Sample NCA Report

General Purpose Natural Capital Reporting EXAMPLE for EcoFarmCo

Integrated FUTURES

COMMONLAND

Perth NRM

General Purpose Natural Capital Reporting EXAMPLE for EcoFarmCo

This report is an example of a Natural Capital Report for EcoFarmCo covering its farm in the NSW Southern Tablelands. It contains the Natural Capital Accounts and a narrative description that interprets the accounts and explains how the accounts have been developed.

As conventionally provided in annual reports of financial performance of companies, information about NC is composed of narrative information about the enterprise and its goals, supported by tables that present key information in quantitative, and some qualitative, terms. As is also conventional in annual reports, information is first presented in a summarised form with later sections providing more detail. Typically, NC accounts will be complied at an interval of approximately 5 years to reflect that ecological change happens over several years to reflect variability in seasons and ecological timeframes.

This document is an illustration of the potential for Natural Capital Performance reports in agriculture. The designs proposed here demonstrate how farmers might communicate their stewardship of natural capital (NC) and compile information they find useful in making management decisions. The designs summarise key aspects of their NC and its contribution to the enterprise and society. They draw on information already compiled in farm financial accounts and in operational records (agricultural management systems) and add information from NC accounts. The reports and accounts described here will be accompanied by 'natural capital management accounts' that compile and organise the detailed information summarised in these reports. The report and accounts are designed to help farmers plan and communicate their use of natural resources and select appropriate management interventions according to their business and holistic goals.

A key objective of this report is to include a way to communicate, to internal and external stakeholders, the quality of the NC of a farm, the quality of management of NCA and whether one or both has changed over time. External drivers such as drought and climate change will influence NC condition to a reasonable extent independently of the farmer. The design of this report will help communicate that the farmer is doing everything they could reasonably be expected to do to maintain NC condition. It will also help to demonstrate the contribution this makes to their business and to society more broadly.

To be clear – this is a report the farmer provides to their stakeholders to communicate their goals, performance, and strategy. It is not a report by an ecologist or consultant to the farmer[1]. The descriptions about management strategy and goals are documentation of the farmer's goals and practice/strategy to achieve the goals. Not a prescription from an external party

The NC reports in this design include three statements: natural capital position; performance, and stewardship. This is followed by a selection of ecosystem asset accounts that provide supporting and management-useful detail for analysis and interpretation of the reports. A brief description of the purpose and strategy for each of the statements and accounts is provided in italicised text to provide context.

Note that natural capital accounting (NCA) is an emerging field with many areas of active research. At present, some NC concepts and ecosystem services do not have methods to enable their measurement. Where methods don't presently exist or were impractical for this project, they are indicated in this illustrative report by cells for that information shaded in grey. Measures that are proxies rather than direct measures are indicated.

Example of cells shaded in grey

We acknowledge that this report is very detailed. It may contain information that is not important, or the levels of detail presented may not be useful. We aimed to a complete set of information to show the possibilities of natural capital reports with a view that we could decide which sections were not useful and may be removed. We look forward to going through the report with you and getting your feedback.

Disclaimer

This report has been prepared by Integrated Futures Pty Ltd (IFPL) for the purpose of demonstrating how natural capital accounting principles may be applied to individual farms. IFPL advises that the information and recommendations contained in this publication comprises general statements based on informal research and published and other literature. IFPL advises that such information may be incomplete or unable to be used in any specific situation. This report and case studies associated with it uses simulated data and data provided to IPFL by third parties, and whilst IFPL has exercised due care, skill, and diligence in preparing this report IFPL does not warrant the accuracy of data provided to it, or the accuracy of any conclusions drawn in reliance on the data. This report does not constitute financial or investment advice and should not be relied upon for this purpose. To the extent permitted by law IFPL accepts no responsibility for any loss, claim or liability incurred by any party in connection with this report.

1 Ecologist or consultant reports would be inputs to the accounts and this report.

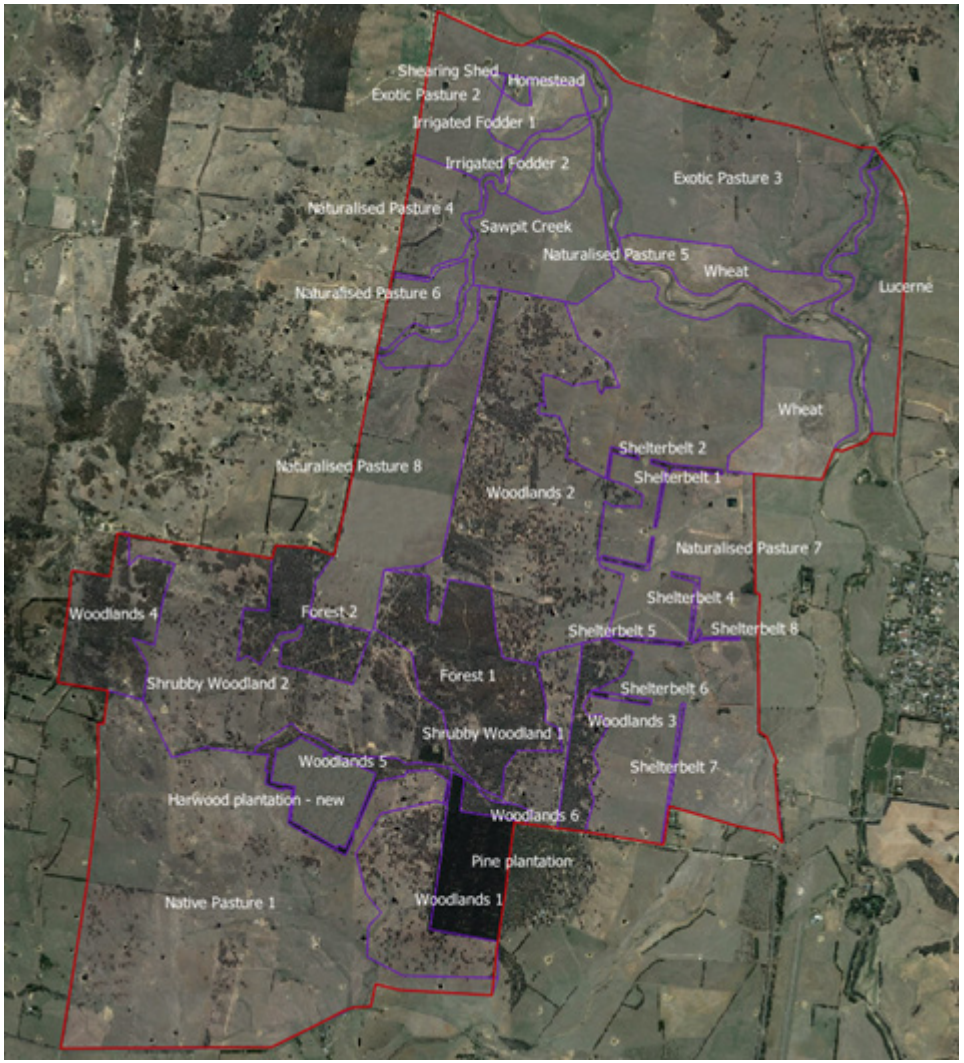
Contents

Table of Tables

EcoFarmCo – a leading producer of positive environmental outcomes alongside agricultural commodities

EcoFarmCo is owned by Jill and Joe Einstein. With the support of their farm accountant and advisor and several clever ecologists, Jill and Joe apply new ways of thinking about farm profit. They use Natural Capital Accounting (NCA) to include natural capital alongside financial and operational information to gain a more complete picture of farm profit.

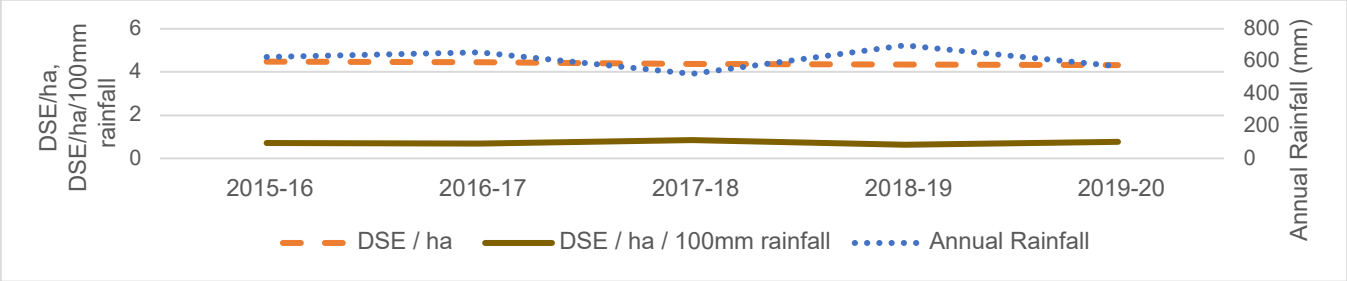
This expanded view of farm profit provides information about the relationship between farming practice, ecological health, and financial returns so that natural capital's contribution to the present and future productivity of the farm enterprise and society more broadly can be understood. EcoFarmCo's farm goals are to operate profitably, generating sufficient financial returns to enable owners and staff to be paid appropriately and to generate sufficient returns to cover retirement. EcoFarmCo is determined to leave the land in better condition than when it was acquired, to be a good environmental citizen, to be net zero for carbon emissions and biodiversity loss in its own operations. To complement its production of agricultural commodities, EcoFarmCo will supply carbon sequestration and storage services and biodiversity investment services to organisations who need to offset carbon emissions and biodiversity loss from their own operations.



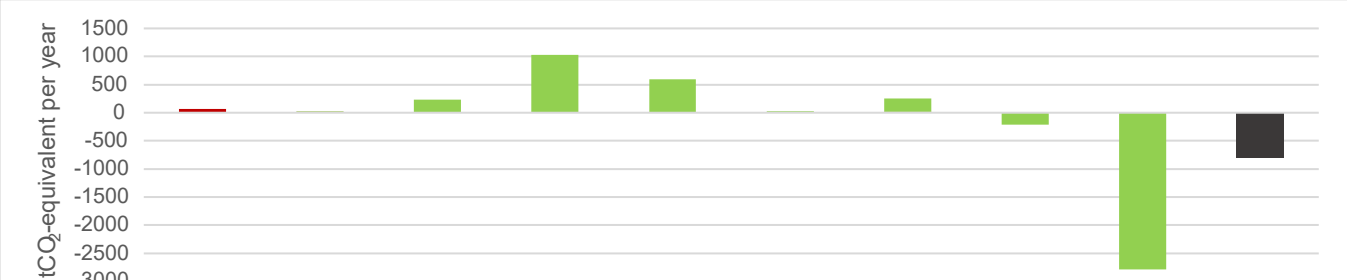
Natural Capital Dashboard

Ecological Condition Changes			Conservation		
	Ha	% property			
increase condition	242	8.3%	Area dedicated for conservation	205 ha	(+18%)
Decrease condition	0	0%	Critically endangered ecological community	521 ha	(+0%)
Conservation	71	2.4%	Habitat for critically endangered species	263 ha	(+0%)

