NSW Biodiversity Conservation Trust (BCT) Native Vegetation Monitoring Method

DOCUMENT DETAILS

Method Name: NSW Biodiversity Conservation Trust (BCT) Native Vegetation Monitoring Method

Method Reference #: AfN-METHOD-NV-13

Relevant Environmental Asset Class: Native Vegetation

Accuracy Level: 95%

Author: NSW Biodiversity Conservation Trust

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NSW Biodiversity Conservation Trust (BCT) Native Vegetation Monitoring Method

Overview of Method

Purpose	This method in conjunction with the NSW Biodiversity Conservation Trust (BCT) Ecological Monitoring Module (EMM) outlines a process to develop an Environmental Account under the Accounting for Nature® Framework. This Environmental Account will detect long-term change in the condition of native vegetation within BCT Private Land Conservation Agreements. It is intended to support BCT and landholders with a BCT Private Land Conservation agreement to measure and track the condition of native vegetation over time.
Assessment type	This method will assess: i) the change in the condition of vegetation assets through time due to management under a BCT private land conservation agreement.
Target Audience	All land managers including government agencies (ecologists and officials) that oversee administration of BCT Private Land Conservation Agreements.
Decisions to inform	To inform and assess land management outcomes over time.

Application of the Method

Scale and Size	An aggregate, project-scale account for NSW.
Geographical application	This account will apply to all BCT Private Land Conservation Agreements subject to EMM within New South Wales.
Realm	Land Freshwater and Saline wetlands
Biome/Functional Ecosystem Group	All areas of native vegetation. Not Marine ecosystems.

<table>
<tr><th rowspan="2"></th><th colspan="2">Accuracy Level</th></tr>
<tr><th colspan="2">95%</th></tr>
<tr><td>Assessment units</td><td colspan="2">Assessment units, known as Vegetation Zones, are stratified by vegetation community (Keith Class), categorical condition (high, moderate, low) and Conservation Agreement identifier.</td></tr>
<tr><td>Sample size</td><td colspan="2">The number of plots are specified based on vegetation zone area and the required sampling intensity (see Table 1). 95% Accuracy is achieved where sampling density meets or exceeds that required under Table 1.</td></tr>
<tr><td rowspan="6">Indicators</td><td>Indicator Class</td><td>Indicator & Sub-indicator</td></tr>
<tr><td rowspan="3">Composition
(Vegetation Integrity)</td><td>Richness
Full scientific name for all vascular plant species found to occur within a 20x20m plot, including whether the species is native, exotic or High Threat exotic.</td></tr>
<tr><td>Structure
Estimated % foliage cover[1] and abundance[2] for each species with individuals rooted in or overhanging the plot.</td></tr>
<tr><td>Function
• Litter cover (%)
• Number of tree stem size classes
• Number of large trees
• Total length of fallen logs (m)</td></tr>
<tr><td>Extent</td><td>Extent of the vegetation class (sub-asset)</td></tr>
<tr><td>Configuration</td><td>Percent of retained remnant vegetation within a 1500m radius of each Assessment Unit</td></tr>
<tr><td>Data collection</td><td colspan="2">Field surveys + Photographs (Composition Indicator)

GIS Remote sensing (Extent and Configuration Indicators)</td></tr>
<tr><td>Expertise required</td><td colspan="2">Plant community and species identification conducted by BCT Ecologists and contractors.

GIS / spatial working capability</td></tr>
</table>

[1] percentage of the plot covered by a vertical projection of all attached plant material, regardless of whether it appears alive or dead, of all individuals of a species. This includes leaves, stems, twigs, branchlets and branches, and any canopy overhanging the plot, even if the stem is outside the plot. *Values should be recorded in decimals if less than 1% (0.1, 0.2, 0.3…), or whole numbers up to 5% (1, 2, 3…), or to the nearest 5% where greater than 5% cover (5, 10, 15…)*

[2] Within this document, abundance refers to the number of individuals, using the following intervals: 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 20, 30, 40, 50, 60, 70, 80, 90, 100, 200, 300, 400, 500, 600, 700, 800, 900, 1000, 2000, 3000, etc.

1. Introduction

1.1. Aim and background of this Method

This Method has been developed to generate an account to assess the change in vegetation condition resulting from BCT management of a portfolio of Conservation Agreements throughout the state of New South Wales. Note that this does not cover the entire state.

The BCT's purpose is partnering with landholders to enhance and conserve biodiversity across NSW. As such, ability to demonstrate improvements in biodiversity are central to the value proposition of the BCT. Evidence of improvement in vegetation condition, in the form of third-party certified environmental accounts, is one pathway.

This method steps out a process to develop accounts for native vegetation condition that:

- are fit-for-purpose as a line of evidence for demonstration of environmental change under the *NSW BCT Ecological Monitoring Module* (EMM)
- are scientifically robust,
- utilises control sites to establish a counterfactual to BCT management,
- generate quality data, and
- provide appropriate measures of native vegetation condition that can be aggregated at the project-level.

Measures of Vegetation Condition, as used in this method, are further described in the BCT EMM (BCT 2021). In particular, the Composition indicator class (Vegetation Integrity) used in this method is based on the NSW standard assessment of vegetation, the *NSW Biodiversity Assessment Method* (BAM) (OEH 2020).

The reason for submitting this method is that prior to this Method being approved, the BCT EMM was not being used to develop an Econd® to summarise change in vegetation condition over time.

The BCT has developed this method, under the Accounting for Nature® Framework, as a basis for third-party certification of measurement and reporting of native vegetation condition. This method can be used to provide BCT and landholders with a BCT Private Land Conservation agreement subject to EMM with an account of the impact of private land conservation investment and in so doing provide opportunity to monitor change in vegetation condition over time.

This method provides an opportunity for monitoring the absolute change in vegetation condition resulting from BCT Private Land Conservation agreements. It can do this because landholders with a BCT Private Land Conservation agreement subject to EMM are able to demonstrate what changes in vegetation condition have occurred through participation in BCT programs. It also provides landholders with a BCT Private Land Conservation agreement subject to EMM the opportunity to develop a private account should they wish to demonstrate the change in vegetation condition on their individual Conservation Agreement.

Details of this method can also be found in the BCT Ecological Monitoring Module (EMM).

1.2. Justification of Confidence Level

Accounts generated by this method must opt for 95% Accuracy only.

This method follows the Guidelines for Developing Native Vegetation Methods (Butler et al. 2020) to assess vegetation condition using the following three vegetation **indicator classes**.

1. Composition (Vegetation Integrity); this measures Vegetation Integrity (VI) as per BAM (OEH 2020) which captures full floristics to assess richness, structure and function);

2. Configuration; and
3. Extent

Each of these indicators are either collected or confirmed on site by qualified field ecologists. Accuracy of data collected is considered to exceed 95% and so are considered to have an Accuracy Level of 95%.

