key internal stakeholders, please refer to Appendix 2.

## 2.2 Assessment of core co-benefits

The prioritisation and characterisation of this long list of co-benefits has not been assessed quantitatively, but has been gauged based on:

- Review of project documentation
- Availability and quality of data, or opportunity to collect data in the future
- Benchmark with similar projects in the public domain
- Discussions with CPOS and Carbon Neutral Pty Ltd team members
- Potential to be valued using non-market valuation techniques

The core co-benefits resulting from the prioritisation process are summarised in Table 1 below. The table also maps the co-benefits to corresponding UN Sustainable Development Goals. Details on other co-benefits of the project are outlined in Appendix 6.

***Table 1. Identified core co-benefits created by the Yarra Yarra project***

| Co-benefits category | Core co-benefit | Co-benefit description/nature of potential co-benefit | UN Sustainable Development Goals |
|---|---|---|---|
| **Environment** | Biodiversity / ecosystem services[4] | The Yarra Yarra project reconnects and restores fragmented and declining (remnant) woodland and shrubland which provides habitat for threatened flora and fauna. | Goal 15: Life on land |
| | Water Quality | Water quality is assumed to improve due to reduced surface runoff and reduction in sediment and nutrient loads in water catchments. Groundwater levels and salt concentrations are also expected to reduce over time. | Goal 6: Clean Water and Sanitation |
| | Soil Quality | Soil quality of the Yarra Yarra project area is expected to improve over time with soil organic matter increasing and salt concentrations declining. | Goal 15: Life on land |
| **Economic** | Local Employment and Skills | The establishment of plantations and conservation areas creates employment opportunities and skills development during the preparation, planting, management of the Yarra Yarra project. | Goal 3: Good Health and Well-being<br>Goal 4: Quality Education<br>Goal 8: Decent Work and Economic Growth<br>Goal 17: Partnerships for the goals |
| **Social** | Indigenous cultural heritage | The Yarra Yarra project recognises and continues to protect significant cultural heritage sites that are located in the project area. This is assumed to strengthen cultural heritage and support spiritual re-connection to country which potentially has positive | Goal 3: Good Health and Well-being<br>Goal 17: Partnerships for the goals |

[4] Note that in this report, biodiversity and ecosystem services are considered as a unique value; it is acknowledged that this is a simplification but is legitimate in this context.

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| | impacts on mental health and wellbeing of indigenous communities. |

## Justification of core co-benefits

Based on the evidence presented below it is suggested that biodiversity, water quality, soil quality, local employment and skills and Indigenous cultural heritage are the material co-benefits of the project. The next stage of the study reviewed co-benefit quantification methods that could be used for each of these co-benefits (see Section 3). It should be noted that this does not mean that adequate information or data was always found to be available to appropriately quantify these co-benefits.

### 2.2.1 Biodiversity and ecosystem services

The Yarra Yarra project aims to create a corridor that connects inland habitats with their coastal counterparts. Through reforestation activities on landscape level, it reconnects and restores endangered and declining (remnant) woodland and shrubland while providing habitat for flora and fauna. The woodlands restored are expected, over time, to reach the same biodiversity value as the original vegetation.

In the Western Australian wheatbelt, the development of intensive agricultural land-use systems has profoundly changed the landscape. Natural vegetation was cleared and converted to agricultural land and only small patches of natural habitat remained. Large scale agricultural land provides limited ecological resources for native biota, leading to declining numbers in native species and in some cases to extinction. Moreover, the introduction of weeds, plant diseases (e.g. phytophthora dieback) and animals of Eurasian origin such as sheep, foxes, cats and rabbits have put additional pressure on remaining areas of natural habitat and biota. Changing climatic conditions, in particular dryer conditions put the fragmented landscape under additional pressures (Wallace, et al., 2003; Jackson, et al., 2016). The fragmentation and degradation of especially remnant vegetation can result in a loss of species, and more broadly disrupt essential ecosystem processes such as seed dispersal and regeneration. Habitat loss and fragmentation are major threats for those species that are listed as threatened or near-threatened under the Environment Protection and Biodiversity Conservation Act[5] (Saunders, 1989; Jackson, et al., 2016). Assessment of biodiversity trends as part of the State of the Environment report 2016 have shown that the condition of the native vegetation extent in eastern and south-western Australia is poor (Jackson, et al., 2016), highlighting the need for large-scale restoration.

All properties certified under the Gold Standard were previously cleared for grazing and cropping and were sold because they were deemed to be marginal for traditional agriculture production. The Yarra Yarra project retains and reconnects remnant vegetation through reforestation, as well as restoring marginally viable agricultural land which helps towards mitigating the above pressures. The project aims to restore habitat connectivity on a landscape level by establishing woodland to facilitate the cross-landscape movement, dispersal and genetic exchange of fauna and flora. We note that revegetation must go along with the protection of remnant vegetation and the management of threats such as invasive species to create suitable habitat linkages.

The Yarra Yarra project is located in the South West Australia Ecoregion (SWAE) which comprises almost 50 million hectares. The SWAE has the highest concentration of rare and endangered species in Australian and is recognised as global biodiversity hotspot by Conservation International (Southwest Australia Ecoregion Initiative, 2006). The Central and Eastern Avon Wheatbelt, a nationally recognised biodiversity hotspot, forms part of this region too. The woodlands of the Central and Eastern Avon Wheatbelt contain many of Western Australia's threatened plants and birds. While the area is rich in endemic flora and fauna, extensive clearing of vegetation for agricultural purposes has resulted in a substantial loss of original habitat (70-90%) putting those species native and endemic to the region under risk of extinction. A biodiversity audit of Western Australia's 53 biogeographic subregions in 2002 (McKenzie, et al., 2002) has found remnant vegetation, wetlands, riparian systems, population and ecosystems at risk to be in poor condition, highlighting not only the need for landscape conservation but also landscape restoration.

[5] The Australian Government Environment Protection and Biodiversity Conservation Act 1999 provides the legal framework for protecting internationally and nationally significant flora, fauna, ecological communities and heritage places.

The project provides and connects habitat for a number of threatened species[6] including the following:

- Malleefowl (*Leipoa ocellate*): Listed as 'vulnerable' under the Biodiversity Conservation Act 2016 (EPBC Status 'vulnerable')
- Carnaby's Cockatoo (*Calyptorhynchus latirostris*): Listed as 'endangered' under the Biodiversity Conservation Act 2016 (EPBC status 'endangered')
- Western Spiny-tailed Skink (*Egernia stokesii badia*): Listed as 'vulnerable' under the Biodiversity Conservation Act 2016 (EPBC Status 'endangered')
- Woylie (Brush-tailed Bettong) (*Bettongia penicillata ogilbyi*): Listed as 'critically endangered' under the Biodiversity Conservation Act 2016 (EPBC status endangered)

A systematic biodiversity monitoring study conducted in 2014 and 2015 at the Hill View property (Huggett, et al., 2015) confirmed the presence of a number of bird species of conservation significance such as the Crested Bellbird as well as those of local conservation significance. A large number of species of conservation-significant native plants were also recorded in the project area including *Eucalyptus synandra* which is listed as 'vulnerable' under the Wildlife Conservation Act 1950 (Rare Flora Notice).

Over the whole Yarra Yarra project area (not only the Gold Standard certified project area) tree planting was conducted through direct seeding and hand planting of Eucalyptus, Acacia and Melaleuca species native and/or endemic to the region. The project aims to restore the landscape to its perceived natural condition comprising of a tree community dominated by York Gum. The main species planted are York Gum (*Eucalyptus loxophleba*) and Acacia Jam (*Acacia acuminate*). Additionally, endemic species *Eucalyptus horistes* and salt-tolerant River saltbush (*Atriplex Amnicola*) were planted as well as the following native species: Brushwood (*Melaleuca uncinate*), *Maleleuca eleutarostachya*, Rhagodia, *Acacia assimilis, Acacia anthocharea, Acacia brumalis.* Casuarina species and Wandoo (*Eucalyptus wandoo*) were planted to a smaller extent too as they are considered dominant vegetation in the Central and Eastern Avon Wheatbelt. We also note that Australian sandalwood (*Santalum spicatum*) native to semi-arid areas in South-West Australia has been planted in the Gold Standard certified project area.

### 2.2.2 Water Quality

Through reforestation activities, water quality is assumed to improve in groundwater due to lowering the water table and a reduction in surface runoff and reduced sediment, salinity and nutrient loads in water catchments.

As mentioned above, natural vegetation was extensively cleared and converted to agricultural land in the Northern Wheatbelt of Western Australia after European settlement. Only small patches of remnant vegetation remain. This has resulted in the emergence of dryland salinity from the build-up of salts in surface soils due to rising water tables. Rising water tables occur when deep-rooted trees and other vegetation are removed. The cleared land allows rainfall to seep through the soil and recharge the groundwater. The water re-emerges in discharge areas bringing with it dissolved salts to surface resulting in increasing salt concentrations in soils, which also impacts on the salinity of surface waters such as rivers and streams (Halse & Rupretch, 2003).

Dryland salinity can be managed through revegetation along with engineering methods (Marcar, 2004). Replanting of trees into cleared areas can reduce groundwater recharge by evaporation of water intercepted by the foliage before it reaches the ground, by transpiration of soil water and by trees utilising the water. (Schofield, 1991). Research has shown that groundwater levels can be reduced by 2 metres in 10 years from the time of planting from half of the cleared farm area at 1200 mm/year rainfall to a third of the cleared farm area at 750 mm/year rainfall (Schofield, 1991).

In areas with rainfall of less than 300mm a year, it may take longer to achieve such outcomes. A study was undertaken on a farm near Wickepin, South-West of Western Australia, which has 300 mm annual rainfall. Trees were established with the aim to reduce groundwater salinity. Seven years after planting, groundwater pressures had declined in 19 out of 20 piezometers in the study area, however it was concluded that it was not possible to determine whether this was due to the tree planting or due to a broader regional decline in

[6] As per the recent 'Threatened and Priority Fauna List': https://www.dpaw.wa.gov.au/plants-and-animals/threatened-species-and-communities/threatened-animals

groundwaters as a result of climate variability. This suggests the need for long-term monitoring, as seen from reforestation and hydrological response studies elsewhere (Harper, et al., 2009).

The area of cleared land that has been revegetated in the Yarra Yarra project averages 52.5% across the entire project area of 16,547 hectares. Given annual average rainfall is less than 350mm, based on the scientific evidence presented above, we can assume that the project should impact on groundwater levels and therefore reduce salt concentrations.

Evidence for this impact is difficult to establish with certainty, as the project currently does not monitor water levels or salt concentrations in the groundwater. The project developer has however been monitoring surface water Electrical Conductivity (EC) at a number of sampling sites across the project area. EC is a measure of the level of salt concentration or salinity in water. Results from the monitoring show that:

- Water flowing from re-established vegetation areas tend to have low electrical conductivity levels indicating good quality water.
- Streams with flowing from agricultural land have much higher electrical conductivity levels – commonly above 5 mS/cm indicating poor water quality.

### 2.2.3 Soil Quality

Reforestation can lead to improved soil quality by increasing soil organic matter and regulating ground temperature. Increased soil carbon leads to increased water retention and therefore soil moisture. This in turn helps to support healthy microbial populations within the soil.

Land clearing for cultivation and animal grazing has led to severe land degradation resulting in increased soil compaction and loss of soil organic matter in the areas where the project has been implemented. Overuse of fertilizers and pesticides has also reduced soil condition (Parkhurst & Standish, 2020). As mentioned under water quality, loss of vegetation also results in increasing salt concentrations in surface soils due to rising water tables which brings salt to the surface.

Revegetation of degraded land has been shown to improve soil quality including increases in soil organic matter and reduction in salinity (Parkhurst & Standish, 2020; Schofield, 1991). A study undertaken by Parkhurst and Standish (2020) on revegetated sites within the project area including Pine Ridge showed positive changes in a number of soil condition outcomes compared with reference woodlands and paddocks; however, woodland reference conditions were not always reached. For example, phosphorous and salinity remained high compared to woodland reference conditions but were lower than levels in paddocks. The study concluded that more time or further interventions will be required to get them back to reference levels.

### 2.2.4 Local Employment and other economic benefits

The establishment of plantations and conservation areas creates employment opportunities and skills development during preparation, planting, management of the project, in rural and remote areas where employment opportunities are rare. Spending with local contractors created flow-on economic benefits that may have help local communities to survive or thrive.

Hill View and the Yarra Yarra project, have employed local staff, including Indigenous employees, West Australian and international employees. The main activities undertaken on the project's sites have included native seed collection, branch pruning, support of the grazing activities, planting seedlings, bee keeping, vermin control, fencing and house maintenance.

While a large number of international transient workforce was also employed on the project, attention was also given to the need for impactful employment opportunities for local people.

- Six revegetated properties overlap with three Native Title claim areas. The project owners are committed to respecting the spiritual connection to the land of its traditional custodians, the Yamatji and Noongar Aboriginal peoples and to collaborate with the local communities. The project owners established a working arrangement with Midwest Employment and Economic Development Aboriginal Corporation (MEEDAC), an Indigenous organisation focused on finding work opportunities within the shires that the Yarra Yarra Biodiversity Corridor is found. MEEDAC are invited to the annual local stakeholders' meetings.

- The project owners also leveraged, when possible, traditional and contemporary knowledge for the local communities by partnering with Indigenous communities to host events.

Beyond employment, spending associated with the project establishment and maintenance can help local contractors, provided preference is given to these in procurement processes. If the local content proportion (salaries, locally sourced materials) is significant, then flow-on economic impacts can be very important for small communities where the money is spent. Local impacts can therefore be really relevant (note that it was not possible to establish based on available data the effectiveness of this impact).

### 2.2.5 Indigenous cultural heritage

Significant cultural heritage sites that have been identified in the Yarra Yarra project area are protected and managed as required under the Aboriginal Heritage Act 1972. The ongoing protection of the sites is assumed to strengthen cultural heritage and support spiritual re-connection to country which potentially has positive impacts on mental health and wellbeing of indigenous communities.

The Southwest of the SWAE has been the homeland of the Noongar people while the Northwest has been homeland to the Yamadji people. Those communities have a close traditional connection to the land of the ecoregion that is rich in their history which goes back to more than 40,000 years (Southwest Australia Ecoregion Initiative, 2006). The re-establishment of natural and cultural landscapes, the conservation of cultural values in the natural system as well as the protection of significant cultural heritage sites is important to strengthen the cultural heritage and support spiritual reconnection in the ecoregion. We also note the importance of incorporating traditional knowledge in conservation and land management to achieve greater collective benefits (Ellis-Smith, 2008).

Cultural heritage site verification surveys were conducted on each property of the Yarra Yarra project. Several sites were identified across the project area (see more details in Section 3.6) and site management advice was put forward. The reforestation activities have not disturbed any physical sites that were recognised to be from indigenous cultural significance, and it has been noted that it is not known that any cultural activities take place in the project area. The project developer has a legal obligation under the *Aboriginal Heritage Act 1972*[7] to continue to protect those sites and follow any Indigenous heritage advice on the management of the sites.

The actual impact on primary beneficiaries could not be established through this project, which did not involve any consultation; these co-benefits though potentially material and significant, remain theoretical.

## 2.3 Linkage of carbon and core co-benefits to the Sustainable Development Goals

The co-benefits of the Yarra Yarra project discussed in Section 2.2 contribute to specific UN Sustainable Development Goals (SDGs).

Table 2 below describes how each of the core co-benefits in the Yarra Yarra Project contribute to the SDGs. In some instances, quantitative evidence is provided such as for Decent Work and Economic Growth, Climate Action and Life on Land. However for Zero Hunger and Clean Water, due to the lengthy time-scales for improvements to occur in soil and water quality in low rainfall areas, evidence of contribution is based on scientific evidence the role trees and shrubs play in reducing water tables and consequently reduction in salinity levels. This is further discussed in Section 2.2 above.

[7] The *Aboriginal Heritage Act 1972* recognises Indigenous people's strong connection to country and details what kinds of places and objects need to be protected.

*Table 2. Project benefits and their associated SDGs*

| SDGs | Project benefit | Project Contribution |
|---|---|---|
|  | **Indigenous cultural heritage**<br>**Local Employment and Skills** | By ensuring a continued protection of culturally significant heritage sites, the project potentially contributes positively to mental health and well-being of indigenous communities as it supports connection to Country which in turn can have a positive impact on the **sense of belonging and identity** of indigenous communities. Additionally, through providing employment opportunities for local people, the project supports **better health of local communities**. |
|  | **Local employment and skills** | The project is providing training and education opportunities for local communities by delivering **induction and job-specific training sessions** for the local employees. The project is also partnering with the Morawa (Regional) Agricultural College providing students with opportunities to undertake training on carbon farming, environmental management and greater awareness of climate change impacts. |
|  | **Water quality** | The project will contribute to **lowering salinity in both ground and surface waters** over its life. Trees planted will capture water in their foliage and use groundwater itself. This will result in lowering of the water table and over time salt concentrations. In steeply sloped areas, the trees planted will also reduce soil erosion and thereby reducing sediment and nutrient loads to surrounding surface waters. |
|  | **Local Employment and Skills** | Through the project and since fiscal year 2015/16, **43 FTEs** have been created including **9 Indigenous FTEs**, allowing local workers to develop new skills and career opportunities since the start of the project. Furthermore, more than **80 local businesses** have so far been engaged for goods and services as a direct result of the project. |
|  | **$CO_2$ sequestration** | Climate change is now affecting every country, with Australia experiencing warming of approximately 1°C and in parts of the country like South-West Australia experiencing significant reductions in rainfall. By planting trees, the project helps to mitigate and adapt to climate change. During the project's lifetime, at least **967,695 $tCO_2$-e** will be sequestered. |
|  | **Biodiversity**<br>**Soil quality** | The biodiverse plantings of native trees and shrubs contains over **30 species of conservation significance**. This in turn is providing habitat to a range of insects, birds, reptiles and mammals including several threatened species including the Malleefowl, Carnaby's Black Cockatoo and the crested Bell bird. Additionally, through reduced soil degradation, the abundance of soil microorganism is expected to increase and the health of soil microbiomes to improve. |


**Local Employment and Skills**

**Indigenous cultural heritage**

The project developers have partnered with **11 local and national organisations** including WWF, BirdLife Australia, Australian Government's Clean Energy Future Biodiversity Fund, Shire of Morawa, Shire of Perenjori, Bush Heritage, Department of Parks and Wildlife, Northern Agricultural Catchment Council, Auscarbon, InSight Ecology and the Yarra Yarra Catchment Management Group.