Grazing Production Capacity



Emissions and sequestration sources - 2020

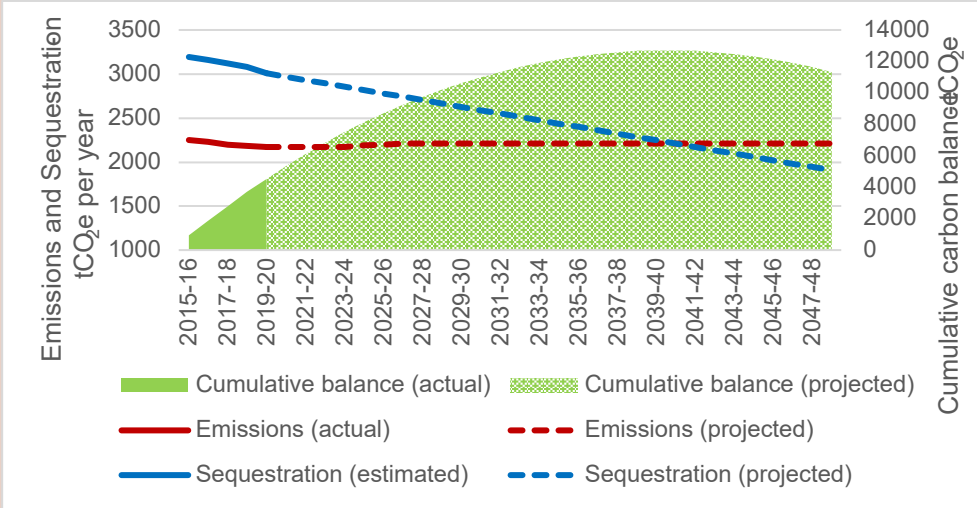


	Energy	Fertiliser	Trading cattle	Breeding cattle	Production sheep	Pasture & crop residues	Pre-farm inputs	Forest (conserv'n)	Woodlands (production)	Net Emissions
Net										-801
Biospheric	0	2	232	1024	589	26	233	-216	-2792	
Geospheric	66	16	0	0	0	0	18	0	0	

Carbon Balance (forecast)

EcoFarmCo is carbon neutral until 2040-41

(assuming no change to natural capital asset structure)



Natural Capital Position

The Natural Capital Position statement provides information summarising the natural capital of the farm and the enterprise's policy position on the management of its natural capital. The current condition of NC is described, as well as any changes since the last reporting period. This summary provides the information needed to judge whether the enterprise is sustaining and/or regenerating natural capital (i.e., its ecosystem assets) or if degradation of its natural capital is occurring with the risk of farm operations being unsustainable in biophysical terms. Illustrative Narrative and Tables[2] follow.

EcoFarmCo Natural Capital Accounting policy

EcoFarmCo is experimenting with natural capital accounting (NCA) as a way to:

1. record and explain (account for) any changes to its natural capital,
2. to estimate the contribution its natural capital is making to its ability to achieve its financial, environmental, and social goals and
3. to communicate its performance to selected stakeholders.

Note: The accounts and statements presented in this report are not designed to be a complete and comprehensive representation of the natural capital being managed by EcoFarmCo but are realistic and complete enough to enable learning and improvement in natural capital accounting designs and concepts. The reports and accounts designed for the NCALCS project can be updated at any time with more detailed information to provide a comprehensive representation of natural capital.

EcoFarmCo adopted natural capital accounting (NCA) in 2015 and 'recognised' its natural capital (NC) in Spring 2015 by establishing ecosystem asset accounts of the different types of ecosystems, their extent and condition a point in time[3]. The narrative and accounts in this report include a revaluation of natural capital in 2020 to show the changes in their extent and condition. This information is presented in accounting tables to test and develop the capacity of natural capital accounting to assist EcoFarmCo to set and achieve its financial, environmental, and social goals and to help them communicate their environmental performance to their stakeholders. For the purpose of the experiment, these goals are:

- To invest in and maintain the health, biodiversity, and resilience of its natural capital
- To produce high quality wool and meat with high levels of animal welfare
- To produce high quality, nutritious cereal and other crops with no chemical residue

2 Simulated data only

3 Consistent with the concepts and approaches to revaluation of long-term assets in financial accounting standards for property, plant and equipment.

- To have good environmental performance, to be an efficient user of resource including energy, with the goal of being net zero carbon
- To operate profitably with low risk, generating sufficient financial returns to enable owners and staff to be paid appropriately and to generate sufficient returns to cover retirement

Natural Capital overview

This initial section provides a commentary about the NC position of the farm with respect to agricultural production, environmental sustainability and any generation of public goods including conservation of native species and ecosystem services relevant to the public. A high-level summary is given of the different types of NC and the environmental, social and production purpose it serves for the enterprise.

EcoFarmCo cares for and benefits from the natural capital on its 2993ha property near Gundaroo, NSW.

EcoFarmCo is situated in the grassy woodland biome of the Southern Tablelands of NSW. In spring 2020, its NC consists of grassy woodlands, plantation forestry, native grasslands managed for production as well as conservation and naturalised pastures managed for production and environmental performance. EcoFarmCo maintains areas of shelterbelt plantings and extensive areas of retained native vegetation for habitat, connectivity, and shelter services. Sustainability of these grassland and crop assets is enabled by management practices that maintain grassland condition and soil health (described in detail in the Natural Capital Stewardship section). Protected riparian areas and extensive areas of eucalypt forest present on EcoFarmCo farm conserve native species and biodiversity and provide water purification services. A proportion of the forest areas are used for production. To mitigate further losses of endangered grassland communities, 481 hectares is maintained as native grassland using carefully planned grazing.

The diversity of natural capital supports a diverse income base with income being generated from agricultural commodity markets and environmental markets. The diversity of natural capital of EcoFarmCo enables it to serve markets for cereal grains, timber, livestock and wool sales, plus carbon and co-benefits markets and to protect and enhance the condition of the land for the benefit of future generations.

The different types of natural capital (hereafter NC) that generate these benefits is described in Table 1 with further detail in Table 10. Changes to type and condition of NC are described in the Ecosystem Asset Accounts provided in Table 16. The methods of measurement of NC are disclosed in the section titled “Methods used to measure Natural Capital”.

Table 1: Overview of natural capital and its role in contributing to the financial, environmental, and social performance of EcoFarmCo.

Natural Capital	Description
Eucalypt open forests and box-gum Grassy Woodlands	Extensive remnant forest and woodland areas are managed to provide habitat for native species. These ecosystems also provide climate regulation, meteorological regulation, soil protection and potentially pest-control and pollination services (depending on their location) as well as food resources for wildlife. In the more open woodland areas they also provide forage provision and shelter services for livestock.
Environmental Plantings	Some environmental planting has been done on the property to restore species that were removed in prior clearing events and that offer important ecosystem services including habitat, shade and shelter for livestock and remediation of salinity.
Native pastures	EcoFarmCo aims to manage its native pastures so they are composed of significant numbers of species to provide sheep with a high diversity of dietary components.
Naturalised pastures	These assets are the predominant sources of forage provisioning and shelter for livestock services for the high-quality wool production component of the EcoFarmCo farm operation. They are managed so that they have highly diverse forage species since these are demonstrated to contribute significantly to livestock performance and productivity, including increased wool quality and reduced reliance on veterinary medicines.
Exotic pastures	EcoFarmCo contains significant extents of sown exotic pastures, a legacy of previous management. These pastures are used as part of the rotational grazing, providing a variation in forage for the livestock.
Riparian areas	Riparian areas are managed to provide water purification services to assure water is not contaminated by agricultural runoff. Areas surrounding drainage lines and watercourses are protected from livestock production and cropping activities by fencing and biofilters composed of native grasses and shrubs extending at least 10 m from both banks.
Croplands (dryland)	EcoFarmCo maintains dryland cropping assets to produce grains for trade in local and export markets and to provide supplementary forages for sheep.
Croplands (irrigated)	EcoFarmCo maintains dryland cropping assets to produce grains for trade in local and export markets and to provide supplementary forages for sheep.

The current configuration of the properties shows approximately 10% of the property reserved for natural ecosystems (Forests and Woodlands, Tree belts, and riparian zones). The more heavily vegetated elements are distributed across the property. This configuration provides a degree of protection across much of the production areas, and also provides corridors and linked areas for birds and insects.

Statement of satisfaction of agricultural sustainability standards

The purpose of this statement is to help farmers to report to 'sustainability-conscious' brands who have described environmental management and animal welfare standards they expect farmers to follow. At present, there are many different 'brands' of these (e.g., Responsible Wool Standard, Nativa, SustainaWool, Land to Market, Unilever…). A review of these indicates there's a great deal of common ground and that they may be happy to do 'cross-certification'. We believe these certification programs may become harmonised during the life of the various NCA projects underway at the moment. This statement anticipates this and provides a way for a farmer to report. In the view[4] of the IFPL team, the reporting in this statement, corroborated and complemented by the Ecosystem Asset Accounts (condition assessments) and ecosystem service accounts satisfies the requirements described in the standards listed.

EcoFarmCo states (Table 2) that its application of its holistic management system ensures that it meets (and exceeds) the requirements of agricultural sustainability standards.

Table 2: Statement of performance to agricultural sustainability standards.

Natural Capital or Environmental Issue	Sustainability policy and related accounts
Land used for grazing	EcoFarmCo applies condition-based grazing planning. It optimises pasture health and diversity and avoids over-grazing by matching short-term stock numbers to annual pasture growth. Evidence that land is not becoming degraded due to overgrazing is provided by groundcover estimates and by the independent valuations of pastureland condition (Table 16).
Biodiversity conservation	EcoFarmCo promotes biodiversity across the landscape. The natural capital asset accounts demonstrate significant areas of important habitat across the property. The increase in biodiversity is reflected in the conversions of previously cropped lands to environmental plantings and additions of native vegetation corridors.
Soil protection	Described above, EcoFarmCo applies best practice grazing management to pastures. This also protects soils. Evidence of soil erosion protection services and soil quality regulation services to maintain or enhance soil health are provided in the ecosystem service accounts (Table 7).
Greenhouse gas emissions	EcoFarmCo quantifies its GHG emissions and quantifies its biocarbon stocks and sequestration rates (Table 6). This information is used to inform operational and natural capital investment decisions.
Deforestation/Land Clearing	Native systems have not been converted to another type of natural capital and EcoFarmCo has done no deforestation or land clearing. The ecosystem asset accounts can be corroborated by publicly available remote-sensing data.
Management of pollution	EcoFarmCo uses very few agricultural chemicals and people are appropriately trained to use them.

4 Sue's considered expert opinion.

Ecosystem Asset Accounts

Ecosystem Asset Accounts (EAA) are the foundational information for NCA and NCA reporting. They are the main vehicle for information about the types of NC on the property and the capacity of NC to contribute to farm production, environmental and social goals.

Ecosystem Asset Accounts – (physical terms)[5]

Table 3 summarises the NC of EcoFarmCo at the initial point of measurement (valuation) in 2015 and at the recent revaluation in 2020. It is anticipated that the table below would be used to show changes in ecosystem condition over time once a future valuation is undertaken. The types of ecosystems summarised in this table follow a 'State & Transition' model approach. Figure 4 provides a description of each of these.

Table 3: Summary Natural Capital Accounts EcoFarmCo

EcoFarmCo Natural Capital Accounts (Ecosystem Asset)	Spring 2015 (ha)	Additions or (Reductions)	Spring 2020 (ha)	Comments
Agroforestry	***52.0***		***91.4***	
Young	0.0	39.4	39.4	Newly established forestry plantation
Intermediate	52.0		52.0	
Eucalypt Open Forest	***173.6***		***173.6***	
State 2	173.6		173.6	
Grassy Woodland[6]	***468.9***		***468.9***	
State 1	82.5		82.5	
State 2	128.7	51.3	180.1	Improvements in condition due to changes to grazing practices
State 3	155.1	25.7	180.7	
State 4	102.7	(77.0)	25.7	
Grassy Woodlands (riparian)	***96.2***		***96.2***	
State 3	0.0	4.3	4.3	Improvements in condition due to changes to grazing practices
State 4	85.5	2.1	87.6	
State 5	2.1		2.1	
Degraded	8.6	(6.4)	2.1	
Shrubby Woodlands	***258.9***		***258.9***	
State 2	258.9		258.9	
Cleared Native Pasture[7]	***48.3***		***481.3***	
V. Good	24.1	24.1	48.1	

5 It is an aspiration of farm-level natural capital accounting to be able to put a monetary value on each ecosystem as well. The capability to do this is based on a) published methods for these types of valuations and b) detailed production and other data available at paddock or ecosystem type level. In the interim, we expect that values in physical terms will be useful.