In addition, a minimum density of plots per Assessment Unit (vegetation zone) is required to ensure very high accuracy in the account. The sampling density per Assessment unit is prescribed under the EMM and is proportionate to the assessment unit's expected amount and rate of ecological change. This expected change is generally a function of the initial condition state (i.e. high condition sites have relatively little potential for change), the size of the assessment unit and the proposed management intensity (e.g. active restoration is likely to result in greater and more rapid ecological change than natural processes alone). This information is used to determine the appropriate number of sample sites per assessment unit (Table 1) which is consistent with the existing AfN approved vegetation methods (AfN-METHOD-NV-01, AfN-METHOD-NV-07) and Guidelines for Developing Native Vegetation Methods (Butler et al., 2020). Sampling density must meet or exceed the sampling density prescribed under the EMM (Table 1) for consideration of 95% Accuracy in this methodology.

Table 1: Minimum density of monitoring plots based on assessment unit area and required sampling intensity to achieve Accuracy Level 95% (table modified from EMM Table 5)

Assessment Unit Area (ha)	Number of monitoring plots per Assessment Unit required to assess the levels of expected ecological change prescribed under the EMM (High, Moderate, Low)		
	High	Moderate	Low
<2	1	0	0
>2-5	2	1	1
>5-20	3	1	1
>20-50	4	2	1
>50-100	5	3	2
>100-250	6	4	3
>250-1000	7, but more may be needed if the condition of the vegetation is variable across the zone	5	4
>1000	8, but more may be needed if the condition of the vegetation is variable across the zone	6	5

Table 2: Accuracy Level for Vegetation Condition indices sampled in this method (follows the BCT EMM)

Accuracy	Indicator classes used	Sample Size
95% Accuracy	• **Composition** (Vegetation Integrity) • **Extent** • **Configuration**	Equal to or greater than sampling density provided in Table 1
90% Accuracy	N/A	N/A
80% Accuracy	N/A	N/A

1.3. What an Environmental account looks like

The *Accounting for Nature®* Framework requires the following information for an Environmental Account to be certified:

1. An **Information Statement** – describes in detail the Method used and the actions taken to address each element of the Accounting for Nature® Framework, including the rationale behind asset selection, choice of indicators, Method used, analysis and management of data and calculation of the Econd®.
2. The **Environmental Account** – a database (such as an excel file) that contains all the data described in Asset Tables, Data Tables, and Balance Sheets.
3. An **Independent Audit** or **AfN Technical Assessment** that determines whether the Account was prepared in accordance with the accredited Method(s), the *Accounting for Nature® Standard* and *Accounting for Nature® Audit Rules*. As part of the audit process, **supporting documentation,** such as the outputs from each step of the Method, will be required to ensure the Method has been followed correctly (refer to Section 1.4 on Record-keeping below).
   - An Independent Audit is completed by an AfN Accredited Auditor and is required if you are seeking to have your account Certified – Independent Audit; OR
   - An AfN Technical Assessment is required if you seek to have your account Certified – AfN Verified.

The Information Statement will be published on the AfN Environmental Account Registry upon account certification.

1.4. Record-keeping

Throughout the Method, each step has a designated output box, which describes the key outputs that should be generated for each step, these outputs are summarised into a checklist in Appendix B. The output of each step and a description on how it was generated is required for the Environmental Account verification and is used to confirm that the Method has been followed correctly. Proponents are therefore required to record and retain each output and provide these in confidence as part of the Environmental Account verification process.

1.5. Overview of Process

This method includes the following seven steps:

Step 1.	Define purpose, scope and accounting area
Step 2.	Compile existing data
Step 3.	Stratify accounting area into assessment units and identify sample sites
Step 4.	Describe Indicators and define reference benchmarks
Step 5.	Collect and analyse data
Step 6.	Calculate Indicator Condition Scores
Step 7.	Calculate the Econd®

2. Creating the Environmental Account

Step 1. Define purpose, scope, and accounting area

The preliminary step to developing an Environmental Account is to **describe** the Environmental Account through defining its intended **purpose**, **scope** and **accounting area.**

Purpose:	The purpose of the account is to assess the vegetation condition over time on land with a BCT Private Land Conservation agreement subject to EMM to demonstrate the impact of BCT investment on vegetation condition on private land.
Account type:	This method will provide for: - *Change over time* – an ongoing assessment of the change of vegetation condition through time
Accounting Area:	All BCT Private Land Conservation agreements within New South Wales. Note, BCT would like to also provision for internal calculation of accounts at the individual Conservation Agreement level through appending Assessment Units with Conservation Agreement identifiers (which are unique codes used to identify a Conservation Agreement (e.g. CA001)). This will enable individual landholders to develop private accounts in the future as needed to enable them to make claims specific to their land.

Output of Step 1

- A description of the accounting area including **location** and **size**
- A table describing the **purpose** and **type** of the account
- A **map** showing the accounting area

Step 2. Compile existing data

Data collection

For this method, existing data required to be collected prior to field assessment includes:

- State-based vegetation classification (Keith Class) mapping
- Details of each BCT Private Land Conservation Agreements including cadastral extent

The state-based (Keith Class) mapping is used as the initial basis of the Asset map but is usually modified following on-ground verification surveys and examination of other relevant information (e.g. aerial photography, soil mapping etc).

All relevant ecological data collected as part of the EMM (with the exception of sensitive material) will ultimately be made publicly available via an appropriate platform (e.g. Bionet or SEED portal), in line with the NSW Government's Open Data Policy.

Sub-assets

In the context of native vegetation, sub-assets describe the different vegetation types or communities that comprise the 'native vegetation environmental asset'. For this method, Vegetation Keith Class, initially sourced geospatially but confirmed through field assessment for accuracy, is considered the sub-asset.

Output of Step 2

- A map, table and description of sub-assets

Step 3. Stratify the accounting area and identify sampling sites

Stratify the accounting area

The accounting area is the area contained by BCT Private Land Conservation agreements subject to EMM throughout the State of New South Wales. An overview of the process for stratifying each BCT Conservation Agreement within the accounting area and establishing locations for permanent monitoring plots is provided in Figure 1.