# 3 ASSESSMENT OF CO-BENEFITS QUANTIFICATION METHODS

## 3.1 Overview

The following section outlines:

- The identification of quantification methods for each core co-benefit and their assessment against the criteria listed below
- A review of the existing information collected by CPOS
- The recommendations of the most relevant methods to measure the Yarra Yarra project co-benefits

We refer to Section 4 and Appendix 4, for an assessment of the economic valuation methodologies and their applicability to the project. As noted in the definitions section, however, there is a significant overlap between quantification and valuation methods, as valuation requires quantification, even when quantification is integrated in the overall valuation method.

This Section 3 focuses on methods that are specific to each core co-benefits identified, while Section 4 present an overview of generic economic valuation methods, used to put a dollar value on tangible and intangible co-benefits, and Section 5 provides a first pass valuation for a few co-benefits for which this was possible.

Quantification methods were sourced from a desktop search for primary and secondary literature and was also informed by the experience of our consultants and discussions with the project developer.

*In the following sections, we will use the terms standards and methods:*

- *Standards describe a set of rules to quantify benefits but do not always provide specific quantification approaches.*
- *A method is a set of instructions underpinned by scientific evidence that are followed to quantify benefits*

Only the main standards and methods are described in this section. They have been prioritised and assessed using the following criteria:

- The applicability in WA and to the Yarra Yarra project as a priority
- The need of a baseline and the data requirements
- The advantages and limitations of each method, from a project developer's perspective.

Table 4 below provides a summary of the most relevant quantification methods identified and the reasons why they were selected.

*Table 3. Summary of quantification methods*

| Co-benefit | Most relevant method identified | Reasons why |
|---|---|---|
| **Biodiversity** | National Standards for the Practice of Ecological Restoration (SERA) | • Generic<br>• Process-oriented<br>• Compatible with other standards and guidelines<br>• Can be used for a high-level assessment based on assumptions |
| **Water Quality** | Nutrient Tracker Tool (NTT) for surface water quality[8] | • Can be used to estimate the impacts of alternative conservation practices on nutrient and sediment losses and flow from agricultural fields<br>• Web-based program which requires no software installation |
| **Soil Quality** | Soil organic carbon (direct sampling and laboratory analysis) | • Suitable proxy of soil quality |
| **Local Employment and Skills** | Local benefits economic evaluation | • Assessment of indicators that can be quantified easily<br>• Analysis can be set up to focus on indigenous impacts for example |
| **Indigenous cultural heritage** | Social Return on Investment (SROI) | • Human-centric internationally recognised method and used in Australia<br>• Compatible with Cost-Benefit Analysis and benefit transfer<br>• Suitable to assess indigenous benefits |

## 3.2 Biodiversity

### 3.2.1 Identification and assessment of benefit quantification methods

We have reviewed a number of national standards and methods to appropriately quantify the Yarra Yarra project's biodiversity benefits as described in Section 2.2. Methods that we reviewed are those quantifying:

- (Native) Vegetation or habitat condition, for instance against a reference ecosystem (benchmark)
- Species (flora and fauna) diversity

In our review, we focused on biodiversity quantification methods that are applicable to restoration and reforestation projects and would be the most appropriate in the context of the Yarra Yarra project.

We shortlisted the below three methods which are further characterised in Table 4.

[8] Note: further research is required to evaluate suitable groundwater methods

- *National Standards for the Practice of Ecological Restoration*: The Society for Ecological Restoration Australia (SERA) have developed standards for adoption by community, industry, regulators/government and land managers (including private landholders and managers of public lands at all levels of government) to raise the standard of restoration and rehabilitation practice across all sectors.
- *Native Vegetation Monitoring method*: A method developed by the Land Restoration Fund and accredited under the Accounting for Nature (AfN) standard which assesses native vegetation condition against a reference condition benchmark for the same vegetation type.
- *Habitat Hectare assessment*: A site-based measure of biodiversity value associated with the Victorian Native Vegetation Offsets Scheme and developed by the Victorian government. It assesses the extent and condition of native vegetation against a benchmark.

*Table 4. Summary of standards and methods for quantifying biodiversity co-benefits*

| Criteria | National Standards for the Practice of Ecological Restoration (SERA) | Native Vegetation Monitoring method (AfN®) | Habitat Hectare Assessment method (Victorian Government) |
|---|---|---|---|
| **Standards/Method summary** | The National Standards by SERA uses a 5-star recovery scale assessed against 6 key principles/attributes of ecological restoration practice: absence of threats, physical conditions, species composition, structural diversity, ecosystem function and external exchanges. The generic 1 to 5-star recovery scale represents a gradient from very low to very high similarity to a chosen reference ecosystem to measure progress towards a restored state. | The Native Vegetation Monitoring Method developed by the Land Restoration Fund assesses the condition of native vegetation and benchmarks natural assets on land against their implied natural state. The method is accredited under the AfN standard. The method applies the BioCondition method, a vegetation condition assessment tool developed for the Queensland context. | The Habitat Hectare is a site-based vegetation assessment method that measures the extent and condition of native vegetation against a benchmark for the same vegetation type. |
| **Tradeable Unit** | No tradeable unit. | The method creates a condition score (Econd™) which is currently not tradeable. An Econd™ is an index between 0 and 100 where 100 describes the reference condition (undegraded). | Yes. General and specific biodiversity equivalence units (GBEU and SBEU) and general and species habitat units (GHU and SHU). |
| **Baseline necessary** | Yes. An ecosystem baseline inventory that is to assess the project's current ecosystem condition. | Yes. It will require a regional benchmark (Regional Ecosystem) for the vegetation type in question and baseline information of the current vegetation condition. | Yes. It will require a bioregional benchmark (Ecological Vegetation Class) for the vegetation type in question and baseline information of the current vegetation condition. |
| **Application level** | National | Queensland | Victoria |
| **Data/information requirements** | • Identification of an (indigenous) reference system<br>• Stakeholder engagement | • Sound knowledge of Regional Ecosystems (RE) under the RE framework to which the vegetation in question needs to be assigned to and the site to be assessed | • Sound ecological knowledge of the reference site and the site to be assessed, including knowledge of Victoria's bioregions and Ecological Vegetation Class (which will function as the ecosystem benchmark) |

| | | | |
|---|---|---|---|
| | • Ecosystem baseline inventory (restoration target) to assess site's current ecosystem condition<br>• Targets, goals and objectives<br>• Analysis of composition (species), structure (complexity and configuration) and function (processes and dynamics) of the ecosystem to be restored<br>• Logistics and processes (e.g. monitoring) | • Spatial information in form of geodata (for digital regional ecosystem mapping and regrowth mapping)<br>• Information collected during field assessment | • Information collected during field assessment |
| **Advantages** | • Generic<br>• Process-oriented<br>• Compatible with other standards and guidelines<br>• Can be used for a high-level assessment based on assumptions | • Accredited method that has been applied successfully<br>• Provides standardised approach to comparing between projects | • Used to calculate biodiversity offsets<br>• Customised to local needs<br>• Approved by the Department for Environment, Land, Water and Planning |
| **Limitations** | • Generic<br>• Potential lack of transparency in results as no independent certification is required<br>• Lack of tradeable units | • Method currently (only) developed for the Queensland region.<br>• Method focuses on the condition of vegetation and overlooks habitat connectivity<br>• Accredited under the Accounting for Nature in April 2020 and requires certification fees<br>• Lack of tradeable units | • Habitat Hectare assessments are undertaken by qualified ecologists/assessors<br>• Specific to the Victorian context (uses Ecological Vegetation Class benchmarks). Method/approach may not be suitable for other states<br>• Highly bureaucratic process<br>• Approach favours protection over restoration due to complexity of assessing net gain projected over 10 years |

### 3.2.2 Review of existing project information

An overview of the currently existing information on biodiversity for the Yarra Yarra project is provided in Table 5 below, noting that the listed studies and surveys also assessed areas such as remnant vegetation which are not part of the Gold Standard certified project.

Gold Standard Ecological Biodiversity monitoring was conducted in 2018. The report details information on seed stocking used during the vegetation establishment (e.g. number of seedlings per establishment year and species). This report is not specifically listed in Table 5 as it only provides us with an understanding of what species were planted but not their survival after the planting was conducted. We have found that York Gum (*Eucalyptus loxophleba*) and Jam (*Acacia acuminate*) were the main species planted (see Section 2.2). Information on tree survival rates after plantings performed before 2016 can be found in the 2016 Biodiversity Monitoring Report which includes details monitoring procedure and results including tree survival rates per property (Hill View, Tomora, Bowgada Hills and Terra Grata). For a more detailed summary of findings please refer to Appendix 3.

It must be noted that biodiversity information was not available for all properties across the Yarra Yarra project. The CPOS Hill View baseline monitoring survey was the first and only systematic baseline survey conducted at any of the Yarra Yarra properties. It was a baseline investigation that assisted in developing an understanding of the ecological dynamics at the Hill View property. The survey was not replicated at Hill View or any other properties. No studies or surveys were conducted at Bowgada Hills and Hughes Block. This mean that there is very limited and fragmented understanding of not only ecological dynamics but overall biodiversity for the whole Yarra Yarra project.

***Table 5. Overview of biodiversity related studies and surveys conducted in the Yarra Yarra Biodiversity Corridor project***

| Properties | GS project area (ha) | % of total GS project area | GS Establishment year | Biodiversity related studies and surveys |
|---|---|---|---|---|
| **Tomora** | 2,270 | 26% | 2008 | Citizen Science Program by Conservation Council WA (2019) |
| **Terra Grata** | 937 | 11% | 2010, 2011, 2015 | Terra Grata Biodiversity Survey Report (Schroeder, 2017) |
| **Hill View** | 617 | 7% | 2010, 2011, 2014 | Hill View Baseline Monitoring Survey (Huggett, et al., 2015), Macroinvertebrate and Herpetofauna Inventory Survey (Knowles & Knowles, 2015), Citizen Science Program by Conservation Council WA (2019) |
| **Bowgada Hills** | 1,299 | 15% | 2009, 2010, 2011, 2015 | None conducted to date |
| **Pine Ridge** | 2,698 | 31% | 2009, 2010 | Project report by Murdoch University (Parkhurst & Standish, 2020) |
| **Preston Waters** | 405 | 5% | 2012 | Citizen Science Program by Conservation Council WA (2019) |
| **Hughes Block** | 473 | 5% | 2016 | None conducted to date |
| **Total area** | **8,699** | | **2008-2016** | |

### 3.2.3 Conclusion

After assessing advantages and limitation of the shortlisted methods, especially in light of the availability and quality of information on biodiversity for the Yarra Yarra project, the *National Standards for the Practice of Ecological Restoration in Australia* ('the National Restoration Standards') developed by SERA appears to be the most appropriate method at this point in time. While the National Restoration Standards are supposed to be applied before a restoration project commences, we see its value in the fact that it is a) process-oriented and b) developed for restoration projects that aim to progress an ecosystem as far as possible towards full recovery

(relative to a reference ecosystem). Importantly, it can also be used to "scale" the valuation of biodiversity co-benefits (see Section 5.1).

While the National Restoration Standards provides an understanding of the overall restoration progress and the state of recovery of the ecosystem, it also assesses biodiversity aspects which are covered by the attributes 'species composition', 'structural diversity', 'ecosystem function' and 'external changes'.

It should be noted that the National Restoration Standards will have to be applied based on out-of-date information from the Hill View survey as well as assumptions as there appears to be currently no scientifically robust and recent understanding of biodiversity across the whole Yarra Yarra project or for individual properties. The National Restoration Standards assessment as outlined in Section 5.1 is therefore associated with a specific uncertainty. Recommendations how this assessment can be improved in the future are made in section 6.2. Because the National Restoration Standards are developed to be generic for compatibility with other guidelines and standards, the assessment can be complemented by other methods and guidelines. This means that biodiversity benefits of the project can be estimated while efforts can be made to continue to improve the understanding of the ecological dynamics within the project, including relative abundance of species, species richness, species composition and habitat interactions and use as well as habitat linkages.

The National Restoration Standards are a suitable method to deliver a high-level affirmation of environmental co-benefits that the Yarra Yarra project. Its recovery scale (1-5 stars) is easily understood by many stakeholders and restoration progress can be communicated in a simple way. The National Restoration Standards can be used to promote biodiversity and, its application to water and soil co-benefits of the project could also be explored.

The Native Vegetation Monitoring method was deemed unsuitable because it was specifically developed for the Queensland context and as being accredited the AfN will require a third-party certification. However, there this method could potentially evolve and become more readily applicable in the Yarra Yarra project context in the near future. Similarly, the Habitat Hectare assessment method was screened out because it is tailored to the Victorian context and requires to be performed by a qualified assessor.

## 3.3 Water quality

### 3.3.1 Identification and assessment of benefit quantification methods

By nature, quantifying water benefits present a number of challenges, including:

- Water flows within catchments or groundwater basin, and connectivity is often not well understood
- Water, especially surface water, does not have permanence, as it flows and evaporates
- Water has multiple users, and agricultural water use is intricately linked to regional socio-economic issues, but also to environmental issues within the catchment

Water quantity and quality issues are also intricately linked together, i.e. when water flows are insufficient, water quality can deteriorate (for example algae bloom). However, some of the existing water markets solely focus on quantity (e.g. the Murray Darling Basin water market).

For this reason, water indicators are often only valid in the local context, and their value is dependent on the local context.

### 3.3.2 Method identification and review process

To identify appropriate quantification methods, our desktop research has focused on the specific impacts from the Yarra Yarra project. Based on the initial review of the project documentation and discussions with Carbon Neutral Pty Ltd, the following potential water-related impacts were identified:

- Enhanced instream water quality by reducing surface rainwater runoff through revegetation benefiting both aquatic ecosystems and downstream users; an important **caveat** is that connectivity is not well understood and it could not be established with certainty that water did not evaporate or seep while flowing through ephemeral streams before reaching other environments.

- Improved ground water levels and salinity by reducing water infiltration into soil, increasing ground cover plant density and regrowth, and restoring natural water movement patterns through revegetation of degraded farmlands.

Our research identified several quantification methods potentially suitable for assessing water benefits from the project. These include:

*Water quality*

**Nutrient Tracker Tool**[9] - is a free, online, user-friendly tool that quantitatively estimates the nitrogen, phosphorus and sediment losses from crop and pasture lands. It is currently used by the Willamette Partnership in the USA to generate water quality credits.

**Point Source Water Quality Offsets Guideline** (Queensland Government) – The methodology, developed under the Queensland Governments Water Quality Offsets Policy, enables sediment and nutrient loads to be estimated and water quality offsets to be developed.

*Groundwater levels and recharge rates*

There are several scientific methods available to quantify recharge rates; however, choosing appropriate techniques is often difficult. Important considerations in choosing a method include space/time scales, range, and reliability of recharge estimates based on different techniques (Scanlon, 2002). In broad terms there are 4 groups of methods and that be used including physical, chemical, indirect and empirical. The main methods under each of these groups include (Ali, 2017):

- **Physical methods**: includes Lysimeter, seepage meter, field-plot water balance (all require some form of physical or direct measurement)
- **Chemical methods**: includes application of chemicals/tracers to estimate the recharge, such as application of dye, chemicals and isotopic tracers.
- **Indirect methods**: includes methods which estimate recharge from other variables, such as general water balance (catchment or basin scale), water table fluctuation, fallout of environmental tracers, groundwater aging, etc.
- **Empirical methods**: estimation of recharge from empirical relationship of recharge with other factors of recharge (having 'cause and effect relationship')

To assess whether any of these methods would be applicable in this study, an assessment of the data requirements for each method was compared to the existing data collected from the project.

### 3.3.3 Review of existing information

Available data records from the project show the following water quality / quantity measures that have been undertaken:

- Surface water quality – Electrical conductivity (EC) measurements taken in 2018 and 2019.
- Groundwater records – the recorded information is annual records of water used from (Licensed) ground water bores. Each bore has a calibrated meter which at any time shows the volume of water in KLs that has passed through it since it was installed. It is not a record of ground water levels.

Table 6 provides a detailed record of what has been monitored and when. We also note that other properties that are not certified under the Gold Standard have been monitored by the project partners (e.g. Wilton Wells and Colganatta which have since been sold).

[9] https://ntt.tiaer.tarleton.edu/welcomes/new?locale=en

*Table 6. Surface water (electrical conductivity) and groundwater usage monitoring records for the Yarra Yarra project*

| Properties | Shire | Years established | Surface water monitoring (Electrical Conductivity) | | Borehole monitoring (water usage rates) | |
|---|---|---|---|---|---|---|
| | | | Monitored Yes/No | Date monitoring started | Monitored Yes/No | Date monitoring started |
| **Tomora** | Morawa | 2008 & 2009 | Yes | 8/2018 | Yes | 2016 |
| **Terra Grata** | Morawa | 2010, 2011 & 2015 | Yes | 8/2018 | No | |
| **Hill View** | Morawa | 2010, 2011 & 2014 | Yes | 8/2018 | No | |
| **Bowgada Hills** | Perenjori | 2009, 2010, 2011 & 2015 | Yes | 8/2018 | No | |
| **Pine Ridge** | Perenjori | 2009 & 2010 | Yes | 8/2018 | Yes | 2016 |
| **Preston Waters** | Morawa | 2011 & 2012 | No | 8/2018 | Yes | 2016 |
| **Hughes Block** | Perenjori | 2016 & 2017 | No | 8/2018 | No | |

Our main findings from the reviewed data include:

- Surface water quality has a limited dataset with only 2 monitoring periods dating back to 2018 and is focused on measuring electrical conductivity, which can be used to determine the salinity levels at a point in time.
- The results indicate that EC is lower in re-established areas with many sites recording low salinity water (e.g. < 1 mS/cm).
- Water quality flowing off land established with native vegetation, including that from revegetated land, can potentially release good quality surface water compared to land that has been managed for agricultural uses.
- Measuring EC as indicator of salinity does not allow calculation of the total salt in the system or the impact the project has had on reducing salts levels from surface water runoff or through groundwater inputs.
- The groundwater measurements undertaken were to monitor water consumption rates as part of the project developer's borehole licence requirements. Unfortunately, these records to not provide any insights into groundwater levels or recharge rates.