6 Condition assessment with respect to the potential for the ecosystem to persist as a grassy woodland (also described as ecological integrity).

7 Condition assessment with respect to forage quality for livestock.

EcoFarmCo Natural Capital Accounts (Ecosystem Asset)	Spring 2015 (ha)	Additions or (Reductions)	Spring 2020 (ha)	Comments
Good	240.6		240.6	
Fair	192.5		192.5	
Poor	24.1	(24.1)	0.0	
Cleared Naturalised Pasture[8]	***825.9***		***794.5***	
V. Good	110.4	31.3	141.7	
Good	412.9	(15.2)	397.8	
Fair	185.1	22.7	207.8	
Poor	117.4	(70.2)	47.2	
Cleared Exotic Pasture[9]	***328.2***		***288.8***	
V. Good	41.6	41.6	83.1	Upgrade in condition due to changes in grazing.
Good	184.8		184.8	
Fair	20.8		20.8	
Poor	81.0	(81.0)	0.0	Some converted to shelterbelts
Irrigated cropping	***53.2***		***53.2***	
Good	42.5		42.5	
Fair	10.6		10.6	
Dryland cropping	***180.0***		***180.0***	
Good	152.3		152.3	
Fair	10.6		10.6	
Shelterbelts	***0.0***		***31.4***	
Young	0.0	31.4	31.4	Newly established
Infrastructure	**4.86**		**4.9**	
TOTAL Property	**2922.9**		**2922.9**	
Biodiversity Index	**0.45**			

8 Condition assessment with respect to forage quality for livestock.
9 Condition assessment with respect to forage quality for livestock.

Natural Capital Performance

The Natural Capital Performance Statement describes the natural capital performance (NCP) over the prior period. The NCP Statement includes information about the types and quantities of ecosystem services have been generated by the enterprise, including public good services such as carbon sequestration, avoidance of soil erosion and water purification. It will also report on the biodiversity of the property and habitat protection services. Note that livestock, wool, grains, fruit, and other crops (as appropriate) harvested are summarised in the benefits section. The tables suggested here communicate information not presently covered in farm accounting. In the Farm-Level NCA project, we will only create a valuation at one point in time, however it may be possible to infer a prior type and condition at a historic point from remote sensing and past ecological or consultant assessments.

Meat quality and animal welfare

[PLACEHOLDER FOR INFORMATION ABOUT THESE PERFORMANCE ASPECTS.]

Meat, particularly from ruminants (for example cattle, sheep and goats) can be a particularly important source of important nutritive elements including critical fatty acids: docosohexaenoic acid (DHA), a particular isomer of Conjugated Linoleic Acid (CLA) and n-3 PUFA . Beef produced from healthy grasslands is as high in n-3 PUFA as white fleshed fish . In addition to being associated with lower risk of cancer and cardio vascular disease, the presence of these nutrients are thought to aid the effectiveness of cancer treatment . Livestock production methods significantly affect the nutritive characteristics of meat. Animals grazed on natural grasslands that are rich with diverse species of perennial grasses have meat that is much closer to the nutritive characteristics associated with good health than the modern high yielding breeds produced in intensive confinement operations . The characteristics of meat produced from natural, free-range environments with high dietary quality and diversity have significantly lower total intramuscular fat, higher Vitamin E, and lower Omega 6 to Omega 3 ratios.

Table 4: Indications of food quality of meat and grains produced by EcoFarmCo using EcoFarmCo Natural Capital

Food qualities	EcoFarmCo	Comparison
Wheat & Oats		
Protein (amino acids)		
Other?		
Cadmium		
Deforestation/Land Clearing		
Residual chemical		
Sheep meat		
Omega three to Omega six ratio		

Food qualities	EcoFarmCo	Comparison
Conjugated Linoleic Acid (CLA)		
Doxohexaenoic Acid (DHA)		
Beef meat		
Omega three to Omega six ratio		
Conjugated Linoleic Acid (CLA)		
Doxohexaenoic Acid (DHA)		

Table 5: Indications of wool quality produced by EcoFarmCo

Wool qualities	EcoFarmCo	Comparison
Micron		
Strength		
Vegetable matter		
Lustre		

Greenhouse Gas Position[10]

NB. The estimates for carbon sequestration exclude soil carbon and are a modelled estimate only. They are not of sufficient detail or accuracy to allow trading of carbon via Australia's Emissions Reduction Fund programs.

EcoFarmCo (EcoFarmCo operations) estimates that it sequesters net 802 tCO_2e per year. Annual emissions are estimated to be 2,207 tonnes of CO_2e. Annual sequestration of atmospheric carbon into above and below ground biomass is estimated to be 3,008 tCO_2e per year.

Table 6 shows detailed estimates of livestock (enteric) emissions and operation-related emissions for the farm and estimates of the present rate of sequestration into its natural capital Bio-Carbon stocks. It estimates that its NC of EcoFarmCo presently stores 168,548 Mg C (metric tonnes C) of bio-carbon.

Table 6: Greenhouse Gas emissions and sequestration (post-hoc basis)

GHG Emissions[11] & Sequestration	*Estimated 5 year average*		
GHG Emissions	*Geosphere Source*	*Biosphere Source*	*TOTAL tCO_2e yr^{-1}*
GHG Emissions - Trading cattle	**7.89**	**443.60**	**451.49**
Enteric/Manure/UrineDung	0.00	232.23	232.23
Energy	5.77	0.00	5.77
Fertiliser	1.50	0.00	1.50

10 NOTE: At present, this will not be sufficient to make formal claims about carbon neutrality or to trade C sequestration.

11 Uses methods of estimation described by the National Greenhouse Gas Inventory and related ERF publications.

GHG Emissions[11] & Sequestration	*Estimated 5 year average*		
Pasture residues	0.00	0.77	0.77
Pre-farm	0.63	210.60	211.23
GHG Emissions - Breeding Cattle	**31.13**	**1047.05**	**1078.18**
Enteric/Manure/UrineDung	0.00	1023.53	1023.53
Energy	22.93	0.00	22.93
Fertiliser	5.52	0.00	5.52
Pasture residues	0.00	2.45	2.45
Pre-farm	2.68	21.06	23.74
GHG Emissions - Production Flock	**17.23**	**591.52**	**608.75**
Enteric/Manure/UrineDung	0.00	588.89	588.89
Energy	12.71	0.00	12.71
Fertiliser	3.03	0.00	3.03
Pasture residues	0.00	1.33	1.33
Pre-farm	1.48	1.30	2.79
GHG Emissions - Crop Production	**44.04**	**24.10**	**68.14**
Energy	24.39	0.00	24.39
Fertiliser	6.06	2.50	8.56
Crop residues	0.00	21.60	21.60
Pre-farm	13.59	0.00	13.59
Total Emissions	**100.30**	**2106.27**	**2206.56**
Bio-Carbon Stocks and sequestration[12]	***Pasture[13]***	***Trees (above and below ground), CWD***	***TOTAL***
Estimated Carbon Stocks (Mg C)	90458	78090	168548
Estimated Carbon Stocks per hectare (Mg C ha^{-1})	31.05	26.76	57.86
Estimated C sequestration per ha per year (Mg C ha^{-1} $year^{-1}$)	0.00	-0.28	-0.28
Emissions balance	***Geosphere / Atmosphere cycle***	***Biosphere / Atmosphere cycle***	***Total***
Total Estimated Emissions (tCO_2e/year)	100.30	2106.27	2206.56
Estimated C sequestration (tCO_2e/year)	0.00	-3008.21	-3008.21
Net carbon sequestration rate (into bio-carbon stocks)[14] (tCO_2e/year)	***100.30***	***-901.86***	***-801.56***

12 NOTE: A negative number indicates carbon being removed from the atmosphere and stored in bio-carbon storages.

13 Estimated based on the carbon in the pasture that is consumed by livestock. All other carbon in the pasture (that not eaten by livestock) is considered to be carbon neutral – ie. It comes from and returns to the atmosphere.

14 Details of sequestration and storage by type of natural capital are presented in Thematic Accounts. These include estimates of the remaining sequestration potential of the farm given the present composition of natural capital.

Ecosystem services produced for the benefit of citizens

'Final' Ecosystem services[15]

In addition to livestock sales and agistment services reported in the financial accounts, EcoFarmCo generates considerable ecosystem services for the benefit of citizens (Table 7)[16]. It estimates that it has sequestered (net) an estimated 219 MgC/yr (802 tCO_2e/yr) into the landscape and is conserving over 225ha of important habitat for species conservation. This is done through the sensitive management of the woodland areas. Further detail about species and habitat is provided in Table 9. As a part of its operation policy to maintain groundcover, EcoFarmCo is ensuring that local businesses, residents, and governments are not exposed to costs of cleaning dust from the farm from their buildings and roads.

Table 7: 'Final' Ecosystem Services produced by EcoFarmCo with EcoFarmCo Natural Capital.

Final Ecosystem Services generated by the farm	*Physical Quantities*	*Farm Financial Benefits*	*Other Beneficiaries*
Global climate regulation (bio-carbon sequestration and storage)	219 Million grams (metric tons) Carbon sequestered per year	$ 0[17]	Estimated as the monetary value to society of EcoFarmCo's contribution to returning atmospheric carbon to safe levels
Education, scientific and research services[18]	The number of People multiplied by number of days	$ 0	Estimated as $ XX research grant Plus the economic value of knowledge (in monetary terms).
Spiritual, symbolic, and artistic services	Cultural Events attended by 80 people 15 days	$ 0	Priceless, but can be estimated as the monetary value communities and society more broadly of maintaining ecosystems that are spiritually, and symbolically significant.[19]...
Habitat maintenance services	225 ha of forest and woodlands with > 10% canopy cover.	$ 20,000/yr[20]	Value to communities and society more broadly of maintaining ecosystems that provide habitat for endangered or threatened species

15 Final ecosystem services are used by businesses, households and governments. They are combined with labour, financial and social capital to produce benefits.
16 Farm financial benefits of producing these services would only be reported in this table if the enterprise is being paid for them by external entities.
17 EcoFarmCo sequesters and stores carbon on a voluntary basis as part of its stewardship policy. It does not participate in ERF or other programs.
18 Public good estimates via the value of EcoFarmCo's contribution to generation of knowledge via field days, scientific research. EcoFarmCo has no current research funding, so no private benefits are recorded.
19 EcoFarmCo does not charge Traditional Owners for access to the land for cultural and spiritual purposes.
20 EcoFarmCo provides habitat maintenance services on a voluntary basis consistent with its stewardship values. A small area of the property is participating in a Stewardship program worth $20,000 per annum to the business.

Final Ecosystem Services generated by the farm	*Physical Quantities*	*Farm Financial Benefits*	*Other Beneficiaries*
Soil erosion control	Proxy measure: Proportion of farm with minimum groundcover above 50%[21] 2020: 95.4% 5-year avg: 97.0% Proxy measure: Average minimum groundcover across the property: 2020: 70% 5-year avg: 78%	There should be a positive financial benefit to the farmer through avoided loss off soil.	Estimated as the monetary value to society of EcoFarmCo's contribution to local governments, residents and businesses of avoiding cost of cleaning roads and buildings following dust storms.