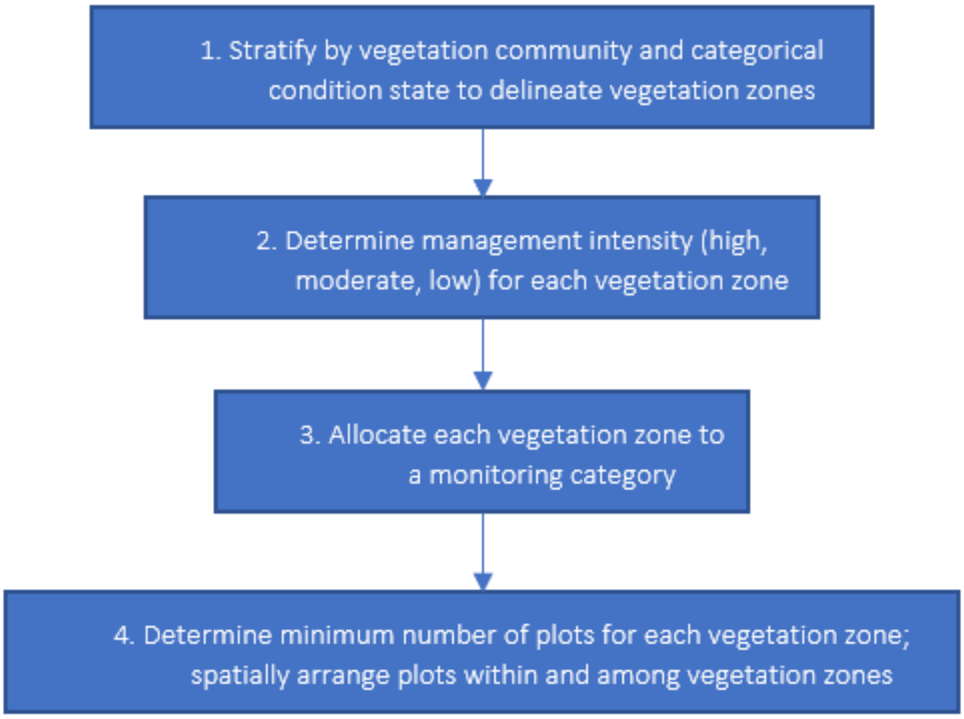
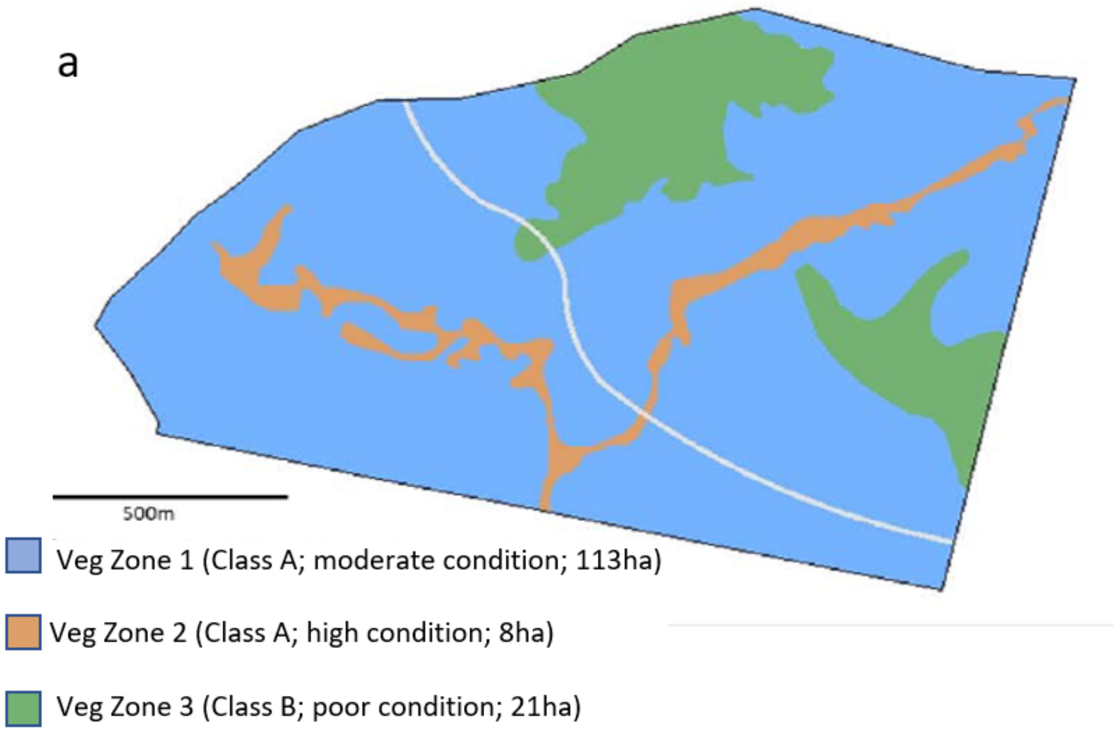


Figure 1: Process for stratifying the accounting area and identifying locations for permanent sampling sites

Step 1: Identify Assessment Units (Vegetation Zones)

Each Conservation Agreement is uniquely identified (e.g. CA054). Each Conservation Agreement (site) is then stratified into unique Assessment Units (also known as Vegetation Zones) where areas representing a unique combination of conservation agreement identifier, vegetation type (Vegetation [Keith] Class), and field-assessed categorical condition state (poor, moderate, good) occur, including all discontinuous patches (Figure 2a). For this method, *vegetation zones* are considered the **Assessment Unit**. The recommended number, type and monitoring frequency of sampling sites for each vegetation zone can be determined with reference to Table 3 and Table 4, and Figure 2a.