In addition to the monitoring data, an independent study by Murdoch University was undertaken to assess how revegetation of the abandoned farmlands in this project were improving biodiversity outcomes. Part of the study included studying soil chemistry in the revegetated areas, reference woodland sites and nearby paddocks. The results indicated EC levels in soils remain higher in revegetation areas compared with paddocks and woodlands indicating that more time is required to monitor the changes before impacts from the biodiverse plantings on groundwater and salinity can be confirmed (Parkhurst & Standish, 2020).

### 3.3.4 Conclusion

Currently there is insufficient data available to quantify water co-benefits linked to the project. There is also insufficient knowledge regarding the hydrology of the project area to be able to make assumptions on the connectivity of the revegetated areas to the ground and surface water catchments. For these reasons, quantification and valuation of potential water benefits is not currently possible.

Recommendations to improve understanding and monitoring of water quality impacts from the projects are provided in Section 6.1.2.

## 3.4 Soil quality

As mentioned above, soil quality is an important consideration and a likely core co-benefit from the project; however improved soil quality is likely to mostly benefit the project itself, as benefits are unlikely to be felt beyond the boundaries of the project and the reforestation is intended to be permanent (i.e. not converted back to agricultural land). The quantification or valuation of soil quality should be considered in this context and the required investment may not be a priority for the project owners.

### 3.4.1 Identification and assessment of benefit quantification methods

Soil quality indicators can be separated into 3 main types: chemical, physical and biological. Their relationship to soil function can be categorised in the following way[10]:

- **Chemical**: Nutrient Cycling, Water Relations, Buffering
- **Physical**: Physical Stability and Support, Water Relations, Habitat
- **Biologica**l: Biodiversity, Nutrient Cycling, Filtering

Organic carbon transcends across all three categories and has the most widely recognised influence on soil quality[11]. Depending on the environmental issues pervading the area of interest other indicators maybe of interest as well. For the Yarra Yarra project areas, salinity and nutrients are other obvious indicators that are of interest that could be quantified.

For soil organic carbon, there are a range of carbon offset methodologies that can be used including the Gold Standard's Soil Carbon Framework. For assessment of salinity and nutrients there are a range of scientific methods available.

Soil salinity can be estimated or measured by[12]:

- the electrical conductivity (EC) of a solution or soil and water mix, in the field or laboratory
- the apparent electrical conductivity of soil using an electromagnetic induction (EM) device
- chemical analysis of total dissolved solids (TDS) of water or soil in a laboratory to identify and measure ion concentrations.

Soil nutrients can be measured by taking samples and analysing nutrients of interest in a laboratory[13].

### 3.4.2 Review of existing information

The project developer is not currently undertaking any broadscale soil quality measurements. However, an independent study by Murdoch University was undertaken to assess how revegetation of the abandoned farmlands in this project were improving biodiversity outcomes. Part of the study included studying soil chemistry in the revegetated areas, reference woodland sites and nearby paddocks. The results indicated several key indicators such as organic carbon, phosphorous and EC levels in revegetation areas remain outside the expected range seen in the reference woodlands indicating that more time is required to monitor the

[10] http://soilquality.org/indicators.html accessed on 13 August 2020

[11] http://soilquality.org/indicators.html accessed on 13 August 2020

[12] https://www.agric.wa.gov.au/soil-salinity/measuring-soil-salinity accessed on 13 August 2020

[13] https://www.daf.qld.gov.au/__data/assets/pdf_file/0006/65985/Soil-Nutrient-Testing.pdf accessed on 13 August 2013

changes before impacts from the biodiverse plantings on soil quality can be confirmed (Parkhurst & Standish, 2020).

### 3.4.3 Conclusion

Due to a lack of existing soil quality data and taking into account results from the Murdoch University study, it's not possible to quantify soil quality co-benefits and therefore carry out an economic valuation of this co-benefit. Application of the methods identified above also require more data than currently available and the cost-benefit of such data collection may not be apparent. Notwithstanding, should CPOS decide to go down this path, recommendations are provided in Section 6.1.3.

It should be noted that improvements in soil quality within the revegetated areas are intrinsically linked to growth of the trees and biodiversity and are therefore captured within the valuation for biodiversity. Any off-site improvements in soil quality is highly uncertain and would more research to establish such impacts.

## 3.5 Local Employment and Skills

The local employment and skills benefits relate to the benefits delivered by the Yarra Yarra project to the local economy by upskilling and employing people from the region, including Indigenous people and by spending money with local suppliers and contractors.

This category of benefits comprises direct economic benefits which are easily quantifiable.

For further details regarding the valuation of the local employment and skills benefits, we refer to the cost-benefit analysis in Appendix 4 (A.3).

### 3.5.1 Identification and assessment of benefit quantification methods

Based on the benefits listed in Section 2.2, research was undertaken to identify methods that can help monitor and quantify impacts of these employment indicators:

- Number of local jobs and indigenous jobs supported by the restoration and reforestations activities
- Value of the budget to be allocated to local subcontractors and local Indigenous businesses
- Distribution indicators, i.e. what proportion of the spend is going to indigenous businesses and / or employees

Local economic impacts are readily identifiable and quantifiable in monetary terms. Local benefit quantification methods call on classic economic calculations, linking employment and spend in regional area to positive impacts to the local economy (see, for example, Ernst & Young, 2020).

The challenge is then to deal with cross-boundaries and displacement issues in calculating the real **local** benefit.

Table 7 summarises the characteristics of the most appropriate method to quantify the local employment and skill benefits.

***Table 7. Method for quantifying local employment and skills co-benefits***

| Criteria | Local benefits economic evaluation |
|---|---|
| **Method summary** | The method is purely based on economic flow analysis, identifying local activity (in jobs, contractors spend, etc) generated by a project.<br>The number of equivalent Full Time Employment (FTE) units acts as a key indicator and a key aspect of the analysis is to assess "leakage" or "crowding" or displacement aspects, when the capacity of the local economy to respond to the stimulus may be limited. |
| **Tradeable Unit** | No tradeable unit |
| **Baseline necessary** | No |

| | |
|---|---|
| **Data requirements** | • Number of local FTEs created<br>  ○ Of which: Number of local indigenous FTEs created<br>• Average annual salary<br>• $ allocated to local suppliers and local contractors and Indigenous businesses |
| **Application level** | International |
| **Advantages** | • Indicators can be quantified easily<br>• Analysis can be set up to focus on indigenous impacts for example |
| **Limitations** | • While overarching methodology is applicable everywhere, using existing studies and extrapolating their results through "benefit transfer" (see Appendix 4 (B.2)), local capacity and economic context varies from place to place and potentially negative aspects need to be controlled for on a case by case basis.<br>• Boundary impacts are hard to establish / control for, i.e. what is considered as "local", how much of the spend with local companies is sub-contracted or directed to purchase of "imported" goods, etc. |

### 3.5.2 Review of existing information

Since the Yarra Yarra project inception in 2008 and up until fiscal year 2019/20, Carbon Neutral Pty Ltd has employed 427 staff exclusively for farm / plantation activities, out of which the majority was employed on a casual basis. These included local, Indigenous, West Australian and International employees. Head office employees are not considered, to be conservative, as they may not be considered as "local" employment and are likely to be people who would have easily found work elsewhere.

Since fiscal year 2015/16, Carbon Neutral Pty Ltd has recorded the number of FTEs in a consistent manner. Therefore, only information from 2015/16 onwards is included in Table 8***Table 8.*** below. In total, 43 direct FTEs were employed on the Yarra Yarra project.

***Table 8. Farm / plantation employees – FTEs (over 5 years)***

| Employee category | Total Full Time Equivalent (FTE) |
|---|---|
| **Indigenous** | 9 |
| **Non-Indigenous** | 34 |

The numbers of employees have dropped recently, as no plantation activities have occurred in the recent past. Currently, in fiscal year 2019/20, Carbon Neutral Pty Ltd employs 3 direct FTEs on the Yarra Yarra project. However, none of them identify as Indigenous.

Moreover, Carbon Neutral Pty Ltd has cumulatively invested $12.8M in the local economy up until fiscal year 2019/20 (excluding land acquisition costs), including the following costs as illustrated in Table 9. This has likely created positive local economic impacts.

***Table 9. Yarra Yarra Project spending (over 13 years)***

| Type of costs | Million $ |
|---|---|
| **Local labour and suppliers** | 7.2 |
| **Establishment - Trees & Carbon &Sandalwood** | 4.9 |

As described above the project developer engages local contractors and local suppliers for ongoing operations (fuel, stores, etc.).

Other benefits arising as a result of the project include, but are not limited to, development of new knowledge and skills base, increased community member utility and mental health benefits.

### 3.5.3 Conclusion

The local benefits economic evaluation quantifies market values for local employment, potential flow-on impacts and overall economic impact (direct and indirect) created by restoration and reforestation projects. The literature review confirmed that variations of this method are used in Australia and internationally. Therefore, for the Yarra Yarra project, using a study of reference and extrapolating the results to the study area through benefit transfer is the recommended method. It is also important to identify potential distributional impacts (indigenous employment and local aspects) by collecting the most accurate and detailed data possible.

## 3.6 Indigenous cultural heritage

### 3.6.1 Identification and assessment of benefit quantification methods

Indigenous cultural heritage benefits/values can be categorised under direct use values and non-use values (as described in Appendix 4 (A.1)) and have no direct link to market prices. Methods to quantify (and value) cultural services are limited, partly because of the difficulty quantifying (and valuing) these benefits as well as a lack of appropriate methods (Farr, et al., 2016).

The Social Return on Investment (SROI) is an internationally recognised methodology used to understand, measure or estimate and value the impact of a programme or organisation. It is a form of stakeholder-driven evaluation blended with cost-benefit analysis that examines the social, economic, cultural and environmental outcomes created and the costs of creating them. It tells the story of how change is being created and places a monetary value on that change and compares it with the costs of inputs required to achieve it. We have found this to be the only suitable method for the context of the Yarra Yarra project. Advantages and limitations of the method are outlined below.

Advantages of the SROI:

- Human-centric internationally recognised method and used in Australia
- Compatible with Cost-Benefit Analysis and benefit transfer (see Appendix 4 that discusses valuation methods)
- SROI can be evaluative (looking back at what happened) or prospective (projecting likely impacts) and hence can be used to design / enhance design elements of a project
- Suitable to assess indigenous cultural (heritage) benefits

Limitations of the SROI:

- Requires extensive stakeholder consultation to collect data, hence is typically expensive and time-consuming; this is reinforced by the need for peer review, if pursuing certification
- Degree of subjectivity when measuring and evaluating the effects and determining

### 3.6.2 Review of existing information

While the Yarra Yarra project fulfils its safeguard responsibilities by recognising the cultural heritage sites and ensuring their protection under the Aboriginal Heritage Act, the restoration and reforestation of Country may have cultural benefits that have not been identified yet. This could include benefits associated with cultural identity and human-landscape relationships (connection to Country).

Six of the Yarra Yarra project properties overlap with three Native Title claim areas. the project owners engaged with the traditional custodians, the Yamatji and Noongar Aboriginal peoples and the Widi mob throughout the project implementation.

- There are no records or registered cultural heritage sites on the properties Preston Waters, Pine Ridge and Tomora.
- Heritage sites on Hughes Block are all located in remnant vegetation and have not been disturbed by the project activities.
- Cultural heritage sites were confirmed at Bowgada Hills, Terra Grata and Hill View and recommendations for Indigenous site management made.
- The south-western corner of the Terra Grata property for instance is part of a broader 'mythological zone' that surrounds the Lockier River to which the project activities may contribute positively.
- Vegetation establishment was permitted on a portion of the cultural heritage site at Terra Grata as it is not in conflict with its heritage status. All heritage sites are recorded on the Department of Indigenous Affairs Aboriginal Site Register.
- Geodata provided by the project owners and confirms that management advice was followed, and vegetation was not established on cultural heritage sites. It is not known that cultural activities take place in or around the identified cultural heritage areas, however we cannot dismiss this entirely.

Potential indigenous cultural heritage benefits however can only be identified, measured and valuated in close consultation with the relevant traditional custodians of the land (e.g. Widi mob). When there is not enough information on the cultural and heritage benefit of these sites have, we therefore cannot quantify and estimate the value of this benefit.

### 3.6.3 Conclusion

Going forward, we recommend to carefully identify the specific indigenous cultural heritage benefits/values through engagement with the traditional custodians of the land. The SROI, as a stakeholder focused **valuation** method could be the most appropriate method in this context to assess the indigenous cultural heritage values. It starts with a conversation with potential beneficiaries and can be stopped at any time, for instance if the project activities are not found to have a positive impact on indigenous cultural heritage. It is further described in Appendix 4 (B.3).

# 4 CO-BENEFITS VALUATION METHODS

## 4.1 Overview

As a preamble, it is important to note that valuation of co-benefits here refers to the **economic value** of such co-benefits, i.e. a theoretical value, as opposed to the **market value** (i.e. cashflows) that co-benefits such as biodiversity credits could reach on a voluntary or organised market. The "pathway to market" consideration is therefore an important one and a separate section has therefore been dedicated to it (see Section 6.3).

Economic valuation is steeped in economic theory and as economics has the ambition of being able to holistically capture *all* types of values, most of the valuation techniques and methods aim to put a dollar value on benefits and costs associated with a project or an intervention.

An important question is how to account for benefit attributes that may vary greatly across locations and projects. Therefore, it is important to emphasise that **what cannot be measured cannot be valued** and valuation techniques typically rely on either:

- A benefit quantification indicator to scale up and down the value and a financial proxy to translate the impact in monetary terms, or
- An apportionment or attribution of an overall known economic value to a specific action / intervention.

Bringing together complementary economic methodologies, at a generic level, the proposed formula for the valuation of co-benefits for the Yarra Yarra project is as follows:

*Relevant measurement unit to scale benefit (e.g. Ha) X Proxy economic value per unit X moderating factors*

Where:

- The measurement unit is likely to be hectare for biodiversity, but it may be different for other co-benefits (socio-economic) and may not always be scalable (e.g. Indigenous cultural heritage value)
- Proxies have been sourced for this project, noting however that there can be a high level of uncertainty around sourced values, given the specific nature of the project
- A "moderating factor" is introduced to deal with the imperfections of both measurement units and proxies and "moderate" the value of reference based on the qualitative information we may have on the Yarra Yarra Project; the objective is to produce a conservative and transparent estimate of value
- Uncertainty is an important parameter to be conscious of, even after accounting for the "moderating factor" mentioned above.

For further details, Appendix 4 presents:

- An overview of the economic theory (covering both broad frameworks and specific benefit valuation methodologies) that underpins this formula
- How this could best be used, in conjunction to quantification techniques, or in isolation, to put a value on Yarra Yarra Projects' co-benefits
- An application of the valuation to the Yarra Yarra Project.

The recommendations in Section 6 provide suggestions on how uncertainty around the valuation can be reduced, should CPOS be able to invest in monitoring and validation.

# 5 CO-BENEFIT ANALYSIS OF THE YARRA YARRA BIODIVERSITY PROJECT

***This section provides an example of natural capital accounting techniques that could be applied to biodiverse carbon projects.***

By applying the valuation methodologies presented in Section 4, this section provides a first pass valuation for a few co-benefits of the Yarra Yarra project for which this was possible. As mentioned in Section 4.1 and in Appendix 4 (B), while an overarching formula for co-benefit valuation is proposed, various techniques apply to different co-benefits.

To be pragmatic, it is proposed to use a combination of benefit-transfer and market and non-market value "proxies" to put a value on the restored areas:

- Biodiversity could be valued using benefit transfer using regional proxy values, or downscaling value from worldwide biodiversity value studies.
- Employment and regional economic benefits can be valued using direct cashflows from the project.
- Indigenous cultural heritage co-benefits might be valued using techniques such as SROI, see, although this cannot be demonstrated within the scope of this study, as engagement with Indigenous elders and representative would be required to even assess the appropriateness of this method.

While these values can all be expressed in dollars, they fundamentally differ in nature and **should not be aggregated**. In other words, a dollar of biodiversity and a dollar of economic stimulus cannot be equated. A **value judgment** needs to be made and that judgment should be ethical and explicit, not mathematical and implicit. The dollar is used to make non-market values visible, but it does not make them fungible across categories.

The proposed approach is described in the sections below, noting the significant uncertainty, due to the limited data available.

## 5.1 Biodiversity and ecosystem services

Given the location of the project, and its limited "use values", biodiversity is a major co-benefit to be considered. Note that, while the definitions of biodiversity and ecosystem services may be different, for the purpose of valuation, we are looking at both biodiversity offsets or credits and at ecosystem services as two equally valid ways of valuing co-benefits. Also note that the National Restoration Standards apply an ecosystem services lens. As part of the reforestation activities of the Yarra Yarra project, a range of ecosystem services are aimed to be restored including habitat provisioning and nutrient and water cycles.

### 5.1.1 Evidence of value and co-benefit creation

As a reforestation project started from a degraded paddock, from a biodiversity point of view, the Yarra Yarra project has the ambition to restore the land to as close as possible of its pre-development state. The ecological value of the bioregion where the project is located (North Eastern Avon Wheatbelt) is underpinned by the endemic vegetation that can be found in this biodiversity hotspot.