Intermediate Ecosystem services[22]

Table 8 summarises contributions of EcoFarmCo natural capital to the productivity, dependability and sustainability of EcoFarmCo operations. EcoFarmCo's natural capital provides significant services that are intermediate to production. The monetary values are already incorporated into the agricultural products and financial performance of the farm, but contributions of ecosystem assets are typically invisible. The following tables provide estimates of these values[23]. The long-term productive capacity of NC for these intermediate services is estimated to be 2811 tonnes of biomass per annum in the form of forage for livestock. Assisting the ecosystems that produce these goods, are the woodlands that provide shelter for forage crops and livestock. By maintaining above 60% ground cover on average, and replenishing soil nutrition, EcoFarmCo is ensuring that its natural capital is providing soil quality regulating services to maintain soil health. By aiming to maximise ground cover, EcoFarmCo is producing soil erosion control services that have significant private as well as public benefit.

21 https://soilquality.org.au/factsheets/benefits-of-retaining-stubble. Note that these proxy measures do not take into account the timing of rainfall with respect to the bare ground and so is only a measure of the potential for protection from erosion rather than an actual measure. The measures are calculated based on annual ground cover percentiles available from https://data.dea.ga.gov.au/?prefix=fractional-cover/fc-percentile/annual/v2.2.0/combined/.

22 Intermediate ecosystem services are generated and used between ecosystems of a property.

23 Note that methods to estimate and value these are still being developed.

Table 8: Intermediate Ecosystem services that contribute to the production of cultural services, crops, wool and livestock by EcoFarmCo

Ecosystem Services Intermediate factors of production[24]	*Amount & Unit of measure*	*Monetary Value (from farmers perspective)*
Biomass – Forage for livestock	2811 Tonnes dry matter	$ Value of forage
Local (Meso) Climate Regulation[25] (Shelter for crops and livestock)	Area of farm sheltered (ha)	$ Additional crop and livestock production due to shelter.
Pollination	Area covered by pollination services[26] (ha)	$ Additional crop and livestock production due to pollination.
Pest-Control (insects)	Proxy measure: Zone of protection (ha)	$ Additional crop and livestock production due to pest control (and reduced pesticide inputs).
Soil Quality Regulation Services	Proxy measure: average ground cover: Past year: 82% 5 year average: 85%	$ Avoided loss of productivity due to protection of soil quality.
Nutrient-cycling and fixation (soil biology)	Proxy measure: Microbial activity (enzymatic activity/gm of soil)	$ Additional crop and fodder production due to nutrient cycling (and reduced fertiliser inputs).
Water retention (soil structure)	Proxy measure: Water holding capacity	$ Additional crop and fodder production due to improved water holding capacity
Waste removal (decomposers / scavengers)	Proxy measure: habitat for decomposers / scavengers (ha)[27]	$ Saving from reduced disease
Soil erosion control	Proxy measure: Proportion of farm with minimum groundcover above 50%[28] 2020: 99.8% 5-year avg: 99.8% Proxy measure: Average minimum groundcover across the property: 2020: 81% 5-year avg: 80%	$ Avoided loss of productivity due to protection of soil quality[29].
Water Purification services	Proxy measure: riparian buffer and quality of riparian vegetation	$ Cost to produce benefits for downstream businesses and citizens or to comply with water quality regulation.

24 Detailed information that contributes to this summary is drawn from farm operations and natural capital condition accounts.

25 We anticipate that the CSIRO Perennial Prosperity project will contribute ways of valuing this.

26 Given the type, location and extent of pollinator habitat. Not all habitat is equal, so for example, very narrow field margins or small plots may not support as many beneficials and reduce area pollinated / protected. This will be a trade-off between configuration and size and quality of reservoirs (habitat).

27 This is tricky to measure but may be significant and therefore material.

28 https://soilquality.org.au/factsheets/benefits-of-retaining-stubble. Note that these proxy measures do not take into account the timing of rainfall with respect to the bare ground and so is only a measure of the potential for protection from erosion rather than an actual measure. The measures are calculated based on annual ground cover percentiles available from https://data.dea.ga.gov.au/?prefix=fractional-cover/fc-percentile/annual/v2.2.0/combined/.

29 Dust storms cause significant public cost. By controlling soil erosion, EcoFarmCo provides significant public benefit through avoided cost of cleaning buildings and roads of dust.

Habitat Services

Critical Habitat is defined in Guidance Note 6 of the International Finance Corporation Performance Standard 6 (IFC PS6) as an area with high biodiversity value. This includes areas that meet one or more of the following criteria:

- Criterion 1: Critically Endangered (CR) and/or Endangered (EN) species;
- Criterion 2: Endemic and/or restricted range species;
- Criterion 3: Migratory and/or congregatory species;
- Criterion 4: Highly threatened and/or unique ecosystems; and
- Criterion 5: Key evolutionary processes.

The Ecosystem Asset Accounts (Table 3 and Table 16) describe the significant habitat for important and critical species maintained on EcoFarmCo. Table 9 describes the habitat required for key endangered species and the extent of those types of assets on the EcoFarmCo farm. It should be noted that detailed flora and fauna surveys were not undertaken as part of the rapid ecological assessment for the properties, and so the lack of sightings of particular species does not mean they are not there.

Table 9: Habitat areas for species of focus for cultural and conservation purposes (Autumn 2021). Habitat for fauna is conceptualised as the type and extent of ecosystem necessary for that species. Habitat for flora is conceptualised as the type and extent of the ecological community that species is found in.

Habitat	*Species Impacted*	*Excosystem Extent (ha) Spring 2020*	*Commentary*
Southern Tablelands Grassy Woodlands	White Box – Yellow Box – Blakely's Red Gum Grassy Woodland and derived native grassland (EPBC: Critically Endangered Ecological Community)	998	It is an open woodland community (sometimes occurring as a forest formation), in which the most obvious species are one or more of the following: White Box Eucalyptus albens, Yellow Box E. melliodora and Blakely's Red Gum E. blakelyi. Intact sites contain a high diversity of plant species, including the main tree species, additional tree species, some shrub species, several climbing plant species, many grasses and a very high diversity of herbs. The community also includes a range of mammal, bird, reptile, frog and invertebrate fauna species. Intact stands that contain diverse upper and mid-storeys and groundlayers are rare. Modified sites include the following: Areas where the main tree species are present ranging from an open woodland formation to a forest structure, and the groundlayer is predominantly composed of exotic species; and Sites where the trees have been removed and only the grassy groundlayer and some herbs remain.[30]

30 https://www.environment.nsw.gov.au/ThreatenedSpeciesApp/profile.aspx?id=10837

Habitat	*Species Impacted*	*Excosystem Extent (ha) Spring 2020*	*Commentary*
Southern Tablelands Grassy Woodlands	Regent Honeyeater (EPBC: Critically Endangered, IUCN: Critically Endangered)	738	The species inhabits dry open forest and woodland, particularly Box-Ironbark woodland, and riparian forests of River Sheoak. Regent Honeyeaters inhabit woodlands that support a significantly high abundance and species richness of bird species. These woodlands have significantly large numbers of mature trees, high canopy cover and abundance of mistletoes.[31]
Southern Tablelands Grassy Woodlands	Swift Parrot (EPBC: Critically Endangered, IUCN: Critically Endangered)	738	On the mainland they occur in areas where eucalypts are flowering profusely or where there are abundant lerp (from sap-sucking bugs) infestations. Favoured feed trees include winter flowering species such as Swamp Mahogany Eucalyptus robusta, Spotted Gum Corymbia maculata, Red Bloodwood C. gummifera, Forest Red Gum E. tereticornis, Mugga Ironbark E. sideroxylon, and White Box E. albens. Commonly used lerp infested trees include Inland Grey Box E. microcarpa, Grey Box E. moluccana, Blackbutt E. pilularis, and Yellow Box E. melliodora.[32]
Southern Tablelands Grassy Woodlands	Painted Honeyeater (EPBC: Vulnerable, IUCN: Vulnerable)	738	Inhabits Boree/ Weeping Myall (Acacia pendula), Brigalow (A. harpophylla) and Box-Gum Woodlands and Box-Ironbark Forests. A specialist feeder on the fruits of mistletoes growing on woodland eucalypts and acacias. Prefers mistletoes of the genus Amyema.[33]
Southern Tablelands Grassy Woodlands	Superb Parrot (EPBC: Vulnerable)	738	Inhabit Box-Gum, Box-Cypress-pine and Boree Woodlands and River Red Gum Forest. In the Riverina the birds nest in the hollows of large trees (dead or alive) mainly in tall riparian River Red Gum Forest or Woodland. On the South West Slopes nest trees can be in open Box-Gum Woodland or isolated paddock trees. Species known to be used are Blakely's Red Gum, Yellow Box, Apple Box and Red Box.[34]

31 https://www.environment.nsw.gov.au/ThreatenedSpeciesApp/profile.aspx?id=10841
32 https://www.environment.nsw.gov.au/ThreatenedSpeciesApp/profile.aspx?id=10455
33 https://www.environment.nsw.gov.au/ThreatenedSpeciesApp/profile.aspx?id=10357
34 https://www.environment.nsw.gov.au/ThreatenedSpeciesApp/profile.aspx?id=10645

Natural Capital Stewardship

This statement is designed to provide information about the farmers' stewardship of NC and resources that affect the public and whether it is 'socially acceptable'. It describes the management and operational choices being used to protect or invest in NC including information about how management is responding to NC change either to avoid negative economic implications or realise economic opportunities.

Natural Capital Management

This part of the Stewardship Statement describes the major types of NC on EcoFarmCo and the economic purpose (environmental, social or financial) it serves in the business and for the community. It describes the activities and practices involved in the use and maintenance of each type of NC and summarises the condition monitoring regime.

The purpose that each Ecosystem Type (ET) of EcoFarmCo serves for EcoFarmCo is summarised in Table 10 following along with the policies that govern its management and monitoring. For ecosystem assets (EAs) that have a biodiversity or conservation purpose as well as a production purpose, the assessments are performed by an agroecologist using a rapid protocol. Surveyed EA's are considered representative (and any imputations acknowledged in the Ecological Asset Register - EAR). The survey, and background information from satellite data and farm management information, will also assist in forming a view of whether ecosystem assets are likely or unlikely to be improving (or maintaining) their ecological integrity and condition with respect to their specified purpose (primarily production or primarily conservation) in the farm enterprise[35]. Because ecosystem condition typically changes relatively slowly, it is re-assessed (revalued) every five years.

Ecosystem assets where the dominant purpose is production are assessed as follows:

1) condition of the land to support grazing is assessed by the farmer at paddock moves as part of routine grazing planning and forage budgeting

Detailed descriptions of monitoring, methods and results is kept with the management accounts (detailed version) as a supplement to this NC report.

35 The method for this would be described in supplementary material.

Table 10: Detailed description of types of natural capital of EcoFarmCo, its role in the operation and the monitoring strategy applied.