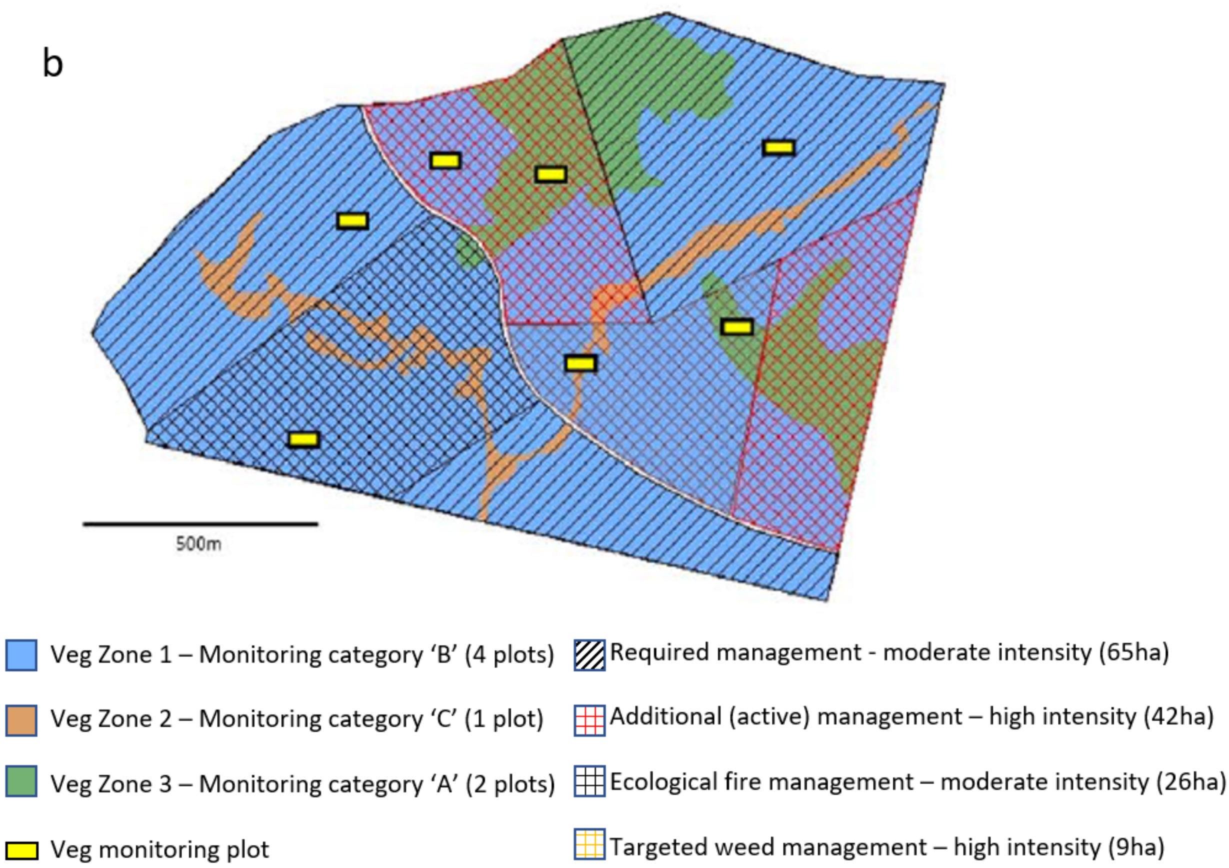


Figure 2: Example conservation area maps, showing (a) vegetation zones and (b) overlayed management arrangements typical to a BCT Conservation Agreement with stratified floristic plot (yellow rectangle) locations (source: BCT EMM)

Step 2: Determine management intensity (high, moderate, low) for each vegetation zone

Once the initial stratification by the Assessment Unit (i.e. vegetation zone) is complete, management zones (i.e. areas of equivalent management regime, including discontiguous patches) should be defined across the conservation area. Depending on the type of agreement and the particular ecological values on-site, management zones may neatly nest within vegetation zones (or vice versa), or may intersect with vegetation zones in a haphazard way (e.g. due to fence lines; see Figure 2). Irrespective, for each vegetation zone a 'management intensity' (high, moderate, low) category should be specified, applicable to the entire zone. If a vegetation zone includes multiple management zones of varying intensity, the categorisation should be based on the management zone representing the largest proportion of the vegetation zone.

The following examples provide some guidance on the determination of intensity categories for different management scenarios (for more information refer to the EMM Operational Manual s 2.2.1):

- ***Low intensity:*** Tier 1 Required (minimum standard) management actions for all BCT Private Land Conservation agreements (e.g. control spread of exotic vegetation)
- ***Moderate intensity***: Tier 2 Additional ("above and beyond") management actions (e.g. targeted reduction / eradication of exotic vegetation)
- ***High intensity***: Tier 3 Active Restoration management actions (e.g. revegetation) on all BCT Private Land Conservation Agreements

Condition states should already have been determined through the process of delineating vegetation zones, generally at an earlier point in time (e.g. initial site assessment), however, there are various reasons why these data should be reviewed and confirmed prior to informing monitoring design. For example, extreme environmental conditions (e.g. drought) may have caused the initial assessment to be unrepresentative of condition state under 'typical' conditions, or time constraints contributed to reduced accuracy of vegetation mapping at initial assessment (including the potential for application of inappropriate vegetation condition benchmarks).

Refer to Section 2.2 of the EMM Operational Manual for more detail.

Table 3: Monitoring categories related to variable condition states and management intensities, required for the definition of appropriate monitoring prescriptions via Table 4

		Management intensity		
		HIGH	MODERATE	LOW
Initial ecological condition state	HIGH ($VI \geq 70$)	A	C	D
	MODERATE ($40 \leq VI < 70$)	A	B/C	C
	POOR ($VI < 40$)	A	B	C

Step 3: Allocate each Vegetation Zone to a monitoring category

Once management intensity and condition state are confirmed for each vegetation zone, Table 3 should be used to categorise each zone (A, B, C or D) for the purposes of designating a plot monitoring prescription (Table 4). Minimum plot densities for each vegetation zone can then be determined using Table 4 and Table 5.

If/where a vegetation zone is completely overlapped by a single management zone, there are no further decisions with respect to plot allocation within the vegetation zone. For scenarios where a single vegetation zone is intersected by multiple management zones, the available plots (minimum number determined from Table 5) should be distributed within the vegetation zone, among management zones. This is to maximise the number of different management zones sampled, prioritising the highest intensity management zone.

Table 4: Recommended site monitoring prescriptions dependent on biodiversity values present and management regime. Legend: EB (ecological burning); FF (full floristic plot); MG (managed grazing); RP (rapid floristic plot); RV (revegetation); WM (integrated / high threat weed management). Source: BCT EMM

Agreement type	Category (Table 3)	Composition (Vegetation Integrity) assessment[3] (20 x 20m floristics, 20 x 50m function for VI)		Composition (tree density and size class assessments (20 x 50m)	Composition (point-intercept) assessments (20 x 50m)	Frequency
		Type	Density[4]	Tree stems	Point-intercept cover	
Biodiversity Stewardship Site / Offset Conservation Agreement (CA)A	A	FF	H	all plots	WM; EB; MG	2-5 yrs
	B	FF	M	n/a	n/a	5 yrs
	C	FF	L	n/a	n/a	5 yrs
Funded CA	A	FF	M	all plots	WM; EB; MG	5 yrs
	B	FF	M	RV; EB; MG	WM; EB; MG (1/zone)	5 yrs
	C	FF	L	RV; EB (1/zone)	n/a	5 yrs
	D	FF	L	n/a	n/a	5 yrs
Voluntary (unfunded) CA / other legacy agreements	A	FF	B	n/a	n/a	5 yrs
Control sites	All	FF	n/a	all	all	5 yrs

[3] BAM function attributes should be collected at all plots as a minimum
[4] Refer to Table 1

Select sample sites

Sampling sites are assigned to each Assessment unit according to the criteria listed below in Table 5. The sampling sites are 50 x 20m permanent monitoring sites that characterise each Assessment unit and are used to collect a combination of transect, quadrat and photopoint data.