As described in Section 2.2, the Yarra Yarra project is located in a region recognised as global and national biodiversity hotspot, and as such is characterised by high endemism as well as high numbers of threatened species due to the loss of the majority of its original natural vegetation. This substantial loss is attributed to historic extensive clearing of vegetation for agricultural purposes which has put endemic and native species under risk of extinction. The urgency of the need for conservation as well as restoration of this biodiversity hotspot is highlighted in the State of Environment Report 2016 (Jackson, et al., 2016) that outlines that remnant vegetation, wetlands, river/riparian systems, populations of species and ecosystems are in poor condition in Southwest Australia. The introduction of weeds, plant diseases and invasive species put additional pressure on those already unstable systems.

### 5.1.2 Measurement units

Section 3.2 discussed in detail the question of measurement of biodiversity. To be able to use benefit transfer (see paragraph on proxies below) ecosystems attributes required to be matched as closely as possible between project area and the project of reference. There can therefore be many variations (see discussion below). However, at a high level, measuring biodiversity theoretically requires taking into account:

- The **extent** of the vegetation, which is typically a measurement in hectares.
- The **significance** of the vegetation, recognising the existence of some "biodiversity hotspot" which support more complex ecosystems, and recognising that some bioregions are so degraded that it confers a higher value to representative remnants or restored vegetation.
- The **condition** of the vegetation, which determines the level of integrity of the ecosystems; an important assumption made for this project is that restoration can deliver just the same biodiversity and ecosystem values as a native vegetation remnant, given sufficient time, noting that this may be disputed by some analysts.

It is acknowledged that the categorisation above is a simplification and that parameters can be refined much further (as evidence, for example, in the habitat hectare methodology, see 3.2), but it would not

For this project:

- The number of hectares is well known and validated, included through the Gold Standard process: 8,700 ha (rounded up from 8,699 ha in the calculations below).
- The significance of the vegetation is very much linked to the choice of a proxy (see below). For this study, it is assumed that the vegetation is of high significance, due to the location of the project within a "hotspot" region.
- For the condition, it is suggested to use the National Restoration Standards developed by SERA and use the rating obtained to scale up and down the value.

### 5.1.3 Proxies

Proxies are used to put a "notional" dollar non-market value on biodiversity and ecosystem services. As per the methodology exploration in Appendix 4 (B.1), application of benefit transfer would require to identify a site with characteristics and vegetation attributes close to those of the project site and where a primary economic valuation study has been carried out. Research did not identify any such study having been undertaken relatively recently, hence a different approach was adopted, with a higher level of uncertainty around the estimates, as the link between project site and original valuation becomes more tenuous.

The two avenues explored here to identify proxies are:

- A reference to a very widely recognised and cited body of work by Costanza and de Groot, putting a value on ecosystems worldwide (de Groot, et al., 2012) and then looking at the variations in value over time. This is consistent with the methodology applied for the Gold Standard report entitled "the Real Value of Climate Action" (The Gold Standard Foundation , 2014).
- Analysing the data in the WA biodiversity offset scheme to source "replacement costs" (see Appendix 4 (B.1)) from these projects for vegetation in the Avon Wheatbelt.

It is important to stress that there is no "right or wrong" answer for the selection of proxies, provided it can be justified. The two values have therefore been used in the calculations below, providing "book-ends" to the valuation.

***Method 1: Worldwide ecosystem services value***

One of the most used and reference sources in terms of ecosystems services value is a meta-study carried out by (de Groot, et al., 2012) "present an analysis of global unit values from the database which was developed during the TEEB project. The paper estimated ecosystem service unit values of 10 main biomes expressed in monetary units. In total, over 320 publications were screened covering over 300 case study locations. A selection of 665 value estimates were used for the analysis.

The values for the "woodland" biome from the study are reproduced below (Figure 2). The woodland biome is the closest "match" for the vegetation form prevalent in the Avon Wheatbelt. When looking into the details of the ecosystem services, it is suggested to exclude provisioning services, as food and raw materials are not extracted from the project area, and cultural services, to avoid any double counting with "aboriginal cultural values" described in 5.3.

The resulting value of the proxy is $1,328 per ha and per year, in 2007 international dollar, which has the same value of a USD. Conversion into mid 2020 AUD results in **AUD 2,305** per ha and per year[14].

***Figure 2. Monetary value for ecosystems services (de Groot, et al., 2012)***

**Table 2**
Summary of monetary values for each service per biome (values in Int.$/ha/year, 2007 price levels).

| | Marine | Coral reefs | Coastal systems | Coastal wetlands [a] | Inland wetlands | Fresh water (rivers/ lakes) | Tropical forest | Temperate forest | Woodlands | Grasslands |
|---|---|---|---|---|---|---|---|---|---|---|
| **Provisioning services** | 102 | 55,724 | 2396 | 2998 | 1659 | 1914 | 1828 | 671 | 253 | 1305 |
| 1 Food | 93 | 677 | 2384 | 1111 | 614 | 106 | 200 | 299 | 52 | 1192 |
| 2 Water | | | | 1217 | 408 | 1808 | 27 | 191 | | 60 |
| 3 Raw materials | 8 | 21,528 | 12 | 358 | 425 | | 84 | 181 | 170 | 53 |
| 4 Genetic resources | | 33,048 | | 10 | | | 13 | | | |
| 5 Medicinal resources | | | | 301 | 99 | | 1504 | | | 1 |
| 6 Ornamental resources | | 472 | | | 114 | | | | 32 | |
| **Regulating services** | 65 | 171,478 | 25,847 | 171,515 | 17,364 | 187 | 2529 | 491 | 51 | 159 |
| 7 Air quality regulation | | | | | | | 12 | | | |
| 8 Climate regulation | 65 | 1188 | 479 | 65 | 488 | | 2044 | 152 | 7 | 40 |
| 9 Disturbance moderation | | 16,991 | | 5351 | 2986 | | 66 | | | |
| 10 Regulation of water flows | | | | | 5606 | | 342 | | | |
| 11 Waste treatment | | 85 | | 162,125 | 3015 | 187 | 6 | 7 | | 75 |
| 12Erosion prevention | | 153,214 | 25,368 | 3929 | 2607 | | 15 | 5 | 13 | 44 |
| 13 Nutrient cycling | | | | 45 | 1713 | | 3 | 93 | | |
| 14 Pollination | | | | | | | 30 | | 31 | |
| 15 Biological control | | | | | 948 | | 11 | 235 | | |
| **Habitat services** | 5 | 16,210 | 375 | 17,138 | 2455 | 0 | 39 | 862 | 1277 | 1214 |
| 16 Nursery service | | 0 | 194 | 10,648 | 1287 | | 16 | | 1273 | |
| 17 Genetic diversity | 5 | 16,210 | 180 | 6490 | 1168 | | 23 | 862 | 3 | 1214 |
| **Cultural services** | 319 | 108,837 | 300 | 2193 | 4203 | 2166 | 867 | 990 | 7 | 193 |
| 18 Esthetic information | | 11,390 | | | 1292 | | | | | 167 |
| 19 Recreation | 319 | 96,302 | 256 | 2193 | 2211 | 2166 | 867 | 989 | 7 | 26 |
| 20 Inspiration | | 0 | | | 700 | | | | | |
| 21 Spiritual experience | | | 21 | | | | | | | |
| 22 Cognitive development | | 1145 | 22 | | | | | 1 | | |
| **Total economic value** | **491** | **352,249** | **28,917** | **193,845** | **25,682** | **4267** | **5264** | **3013** | **1588** | **2,871** |

Numbers in the cells are averages of the values found for a particular service and biome. Calculations are based on a total of 665 values. For details see Appendix 1.
[a] Coastal systems include estuaries, continental shelf area and sea grass, but exclude wetlands like tidal marsh, mangroves and salt water wetlands.

### *Method 2: WA biodiversity offset*

The exploration of the WA database of biodiversity offsets[15] yielded the following information that could be used for the purpose of establishing a proxy for the Avon Wheatbelt region. It is assumed, for the purpose of this study, that the size of area impacted (i.e. cleared) was a good indicator to determine the value per hectare of vegetation restored. Note that:

- this is assumed to be an overall value for the restoration project (one-off payment) compared to the ecosystem value mentioned above in the de Groot study, which is a yearly value of ecosystem services.
- it has also been assumed that the costs mentioned were current (i.e. current dollar value).

[14] Conversion from 2007 to 2020 USD: 1.24 https://www.in2013dollars.com/us/inflation/2007 accessed on 12/08/2020
Conversion from USD to AUD ; 1.40, from www.xe.com/currencyconverter accessed on 12/08/2020
[15] https://offsetsregister.wa.gov.au/public/searchregister/ accessed on 11/08/2020

*Table 10. Cost of offset projects under the WA biodiversity scheme*

| Project | Bioregion | Cost | Size of impacted area (Ha) | $/Ha |
|---|---|---|---|---|
| **Expansion of Jurien Gypsum Mining Operation ML70/1161, Shire of Dandaragan** | Avon Wheatbelt | $138,000 | 31.2 | $4,423 |
| **Parker Range Iron Ore Project Mt Caudan Deposit** | Avon Wheatbelt, Coolgardie | $790,000 | 418.1 | $1,890 |
| **Northam Pithara Road - SLK 129.12 to 152.25 - widening** | Avon Wheatbelt | $188,000 | 15.65 | $12,013 |
| **Average price** | | | | $6,108 |

In a different WA region (Swan Coastal Plain) and based on a different method (establishment cost method, which can be considered as comparable) the authors (Iftekhar, et al., 2019) found, in a recent study, that the mean amount mentioned in the approval notices for offsets for the Banksia woodland habitat (Endangered EPBC status) was $7,500 / ha in 2019, based on 7 approval notices. This would tend to validate the above average as reasonable.

### 5.1.4 Moderating factors and condition

The approach to applying moderating (or discount) factors (i.e. factors to correct any overstatement of the value) varies depending on the proxy approach described in 5.1.3 above. Moderating factors are only discussed for the first method (yearly ecosystem value), as this values assumes a fully functioning, and potentially old growth-based ecosystem, whereas, for the second approach (biodiversity offset value), the replacement method is assumed to take into account the potentially reduced value of the restored area.

*Baseline*

The first moderating factor relates to the fact that, while very degraded, the pre-restoration field acquired by the project would still have provided some ecosystem services. While it is impossible to estimate what this residual value could be, with the limited information available on the baseline, an arbitrary **20%** discount on the total value has been applied, estimating that this would be conservative. This is in line with what was applied in (The Gold Standard Foundation , 2014).

*Significance*

While it has been assumed that the project area can be considered in a “biodiversity hotspot” region, it remains that the restoration process is unlikely to bring the vegetation back to pre-clearing stage, at least in the short to medium stage. It is also important to recognise that the significance of the restored areas, even pre-clearing, might not have been the best in the region.

For these reasons, a correction factor is likely to be necessary, although no data or literature could be found to support the level of discounting that could be reasonable. There is also an argument that this aspect could be wrapped up in the assessment of condition (see below), although the National Restoration Standards allow to define a reference ecosystem, hence a 5 star condition could theoretically be achieved for an ecosystem of lower significance.

A discount factor of **20%** has been applied to account for the fact that restoration can probably never achieve the level of biodiversity of an old forest. However, it is recognised that this is arbitrary, and that further research might enable to vary this parameter.

*Condition*

The condition of the vegetation is an important parameter linked to the level of biodiversity that can be expected, although the relationship is not necessarily linear. For the reasons that have been outlines previously (see Section 3.2), it is recommended to use the National Restoration Standards (and it's recovery scale) as a simple way to assess vegetation/ecosystem condition, without depending on much data including for the baseline. It is therefore proposed to use the National Restoration Standards as an indicator of the realisation of ecosystem services benefits associated with a project area. As the National Restoration Standards rating is scaled from 0 to 5 stars, the rating needs to be transposed into a **0-100% scale** (100% corresponding to a rating of 5 stars).

*Maturity*

Ecosystem services will increase with the age of the trees and accompanying ecosystems. The increase, again, may not be linear, but the relationship for this particular biome could not be established.

By way of simplification, it is assumed that ecosystem services will grow linearly over a period of **50 years**, i.e. 2% per annum until a plateau or equilibrium is reached at year 50. Again, the arbitrariness of this decision is acknowledged.

***Table 11. Hill View property characteristics***

| Property | Establishment year | GS eligible area (ha) | Estimated National Restoration Standards recovery level (cf Appendix Appendix 5) |
|---|---|---|---|
| Hill View | 2010 | 566.8 | |
| | 2014 | 50.1 | |
| Total | | 617 | 2.8 |

### 5.1.5 Value calculations and sensitivity analysis

The formula mentioned in Section 4.1 can now be refined in line with the assumptions described above and becomes more complex, as per the summary presented in the tables below. Table 12 below presents both the theoretical formula and the parameter values estimated for the Hill View property, as this is the property where more and better quality data is available.

As two approaches to proxies are possible, these are presented in two different columns of the table. The values are not comparable, as one is a per year value (ecosystem services method) and the other one is over the project duration (one-off value).

To make the values comparable, a Net Present Value (NPV) over 50 years (assumed duration of the project) has been calculated for Method 1, using a 7% discount rate, noting that such calculations are sensitive to the use of different discount rates. The calculations for methods 1 and 2 still differ very little, bearing in mind:

- the uncertainty around the multiple assumptions required, and the level of conservatism applied to Method 1 and,
- the fact that the NPV is calculated assuming a yearly growth in value over a 50 year of tree growing period.

Table 12 presents different values depending on the parameters value allocated to the different components of the formula, changing one parameter at a time. The parameter with the greatest influence on results is the discount rate, but overall, the sensitivity analysis (see Table 13) shows that the likely biodiversity value for Hill View over the life of the project is in the $2M to $4.5M range, based on the assumptions made, compared to almost $4M under method 2.

The extrapolation of these calculations to the whole of the project area can be made either by:

- Collecting the same level of information on each property or
- Making the assumption that Hill View is representative of the whole project area, in which case, the overall biodiversity value would be between $28M and $63M overall.

Importantly, the value will vary over time, as the parameters fluctuate (National Restorations Standard recovery level, maturity in particular).

***Table 12. Biodiversity benefit valuation calculation formula***

| Parameter | Unit / Scale | Method 1 (per year) | Method 2 (project duration value) |
|---|---|---|---|
| **Area** | hectares | 617 | 617 |
| **Proxy** | $/ha or $/ha/year | $2,300 | $6,100 |
| **Moderating factors:** | | | N/A |
| **Baseline** | Discount | 20% | |
| **Significance** | Discount | 20% | |
| **Condition (National Restoration Standards)** | Stars converted into 0-100% | 2.8 | |
| **Maturity** | Linear discount based on years to full maturity (50y) | 10 Y (567ha)<br>6Y (50ha) | |
| **Calculations** | per year | $98,424 | |
| | over 50 years (NPV, 7%) | $3,099,369 | $3,763,700 |

***Table 13. Sensitivity analysis on Method 1 calculations***

| Parameter | Unit / Scale | Method 1 (original value) | Method 1 (sensitivity test value) | Sensitivity result (NPV) |
|---|---|---|---|---|
| **Comparison value for method 1** | | | | $3,099,369 |
| **Area** | hectares | 617 | 617 | N/A |
| **Proxy** | $/ha or $/ha/year | $2,300 | $2,300 | N/A |
| **Moderating factors:** | | | | |
| **Baseline** | Discount | 20% | 0% | $3,874,212 |
| | | | 40% | $2,324,527 |
| **Significance** | Discount | 20% | 0% | $3,874,212 |

| | | | | |
|---|---|---|---|---|
| | | | 40% | $2,324,527 |
| **Condition (National Restoration Standards)** | Stars converted into 0-100% | 2.8 | 2 | $2,213,835 |
| | | | 4 | $4,427,670 |
| **Maturity** | Linear discount based on years to full maturity (50y) | 10 Y (567ha)<br>6Y (50ha) | 10 Y (567ha)<br>6Y (50ha) | N/A |
| **Discount factor** | | 7% | 2% | $9,457,357 |
| | | | 5% | $4,580,616 |
| | | | 10% | $1,936,225 |

### 5.1.6 Unquantified values

The values calculated above may not fully take into account some of the most site-specific characteristics, in particular the fact that the project has the ambition of creating a "corridor" that could deliver value both to wildlife and to agricultural areas, if acting as a "barrier" against dust or other impacts from the neighbouring arid areas. As it is highly speculative, and the corridor is only in its infancy at present, this could not be accounted for, but may warrant further exploration.

## 5.2 Employment and local economic benefits

This section follows on Section 3.5 and applies the recommended methodology, i.e. extrapolation of market value economic benefits derived from literature, to the data available from the project area.

### 5.2.1 Evidence of value and co-benefit creation

The employment and economic impact are directly quantified in market value terms and well recognised in the literature. More qualitative analysis could be carried out through interviews with local suppliers and community and this could help with accuracy and justification of the benefits, but this is not within the scope of this project and is not deemed necessary for a benefit that is well established.

### 5.2.2 Measurement units

Note that to be consistent with the perimeter of the valuation presented for biodiversity above, the benefits should only be calculated based on the data for the current GS project, and possibly downscaled to the Hill View property. However, at the time of the writing, this data was not available. The data used is therefore that presented in Section 3.5.

Measurement units are:

- employment (FTEs) and
- overall economic impact over time (NPV 20 years), in dollar value (market value).

Key inputs are for the calculations are:

- Number of local jobs in FTE created by the project since fiscal year 2015/16: 43
- Distributional indicator relating to the proportion of Indigenous employees since fiscal year 2015/16: 9
- Investment in the local economy: $12.8M over 13 years, not counting land acquisition and management costs.

### 5.2.3 Study of reference for benefit transfer

As mentioned in the methodology section, studies on economic benefits of economic stimulus of various kinds abound. Matching the characteristics of the stimulus to the project area may however be challenging. Coincidentally, the Covid-19 epidemic has recently created a focus for economic studies looking at how best use stimulus money, and EY published in June 2020 a study entitled "Delivering economic stimulus through the conservation and land management sector Economic impact assessment" (EY, 2020).

The study is very recent and therefore representative of current economic conditions and the sectoral match is therefore perfect and is focusing on regional area, even though the study is using macro-economic modelling at the national level, without tailoring for WA. The study uses a Computable General Equilibrium proprietary model, and very few details on assumptions or calculations are available.