Natural Capital	Economic Benefit Logic & Management Policies
Livestock	*Local adaptation and high animal welfare* EcoFarmCo runs self-replacing plain-bodied merinos producing (17-20 micron) wool, along with a self-replacing Angus and Hereford herd of cattle. These have been selectively bred and managed over multiple (sheep/cattle) generations on the property using practices which are consistent with published mechanisms that positively affect the productivity, resilience, and adaptive capacity of animals[36]. The multiple generations on the landscape ensure that the sheep are physiologically and socially adapted to the landscape. They are managed with low stress stockmanship and rotational grazing practices so they have herd-wide expertise for foraging and can meet their nutritional needs from the diversity of pastures, croplands, and native vegetation areas of the property. No mulesing is used. In addition to the breeding flock and herd, additional pasture production is leveraged in good seasons through the operation of a trading cattle herd, fattening steers for sale when the market and ecological conditions are suitable.
Open Eucalypt Forests and Woodlands	*For conservation and generation of climate regulation services* EcoFarmCo retains its extensive remnant woodland areas to provide habitat for native species and to provide climate regulation services. It does this on a voluntary basis (i.e. not part of a biodiversity trading or environmental stewardship payment program). In addition to providing important habitat, these ecosystems also provide meteorological regulation, soil protection and potentially pest-control and pollination services for proximate pastures. They provide important habitat for wildlife. Approximately 10% of EcoFarmCo is reserved as conservation zones (only grazed for strategic purposes), with a further 14% of the property comprising of production areas that retain significant (>15% canopy cover) of critical tree species. *Ecosystem Condition Measurement – independent expert representative rapid assessment (five-year)*

36 See for example F. D. Provenza, Villalba, J. J., "The Role of Natural Plant Products in Modulating the Immune System: An Adaptable Approach for Combating Disease in Grazing Animals," *Small Ruminant Research* 89 (2010); Fred D Provenza et al., "Linking Herbivore Experience, Varied Diets, and Plant Biochemical Diversity," ibid.49 (2003); D K Revell, "Sustainably Meeting the Nutrient Requirements of Grazing Sheep," in *Achieving Sustainable Production of Sheep* (Burleigh Dodds Science Publishing Limited, 2017); Juan J. Villalba and Serge Y. Landau, "Host Behavior, Environment and Ability to Self-Medicate," *Small Ruminant Research* 103, no. 1 (2012); Juan J. Villalba and Frederick D. Provenza, "Learning and Dietary Choice in Herbivores," *Rangeland Ecology & Management* 62, no. 5 (2009).

Natural Capital	Economic Benefit Logic & Management Policies
Naturalised and Native pastures	*For conservation and for production* Pastures and other resources (see woodlands) are managed to provide a wide diversity of forages to meet the daily and ever-changing needs of sheep. Pastures are managed to optimise the growth of palatable, perennial grasses and annual forbs. Sheep are provided with access to shrubs to fill nutrition gaps when grasses are dormant. These are managed to provide a diversity of high protein, high sulphur and high tannin forages that are known to provide nutritional elements important to good wool quality and strength, improved digestive function including reducing enteric emissions and intestinal parasite burdens . Forage from pastures is supplemented with hay produced on the property. *Pasture Condition Measurement – independent expert representative rapid assessment (five-year)*
Croplands (irrigated & dryland)	*For production and soil conservation* To maintain soil health and crop productivity[37], EcoFarmCo uses minimum or low-till and stubble retention with biology-friendly soil amendments based on partial nutrient balance estimates. These factors improve plant productivity and assure the sustainability of the enterprise. They increase soil organic matter accumulation and stabilisation, reduce erosion risk by lowering wind speed at the soil surface and decreasing run-off, increase soil water content by decreasing run-off and increasing infiltration, increase mineralisation of unused N so it is stored for following crop, increase the biological fertility of the soil and replenish carbon. Additions of organic residues via its compost and compost tea program are expected to provide soil quality regulation via mechanisms consistent with those found to ameliorate Al toxicity and P deficiency in acid soils and acidification (www.soilquality.org.au). EcoFarmCo grazes stubbles to achieve optimal stubble coverage to balance requirements for soil health and clear ground for the following crop. It utilises manure crops to replenish soil organic matter and regenerate biological activity. Stubble retention: • Reduces erosion risk by lowering wind speed at the soil surface and decreasing run-off. • Increases soil water content by decreasing run-off and increasing infiltration. • Increases mineralisation of unused N so it is stored for following crop. Increases the biological fertility of the soil and replenishes carbon. *Measurement – regular farmer observations (visual soil assessments) and independent soil tests (five-year) corroborated by remote sensing*
Shelterbelts (mixed Eucalypt and shrub)	*For conservation and generation of climate regulation services* EcoFarmCo has invested in shelterbelts throughout the property. In addition to providing important habitat, these ecosystems also provide meteorological regulation, soil protection and potentially pest-control and pollination services for proximate pastures and croplands. They provide important habitat for wildlife. *Ecosystem Condition Measurement – independent expert representative rapid assessment (five-year)*

37 To assure that soil quality is being regulated by the combination of farmer interventions and ecological functions.

Ground cover assessment

The levels of groundcover maintained across the properties has a direct impact on the susceptibility of the landscape to wind and water erosion during significant weather events.

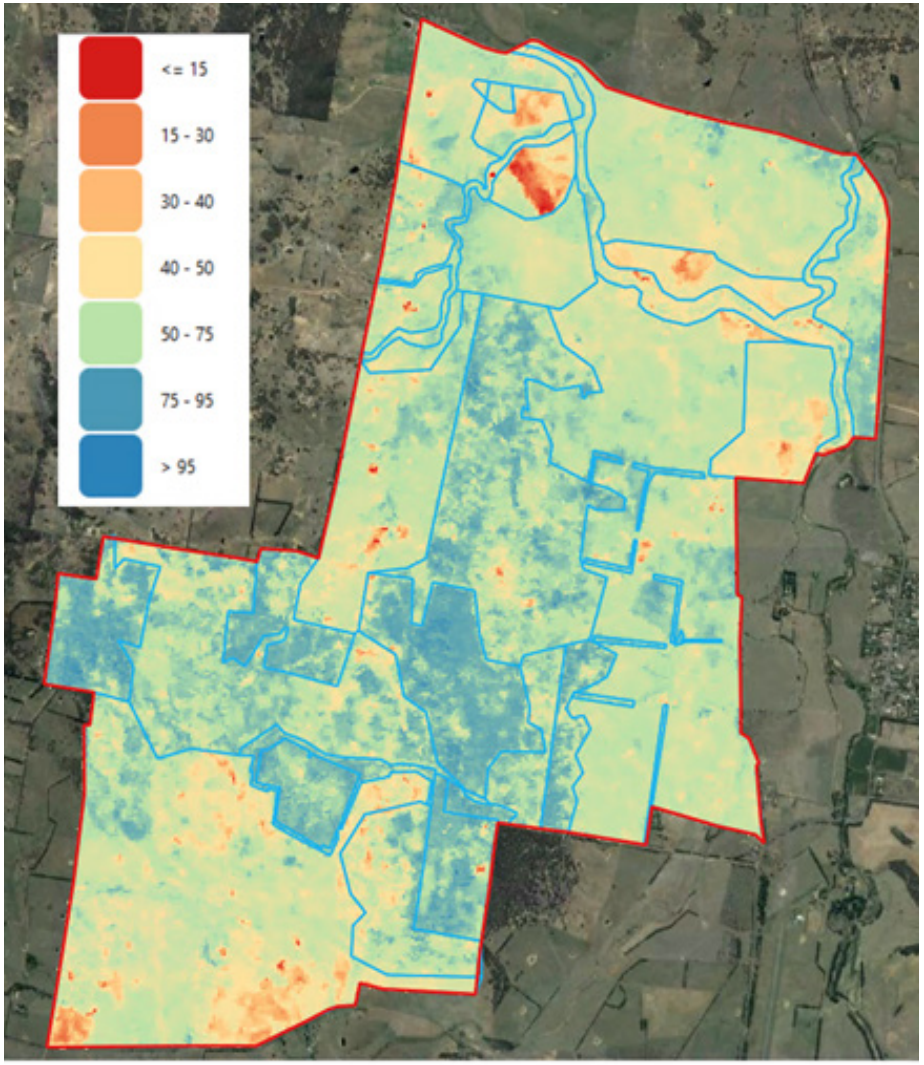
In addition to the on-site ecological assessments, condition information such as ground cover changes over time can be assessed using satellite imagery. Annual groundcover products from the Landstat satellites have been used to generate the ground cover statistics summarised in Table 7 and Table 8. The Landsat satellite maps the property approximately every 6 days and generates data at a resolution of 25x25m.

The challenge with generating a single groundcover statistic for a property (such as the proxy measures presented in Table 7 and Table 8) is that the measure is very coarse and does not clearly highlight where changes have occurred and to help a land manager tune their management approach to minimise any impacts of their management. Figures 1-4 present a spatial and temporal view of the ground cover data and provide a level of detail that would assist EcoFarmCo to manage their exposure to erosion events.

The Ground Cover 10th Percentile map for 2020 is an indicator of the lowest groundcover experienced during the 2020 calendar year. The map demonstrates that the property is managed for high levels of ground cover, with the only areas falling below the threshold of 50% being some infrastructure areas.

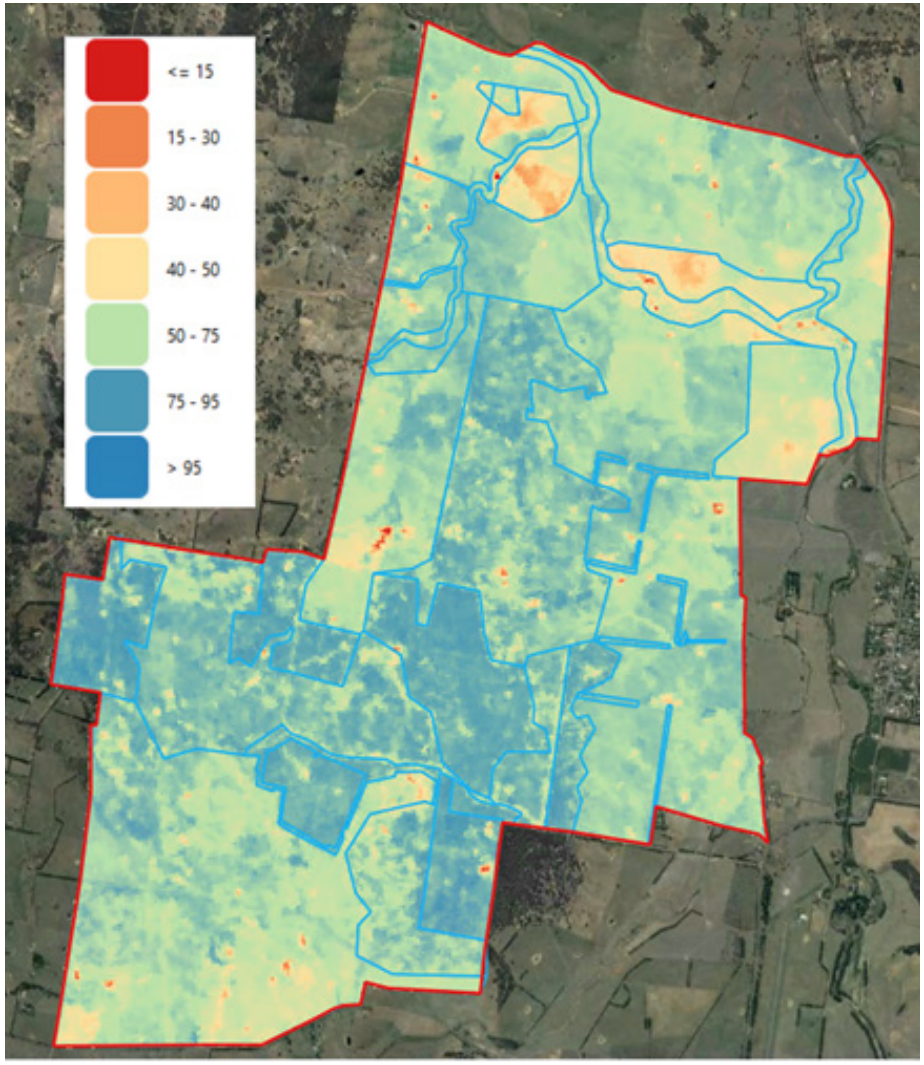
The Mean Ground cover 10th Percentile maps show the 5 year average minimum ground cover for each pixel across the properties. The areas with lower minimum ground cover (50-75%) correlate with those areas that have sown annual pastures. The lower minimum ground cover reflects the fact that the paddocks are ploughed as part of the sowing process.