Table 5. Overview of how to select and establish sampling sites within each assessment unit

Sample	Implementation
Number of sites per Assessment unit	The number of sites for each vegetation zone is determined based on the size of the vegetation zone and the required sampling intensity due to management type. See Table 1. The number of control sites (sites sampled outside of BCT Agreements) is similarly calculated per stratification group (see EMM Section 7.2). Note that control sites are not matched to treatment sites directly (refer to page 15 – select control sites).
Site selection	Once the required number of plots per vegetation and management zone is confirmed via desktop review, permanent plot locations should be established in the field (e.g. walking a random distance into the zone, or selecting a subset of existing assessment sites), with the aim of capturing a representative sample of the ecological variation present within each zone. This variation may include condition (e.g. piosphere, topography, floristics [e.g. Plant Community Types within particular vegetation classes with high intrinsic variability such as swamp forests]), and may necessitate establishing more plots than required by the desktop stratification. Plots should not be located in or near ecotones, vehicle tracks and their edges, or other disturbed areas that are readily distinguishable from the broad condition state of the vegetation zone. Where separate areas of land are mapped into a single vegetation zone, the plots should be located across the separate areas, while being representative of the zone. Generally, the long axis of plots should be oriented across a slope.
Site establishment	All plots (50x20m) should be permanently marked using two sturdy posts (~1500mm; e.g. star picket with cap) erected at the 0m and 50m points on the midline transect (see Figure 3), with the bearing from the 0m post recorded. A waypoint should be recorded at the 0m post location and the plot should be allocated an alpha-numeric identification code that encodes both the identity of the property (or control site) and the plot, and is unique across the BCT's ecological monitoring program (a *Monitoring Point ID* will be allocated automatically if data are entered directly using the BCT system). It is important for the quality and utility of the data collected, that plots are laid out identically each time the plot is reassessed in the future.
Timing	The sampling frequency is provided in Table 4 and is generally intended to be a single monitoring period every 5 years. Given the number of Conservation Agreements requiring monitoring, it isn't considered feasible to monitor all sites within the same 12-month period and so sites are grouped into cohorts that can be monitored each year. Timing of sampling is optimised with respect to flowering and identification to maximise probability of identifying all species present. While effort is made to conduct monitoring over the same season it is not necessarily something that can be done given the number of agreements.

Select control sites

Controls are important for any ecological monitoring program, and are required to properly attribute inputs (i.e. investment, management activity) to their associated outcomes (i.e. state and change in biodiversity values). In the context of assessing change in Vegetation Condition on BCT Private Land Conservation agreements for this method, control sites (or counterfactuals) are critical to inform outcome evaluation for three scenarios in particular:

a) demonstrating if and how much observed improvement in biodiversity condition can be attributed to BCT investment in management;
b) if/where declines in biodiversity condition are observed, associated with variation in environmental conditions (e.g. drought), demonstrating marginal benefits (e.g. reduced severity of decline) attributable to management; and
c) quantifying the value of averted biodiversity loss (reduction in risk of total loss) associated with establishing an agreement – critical for sites with high initial biodiversity condition (i.e. where value derived from condition improvement is minimal).

The gold standard design of controls for a monitoring program would include one biophysically matched control (site) paired to every monitoring site within conservation areas, located on the same property, outside of the conservation area. This approach is not considered feasible or cost-effective for application in this method (as well as the BCT EMM), due to both the significant resource demand associated with the large number of additional monitoring plots, as well as the likely difficulty of identifying enough appropriate sites on every property. Instead, this method requires the establishment of a program-wide set of control site samples – i.e. for each stratification group, as required, a sample of control sites will be monitored (coordinated by the BCT). Stratification groups are defined as the unique combination of Vegetation Class, Bioregion (IBRA), and baseline condition state (*poor*, *moderate*, *good*). Control sites will capture all of the same data as that measured in treatment sites.

The requirement for a control site sample for any given stratification group, is based on the total number of plots (and associated hectares) representing the group that are established at agreement sites and the number of plots likely to be required to detect expected change in ecological condition (at the stratification group scale; i.e. statistical power). Each of these factors will set a lower threshold – i.e. number of plots and associated conservation area below which it is cost-ineffective to establish matched controls and sample size with adequate statistical power, respectively – to guide the design of the control plot monitoring program. The number of plots required to ensure sufficient statistical power to detect expected change has been estimated for each stratification group (Vegetation Unit) and is presented in Appendix 3 of the BCT EMM Operational Manual.

When selecting the location of Control sites, it is important that they reflect a valid counterfactual or 'business as usual' scenario. This should be ensured by selecting sites that – to an extent that is feasible – are biophysically matched, likely to be continually accessible and have stable management over the long term, and have land use consistent with agreement sites prior to agreement establishment. Therefore, control sites will be established, predominantly on public land (particularly National Parks and Wildlife [NPWS] estate and Travelling Stock Reserves [TSR]), but may be established on private land if/where appropriate (e.g. on an agreement-holder's property, outside of the conservation area).

The following criteria will also be used to guide the selection and establishment of monitoring sites:

- use of the site has been approved by the landholder or land manager;
- the site can be allocated to a required stratification group;
- it is generally accessible by BCT staff (with appropriate permissions); and
- is not subject to 'active' biodiversity management (e.g. pest/weed control).

Multiple control plots may be established within the same reserve (TSR or NPWS), however, to avoid biasing the control site samples with site-level effects, there should be no more than 3 plots per stratification group per reserve, and these plots should be >500m apart. Control plots should be distributed within a bioregion, to the extent practicable, in alignment with the distribution of agreement sites in the matched stratification group (e.g. if all agreement sites containing vegetation zones in a given stratification group are clustered in a particular area, then control plots should be established predominantly in the same area). Similarly, timing of monitoring control sites and agreement sites in the same stratification group should align as much as is practicable.

With respect to accessing control sites, it is important that relevant local land managers' (e.g. LLS or NPWS) permission is sought prior to each visit. Also, when on-site, and particularly when visiting multiple sites within a day, it is critical that staff employ appropriate hygiene protocols to minimise the spread of plant and animal pathogens (see DPIE Hygiene Guidelines).

Output of Step 3

- A map and table showing the **stratification** of the accounting area
- A map and table with central coordinates of each **sample site** within the accounting area.