The key numbers from the EY study to be transferred to this project are documented in the table below. Notwithstanding the type of investment program chosen to deliver the stimulus, the ratio appears to be around 1.4 and 2.3 over a 4 year and 20 year period return respectively. It is therefore proposed to apply this ratio to the investment in the Yarra Yarra project.

***Table 14. Economic impacts from investment in conservation and land management sector (EY, 2020)***

| Scenario | Stimulus ($M) | Fiscal stimulus impact - 4 years (NPV) | | Total economic impact 20 years (NPV) | |
|---|---|---|---|---|---|
| | | NPV | Ratio | NPV | Ratio |
| **Recovery Program** | 4,000 | 5,678 | 1.42 | 9,269 | 2.32 |
| **Accelerator Program** | 2,000 | 2,817 | 1.41 | 4,687 | 2.34 |
| **Impulse Program** | 500 | 717 | 1.43 | 1,194 | 2.39 |

For jobs, the number of direct FTEs is a sufficient indicator; additional "flow-on" impacts could be calculated based on the EY report, which has estimated such impact, but it would probably not change the narrative significantly. The EY study estimates that about 1,000 FTEs are created through a $100M investment in conservation and land management, or about 10 FTEs per million invested. Based on the data collected from the project owners and presented in Section 3.5, the Yarra Yarra total project created 43 direct FTEs (plantation staff) since fiscal year 2015/16. This direct number of FTEs appears conservative compared to the 128 jobs for a $12.8M investment in the project, that could be extrapolated from the EY study referenced above (10 per $1M invested).

### 5.2.4 Moderating factors considerations

Given the good fit between the initial study and the project area activities, moderating factors may not need to be applied, and uncertainty can be dealt with through sensitivity analysis (see below).

### 5.2.5 Value calculations and sensitivity analysis

The direct employment co-benefit of the project is 43 FTEs over 5 years.

The expected economic impact, based on an investment of $12.8M in the local economy (ex. land acquisition, see 3.5) is between $18M and $30M, depending on whether the 4 year or 20 year economic impact is considered in the NPV.

Note that these calculations take into account the investment and employment impact to date, not the investment over the full life of the project (data not available at present). This would be relevant when standardising the co-benefit value per carbon credit.

### 5.2.6 Unquantified values

The unquantified values may include:

- **Threshold economic impacts** in the local community, i.e. the contribution of local employment and local spending into a small community. Depending on the cumulative impacts with other projects, such a stimulus may determine whether local businesses thrive or die, whether local communities grow or whither. Such dynamics are complex and depend on a vast range of local factors that would require a very specific study.
- **Distribution impacts**: while job creation benefitting specific groups (e.g. Indigenous employees) is easy to assess, distributional aspects within the local business communities could not be assessed; distribution across a range of contractors and suppliers rather than concentration on one single company can have socio-economic impacts on the local economy (in a similar way to the threshold impacts).
- Leakages into the broader economy: if the local economy is not able to respond to the demand **stimulation** from the project (due to lack of capacity), then it is likely that contractors from further afield will be called upon, creating "leakages" benefitting the broader economy rather than the local economy. This is again complex and specific to ascertain and would require detailed local studies.

## 5.3 Indigenous cultural heritage values

The information to quantify and value indigenous cultural heritage that has been preserved on project land is not available, nor is it ascertained for sure that valuation would be appropriate. Benefits associated with culture can be valued through stated-preference techniques, however we note that it is likely inappropriate to convert cultural values such as spiritual and ceremonial values into monetary values as they cannot and should not be subject to monetisation (Farr, et al., 2016).

Because of these uncertainties, a staged approach is recommended, tailoring the level of engagement with traditional owners of the land to:

1. Identify the likely significance of the heritage
2. Confirm the appropriateness of putting a value on this heritage using an SROI methodology
3. Undertake the SROI in collaboration with relevant stakeholders.

It is recognised that the process might end up being costly, as it is consultation-intensive and can be a lengthy process, and that the benefit of defining a value should be weighted up against such costs.

If after the first step of the engagement, benefits be likely to be core, which, in our view, can only be decided by traditional owners, then a decision to invest or not should be made before engaging further into the process, as from step 2 onwards, expectations will be raised. Step 2 could see the approval of the SROI methodology to value these benefits and Step 3 the realisation of the work.

Before this work is undertaken, it would not be possible and appropriate to value indigenous heritage through benefit transfer.

The SROI methodology has been outlined in Appendix 4 (B.3) and is detailed in A Guide to Social Return on Investment (Social Value UK, 2012).

From a practical point of view, for Carbon Neutral, this would likely require:

1. Defining the exact scope of the study area (the project area) and who the relevant stakeholders are, i.e. the traditional owners and Indigenous people who have a connection with that land.
2. Working with them to define values relevant to them, and potentially to secondary stakeholders
3. Mapping the outcomes of the project on these relevant values (preservation, access, etc.)
4. Evidencing the outcomes or impacts (positives and negative), collaboratively with the same people
5. Sourcing proxies and calculating value (if and as appropriate), calculating an SROI if necessary.

An additional benefit of the process could be to gather information on the best way to manage and enhance these values on existing and possible project land in the future.

## 5.4 Co-benefit value per carbon credit

The value of co-benefits calculated above can be downscaled to a per carbon offset value. This however requires to understand the relationship between the growth of the carbon stock and the value of co-benefits, especially biodiversity, this relationship not being necessarily linear, as highlighted above. It may also vary from property to property.

At an overarching level, the project is expected to deliver 967,695 tonnes $CO_2$-e over the crediting period[16]. This means that the value per carbon offset could be as per the table below (notwithstanding the caveat mentioned above). It is recommended not to add the two values provided below, for the reasons discussed previously (Introduction to Section 5).

***Table 15. Value per carbon offset***

| Value component | Overall ($M) | | Per carbon offset ($ per offset) | |
|---|---|---|---|---|
| | **Low** | **High** | **Low** | **High** |
| **Biodiversity** | 28 | 63 | 29 | 65 |
| **Regional economic impact** | 18 | 30 | 52 | 83 |
| **Aboriginal heritage** | Not valued as this stage | | | |

[16] GS3039 Auscarbon Gold Std Key Project Info 2018 - 171018

# 6 RECOMMENDATIONS

These recommendations should be considered in light of revegetation carbon farming stakeholder objectives to:

- Improve their understanding of the impacts of the project, in particular co-benefits, through better monitoring (6.1). Some of these recommendations can only been applied to new project sites (when baseline data is concerned for example).
- Improve the robustness of the SERA score for vegetation condition obtained through the application of the National Restoration Standards (6.2), and hence support the valuation of biodiversity co-benefits valuation using the methodology proposed in 5.1.
- Improve their ability to market and monetise the co-benefits (6.3).

## 6.1 Project monitoring

Different co-benefits may warrant or require different approaches to monitoring. As mentioned above, the benefits derived from undertaking such monitoring should be weighed against the costs. However, better monitoring is an important step towards establishing robust credentials in terms of impact quantification and valuation.

### 6.1.1 Biodiversity (flora and fauna)

The monitoring data for biodiversity has been found to be patchy. It is recommended to develop a monitoring strategy, identifying where monitoring efforts would yield the greatest benefits and how collected data would be used, considering the following points:

- Form a clear view of which sites are similar to establish a strong basis to extrapolate information from one site to the entire project.
- Conduct ongoing and repeatable monitoring at all properties certified under the Gold Standard (and those that are potentially added to the project) to obtain a better picture of the relative abundance, species richness, community composition and habitat use. This can be done by replicating the monitoring study conducted at Hill View and repeat it across time, seasons and space, potentially also with more sample plots and combining it with satellite imagery. Some of the key features of the monitoring program should include:
    - Targeted monitoring, for example of indicator species such as bird species sensitive to loss of habitat connectivity due to landscape fragmentation, and species of national and/or local conservation significance such as EPBC listed Carnaby's Cockatoo and Western Spiny-tailed Skink.
    - Monitor tree survival and tree growth at revegetated sites one year after planting and/or on an annual basis to ensure successful and long-term landscape restoration.
- Adopt the monitoring recommendations from the Hill View study undertaken in 2014 and 2015.
- Continue conducting citizen/community-based science studies to assist monitoring efforts. However, we note that they are not a substitute for professional studies or surveys as they are not scientifically rigorous enough. Rather, they can complement professional studies or surveys if done consistently (over time) with appropriate training.
- For new projects, baseline assessments following the Hill View study approach should be implemented in order to have a robust and systematic approach to assessing co-benefits from biodiversity.

### 6.1.2 Water quality

The major question in relation to water quality is what receiving / connected system will benefit from improved water quality from the project area. Little is known at the moment about groundwater connectivity and

whether water quality benefits could accrue to neighbouring farms or other users. Equally little is known about surface run-off final destination, other than the fact that there is no permanent stream nearby the Yarra Yarra project's properties. Indeed, this report does not propose to put a value on water quality per se (other than the value that is already captured through biodiversity values).

The following recommendations should be put in the context of what benefit can be expected from better understanding water quality. As for biodiversity, the ultimate use of the data should be understood before embarking in further monitoring. These recommendations also apply to new projects where revegetation has the potential to generate significant water co-benefits such as in areas that have rising water tables or have high rates of erosion.

- Consider monitoring groundwater levels and salinity on a regular and long-term basis. Scientific evidence indicates that revegetation of degraded lands can have a large impact on reversing groundwater levels (lowering them) and salinity. However, in arid and semi-arid areas reversal can take a long time to occur (e.g. > 10 years). Given the complexity of assessing groundwater recharge any research is likely to be cost intensive and time consuming. Therefore, the project developers should seek to partner with relevant West Australian State Government agencies and / or local universities to take this work forward if desired.
- Consider using empirical tools such as the Nutrient Tracker Tool (NTT) to quantify the potential co-benefits the project is having on surface water quality, soil erosion and runoff rates. If choosing to use the NTT, the project developers should increase the number of sites and sampling frequency (dependent of rainfall) for EC measurements to validate the results from the NTT, and include additional indicators such as phosphorous, nitrogen and turbidity. However, it is noted that rainfall is low and intermittent and streams and rivers in the catchment area do not flow all year-round, thus making it difficult to quantify benefits. Therefore, any additional quantification effort should be undertaken in areas that are likely to show greatest impact including steeply sloped areas and areas with high erosion.

### 6.1.3 Soil quality / health

Similar to water, soil quality is likely to greatly improve in the project areas, benefitting the vegetation on the property and local biodiversity, but the benefit beyond these boundaries are unclear, as the land is destined to remain forested in the foreseeable future. Soil quality cannot really be valued (beyond the biodiversity aspects, already accounted for under the biodiversity proxies). Monitoring soil quality for purposes other than understanding local growing conditions for the vegetation may not be a priority. Should CPOS wish to invest nevertheless, the following recommendations could be considered:

- Use soil organic carbon as proxy to measure soil quality within the revegetation areas. Soil organic carbon should be measured using direct methods (soil sampling and laboratory analysis) rather than relying on empirical models. Empirical models however can be used to estimate soil carbon sequestration. The Murdoch University study or a similar study could be repeated once sufficient time has passed for change to occur (i.e. 5 – 10 years) to provide relevant input.
- Given the potential revegetation has on reducing soil salinity through the lowering of water tables, consider undertaking targeted research and / or regular monitoring of soil salinity in nearby farms. This should be combined with the groundwater level assessment suggested above.

### 6.1.4 Local employment and skills

As described in Section 3.5, the local benefits economic evaluation requires to track easily quantifiable indicators to quantify the impact on local employment and skills created by the Yarra Yarra project.

Carbon Neutral Pty Ltd is already tracking these indicators and it should continue to do so, and specifically for the Gold Standard project area, to ensure the most accurate measurement of this co-benefit.

Additional effort could be made to track (through surveys for example):

- Ability to find other positions after leaving the project, for those who have been employed on site (upskilling / experience / reference benefits)
- Broader benefits for Indigenous people employed, and potential linkages to "bridging the gap" types of benefits.

### 6.1.5 Indigenous cultural heritage

As for the valuation of impacts, any monitoring activity should be discussed and developed in consultation with traditional owners.

## 6.2 Application of the National Restoration Standards

The National Restoration Standards assessment used in this study is only an approximation based on the Hill View baseline monitoring report from 2015 and information that complemented the findings from this study.

More information is required to improve on the assessment and to be able to generalise it to other Yarra Yarra project properties (all 7 properties). To improve the application of the Standards, the following can be envisaged:

- Identify a specific reference ecosystem which represents the restoration target. We note that we understand the restoration goal to be 'full recovery' (5 star), a state where all ecosystem attributes closely resemble those of the reference ecosystem.
- Identify and define measurable and quantifiable indicators to monitor restoration progress. These indicators could include:
    - species stocking, tree survival rates per species, tree growth (based on diameter at breast height, tree height and canopy size). Some of this information is already collected through Gold Standard (sustainability) monitoring.
    - number of endemic and/or native species,
    - levels of soil organic carbon,
    - levels of salinity in soils
    - levels of physical and chemical condition of rivers or creeks - if suitable given they are likely to not flow all year-round.
- Engage a qualified ecologist to establish a consistent inventory of all endemic, native and non-native species occurring in the project area, and where they are occurring. Distinguish between remnant and revegetated sites as well as properties. This can be used to develop a targeted monitoring plan (see recommendations in Section 6.1). Additionally, the inventory can assist in capturing areas of higher and lower condition and those that require specific treatment that foster natural recovery (e.g. management of threats).
- Identify standard approaches to mitigate or eliminate threats (some of which are already in place)

## 6.3 Access to market

An important aspect to consider is how co-benefits values, once established, can be monetised or "banked".

### 6.3.1 Biodiversity Co-benefit

As the major and better understood co-benefit, this is probably the major opportunity for CPOS to consider "going to market".

Different angles can be considered:

- The proposed valuation of biodiversity co-benefits (see 5.1) will lead to a "non-market" value that could help secure a "premium" for offsets from the project; this premium is likely to be significantly lower than the valuation suggests, as the market value of the co-benefits will ultimately be determined by the buyers' willingness to pay.
- Another avenue is to access existing organised markets. The most immediate market is the **WA biodiversity offset** market (which was used as proxy price reference for the valuation calculations in 5.1).

*WA biodiversity offsets*

The West Australian government runs an environmental offsets program which is underpinned by the WV Environmental Offsets Policy and Register. Accessing funding under the scheme requires to meet eligibility requirements and standards (see below).

There are generally three types of environmental offsets – land acquisition, on ground management and research.

- **Land acquisition offsets –** These involve the protection of environmental values through improved security of tenure or restricting the use of the land.
- **On-ground management –** This includes revegetation (re-establishment of native vegetation in degraded areas) and rehabilitation (repair of ecosystem processes and management of weeds, disease or feral animals). The objective of on-ground management actions is tangible improvement to environmental values in the offset area.
- **Research -** Research project offsets can only be applied under Part IV of the EP Act and must be reasonably related to the impact. Research projects can add significant value to the outcomes of on-ground management and the understanding of the environmental value being impacted. The research must be designed to result in positive conservation outcomes.

The most relevant avenue for the project developer to consider is 'on-ground management' offset types, requiring the "**quantification of the value of environmental benefit** provided from the proposed offset." The Guidelines are not specific around what methods should be applied to quantify an offset. However, case studies are provided in the guidelines and there may be an opportunity for the project developer to sell biodiversity offsets into that scheme (compatibility with selling carbon credits separately should be investigated). The project developer could also assess the viability of creating offsets from remnant vegetation.

*Non-organised schemes*

Beyond the WA environmental offsets program, potential project developers should also investigate the potential for selling offsets created under the WA Environmental Offsets policy as voluntary units. One such example is the EcoAustralia Credit marketed by South Pole. These are created by blending carbon offsets with Australian Biodiversity Units which are created from biodiversity offsets generated under the Victorian and South Australian offset schemes.

### 6.3.2 Other co-benefit opportunities

No "commodity'' markets for other environmental units or for social co-benefits could be identified.

However, say co-benefits other than biodiversity can also be recognised as adding value to the carbon offsets generated through the Yarra Yarra project. Opportunities to increase the "premium" on the offset price include:

- Use enhance monitoring and valuation to promote the additional value the Yarra Yarra project is bringing to the environment and local communities. There is growing interest in social impact investments from philanthropists and investors, which opens an opportunity for the project developer to market its carbon credits at a premium or to justify funding campaigns due to the additional benefits that this project brings for the local economy.

  Many organisations are also setting ambitious socio-economic targets and developing meaningful Reconciliation Action Plans (RAP), opening opportunities to specifically market "closing the gap" or Indigenous employment benefits, if these can appropriately be demonstrated.
- Explore the potential to link the project to agricultural supply chains – particularly in relation to improving nearby agricultural productivity through reduction in dryland salinity (assuming this can be proven through the suggested research outlined in Section 6.1.

# REFERENCES


Interjurisdictional Environmental-Economic Accounting Steering Committee for the Meeting of Environment Ministers, 2018. *Environmental Economic Accounting: A Common National Approach Strategy and Action Plan,* s.l.: Commonwealth of Australi.

Ali, M. H. a. S. M., 2017. Approaches and Methods of Quantifying Natural Groundwater Recharge – A Review. *Asian Journal of Environment & Ecology ,* 5(1), pp. 1 - 27.

Austin, Z. et al., 2016. The co-benefits of biodiversity conservation programmes on wider ecosystem services. *Ecosystem services,* Volume 20, pp. 37-43.

Baker, R. & Ruting, B., 2014. *Environmental Policy Analysis: A Guide to Non-Market Valuation. Productivity Commission Staff Working Paper,* Canberra: s.n.

Banke-Thomas, A., Madaj, B., Ameh, C. & Broek, N., 2015. Social Return on Investment (SROI) methodology to account for value for money of public health interventions: A systematic review. BMC public health.. Volume 15. 582. 10.1186/s12889.