Figure 2: EcoFarmCo - Ground cover 10th percentile - 2020



EcoFarmCo - 2020
Ground Cover 10th Percentile

Figure 1: EcoFarmCo - 5 year mean Groundcover 10th percentile - 2016-2020



EcoFarmCo - 2016-2020
Mean Ground Cover 10th Percentile

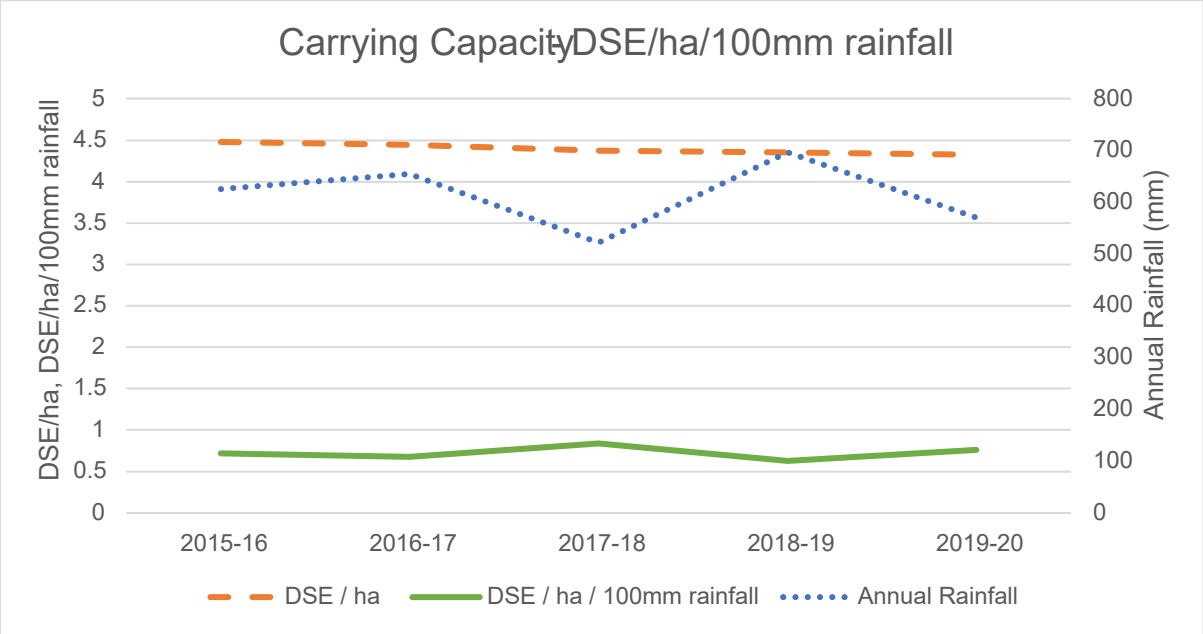
Resource use efficiency

This part of the Stewardship Statement describes the resource efficiency of the enterprise. It includes estimates of the use of resources such as water, GHG emissions, finite minerals and energy, and community infrastructure such as landfill for non-biodegradable materials.

Rainfall use efficiency

EcoFarmCo is an efficient user of rainfall because the capacity of the soil to infiltrate and store soil-water is maintained by management practices that preserve soil surface functions and soil structure. The reduction in carrying capacity shown in Figure 3 are due to destocking of livestock to protect the remnant grasslands. It is expected that stocking rates will increase again once the pasture is restored to a more functional grassland.

Figure 3 - Carrying capacity over time



Product Specific Resource Usage

Increasingly, businesses in the agricultural supply chain are asking for information about farm performance on key social issues such as pollution generation, and efficiency of resource-use. This section aims to provide this information and to estimate the farm's dependence on non-renewable inputs.[38]

EcoFarmCo manages its natural capital and operations to minimise pollution of air and water with GHG and other pollutants[39]. The farm is located within a region where the

38 Suggestions so far include Externalities Generated.
39 We include these because most sustainability reporting focuses on these 'externalities.

ratio of mean annual evapotranspiration to annual precipitation (Et/P) is outside the range of 0.8 and 1.0. Therefore, there is there is the potential for leaching associated with Nitrogen application to the ground (either through urine and dung from livestock and the application of N based fertilisers).

The following tables outline the resource use intensities of the various products generated by the farm.

Table 11: Summary of pollution intensity of beef production

Cattle – based on kg liveweight sold			***Benchmark***
Metric[40]	Units	**5-year average**	NSW HRZ Domestic market[41]
Water Pollution Generated	kg N leached / kg liveweight	**0.04**	N/A
Air Pollution Generated[42]	kg pollutant / kg liveweight	**<tbc>**	N/A
GHG emissions (livestock emissions + emissions associated with pasture and fodder management)	kg CO_2e / kg liveweight	**15.05**	11.7
Waste (non-biodegradable)	kg waste / kg liveweight	**negligible**	N/A
Water use (livestock drinking and embedded water in fodder)	Litres H_2O / kg liveweight	**58.52**	196
Normalised stress weighted water consumption (including evaporation)	litres H_2O-eqiv/ kg liveweight	**79.25**	15.6
Nitrogen use efficiency	kg N applied / kg liveweight	**0.01**	N/A
Lime use efficiency	kg Lime applied / kg liveweight	**0.02**	N/A
Phosphorus use efficiency	Kg P applied / kg liveweight	**0.00**	N/A

Table 12: Summary of pollution intensity of wool production

Sheep – based on kg greasy wool			***Benchmark***	
Metric[43]	Units	**5-year average**	**Kering Conventional / Regenerated**	WA Wheat Sheep Zone[44]
Water Pollution Generated	kg N leached / kg greasy wool	**negligible**	**0.66 / 0.35**	N/A
Air Pollution Generated[45]	kg pollutant / kg crops	**<tbc>**	**0.97 / 0.52**	N/A

40 The definitions of these concepts and the detailed methods for measurement are described in accompanying documentation, but would be summarised here as 'notes to the accounts'.
41 Wiedemann et al. 2015 – Resource use and environmental impacts from beef investigated using life cycle assessment
42 We're not aware of methods to estimate this at the moment, so this remains an 'empty cell'.
43 The definitions of these concepts and the detailed methods for measurement are described in accompanying documentation, but would be summarised here as 'notes to the accounts'.
44 As per Wiedemann et al 2016 – Resource use and greenhouse gas emissions from three wool producing regions in Australia
45 We're not aware of methods to estimate this at the moment, so this remains an 'empty cell'.

Sheep – based on kg greasy wool			*Benchmark*	
GHG emissions (livestock emissions + emissions associated with pasture and fodder management)	kg CO_2e / kg greasy wool	**27.70**	**95.42 / 50.96**	20.10 ± 3.1
Waste (non-biodegradable)	kg waste / kg greasy wool	**negligible**	**0.03 / 0.01**	N/A
Water use (livestock drinking and embedded water in fodder)	Litres H_2O / kg greasy wool	**56.44**	**274.85 / 146.78**	393.7 ± 123.8
Normalised stress weighted water consumption (including evaporation)[46]	litres H_2O-eqiv/ kg greasy wool	**76.44**	**N/A**	21.50
Nitrogen use efficiency	kg N applied / kg greasy wool	**0.04**	**N/A**	N/A
Lime use efficiency	kg Lime applied / kg greasy wool	**0.01**	**N/A**	N/A
Phosphorus use efficiency	Kg P applied / kg greasy wool	**0.00**	**N/A**	N/A

Table 13: Summary of pollution intensity of sheep meat production

Sheep – based on kg liveweight sold			*Benchmark*
Metric[47]	Units	**5-year average**	WA Wheat Sheep Zone
Water Pollution Generated	kg N leached / kg liveweight	**negligible**	N/A
Air Pollution Generated[48]	kg pollutant / kg liveweight	**<tbc>**	N/A
GHG emissions (livestock emissions + emissions associated with pasture and fodder management)	kg CO_2e / kg liveweight	**7.91**	9.4
Waste (non-biodegradable)	kg waste / kg liveweight	**negligible**	N/A
Water use (livestock drinking and embedded water in fodder)	Litres H_2O / kg liveweight	**16.13**	185.7
Normalised stress weighted water consumption (including evaporation)	litres H_2O-eqiv/ kg liveweight	**21.85**	N/A
Nitrogen use efficiency	kg N applied / kg liveweight	**0.01**	N/A
Lime use efficiency	kg Lime applied / kg liveweight	**0.00**	N/A
Phosphorus use efficiency	Kg P applied / kg liveweight	**0.00**	N/A

46 Normalised stress weighted water consumption is calculated by multiplying the freshwater used in production by the local Water Stress Index (WSI), and then divided by global average WSI (0.602). It represents the equivalent volume of fresh water consumption at the global average WSI (<ref Ridoutt 2012>) and allows results to be compared across geographies.

47 The definitions of these concepts and the detailed methods for measurement are described in accompanying documentation, but would be summarised here as 'notes to the accounts'.

48 We're not aware of methods to estimate this at the moment, so this remains an 'empty cell'.

Table 14: Summary of pollution intensity of crop production

Crop – based on TONNE of crop produced			*Benchmark*
Metric[49]	Units	**5-year average**	WA Central Regions
Water Pollution Generated	kg N leached / Tonne crop	**0.41**	N/A
Air Pollution Generated[50]	kg pollutant / Tonne crop	**<tbc>**	0.40
GHG emissions (livestock emissions + emissions associated with pasture and fodder management)	kg CO_2e / Tonne crop	**70.12**	402.13
Waste (non-biodegradable)	kg waste / Tonne crop	**negligible**	N/A
Water use (livestock drinking and embedded water in fodder)	Litres H_2O / Tonne crop	**134794**	N/A
Normalised stress weighted water consumption (including evaporation)	litres H_2O-eqiv/ Tonne crop	**182555**	N/A
Nitrogen use efficiency	kg N applied / Tonne crop	**1.69**	N/A
Lime use efficiency	kg Lime applied / Tonne crop	**6.89**	N/A
Phosphorus use efficiency	Kg P applied / Tonne crop	**1.87**	N/A

Non-renewable (finite) resources

An important consideration in assessment of farm enterprise sustainability is the degree of dependence on finite resources. These include phosphorous and lime supplied from mines and water sourced from fossil aquifers[51].

We estimate that the proportion of inputs that are finite is 72% of total inputs (by weight).

Table 15: Estimates of proportion of finite resources used in enterprise (that the enterprise has no present substitute for).

Finite resource[52]	5-year average (tonnes)	Proportion
Phosphorous	2.9 Tonnes from mined stocks	**68% of nutrient replenishment (tonnes)**
Lime	120 Tonnes from mined stocks	**100% of pH remediation (tonnes)**
Fossil Water	0 Litres from fossil aquifers	**0% of total water use**

49 The definitions of these concepts and the detailed methods for measurement are described in accompanying documentation, but would be summarised here as 'notes to the accounts'.

50 We're not aware of methods to estimate this at the moment, so this remains an 'empty cell'.

51 Aquifers that contain fossil water and that are not able to be significantly recharged from surface water or other aquifers.