Step 4. Describe environmental indicators and determine reference benchmarks

Indicators

The Guidelines for Developing Native Vegetation Methods (Butler et al., 2020) established three indicator themes used to describe native vegetation condition. The indicator themes for native vegetation must represent the following three classes: the extent of vegetation (the proportion remaining in the landscape), its configuration (how the vegetation assets are distributed across the landscape) its and composition (such as structure and species richness). Together these three components provide the foundation for indicators required for native vegetation condition methods consistent with this Protocol. Methods must require indicators within each of these three indicator classes:

Extent	The extent of native vegetation refers to the area of 'native' vegetation within the accounting area. This Method assesses the condition of vegetation within every assessment unit, and therefore within the entire accounting area. Therefore, extent is captured through the stratification process and in Step 7 – where all assessment unit Econd® scores (including those that are assigned an Econd® of 0) are aggregated into a sub-asset Econd® using area weighted averages, and the sub-asset Econd® is then aggregated into an overall Econd® score using area weighted averages. Refer to step 7 for more details.
Configuration	The configuration of native vegetation relates to the positioning of a specific area of native vegetation within the landscape with regard to its connectivity, context and patch size. In this Method, the configuration indicator is site context, which is measured as the percent of retained remnant vegetation within a 1500m radius of each assessment unit (Appendix C).
Composition	The composition of native vegetation relates to its structure, function and the assemblage of species. In this method, composition is assessed using various attributes measured in the field along transect and within quadrats. These indicator classes and their relevant indicators are further outlined below in Table 6.

Composition Indicator: Vegetation Integrity

Vegetation Integrity is captured following the same methodology as used in the EMM, which is derived from the BAM (OEH 2020). Vegetation Integrity is captured at a 50x20m plot scale and scored on a range of 0-100 which is applied to the Assessment Unit.

The following data must be collected for *all* vascular plant species found to occur within the 20x20m plot. These indicators are the same as those sampled in the NSW Biodiversity Assessment Method:

- Full scientific name (*Genus species*, subspecific epithet if known)
- Estimated % foliage cover[5] of each species with individuals rooted in or overhanging the plot. Cover should be recorded in decimals if less than 1% (0.1, 0.2, 0.3…), or whole numbers up to 5% (1, 2, 3…), or to the nearest 5% where greater than 5% cover (5, 10, 15…)[6]
- Estimated abundance (number of individuals) of each species, using the following intervals: 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 20, 30, 40, 50, 60, 70, 80, 90, 100, 200, 300, 400, 500, 600, 700, 800, 900, 1000, 2000, 3000, etc.
- Whether the species is native, exotic, or high threat exotic

If insufficient plant material is present for identification to species level, genus name can be recorded, providing it can be discriminated from other species of the same genus occurring within the plot (e.g. '*Eucalyptus sp.1*').

It is important that the data from every vegetation integrity plot assessment are sufficient to inform calculation of a *BAM Vegetation Integrity* (VI) *Score*. Therefore, as a minimum (in additional to structure and composition attributes described above), function attributes should be assessed within the 20x50m plot as per the BAM, i.e.:

- Litter cover (not required if implementing SSCA)
- Number of tree stem size classes (not required if implementing tree density and size distribution assessment)
- Number of large trees (not required if implementing tree density and size distribution assessment)
- Total length of fallen logs

Reference Benchmarks

Under the Accounting for Nature® Framework, the Reference Condition Benchmark ('Reference Benchmark') is the condition of the native vegetation type in an 'undegraded' state. For example, a vegetation community that has not experienced any negative impacts as a result of disturbance, edge effects, invasive species, or altered management regimes (e.g. fire) would be considered to exist in an 'undegraded' state. Vegetation condition benchmarks (v1.2) have been published for NSW (Oliver et al. 2019) at the scale of the Assessment unit (Vegetation Keith Class) and so are used to estimate the reference condition in this method.

NSW Vegetation condition benchmarks v1.2 use data from >36,335 full-floristic plots to model growth form richness and cover benchmarks (Oliver et al. 2019).

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[5] percentage of the plot covered by a vertical projection of all attached plant material, regardless of whether it appears alive or dead, of all individuals of a species. This includes leaves, stems, twigs, branchlets and branches, and any canopy overhanging the plot, even if the stem is outside the plot.

[6] Note: 1% cover equates to $4m^2$

Regardless of the source of the Reference Benchmark, to ensure full transparency the source of the Reference Benchmarks used in the Account must be described in full in the Information Statement.

The source of the Reference Benchmark for each indicator is summarised below in Table 6.

Table 6: Indicator classes and indicators

Indicator class	Indicator	Reference Benchmark
Configuration	Indicator assessed using a GIS and a current vegetation map and on-ground/aerial photography verification. Configuration (%)	The Reference Benchmark for Context will be taken as the pre- 1750 extent of all vegetation types within 1 km and 5 km of each sample site, which is typically 100 %.
Composition (Vegetation Integrity)	*Indicators assessed in the field:* A) **Richness**; Full scientific name (*Genus species*, subspecific epithet if known) for all vascular plant species found to occur within a 20x20m plot, including whether the species is native, exotic or High Threat exotic. B) **Structure;** *Estimated % foliage cover*[7] *and abundance*[8] *for each species with individuals rooted in or overhanging the plot.* C) **Function** • *Litter cover* • *Number of tree stem size classes*[9] • *Number of large trees*[3] • *Total length of fallen logs*	The reference condition of this composition indicator will be derived from Bionet Vegetation Condition Benchmarks.
Extent	*Captured as part of site stratification*	NA

Output of Step 4

- A table describing the **environmental indicators** to be measured in the account
- A table that includes the **Reference Benchmark value** for each indicator for each sub-asset

[7] percentage of the plot covered by a vertical projection of all attached plant material, regardless of whether it appears alive or dead, of all individuals of a species. This includes leaves, stems, twigs, branchlets and branches, and any canopy overhanging the plot, even if the stem is outside the plot. *Values should be recorded in decimals if less than 1% (0.1, 0.2, 0.3…), or whole numbers up to 5% (1, 2, 3…), or to the nearest 5% where greater than 5% cover (5, 10, 15…)*

[8] Within this document, abundance refers to the number of individuals, using the following intervals: 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 20, 30, 40, 50, 60, 70, 80, 90, 100, 200, 300, 400, 500, 600, 700, 800, 900, 1000, 2000, 3000, etc.

[9] Not required if implementing Indicator - tree density and size distribution assessment

Step 5. Collect and analyse data

Data collection for the Environmental Account involves desktop analyses using GIS (i.e. for Extent and Configuration) and data collection in the field (i.e. for all Composition measurements along transects and within quadrats).

Desktop/remote sensing analyses

Desktop/remote sensing analyses for the two indicator classes of Configuration and Extent require the following data:

- Aerial imagery (e.g. 30cm res global ESRI products[10])
- State vegetation type mapping (SVTM)
- Details of BCT Private Land Conservation agreements including cadastral extent and management information

Collecting data in the field

Following the instructions for identification of sample sites (Step 3), a permanent 50 x 20m plot (Figure 3) is established from which the three Composition indicator classes (Vegetation Integrity, Tree density and size distribution, and Point-intercept cover) are assessed through a mix of transect, quadrat and photopoint data capture. A full list of the required equipment are provided in Appendix D. Datasheets are provided in Appendix E.