Baral, S., Basnyat, B., Khanal, R. & Gauli, K., 2016. A total economic valuation of wetland ecosystem services: an evidence from Jagadishpur Ramsar site, Nepal. *The Scientific World Journal.*

Baumber, A. et al., 2019. Promoting co-benefits of carbon farming in Oceania: Applying and adapting approaches and metrics from existing market-based schemes. *Ecosystem Services,* Volume 39.

Belluomini, D., 2016. Payments for Ecosystem Services: General Presentation and Review of Key Examples. *Revista tinerilor economişti,* Volume 26, pp. 23-34.

Carbon Neutral Charitable Fund, n.d. *Biodiversity Works: The Hill View Story,* s.l.: s.n.

Costanza, R. &. a., 2014. Changes in the global value of ecosystem services. *Global Environmental Change,* Volume 26, pp. 152-158.

Costanza, R. et al., 2017. Twenty years of ecosystem services: how far have we come and how far do we still need to go?. *Ecosystem services,* Volume 28, pp. 1-16.

de Groot, r. et al., 2012. Global estimates of the value of ecosystems and their services. *Ecosystem Services,* Volume 1, pp. 50-61.

Duguma, L. et al., 2020. *From Tree Planting to Tree Growing: Rethinking Ecosystem Restoration Through Trees. ICRAF Working Paper No 304,* s.l.: World Agroforestry.

Eigenraam, M., Chua, J. & Hasker, J., 2013. *Environmental-Economic Accounting: Victorian Experimental Ecosystem Accounts, Version 1.0,* State of Victoria: Department of Sustainability and Environment.

Eigenraam, M., Chua, J. & Hasker, J., 2013. *Environmental-Economic Accounting: Victorian Experimental Ecosystem Accounts, Version 1.0.,* Melbourne: Department of Sustainability and Environment,.

Ellis-Smith, G., 2008. *Aboriginal Site Management Plans, Literature Review and Legislation: Discussion Paper,* s.l.: Wheatbelt Development Commission.

EY, 2020. *Delivering economic stimulus through the conservation and land management sector - Economic impact assessment,* s.l.: s.n.

Farley, J. & Costanza, R., 2010. Payments for ecosystem services: from local to global. *Ecological Economics,* 69(11), pp. 2060-2068.

Farr, M. et al., 2016. *Economic values and Indigenous protected,* Townsville: James Cook University.

Halse, S. A. & Rupretch, J. K. a. A. M. P., 2003. Salinisation and prospects for biodiversity in rivers and wetlands of south-west Western Australia. *Australian Journal of Botany,* 51(6), pp. 673 - 688.

Harper, R. J. et al., 2009. *Catchment scale evaluation of "Trees, Water and Salt".* 09/059 ed. s.l.:Rural Industries Research and Development Corporation.

Heather, K. et al., 2017. *Experimental Ecosystem Accounts for the Central Highlands of Victoria - Summary Report,* Canberra: Fenner School of Environment and Society, The Australian National University.

Huggett, A., Borger, J. & McCaw, T., 2015. *Final Report: Systematic Biodiversity Monitoring of "Hill View", Morawa, Western Australia – Avifauna and Flora (Main Report). Technical report for Carbon Neutral Charitable Fund and AusCarbon Pty Ltd,* Perth: s.n.

Iftekhar, M. S., Pannell, D. & Hawkins, J., 2019. Costs of Conservation Offset Activities: The State of Publicly Available Information in Australia. *Sustainability,* 11(19).

Jackson, W. J. et al., 2016. *Australia state of the environment 2016: overview, independent report to the Australian Government Minister for the Environment and Energy,* Canberra: Australian Government Department of the Environment and Energy.

Knowles, D. & Knowles, F., 2015. *"Hill View", Morawa. Macroinvertebrate and Herpetofauna Inventory survey September-October 2014, April 2015,* Balga, Western Australia: Spinless Wonders.

Marcar, N. .. a. D. F. C., 2004. *Trees for saline landscapes,* s.l.: Rural Industries Research and Development Corporation publication no. 03/108.

McKenzie, N. L., May, J. E. & McKenna, S., 2002. *Bioregional Summary of the 2002 Biodiversity Audit for Western Australia,* s.l.: Department of Conservation and Land Management.

Pandit, R. S. V. G. S. T., Zander, K. K. & Pannell, D., 2015. *A review of non-market valuation studies of threatened species and ecological communities. Report to the National Environmantal Science Programme,* s.l.: Department of Environment.

Parkhurst, T. & Standish, R., 2020. *Improving Biodiversity Outcomes in Ecological Restoration of Abandoned Farmland. Project Report prepared by Murdoch University for Carbon Neutral Pty Ltd, Western Australia,* s.l.: Murdoch University.

Pettit, N. E. et al., 2015. Environmental change: prospects for conservationand agriculture in a southwest Australia biodiversity hotspot. *Ecology and Society,* 20(3).

Rashidi, K., Stadelmann, M. & Patt, A., 2017. Valuing co-benefits to make low-carbon investments in cities bankable: the case of waste and transportation projects. *Sustainable Cities and Society,* Volume 34, pp. 69-78.

Reed, M. et al., 2017. A place-based approach to payments for ecosystem services. *Global Environmental Change,* Volume 43, pp. 92-106.

Saarikoski, H. et al., 2016. Multi-Criteria Decision Analysis and Cost-Benefit Analysis: Comparing alternative frameworks for integrated valuation of ecosystem services.. *Ecosystem services,* Volume 22, pp. 238-249.

Saunders, D. A., 1989. Changes in the avifauna of a region, district and remnant as a result of fragmentation of native vegetation: the wheatbelt of Western Australia. A case study. *Biological Conservation,* 50(1-4), pp. 99-135.

Scanlon, B. R. H. R. W. a. P. G. C., 2002. Choosing appropriate techniques for quantifying groundwater recharge. *Hydrogeology Journal,* Volume 10, pp. 18 - 39.

Schofield, N. a. P. S., 1991. Planting trees to control salinity. Journal of the Department of Agriculture, Western Australia. *Journal of the Department of Agriculture, Western Australia series 4,* 32(1).

Schroeder, T., 2017. *Biodiversity Survey. Remote Camera Trapping, Terra Grata 2017. Technical Report for Carbon Neutral Charitable Fund,* Perth, Western Australia: s.n.

Singh, G. G. et al., 2018. A rapid assessment of co-benefits and trade-offs among Sustainable Development Goals. *Marine Policy,* Volume 93, pp. 223-231.

Social Value UK, 2012. *A Guide to Social Return on Investment ,* s.l.: s.n.

Southwest Australia Ecoregion Initiative, 2006. *The Southwest Australia Ecoregion. Jewel of the Australian Continent,* Wembley, Western Australia: Southwest Australia Ecoregion Initiative.

The Gold Standard Foundation , 2014. *The Real Value of Robust Climate Action - ,* s.l.: s.n.

Uerge-Vorsatz, D., Herrero, S. T., Dubash, N. K. & Lecocq, F., 2014. Measuring the co-benefits of climate change mitigation. *Annual Review of Environment and Resources,* Volume 39, pp. 549-582.

Van Hecken, G. & Baker, K., 2015. Crossfire:'Are we using payments for ecosystem services to transfer our responsibility for over-consuming natural resources onto poor farmers in the Global South?. *Enterprise Development and Microfinance,* 26(3), pp. 215-221.

Varcoe, T., O'Shea, H. B. & Contreras, Z., n.d. *Valuing Victoria's Parks. Accounting for ecosystems and valuing their benefits: Report of first phase findings,* s.l.: Parks Victoria, DELWP.

Wainaina, P., Gituku, E. & Minang, P., 2020. *An exploratory studyof cost-benefit analysis of landscape restoration. Working Paper number 306,* Nairobi, Kenya: World Agroforestry.

Wallace, K. J., Beecham, B. C. & Bone, B. H., 2003. *Managing Natural Biodiversity in the Western Australian Wheatbelt. A conceptual framework,* s.l.: Department of Conservation and Land Management.

Wang, P., Poe, G. & Wolf, S., 2017. Payments for ecosystem services and wealth distribution. *Ecological Economics,* Volume 132, pp. 63-68.

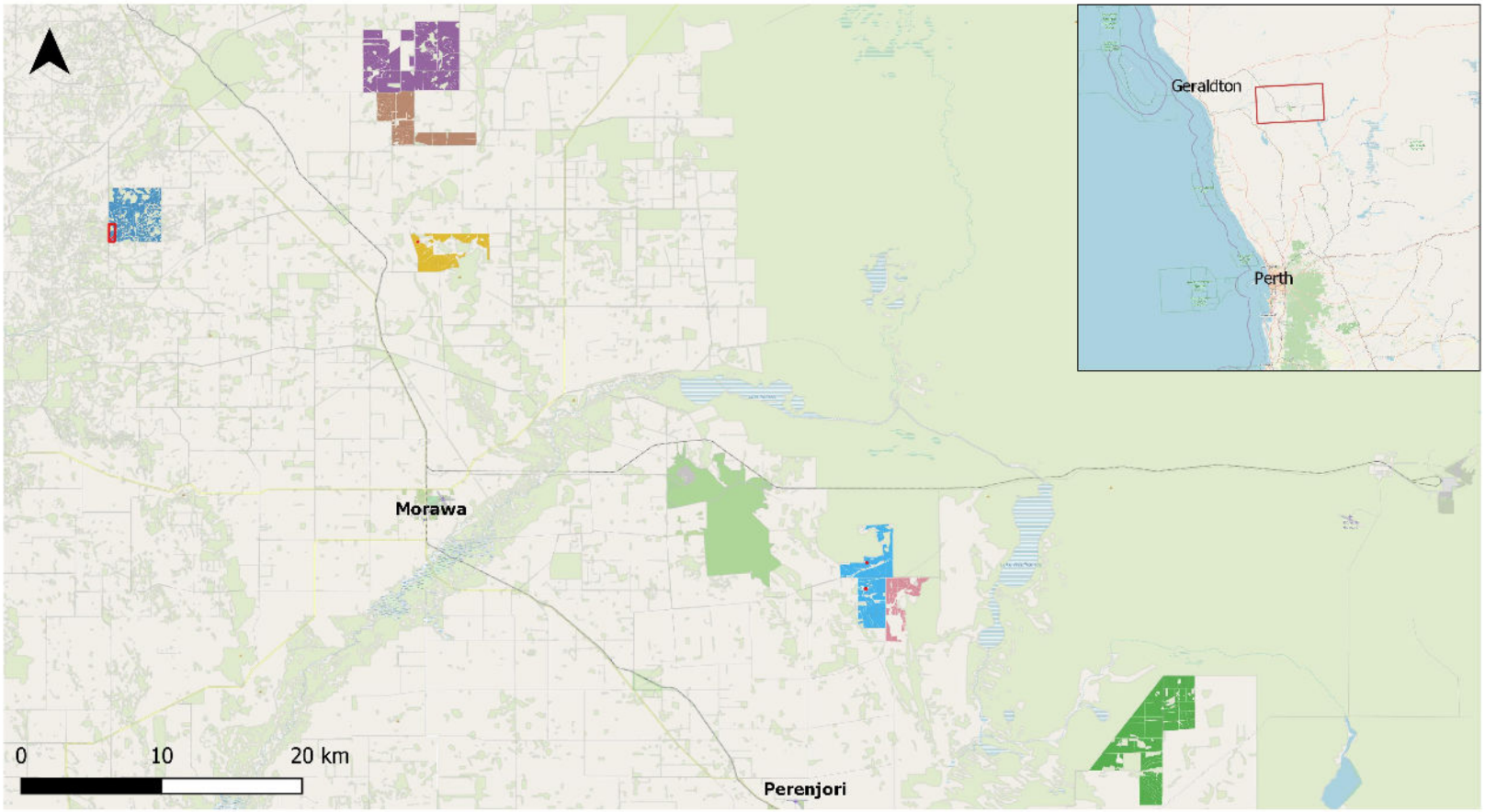
Wegner, G. I., 2016. Payments for ecosystem services (PES): a flexible, participatory, and integrated approach for improved conservation and equity outcomes. *Environment, Development and Sustainability,* 18(3), pp. 617-644.

Wegner, G. & Pascual, U., 2011. Cost-benefit analysis in the context of ecosystem services for human well-being: A multidisciplinary critique. *Global Environmental Change,* 21(2), pp. 492-504.

Wegner, G. & Pascual, U., 2011. Cost-benefit analysis in the context of ecosystem services for human well-being: A multidisciplinary critique. *Global Environmental Change,* 21(2), pp. 492-504.

Wunder, S., Engel, S. & Pagiola, S., 2008. Payments for environmental services in developing and developed countries. *Ecological Economics,* 65(4), pp. 663-852.

# APPENDIX 1 MAP OF ACTUAL ESTABLISHMENT AREAS



# APPENDIX 2 DISCUSSION WITH KEY INTERNAL STAKEHOLDERS

The purpose of the discussion with key stakeholders was to increase our understand of the project, project boundaries and what project activities are understood to lead to co-benefits. The consultation also helped us to gain an understanding of the projects' biodiversity monitoring efforts and whether the existing information can be used for the valuation of biodiversity co-benefits.

Point Advisory conducted interviews with Dr. Andrew Huggett and Jenny Borger who both performed the systematic biodiversity monitoring survey of flora and avifauna at the Hill View property near Morawa in 2014 and 2015. Dr Huggett was the project manager, ecologist/ornithologist consultant and client liaison for the survey. He worked together with Ms Borger, a botanical consultant, and her field assistant Tanith McCaw to survey plants, vegetation communities, birds and other fauna present in remnant woodland and shrubland and planted native vegetation on the property.

The Hill View survey was the first systematic survey conducted at any of the Yarra Yarra properties. It was a baseline investigation that assisted in developing an understanding of the ecological dynamics at the Hill View property. Two replicated sets of site surveys were undertaken in spring 2014 (bird breeding season) and autumn 2015 (non-breeding season). More detailed findings of the Hill View monitoring survey are outlined in Appendix 3. From our discussions with Dr Huggett and Ms Borger we gained a better understanding of the purpose and aim of the monitoring survey, were able to outline the limitations of the survey for the purpose of co-benefits valuation and collected recommendations on future monitoring. Additionally, we were able to confirm our preliminary list of co-benefits.

Dr Huggett and Ms Borger listed following co-benefits of the Yarra Yarra project:

- habitat and landscape connectivity for threatened and declining native fauna (including birds, bats, reptiles and mammals) which improves movement between remnants
- improved soil health,
- reduced soil erosion/reduced run off and water erosion
- reduced groundwater recharge
- improved land/soil productivity
- reduction in weeds in the long-term
- creation of micro-habitats and micro-climate (e.g. through moisture retainment and reduced evaporation from land surfaces)
- reduced edge effect in remnant vegetation
- protection of cultural heritage sites
- tourism (wildflowers)
- protection of locally sparce and threatened species
- intrinsic values of people being able to see revegetated hillsides and sandy plains at Hill View, Tomora, Terra Grata, Preston Waters and Bowgada Hill

### Limitations of the Hill View baseline study (for the quantification and valuation of biodiversity)

The data collected for the monitoring survey only relates to two short windows of field assessment (spring 2014 and autumn 2015). As a 'snapshot in time' specific to the Hill View property, it does not provide a holistic understanding of the habitat condition at the property or other project properties. Both Dr Huggett and Ms Borger highlighted that further monitoring is needed to obtain a better picture of the relative abundance, species richness, community composition and habitat use.

Additionally, the drought conditions from 2017 and 2019 will likely have had severe impact on flora and avifauna which highlights the importance of replicating the monitoring survey. Therefore, neither Dr Huggett nor Ms Borger feel confident using the 2014 and 2015 data to make assumption of current habitat conditions at Hill View or attempting to value the biodiversity related co-benefits of the Yarra Yarra project.

However, findings from the Hill View monitoring survey can be viewed as representative of woodland bird and plant responses to habitat restoration and revegetation across the region. Dr Huggett noted the following: "Bird populations and communities recorded on Hill View comprise species found in Buntine-Marchagee and other Northern Wheatbelt districts that are similarly pressured by habitat loss, fragmentation, poor habitat condition and reduced connectivity and, increasingly, climate change effects."

### Recommendations made by Dr Huggett and Ms Borger

- Conduct further monitoring to obtain a better picture of the relative abundance, species richness, community composition and habitat use. This can be done by replicating the monitoring study conducted at Hill View and other properties and repeat it across time, seasons and space (potentially also with more sample plots and combining it with satellite imagery). This is necessary as the habitat condition are likely to have changed over the past years.
- Conduct soil specific studies to assess reduced run off, water erosion and salinity.
- Potential to use those species that are highly sensitive to isolation and fragmentation or EPBC listed species as indicator species for further monitoring. For example, specific shrubland and woodland birds such as the Crested Bellbird, White-browed Babbler and White-winged fairy Wren, but also reptiles such as the Western Spiny-tailed Skink.
- Citizen Science studies are not scientifically rigorous to be able to address monitoring needs or adequately substitute for professional surveys, however if done consistently with appropriate training, it could assist monitoring efforts.

# APPENDIX 3 SUMMARY OF EXISTING PROJECT INFORMATION

### Baseline biodiversity monitoring survey at Hill view near Morawa

The Hill View baseline monitoring survey (Huggett, et al., 2015) was the first systematic survey conducted at the Yarra Yarra project and assisted in developing an understanding of the ecological dynamics at the Hill View property located in the Shire of Morawa. The survey monitored **bird, insect and plant biodiversity** in spring 2014 and autumn 2015. The collected data only relates to these two short windows of field assessment.