52 Fossil fuel amounts are already reported. The entity considers that suitable substitutes (e.g., electric vehicles) will be available in future. Accordingly, the entity considers that it has no obligate dependence on fossil fuel.

Ecosystem Asset Accounts

Ecosystem Asset Accounts (EAA) are the foundational information for NCA and NCA reporting. They are the main vehicle for information about the types of NC on the property and the capacity of NC to contribute to farm production, environmental and social goals. Different types of EAA's are used to communicate different types of information about NC.

Ecosystem Extent-Condition Accounts

These accounts provide information that explains (accounts for) changes to the extent and condition of ecosystem assets.

Table 16: Detailed Ecosystem Asset Accounts for EcoFarmCo showing reasons for natural capital type and condition change.

Ecosystem Type-Extent-Condition EcoFarmCo	Spring 2015 (ha)	Additions (ha)				Reductions (ha)				Spring 2020 (ha)
		Conversions[53]	Condition change[54]	Natural Increase[55]	Reappraisal[56]	Conversions	Condition change	Reappraisal	Catastrophic loss[57]	
Agroforestry	***52.0***									***91.4***
Young	0.0	39.4								39.4
Intermediate	52.0									52.0
Eucalypt Open Forest	***173.6***									***173.6***
State 2	173.6									173.6
Grassy Woodland	***468.9***									***468.9***
State 1	82.5		51.3				77.0			82.5
State 2	128.7		25.7							180.1
State 3	155.1									180.7
State 4	102.7									25.7

53 Used to communicate that a spatial area has been converted from one type of ecosystem to another. For example, the conversion of a part of forest to cropland or conversion of crop land to environmental plantings.

54 Used when the explanation for a change is due to improvement (deterioration) in condition. For example, a grassy woodland that was assessed on Date 1 as being in State 1 and on Date 2 as being in State 2, or a pasture assessed on Date 1 as being in Fair Condition, being assessed on Date 2 as being in Good Condition.

55 Natural Increase is used when growth of vegetation explains a change of capacity to deliver ecosystem services. Used mainly for timber assets or environmental plantings when increased biodiversity or carbon storage is directly associated with growth (natural increase).

56 Used when methods for quantification have changed. This allows accounts to be updated to reflect the latest science.

57 Used to indicate where an ecosystem has been destroyed by an event beyond management's control (e.g., storm, disease, pollution). Gradual changes due to climate change will be reflected in the condition change classifications.

Ecosystem Type-Extent-Condition EcoFarmCo	Spring 2015 (ha)	Additions (ha)				Reductions (ha)				Spring 2020 (ha)
		Conversions[53]	Condition change[54]	Natural Increase[55]	Reappraisal[56]	Conversions	Condition change	Reappraisal	Catastrophic loss[57]	
Grassy Woodlands (riparian)	***96.2***									***96.2***
State 3	0		4.3							4.3
State 4	85.5		2.1							87.6
State 5	2.1									2.1
Degraded	8.6						6.4			2.1
Shrubby Woodlands	***258.9***									***258.9***
State 2	258.9									258.9
Cleared Native Pasture	***481.3***									***481.3***
V. Good	24.0		24.1							48.1
Good	240.6									240.6
Fair	192.5									192.5
Poor	24.1						24.0			0.0
Cleared Naturalised Pasture	***825.9***									***794.5***
V. Good	110.4		39.2							141.7
Good	412.9						23.0			397.8
Fair	185.1		54.1			31.4				207.8
Poor	117.4						70.2			47.2
Cleared Exotic Pasture	***328.2***									***288.8***
V. Good	41.6		41.6							83.1
Good	184.8									184.8
Fair	20.8									20.8
Poor	81.0					39.4	41.6			0.0
Irrigated cropping	***53.2***									***53.2***
Good	42.5									42.5
Fair	10.6									10.6
Dryland cropping	***180***									***180***
Good	152.3									152.3
Fair	27.7									27.7
Shelterbelts	***0.0***									***31.4***
Young	0.0	31.4								31.4
Infrastructure	**4.9**									**4.9**
TOTAL Property	**2922.9**									**2922.9**

Production Condition Accounts

These accounts provide information relating to the condition of the natural capital with respect to its capacity to provide forage for livestock. The classifications used in these accounts use the approach developed for grazing management best practice[58]. The accounts (Table 3) show that, using the industry-standard classifications, 22% of EcoFarmCo can be classified as being in very good condition for livestock grazing, 39% in good condition, 16% in fair condition and 5% in poor condition.

Table 17: Production (Grazing) condition - extent and change since last assessment

	Grazing Condition									
	Very Good		**Good**		**Fair**		**Poor**		**N/A**	
Ecosystem Type	ha	**%Δ**	**ha**	**%Δ**	**ha**	**%Δ**	**ha**	**%Δ**	**ha**	**%Δ**
Cleared Exotic Pasture	83.1	+100%	184.8	0%	20.8	0%		100%		-
Cleared Native Pasture	48.1	+100%	240.6	0%	192.5	0%		100%		-
Cleared Naturalised Pasture	141.7	+28%	397.8	-4%	207.8	+12%	47.2	-60%		-
Dryland cropping		-	152.3	0%	27.7	0%		-		-
Irrigated cropping		-	42.5	0%	10.6	0%		-		-
Grassy Woodland	360.8	+27%	25.7	-75%		-	82.5	0%		-
Grassy Woodlands (riparian)	6.4	+200%	87.6	+3%		-	2.1	-75%		-
Eucalypt Open Forest		-		-		-		-	173.6	0%
Shrubby Woodlands		-		-		-		-	258.9	0%
Pine plantation		-		-		-		-	91.4	+76%
Shelterbelts		-		-		-		-	31.4	-
Total	**640.2**	**+39%**		**-7%**	**459.5**	**+5%**	**131.9**	**-58%**	**555.2**	**+15%**

58 Alessandra La Notte, Sara Vallecillo, and Joachim Maes, "Capacity as "Virtual Stock" in Ecosystem Services Accounting," *Ecological Indicators* 98 (2019).

Methods used to measure Natural Capital

This section summarises the methods used for measurement of the ecosystems. This information would be used by users of the report to decide how they wish to use the information (and potentially the confidence they can have in it).

To satisfy the requirements for confidence in the NCA's within the annual budget for NC measurement, EcoFarmCo uses a mix of measurement approaches to assess its NC. These include informal and formal farmer observations, remote sensing, rapid assessments by independent experts and detailed plant and soil surveys. A long-term monitoring plan has been designed to underpin the NCA. It describes the sampling scheme (sampling strategy and protocols) used to assess the type and condition of the ecosystems. This is updated as required in response to changing management goals and practices. Table 18 summarises this information providing details of site locations for direct observations and which ecosystem units condition estimates have been imputed from these values. The details of the methods are described in accompanying documents and full details are available in the Ecological Asset Register.

Table 18: Natural Capital measurement design for ecosystem condition assessments.

Ecosystem Assets & services	Paddocks where directly observed	Method	Imputed to paddocks [59]
Native Pasture	10	Rapid Independent Expert Visit	11
	12	Rapid Independent Expert Visit	18, 55, 56, 57, 58
	13	Rapid Independent Expert Visit	24, 27, 68, 69, 70
	17	Rapid Independent Expert Visit	25, 23, 16
	19	Rapid Independent Expert Visit	9G
Naturalised Pasture	21A	Rapid Independent Expert Visit	6, 21C, 21D
	16A	Rapid Independent Expert Visit	26B
	28	Rapid Independent Expert Visit	26C
	32	Rapid Independent Expert Visit	33
	35	Rapid Independent Expert Visit	34
Exotic Pasture	40	Rapid Independent Expert Visit	41A, 59, 60, 61
	5	Rapid Independent Expert Visit	22, 62, 63
	9F	Rapid Independent Expert Visit	9E
Irrigated Cropping	9H	Rapid Independent Expert Visit	30, 31
Dryland Cropping	9H New	Rapid Independent Expert Visit	9O New, 9A New
Woodland Riparian	RiparianOpen1	Rapid Independent Expert Visit	RiparianOpen2

59 These condition of these paddocks or ecosystem units have been assessed as being represented by the Ecosystem Unit that is directly measured (the indicator unit for these combinations of ecosystem types and management/use types).

Ecosystem Assets & services	Paddocks where directly observed	Method	Imputed to paddocks [59]
Grassy woodland	20	Rapid Independent Expert Visit	25
	39	Rapid Independent Expert Visit	37, 38
	42	Rapid Independent Expert Visit	32, 40, 41, 33, 43, 44
	House Pdk 2	Rapid Independent Expert Visit	7A, 14, 15, Holding Pdk 2, House Pdk, Horse Pdk
	Woodland1	Rapid Independent Expert Visit	37, 38, 44
	Woodland2	Rapid Independent Expert Visit	19, 7B
	Woodland4	Rapid Independent Expert Visit	22
	Woodland5	Rapid Independent Expert Visit	
	Woodland6	Rapid Independent Expert Visit	13, Woodland6

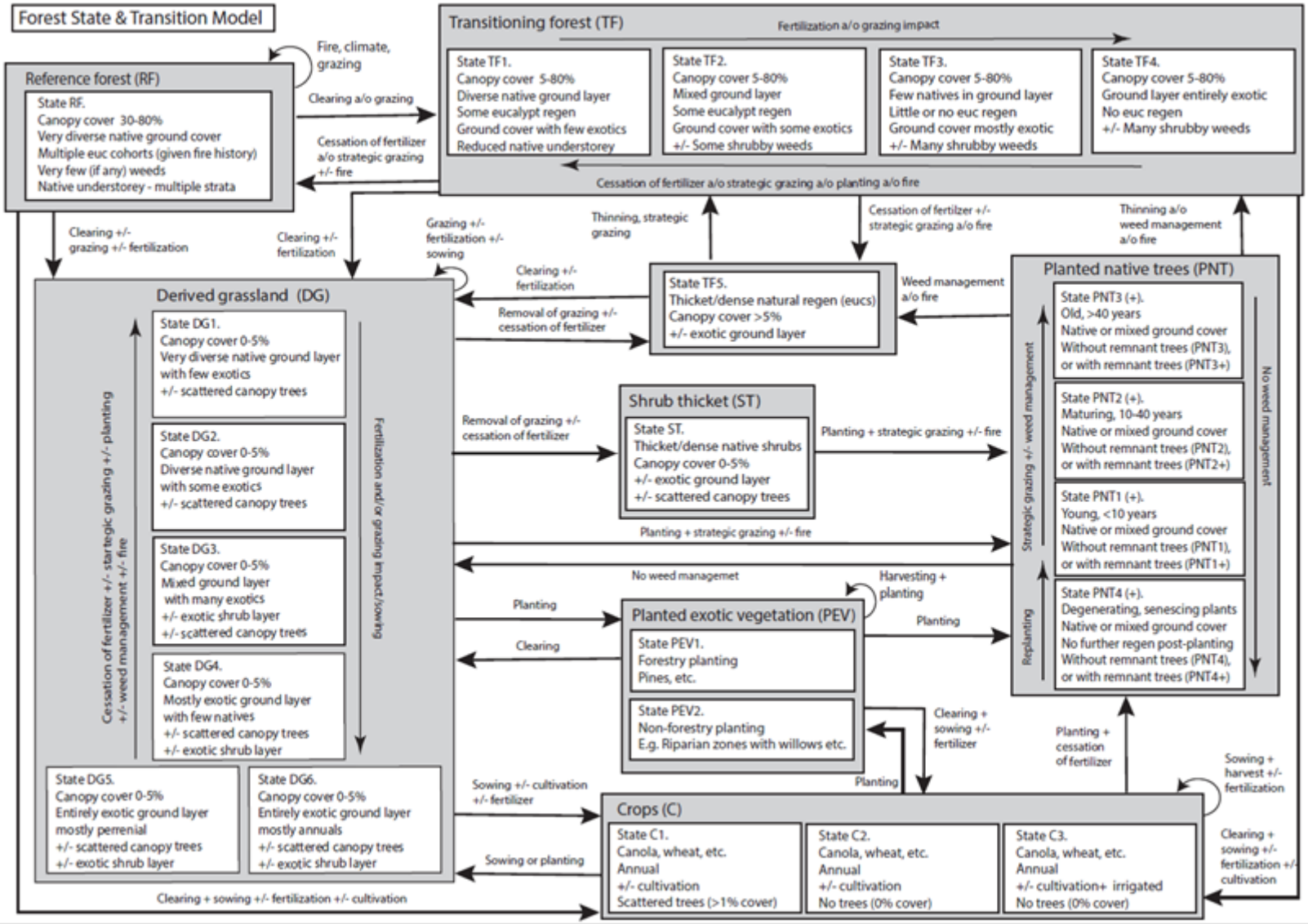
Ecological Condition – State & Transition Model

The ecological condition of the property is assessed using the field-based rapid assessment, with the results of the survey being used to assign the area surveyed to an ecosystem type and state (condition) based on a State and Transition Model (S&TM). The S&TM is defined based on the original biome of the landscape and has been defined broadly enough to allow for the characterisation of all types of landscapes, ranging from pristine remnant vegetation all the way through to highly fertilised, intensively managed cropping zones.