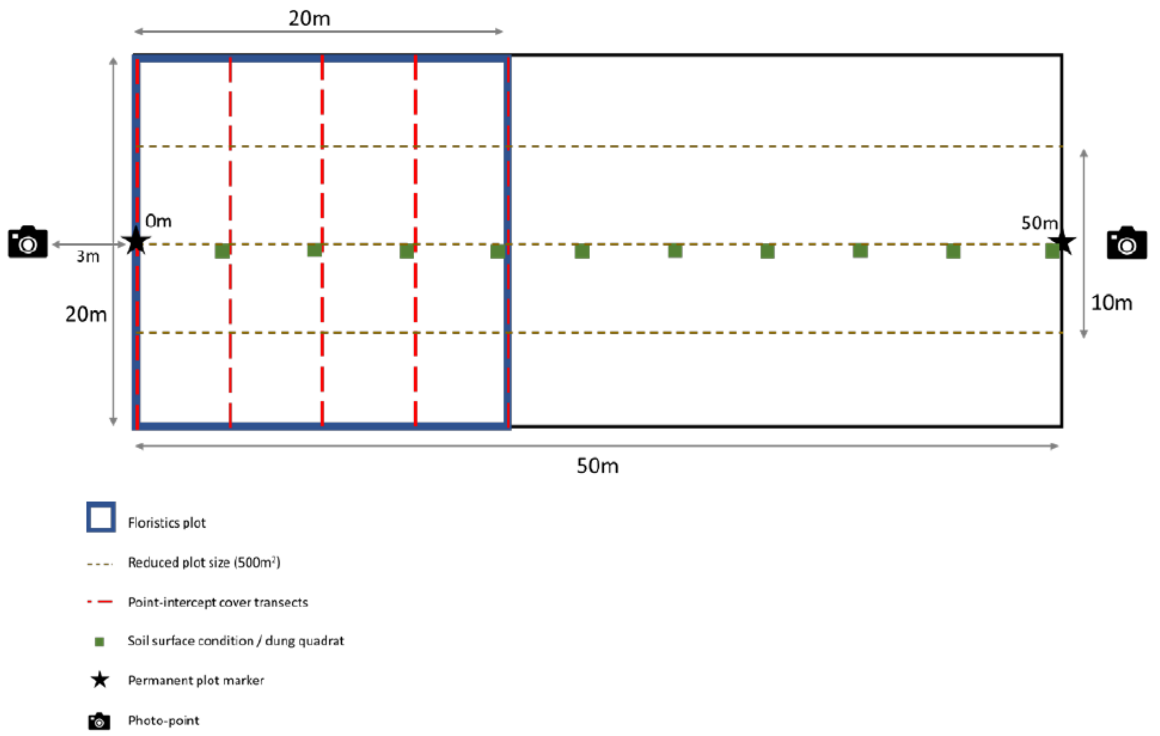

Figure 3: Layout for 20x50m floristic plot and sub-plots

[10] https://hub.arcgis.com/datasets/esri::high-resolution-30cm-imagery/about

Procedure to layout and collect transect data for Vegetation Integrity

From the 0m post, roll the tape out to the 50m post. The assessor must establish survey plots around a central 50 m midline as follows:

- one 400 m^2 plot (standard 20 m × 20 m), to assess all the richness and structure attributes set out below
- one 1000 m^2 (standard 20 m × 50 m) plot, to assess the function attributes set out below
- five 1 m^2 subplots, to assess average litter cover (and other optional ground cover components) for the plot.

For more details on this sampling, refer to Section 4.3.4 of the BAM (OEH 2020).

Floristic measures for Richness and Structure

Capture Richness and Cover indicators by collecting the following data for all vascular plant species found to occur within the 20 x 20m plot:

- Full scientific name (*Genus species*, subspecific epithet if known)
- Estimated % foliage cover[11] of each species with individuals rooted in or overhanging the plot. Cover should be recorded in decimals if less than 1% (0.1, 0.2, 0.3…), or whole numbers up to 5% (1, 2, 3…), or to the nearest 5% where greater than 5% cover (5, 10, 15…)[12]
- Estimated abundance of each species, using the following intervals: 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 20, 30, 40, 50, 60, 70, 80, 90, 100, 200, 300, 400, 500, 600, 700, 800, 900, 1000, 2000, 3000, etc.
- Whether the species is native, exotic, or high threat exotic

Note, the EMM departs slightly from the BAM in requiring complete richness and cover estimates, rather than summarise by growth form group. This is to ensure higher precision than possible under the BAM. If insufficient plant material is present for identification to species level, genus name can be recorded, providing it can be discriminated from other species of the same genus occurring within the plot (e.g. '*Eucalyptus sp.1*').

20 x 50m plots for Function

It is important that the data from every vegetation integrity plot assessment are sufficient to inform calculation of a *BAM Vegetation Integrity* (VI) *Score*. Therefore, as a minimum (in additional to structure and composition attributes described above), the following function attributes must be assessed within the 20x50m plot as per the BAM:

- **Tree stem size classes.** The assessor must determine the number tree stem size classes within the 50 x 20m plot. Stem size classes identify the presence of living stems in each size class that is ≥5 cm DBH and less than the large tree benchmark size DBH for the PCT. The numbers of stem size classes for a PCT or a vegetation class/IBRA are published in the BioNet Vegetation Classification database. Only native tree species are recorded for these attributes. The tree stem size is measured at 1.3 m above ground height, referred to as 'diameter at breast height over bark' (DBH). For multi-stemmed trees, only the largest living stem is included in the count. Tree stem size classes include all species in the tree growth form group. DBH classes are (in centimetres): <5; 5–9; 10-19; 20-29; 30-49; 50-79; 80+.

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[11] percentage of the plot covered by a vertical projection of all attached plant material, regardless of whether it appears alive or dead, of all individuals of a species. This includes leaves, stems, twigs, branchlets and branches, and any canopy overhanging the plot, even if the stem is outside the plot.

[12] Note: 1% cover equates to 4m^2

- **Number of large trees** This is a count of all living stems with a DBH equal to or greater than the large tree benchmark DBH for that PCT or vegetation class. For a multi-stemmed tree, at least one living stem must be equal to or greater than the large tree benchmark DBH. The large tree benchmark sizes for a PCT or a vegetation class/IBRA are published in the BioNet Vegetation Classification database.
- **Tree regeneration** This is the presence of living trees from the tree growth form group with a maximum stem diameter of <5 cm regardless of height.
- **Fallen logs.** The assessor must record the length of fallen logs within the 1000 m_2 plot. The combined length of fallen logs from native and exotic species are recorded for this attribute. The length of fallen logs is the total length in metres of all woody material greater than 10 cm in diameter that is dead and entirely or partly on the ground within the 1000 m_2 plot. If logs extend outside the plot, the assessor must record only the length of fallen logs within the plot.
- **Litter cover.** Litter includes leaves, seeds, twigs, branchlets and branches (<10 cm in diameter). Litter from native and exotic species (combined) are recorded for this attribute. Litter cover is the average percentage ground cover of litter recorded from five 1 m × 1 m plots evenly located parallel to the central 50 m midline. The assessor must include all plant material that is detached from a plant and forms part of the litter layer on the ground surface. Litter cover is the two-dimensional litter layer in contact with the ground surface, including litter under the canopies of erect plants. Plant material that is not detached should be assessed as growth form foliage cover, regardless of whether it appears alive or dead.