The monitoring survey was conducted at 12 sites: 6 located in remnant vegetation (not part of the GS certified project area) and 6 in revegetated areas (assumed to be part of the GS certified project area). A total of 333.68 ha was surveyed, which represents approx. 22% of the total size of the property (1,524ha). Of the 334ha, a total of 225.44 ha of revegetation comprising 28% of the total planted area (800ha) was surveyed. Most significant findings were the following:

- No bird species listed as endangered or vulnerable under the Environment Protection and Biodiversity Conservation (EPBC) Act 1999 were recorded during the study.
- Condition of revegetated sites was mostly degraded (5 out of 6) while conditions of two sites were noted to have improved showing some natural germination.
- A total recorded 50 species part of which were 13 bird species of local/regional conservation significance, including the Crested Bellbird listed as near threatened under WA Wildlife Conservation Act 1950 and the de-listed White-browed Babbler. Out of the 13 species, 11 species of local conservation significance were recorded breeding in the study area such as Wedge-tailed Eagle, Mulga Parrot, Variegated Fairy-wren, Redthroat, Chestnut-rumped Thornbill, Inland Thornbill, Southern Whiteface, Crimson Chat, Grey Shrike-thrush, White-winged Triller and White-backed Swallow
- A total of 147 plant species were recorded including 97 perennial and 50 annual species. This includes 3 tree species of significance classified as threatened or rare under the WA Wildlife Conservation Act 1950: *Eucalyptus synandra* (threatened/declared rare), *Melaleuca barlowii* (priority 3) and *Persoonia pentasticha* (priority 3)
- A total of 256 species of insects were recorded during the survey. The majority of those insects were flower-visiting insects.
- Several other species of fauna were recorded, or evidence of their presence detected such as the Western Red Kangaroo, Common Wallaroo, Short-beaked Echidna, Perentie and introduced species fox, cat, goat and rabbit. Threatened reptile species Western Spiny-tailed Skink or Gilled Slender Blue-tongue were not recorded but are likely to occur on the property due to availability of suitable habitat.

### Baseline survey in the Terra Grata reforestation project

A baseline survey of **medium to large vertebrate fauna** (Schroeder, 2017) was conducted in April, May and June 2017 on the Terra Grata property which is part of the Yarra Yarra project. The survey was conducted through 'camera trapping' which recorded 12 native and 4 invasive species. It also confirmed the presence of Malleefowl (*Leipoa ocellataon*) at the property which is listed as 'vulnerable' under the Biodiversity Conservation Act 2016 and 'vulnerable' under the EPBC.

### Improving Biodiversity Outcomes in Ecological Restoration of Abandoned Farmland 2020

A study was undertaken in 2017 to investigate **changes in soil properties, plant and invertebrate species richness in revegetated sites** of the Pine Ridge property (Parkhurst & Standish, 2020). Findings

were then compared to paddocks and reference woodlands. Revegetated sites at Pine Ridge showed positive changes in a number of soil condition and biodiversity outcomes. That being said, woodland reference conditions were not always reached. Additionally, the number of plant species recorded on revegetated sites was higher compared to paddock reference sites but were lower compared to woodland reference sites. The number of invertebrate species across paddocks, revegetated sites and woodlands was similar. We can therefore conclude that reference conditions (woodlands) have not been met since revegetation at Pine Ridge commenced in 2009.

### Citizen Science Program: Bush bird monitoring 2019

Conservation Council of WA (CCWA) conducting a Citizen Science Program to monitor bush birds on parts of the Yarra Yarra project. The program relied on volunteers and was led by CCWA program coordinator Dr Nic Dunlop. The plantings have been assessed for ecosystem development and related biodiversity conservation values, using bush bird communities as indicators. Crested Bellbird, a species indicative of sensitivity to loss of habitat connectivity, particularly in the fragmented farming landscape, was recorded at Tomora. Around six species of local conservation significance were recorded too.

### 2016 Biodiversity Monitoring Report

The 2016 Biodiversity Monitoring Report details tree survival rates for the properties Hill View, Terra Grata, Bowgada Hill and Tomora. Based on this information we have calculated average tree survival rates for each of those properties (across the sampled sites). See table below for the results. The monitoring report states that hand planted seedling survival was generally greater compared to direct seeding.

***Table 16. Tree survival rates after hand-planting and/or direct-seeding (as per the 2016 Biodiversity Monitoring Report)***

| Property | Establishment year | Average tree survival rate | Tree species mix |
|---|---|---|---|
| **Hill View** | 2014 | 40% | Acacia (over 10 species), Eucalypts (more than 2 species), Melaleuca (2 species) |
| **Terra Grata** | 2015 | 61% | Acacia (over 10 species), Eucalypts (more than 2 species), Melaleuca (1 species) |
| **Bowgada Hill** | 2015 | 33% | Acacia (over 10 species), Eucalypts (more than 2 species) |
| **Tomora** | 2015 | 53% | Acacia (over 10 species), Eucalypts (more than 2 species), Melaleuca |

# APPENDIX 4 ECONOMIC VALUATION FRAMEWORKS AND METHODOLOGIES

## A. Economic Valuation Frameworks

These frameworks are presented as economic background theories to introduce the more specific valuation methodologies presented in Section B**Error! Reference source not found.**. Note that this distinction between economic valuation frameworks and methodologies is somewhat artificial and was only made for the reader's convenience, allowing them to focus on the sections of greater relevance to them.

### 1. Total Economic Value

The Total Economic Value (TEV) is a well-established framework for identifying the various values associated with a protected and/or restored area. See Figure 3 for a simplified overview of the framework. **Such a framework is useful to ensure that no category of benefit has been omitted or forgotten from an impact assessment.**

From a practical point of view, however, TEV does not lead to quantification and valuation of benefits and costs as such, and needs to be used in conjunction with other methodologies, in particular non-market valuation methodologies (Section B). It can be used at the benefit mapping stage and / or to present the results of an impact valuation exercise.

The TEV is the sum of all benefits derived from a natural resource which consists of use values and non-use values:

- **Use values** are those either directly or indirectly derived from the use of a resource.
    - Direct use values relate to the benefits obtained from the direct use or consumption of an ecosystem. This includes timber as well as non-timber forest products and recreation value. Typically, a **market value** can be calculated for these value components.
    - Indirect use values are functional benefits usually associated with regulating ecosystem services, such as carbon sequestration, pollination and pest and disease control. There is not always a market value for these value components (although there may be, as is the case for carbon credit, when an "externality" has been priced by creating a market).
- **Non-use values** reflect the importance the community put on the preservation of the future existence of a natural resource (not considering its actual use) and includes existence and bequest values (Wainaina, et al., 2020). There is typically no market value for these value components.

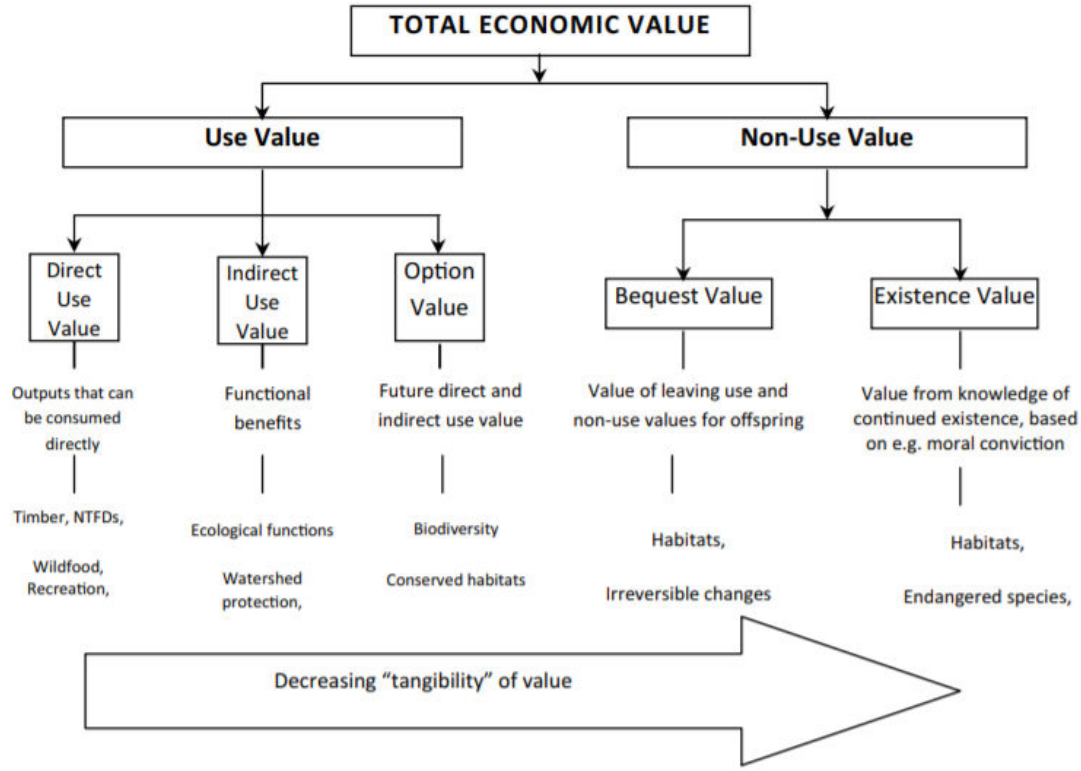



***Figure 3. Total Economic Value (David Pearce, 1991)***

## 2. Natural Capital Accounting Frameworks

The ambition of natural capital or ecosystem accounting is broader than putting a value on the environment. It is essentially aiming to inform better decisions and avoid trade-offs between the natural environment and economic outputs, that do not consider longer feedback loops that can damage both society and economy by depleting natural capital. Nonetheless the concept is relevant in the context of landscape and vegetation restoration, as such projects effectively create Natural Capital that can be accounted for.

The idea underpinning ecosystem accounting frameworks is to make the connection between natural systems and economic activity explicit, in economic terms, to demonstrate that preserving natural systems is a pre-condition to a thriving society and economy.

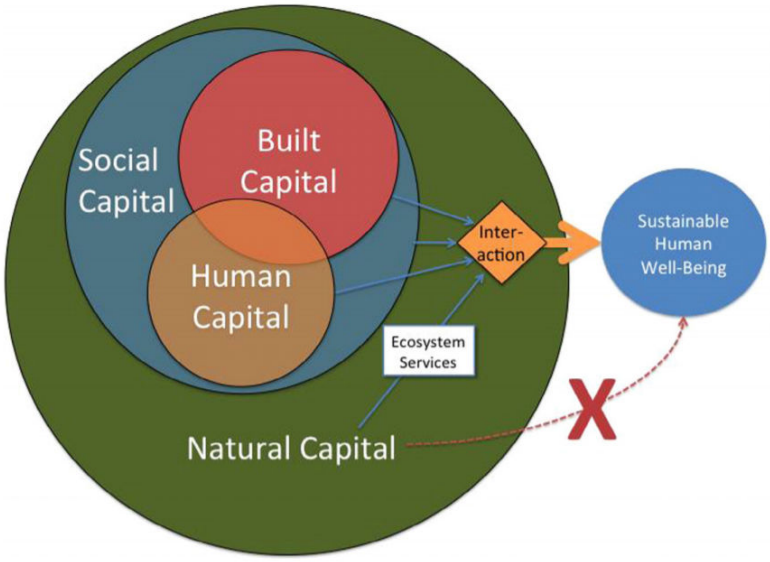



***Figure 4. Natural capital conceptual framework: natural capital supporting human wellbeing (Costanza, 2014)***

The conceptual basis of economic accounting defines capital (stocks) and income (flows) of assets that are valued through time and space/between economic actors. An economic account describes stocks and flows of economic goods and services, while environmental accounts describe flows of ecosystem goods and services.

Environmental accounting approaches could theoretically be used to put a value on ecosystem services, and hence, by extension, on biodiversity and water benefits.

While this method appears attractive, as it is universally applicable, it must be stressed out that, while work in this space has attracted considerable attention and has been met with international enthusiasm, the complexity of the task means that the application of these frameworks remains limited (see below).

The two key initiatives mentioned below outline the state of play for environmental accounting at an international level.

*System of Environmental and Economic Accounting (SEEA)*

The United Nations SEEA framework integrates economic, environmental and social data for a holistic decision-making. The SEEA describes stocks and changes in stocks of environmental assets. Accounting for Agriculture, Forestry and Fishery considers two main types of accounts:

- flow accounts and
- asset accounts.

Flow accounts are physical flows (income) between the environment and the economy. Asset accounts are monetary accounts that record monetary flows associated with agriculture, forestry and fishery transactions for products.

The SEEA Experimental Ecosystem Accounting (EEA) applies core environmental-economic accounting as used in the SEEA but assesses both the quantity and economic, environmental or social value of ecosystem services. Ecosystem accounting is based on environmental accounting but focuses on a) ecosystem assets and b) ecosystem services. It considers the flows of ecosystem services and the changes in stock of ecosystem assets, e.g. due to changes in the condition of the ecosystem.

The Victorian Government has contributed to the development of the SEEA-EEA and published its own Victorian Experimental Ecosystem Accounts (version 1.0) in 2013 (Eigenraam, et al., 2013). In 2018, the Victorian government published a national approach strategy and action plan for environmental

economic accounting (EEA) ( Interjurisdictional Environmental-Economic Accounting Steering Committee for the Meeting of Environment Ministers, 2018). The national approach uses the SEEA framework under which the Australian Bureau of Statistics produces a selected set of environmental-economic accounts annually.

*The Economics of Ecosystems and Biodiversity (TEEB)*

The TEEB adopts an economic framework and describes two components to the economic value of ecosystems in its approach:

- total economic value (TEV) of the ecosystem service benefits at a given ecological state (monetary) and
- ecological insurance value that lies in sustaining the resilience of the ecosystem which provides flows of ecosystem service benefits (non-monetary).

TEEB is being widely referred to and adopted when performing EEA.TEEB emphasises the importance of measuring biophysical aspects of ecosystems before benefits and values can be assessed. This measurement includes the recognition of ecological "tipping points" which may be difficult to capture in valuations, and suggests that "an ecological (insurance) value" is defined through a non-monetary assessment of ecosystem integrity, health, or resilience, all of which are important indicators to determine critical thresholds and minimum requirements for ecosystem service provision. TEEB is a e a nuanced approach of accounting, but as such is quite difficult to apply in practice.

*Examples of accounting approaches*

1. The SEEA framework was used to assess the benefits that parks ecosystems provide to the Victorian community (Varcoe, et al., n.d.). The project used the following approach:

- Reporting on the stock and condition of environmental assets.
- Quantification of the goods and services (ecosystem services) from park ecosystems that benefit the community.
- Valuation/assessment of the benefits from the provision of ecosystem services from parks.

2. Environmental-Economic Accounting for Forico's Surrey Hill Estate in Tasmania used the SEEA in a corporate setting by integrating environmental accounts with (already established) standard corporate financial accounts such as financial (profit & loss) and management (expenditure) accounting.

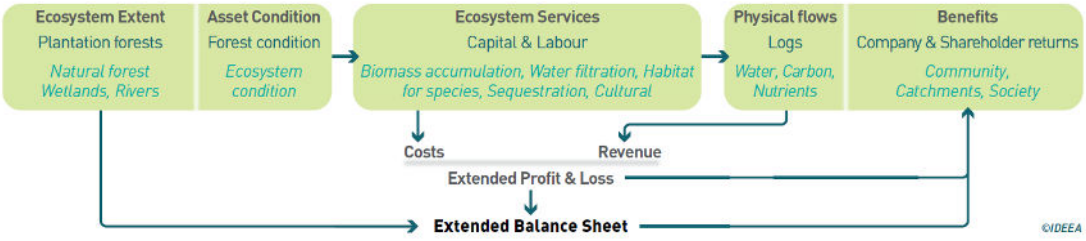



***Figure 5. Forico's EEA approach***

3. SEEA was applied for the Central Highlands of Victoria to value ecosystem services and land use activities, as a tool for decision-makers and to demonstrate the applicability of SEEA in such as context (Heather, et al., 2017).

## 3. Cost-Benefit Analysis

Cost-benefit analysis (CBA) is the most widely used economic framework, due to its flexibility and versatility. CBA is the instrument of choice to support decision making, as it sets the rules for a robust

comparison between a baseline and one or more "change" options or interventions over time. The CBA requires:

- The definition of a credible baseline, incorporating all known likely evolutions (e.g. environmental degradation)
- The description of "change" options, identifying systematically what may differ from the base case
- The identification of resulting costs and benefits, either / or in financial terms (real cash flows) or economic terms (market AND non-market values), by comparison of each "change" option with the baseline
- The quantification and, if necessary, translation of these costs and benefits in monetary terms
- The calculation of a Net Present Value of each considered option compared to the base case (over a certain period of time, using a disclosed discount factor), bringing together the value of all future costs and benefits into one number.

The attraction of such a technique is immediately evident, as it provides a transparent, objective support to decision making, wrapped up into one number.

It is a commonly applied approach in the economic analysis of landscape restoration. For example, when applied to ecosystem services, CBA can be used to incorporate environmental values into decision making, representing nature as natural capital from which ecosystem services flow to society. Positive changes in the flow of services are seen as benefits and negative ones as costs (Wegner & Pascual, 2011).

While flexible, CBA however has also its limitations for instance in form of the concepts it employs, ecological non-linearity and the spatial and temporal scales involved (Wegner & Pascual, 2011).

CBA, being the methodology of choice for economists, presents the advantage of being instantly recognised by most and most techniques valuing co-benefits are directly underpinned by CBA. In particular, Social Return On Investment (SROI) uses CBA, benefit transfer and non-market valuation proxies, in conjunction with stakeholder engagement techniques to put a value on socially beneficial projects (see B.3).

However, a comprehensive CBA of landscape restoration must assess the total economic value of the restoration benefits, i.e. direct and indirect use values as well as non-use values (Wainaina, et al., 2020). Indirect-use and non-use values (non-market values[17]) are often not easy to quantify and value, hence non-market valuation techniques (see B.1) need to be used to provide values that can be integrated into a CBA framework.

## B. Valuation Methodologies

Non-market valuation and benefit (or value) transfer methods, often used together, help to assess indirect and non-use values (Wainaina, et al., 2020; Costanza, et al., 2017) and are therefore useful, in the present study, to put a dollar value on co-benefits that may not have a marketable value. These methodologies are briefly described below, as they underpin the key components of the valuation formula presented in 4.1. Application of these techniques to the project is outlined in Section 5. However, as mentioned in 4.1, such valuation may prove superfluous if buyers can readily be found for benefit units (e.g. biodiversity offsets, see Section 6), without requiring a dollar value to be assigned to the benefit.