The Forest S&TM has been used for assessment for EcoFarmCo is based on the following ecological characteristics:

- NVIS Major Vegetation Group: Eucalypt Woodlands, Eucalypt Open Forests
- NVIS Common Description: Eucalypt woodlands (tree crowns not touching), Eucalypt forests (trees 10-30m tall)
- NVIS Subgroup: Eucalyptus Woodland with a shrubby understory.

Figure 4: Forest State & Transition Model



Pasture Condition Score

A five-point classification system of pasture condition (Table 19) was drawn from industry good practice for grazing management on sown pastures (MLA 2016; Queensland Government 2017; Ryan et al. 2013; Walsh & Cowley 2014). The principles of perenniality, palatability and persistence were adopted and apply to both sown and native grasslands in temperate regions. Grazing condition will be assessed at the same assessment points as for ecosystem integrity, based on the 10 m X 10 m (100 m2) quadrat around the same pre-determined assessment point. Each point is assigned to one of the five categories in Table 19. Land condition includes both soil condition and pasture condition. Soil condition is the capacity of the soil to absorb and store rainfall, to store and cycle nutrients, to provide habitat for seed germination and plant growth and to resist erosion. Pasture condition is the capacity of the pasture to capture solar energy and convert it into palatable green leaf, to use rainfall efficiently, to conserve soil condition and to cycle nutrients. Assessment is done relative to productive potential (i.e., land capability).

Table 19 - Condition assessment classes of the land for grazing - the capacity of the land to respond to rain and produce useful forage

Category	*Description*
A (very good)	Very high levels of groundcover1 (>90%), including perennial and palatable species and litter that contribute to soil protection and water and nutrient retention and an appropriate2 mix of perennial, palatable and persistent species. Few invasive weeds (≤5%) are present and soil erosion is absent. A good amount of biomass is retained (e.g., a beer bottle on its side wouldn't be seen from a few metres away), even when livestock are present, or after a grazing event.
B (good)	High levels of groundcover (70¬-90%) with some decline in perennial and palatable species, including grass species and litter compared to class A and likely to be a minor presence of invasive weeds (>5-15%). There may be signs of previous erosion and potential for current erosion in some areas. Reasonable biomass (e.g., a cricket ball wouldn't be seen from a few metres away) is retained even where grazing animals are present.
C (fair)	Moderate groundcover (40-70%), a low diversity of palatable and perennial species, and persistent species that protect soil assets in poor times are missing. Annual and/or perennial invasive weeds are significant (>15-50%). A high proportion of bare ground is likely to be present (up to 50%) and obvious signs of past erosion with current susceptibility to erosion high. Low biomass (e.g. a golf ball easily seen from a few m away).
D (poor)	Low levels of groundcover (<40%) with a high proportion of bare ground (>50%), low pasture biomass most of the time and likely to very low in extended dry times, a low diversity of perennials and dominated by unpalatable species and/or annual weeds. Clear signs of past and current erosion present.
E (Dysfunctional)	Few (if any) perennial species are present and it is a severe and hostile environment for plant growth (i.e., scalding, salinity, severe and continuing gullying in susceptible areas). Potential and likelihood of weed invasion is high.

References

Ådnøy, T., A. Haug, O. Sørheim, M. S. Thomassen, Z. Varszegi, and L. O. Eik. "Grazing on Mountain Pastures-Does It Affect Meat Quality in Lambs?". Livestock Production Science 94, no. 1–2 (6// 2005): 25-31.

Bartsch, H., Nair, J., Wyn Owen, R. "Dietary Polyunsaturated Fatty Acids and Cancers of the Breast and Colorectum: Emerging Evidence for Their Role as Risk Modifiers." Carcinogenesis 20 (1999): 2209-18.

Belury, M.A. "Dietary Conjugated Linoleic Acid in Health: Physiological Effects and Mechanism of Action.". Annual Review of Nutrition 22 (2002): 505–31.

Bünemann, E. K., G. D. Schwenke, and L. Van Zwieten. "Impact of Agricultural Inputs on Soil Organismsa Review." Soil Research 44, no. 4 (2006): 379-406.

Carson, J., and K. Flower. "Benefits of Retaining Stubble." Online: soilquality.org.au, nd.

Decker, E., Park, Y. "Healthier Meat Products as Functional Foods." Meat Science 86 (2010): 49-55.

Eduard Escrich, Montserrat Solanas, Montserrat Soler, Ma Carmen Ruiz de Villa, Josep A. Sa´nchez, Ramon Segur. "Dietary Polyunsaturated N-6 Lipids Effects on the Growth and Fatty Acid Composition of Rat Mammary Tumors." Journal of Nutritional Biochemistry 12 (2001): 536-49.

Evans, L. M. , Toline, E. C., Desmond, R., Siegal, G. P., Hashim, A. I., Hardy, R. W. "Dietary Stearate Reduces Human Breast Cancer Metastasis Burden in Athymic Nude Mice." Clin Exp Metastasis 26 (2009): 415-24.

Fraser, M. D., D. A. Davies, J. E. Vale, G. R. Nute, K. G. Hallett, R. I. Richardson, and I. A. Wright. "Performance and Meat Quality of Native and Continental Cross Steers Grazing Improved Upland Pasture or Semi-Natural Rough Grazing." Livestock Science 123, no. 1 (7// 2009): 70-82.

Haynes, R. J., and M. S. Mokolobate. "Amelioration of Al Toxicity and P Deficiency in Acid Soils by Additions of Organic Residues: A Critical Review of the Phenomenon and the Mechanisms Involved." Nutrient Cycling in Agroecosystems 59 (2001): 47-63.

Howe, Peter, Jon Buckley, and Barbara Meyer. "Long-Chain Omega-3 Fatty Acids in Red Meat." Nutrition & Dietetics 64 (2007): S135-S39.

Moloney, A. P., N. D. Scollan, and L. Miles. “Enrichment of N-3 Fatty Acids and Conjugated Linoleic Acid in Beef: Prosafebeef.” British Journal of Nutrition 2008, no. 33 (2008): 374-81.

Mulvihill, B. “Ruminant Meat as a Source of Conjugated Linoleic Acid (Cla).” British Journal of Nutrition 26 (2001): 295-99.

Panea, B., Carrasco, S. Ripoll, G., Joy, M. “Diversification of Feeding Systems for Light Lambs: Sensory Characteristics and Chemical Composition of Meat.” Spanish Journal of Agricultural Research 1, no. 9 (2011): 74-85.

Pickett, H. “Nutritional Benefits of Higher Welfare Animal Products “. Surrey: Compassion in World Farming, 2012.

Ponnampalam, E. N., V. F. Burnett, S. Norng, R. D. Warner, and J. L. Jacobs. “Vitamin E and Fatty Acid Content of Lamb Meat from Perennial Pasture or Annual Pasture Systems with Supplements.” Animal Production Science 52, no. 4 (2012): 255-62.

Ponnampalam, E. N., Mann, N. J., Sinclair, A. J.,. “Effect of Feeding Systems on Omega-3 Fatty Acids, Conjugated Linoleic Acid and Trans Fatty Acids in Australian Beef Cuts: Potential Impact on Human Health.” Asia Pacific Journal of Clinical Nutrition 15 (2006): 21-29.

Ponnampalam, Eric N., Neil J. Mann, and Andrew J. Sinclair. “Effect of Feeding Systems on Omega-3 Fatty Acids, Conjugated Linoleic Acid and Trans Fatty Acids in Australian Beef Cuts: Potential Impact on Human Health.” [In English]. Asia Pacific Journal of Clinical Nutrition 15, no. 1 (Mar 2006 2006): 21-9.

Provenza, F. D., Villalba, J. J. “The Role of Natural Plant Products in Modulating the Immune System: An Adaptable Approach for Combating Disease in Grazing Animals.” Small Ruminant Research 89 (2010): 131-39.

Provenza, Fred D, J J Villalba, L E Dziba, S B Atwood, and R E Banner. “Linking Herbivore Experience, Varied Diets, and Plant Biochemical Diversity.” Small Ruminant Research 49 (2003): 257-74.

Revell, D K. “Sustainably Meeting the Nutrient Requirements of Grazing Sheep.” In Achieving Sustainable Production of Sheep: Burleigh Dodds Science Publishing Limited, 2017.

Revell, D. K., H. C. Norman, P. E. Vercoe, N. Phillips, A. Toovey, S. Bickell, E. Hulm, S. Hughes, and J. Emms. “Australian Perennial Shrub Species Add Value to the Feed Base of Grazing Livestock in Low- to Medium-Rainfall Zones.” Animal Production Science 53, no. 11 (2013): 1221-30.

Roynette, C. E., Calder, P. C., Dupertuis, Y. M., Pichard, C. "N-3 Polyunsaturated Fatty Acids and Colon Cancer Prevention." Clinical Nutrition 23, no. 2 (2004): 139-51.

van der Heijden, Marcel G. A., Richard D Bardgett, and Nico M van Straalen. "The Unseen Majority: Soil Microbes as Drivers of Plant Diversity and Productivity in Terrestrial Ecosystems." Ecology Letters 11 (2008): 296-310.

Villalba, Juan J., and Serge Y. Landau. "Host Behavior, Environment and Ability to Self-Medicate." Small Ruminant Research 103, no. 1 (2012): 50-59.

Villalba, Juan J., and Frederick D. Provenza. "Learning and Dietary Choice in Herbivores." Rangeland Ecology & Management 62, no. 5 (2009): 399-406.

Wood, J. D., R. I. Richardson, G. R. Nute, A. V. Fisher, M. M. Campo, E. Kasapidou, P. R. Sheard, and M. Enser. "Effects of Fatty Acids on Meat Quality: A Review." Meat Science 66, no. 1 (1// 2004): 21-32.

Yaqoob, P., Tricon, S., Williams, C. M., Grimble, R. F., Burdge, G. C., Calder, P. C. "Conjugated Linoleic Acid and Human Health-Related Outcomes." British Nutrition Foundation Nutrition Bulletin 31 (2006): 93-99.