[17] In contrary to market values, non-market values are those environmental values that are not traded in markets and therefore do not have a monetary value attached to it. An example for this would be recreation.

## 1. Non-Market Valuation Techniques

Non-market valuation techniques are methods that estimate value for goods or benefits that do not have a price in the marketplace (e.g. intangibles). Used in combination with a CBA framework, such techniques underpin methodologies such as Social Return on Investment (SROI).

One of the main disadvantages of non-market valuation techniques is that they can be time-consuming and costly, especially when they need to be replicated for each different site, to take into account local conditions. Hence the use of benefit transfer , to estimate values without having to undertake primary valuation studies.

Non-market valuation techniques include the following (and associated variations):

- avoided damage,
- replacement cost,
- contingent valuation (stated preference),
- revealed preferences or production functions.

Some of them require extensive primary research.

For example, stated preference and revealed preference studies aim to estimate the "willingness-to-pay" for a non-market value (e.g. preservation of a threatened species or restoration of a specific environment).

The **stated preference or contingent valuation method** is used to estimate the willingness to pay (WTP) for the conservation or restoration of a resource (or environmental service) based on surveys or interviews (Baral, et al., 2016). Because of this primary data collection, it is quite costly to implement. It used the 'stated preference' from respondents faced with a hypothetical scenario and asked to choose between options which involve some payment to obtain a certain environmental outcome. This method is very specific and attractive as it allows community to express preferences. It is not without biases, though, which have been extensively documented (see below).

Similarly, the **revealed preference method** analyses individuals' purchasing decisions and other (actual) behaviour in a real-world setting. For instance, it estimates values based on direct or indirect financial support (expenditure) of the protection or restoration of a resource or service (Baral, et al., 2016; Costanza, et al., 2017). The travel-cost method is the most commonly used revealed preference method for recreation areas, as it collects or infers recreation expenditure and travel time to estimate people's WTP for specific recreation sites such as national parks (Baker & Ruting, 2014). This is obviously skewed by the "catchment" of some sites that may be located far away from populated areas and heavily favours the most practically accessible areas.

**Examples** of non-market valuation in practice have been reported in the literature: "There is strong evidence that the broader community does support and is willing to pay for protection and recovery of threatened species. In many cases, the estimated non-market values far exceed the expenditure that would be required to protect or recover the species." (Pandit, et al., 2015)

## 2. Benefit Transfer

The "**benefit transfer**" method is used to estimate outcome values for a project or study area by "transferring" results from another project or study area where relevant valuation exercises have been carried out, provided similar conditions or attributes can be identified between the two projects or study areas to make the transfer valid.

The benefit transfer approach is widely used and accepted when direct valuation is not possible (for example due to either limited data and/or time and/or funding).

The accuracy of the estimates obtained depends on the extent to which the sites are similar (e.g. ecology, accessibility, local/regional climate) and how detailed the obtained information is (Wainaina, et al., 2020; Costanza, et al., 2017; Baker & Ruting, 2014).

Therefore, it is important to make both assumptions and uncertainty explicit when using benefit transfer:

- The value of a site with perfectly matching attributes to another site that has been valued through robust primary economic research can be considered quite robust.
- However, the value of a site with a very loose attribute match to another site that has been valued through less robust research, should be considered as indicative.

In this particular case, for biodiversity values, it was not possible to find direct reference sites that had been valued using the primary techniques referred to above and would present similar biodiversity attributes to the Yarra Yarra Project. Therefore, uncertainty in the values presented in 5 above should be considered high.

## 3. Social Return On Investment (SROI)

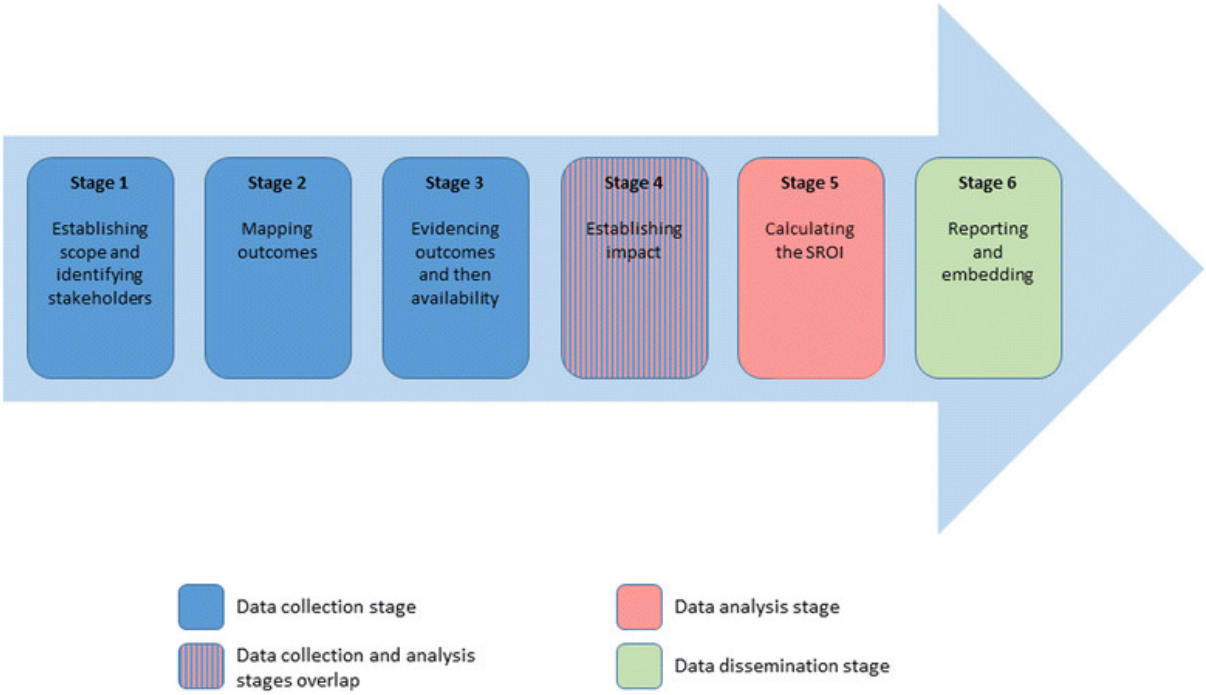
SROI is an internationally recognised methodology used to understand, measure or estimate and value the impact of a programme or organisation. It is a form of stakeholder-driven evaluation blended with cost-benefit analysis that examines the social, economic, cultural and environmental outcomes created and the costs of creating them.

It tells the story of how change is being created and places a monetary value on that change and compares it with the costs of inputs required to achieve it:

- It uses a CBA framework to rigorously define a baseline, identify changes and compare the quantum of change to the baseline.
- The use of proxies borrows from benefit transfer and non-market valuation.

Specific to SROI, though, is the engagement of beneficiaries in the process, in particular for the identification of benefits and the estimation of the quantum of benefits. The technique is therefore highly anthropocentric and embraces the subjectivity of human value judgments, even when it comes to individual experience. SROI requires extensive stakeholder consultation to collect data and is hence typically expensive and time-consuming; this is reinforced by the need for peer review, if pursuing certification. However, the high level of engagement required makes it particularly suitable to assess benefits accruing to indigenous people.

*Figure 6. SROI Process (Banke-Thomas, et al., 2015)*




SROI further explanations and guidance is available through multiple documents, the original source being (Social Value UK, 2012).

This document lists the principles of SROI:

- *Involve stakeholders*: Inform what gets measured and how this is measured and valued by involving stakeholder
- *Understand what changes*: Articulate how change is created and evaluate this through evidence gathered, recognising positive and negative changes as well as those that are intended and unintended.
- *Value the things that matter*: Use financial proxies so that the value of the outcomes can be recognised.
- *Only include what is material*: Determine what information and evidence must be included in the accounts to give a true and fair picture, such that stakeholders can draw reasonable conclusions about impact.
- *Do not over-claim*: Only claim the value that organisations are responsible for creating.
- *Be transparent*: Demonstrate the basis on which the analysis may be considered accurate and honest, and show that it will be reported to and discussed with stakeholders.
- *Verify the result*: Ensure appropriate independent assurance.

The application of SROI to the Yarra Yarra Project is further developed in Section 5.3.

## 4. Limitations of Co-Benefit Valuation

***Non-market valuation limitations***

Non-market valuation techniques present several difficulties (as reported in (The Gold Standard Foundation , 2014)):

- value is considered from the sole point of view of human-centric “utility”;

- values for intangibles such as flora or fauna species are problematic to apportion down to a local scale;
- threshold impacts and marginal values are usually difficult to incorporate in such studies;
- values are location specific and, while primary data sources are many, there is a general lack of consistency across studies; this is emphasised by the fact that each field is highly specialised and compartmentalised (health studies, biodiversity, macro-economics) and there is no standardisation of the values produced across these areas of research.

*Other challenges for valuation*

### Project context and location

It needs to be acknowledged that co-benefits are context and location specific/dependent which needs to be recognised by frameworks that attempt to identify and measure co-benefits (Uerge-Vorsatz, et al., 2014). To be environmentally and socially robust, we must understand the context of the project: the place-based social and political dynamics, power relations and the shared and cultural values associated with the ecosystem services.

### Double-counting & acknowledging complexities of ecosystem service interactions

When monetary values are assigned to co-benefits, special focus should be given to the avoidance of ecosystem service overlaps as we may not fully understand and/or acknowledge ecosystem service interactions and associated complex dynamic feedback loops with an ecosystem. These interactions can be left unaccounted for when quantification and valuation methodologies are not available (Uerge-Vorsatz, et al., 2014; Wegner & Pascual, 2011).

# APPENDIX 5 NATIONAL RESTORATION STANDARDS ASSESSMENT ESTIMATES

As outlined in Section 5.1, the National Restoration Standards developed by SERA were used to assess vegetation condition of the Yarra Yarra project based on the only available baseline monitoring study which was conducted at the Hill View property in 2014 and 2015 (see more details in Section 3.2, 5.1 and Appendix 3).

The National Restoration Standards applies six key ecological principles or attributes as illustrated in Figure 7 below: Absence of Threats, Physical Conditions, Species Composition, Structural Diversity, Ecosystem Function, External Exchanges. Each attribute has three sub-attributes assigned to it. The generic 1 to 5-star recovery scale has been designed to evaluate the progression of an ecosystem along its recovery trajectory – from a very low (1 star) to very high (5 star) similarity to an identified reference ecosystem.

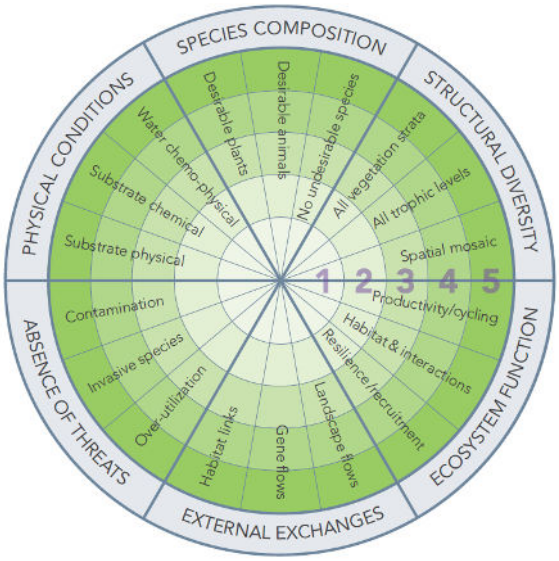



***Figure 7. National Restoration Standards progress evaluation "recovery wheel"***

The National Restoration Standards have previously been applied by Geoff McArthur from Carbon Neutral Pty Ltd. He had concluded an average rating of 3.9 for the whole project area, obtained using a current qualitative rather than a quantitative appraisal approach, while noting that the project is in various stages of recovery.

As there is currently no scientifically robust and recent understanding of biodiversity across the whole Yarra Yarra project area, we have based our assessment on information from the baseline monitoring survey conducted at the Hill View property in 2014 and 2015, used some of the information from Geoff McArthur and have made sure we were conservative.

Hence, the below assessment is strictly speaking only representative for Hill View and is also based on information that only relates to conditions in 2014 and 2015. We therefore note that this assessment does not adequately capture the current level of recovery for Hill View or the whole project. While we could not assess two sub-attributes because of a lack of information (indicated as N/A in column 'recovery level'), we have concluded an average recovery level of 3 stars (see last row).

*Table 17. Point Advisory's National Restoration Standards Hill View self assessment*

| Attributes | Sub-attributes | Recovery level | Reasoning |
|---|---|---|---|
| **Absence of threats** | Contamination | 4 | No chemical contamination discussed in Hill View survey. Rated 4 as we cannot exclude some level of biological or chemical contamination (even if those occur due to activities in adjacent properties). |
| | Invasive species | 3 | Weed growth detected at most revegetated sample plots. Identified impacts from rabbits and possibly feral goats. |
| | Over-utilisation | 3 | Impacts of historic livestock grazing and cropping still present. Evidence of browsing by feral goals. |
| **Physical Conditions** | Substrate physical | 3 | Slope erosion at some revegetated sites (existing erosion channels). Most revegetated sample sites showed evidence of erosion, with rills and gullies. Ground substrate (woody debris). Only minor land surface activities were undertaken. |
| | Substrate chemical | N/A | Not specifically mentioned or assessed in Hill View study. Cannot assess. |
| | Water chemo-physical | N/A | Not specifically mentioned or assessed in Hill View study. Cannot assess. |
| **Species Composition** | Desirable plants | 3 | Native grasses and tree species were recorded. 10 species occurred in revegetation sites (9 Acacia species and 1 Eucalyptus species). Some identified species form part of the plant assemblages of the Moonagin System Threatened Ecological Community. Due to climatic conditions, there was low survival rates from the 2010 plantings. The condition of most sampled revegetation sites was degraded (5 out of 7). We conclude moderate survival. |
| | Desirable animals | 3 | A total recorded 50 species part of which were 13 bird species of local/regional conservation significance. Natural inflow. |
| | No undesirable species | 3 | As mentioned above, influx of invasive species that have negative impact on plantings (such as foxes and cats). |
| **Structural Diversity** | All vegetation strata | 3 | Older revegetated/reforested sites had canopy and ground layers of foliage. Most strata (ground, understory, overstory/canopy) present in revegetated sites as suggested by Hill View survey. Survey noted that all vegetation strata were present within woodland remnants (not being assessed here). |
| | All tropic levels | 2 | Trophic complexity is starting to develop, however due to the low condition of revegetation sites we assume that complexity is still low compared to a reference ecosystem. |
| | Spatial mosaic | 3 | Some spatial pattering evident |
| **Ecosystem Function** | Productivity/cycling | 2 | Rate of biomass generation assumed to be low to moderate given the degraded condition of most of the sampled revegetation sites. |
| | Habitat & interactions | 2 | Trophic complexity required to allow plant-animal/habitat interactions. Rated 2 due to the above. |
| | Resilience/recruitment | 2 | Assumed low to moderate levels of resilience to the condition of the revegetated sites |
| **External Changes** | Landscape flows | 3 | Landscape exchanges are understood to be facilitated by habitat linkages, and species using remnant and revegetation sites as steppingstones. The importance of remnants in creating habitat is understood to be higher and revegetated sites offered a smaller range of habitat. |

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|---|---|---|---|
| | Gene flows | 3 | Dispersal of biota promotes the necessary exchange of genetic material between previously isolated populations and habitats. |
| | Habitat links | 3 | Reforestation at Hill View has started to re-introduce a degree of connectivity to highly fragmented landscapes. |
| **Average recovery level** | | **2.8** | **The overall ecosystem recovery level at Hill View is rated at 3 stars (rounded up from 2.8).** |

Note that this rating is considered conservative and that the Hill View study did not quantitatively assess a number of sub-attributes such as substrate chemical and water chemo-physical.

# APPENDIX 6 OTHER CO-BENEFITS

The restoration and reforestation activities of the total Yarra Yarra project are vast and therefore deliver environmental and socio-economic benefits in addition to the core co-benefits identified above.

Table 18 below illustrates the other co-benefits created by the Yarra Yarra project or that will be created once the project progresses further.

However, we note that, based on our analysis, these were not considered as core co-benefits against the criteria listed above. Some of these co-benefits may be anecdotal, difficult to establish and they may have a minimal market value or be very limited in the project area. Therefore, these are not currently significant enough to quantify and value.

***Table 18. Non-core co-benefits of the Yarra Yarra project***

| Co-benefits category | Co-benefit | Co-benefit description/nature of potential co-benefit | Reason for excluding from core co-benefits |
|---|---|---|---|
| **Environment** | Local climate regulation | Scientific studies suggest that reforestation of degraded landscapes helps to regulate local water cycles, temperature and wind speeds. | Can be considered as included in "ecosystem services" / biodiversity valuation methodology (see Section 5.1) |
| | Disaster Risk Reduction and resilience | Reforestation of degraded landscapes helps to regulate water flows during flood events and protect against landslides. It therefore decreases the impacts of these events on peoples' livelihoods and wellbeing. This benefit could become significant once the Yarra Yarra project progresses further (e.g. in size as well as ecosystem condition). | Can be considered as included in "ecosystem services" valuation methodology (see Section 5.1) |
| **Economic** | Non-timber forest products | The establishment of plantations and conservation areas creates opportunities to produce a range of economically valuable products such as honey, sandalwood nuts, seeds, etc. | Minimal market value from products from the project areas is expected at present |
| | Research & tourism | The project areas can create potential ecotourism opportunities and therefore, generate recreational value.<br><br>The Shire of Morawa and the Shire Perenjori are part of the local government collective called 'Western Australia's Wildflower Country' and attracts wildflower tourists during the wildflower season from late winter to early October. | Remoteness of the area suggest that tourism is likely to be very limited |

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|---|---|---|---|
| **Social** | Community socio-economic resilience and environmental connectivity benefits | Strong communities are composed of people who are connected, have access to goods and services, and are able to pay for these through employment or activities. Other aspects of this co-benefit include: health, well-being, connection to place, social connectivity, and local identity. | Beyond the economic benefits mentioned above, this is difficult to evidence and separate from confounding factors |