Photo points

Two photos are to be taken at each sample site during each resurvey event. One photo should be taken from the 0m end, down the transect length, standing 3m back from the 0m marker post and positioning the camera's field of view such that bottom of the frame aligns with the (20m) edge of the plot and the marker post is in the centre (Figure 4). This procedure should be repeated for the second photo at the 50m end of the transect, aiming the camera back up the length of the transect (towards the 0m point).

Ideally, the image file should be digitally stamped with identifying information (e.g. Plot ID, Agreement ID, date) at the point of creation and storage (e.g. using a BCT system). If this is not possible, a photo-board should be attached to each sighter post with this information clearly displayed.

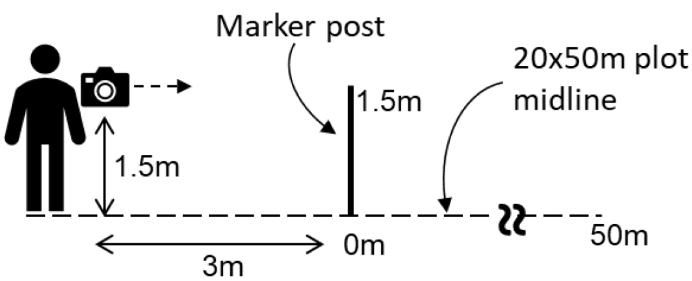

Figure 4: Setup for taking a photo-point at a vegetation integrity plot. Setup is repeated in reverse at 50m point.

Output of Step 5

- A **data table** (e.g. a spreadsheet) containing all the raw data for each environmental indicator for each sample
- A **folder** (preferably stored on the cloud) containing all photographs appropriately labelled according to the sample.

Step 6. Calculate Indicator Condition Scores

Indicator Condition Scores (ICS) generally represent the observed values expressed relative to a Reference Benchmark value. Each indicator within the Configuration and Composition Indicator Classes is converted to an index ranging from 0-100, where 100 represents the Reference Benchmark value for the indicator. There are formulas for calculating these indices that vary considerably between the indicators. Appendix A provides an example output of how ICS contribute towards the Econd®.

Configuration

To calculate the Configuration Indicator Condition Score (the only Configuration Indicator Class), a GIS is used to calculate the proportion of remnant vegetation retained in an area that includes the Assessment Unit and a 1500m buffer.

Composition

For the Composition Indicator (Vegetation Integrity), a continuous scoring system (i.e., not an interval score system) is applied to the field data using the following procedure (with applicable transformation formula summarised in Table 7).

For a comprehensive review of this approach refer to Appendix H of the BAM.

Table 7: How to calculate Indicator Condition Scores for Composition Indicators. This table is a summary and contains acronyms and variables that are explained in the subsequent section.

Measure	Method	Indicator Condition Score (ICS)		
Composition (Vegetation Integrity)				
Richness, Structure, Function	20 x 20m floristics and 20 x 50m plot	Richness Unweighted Score: $UCS_i = 100.68 \times (1 - e^{-5(\bar{x}_i/B_i)^{2.5}})$	Structure Unweighted Score: $USS_i = 100.68 \times (1 - e^{-5(\bar{x}_i/B_i)^{2.5}})$	Function Unweighted Score
		Weighted Score $CCS = \sum_{i=1}^{n} UCS_i \times w_i$	$SCS = \sum_{i=1}^{n} USS_i \times w_i$	$FCS = \sum_{i=1}^{5} UFS_i \times w_i$
		Current Vegetation Integrity $VI = \sqrt[3]{CCS\ x\ SCS\ x\ FCS}$		

To determine the vegetation integrity score for a vegetation zone, the assessor must determine the richness score, structure score and function score using the plot and transect survey data collected for the vegetation zone.

Richness *(also compositional) condition score*

Each growth form group (Table 8) is initially scored out of 100 for richness condition (known as compositional condition in BAM and hereon). Average observed values for each growth form group are converted to continuous unweighted condition scores using Equation 16 (Weibull function; Figure 5).

Table 8: Growth form groups and condition attributes used to assess the composition, structure and function components of vegetation integrity

Condition attributes used assess composition	Condition attributes used assess structure	Attributes used to assess function
Tree richness	Tree cover	Number of large trees
Shrub richness	Shrub cover	Tree regeneration
Grass and grass-like richness	Grass and grass-like cover	Tree stem size classes
Forb richness	Forb cover	Total length of fallen logs
Fern richness	Fern cover	Litter cover
Other richness	Other cover	High threat weed cover

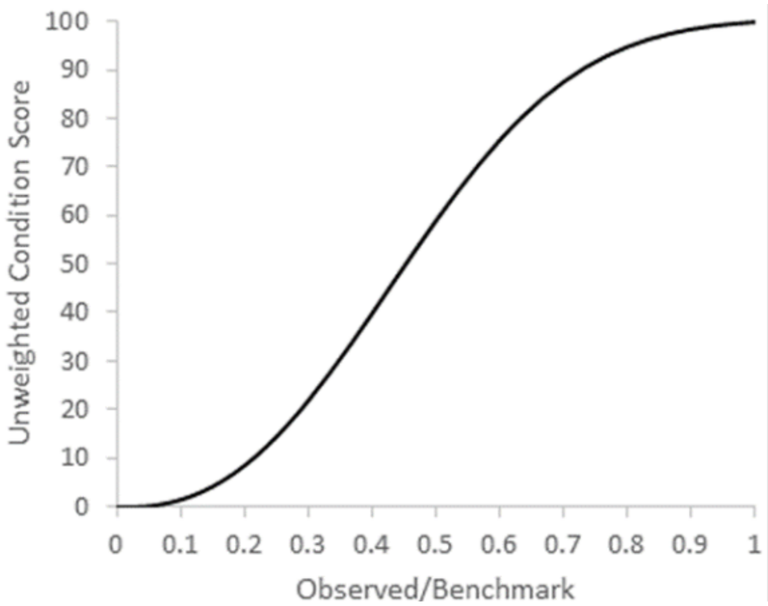

Figure 5: Weibull distribution used for continuous unweighted scoring of composition condition for each growth form group in calculation of vegetation integrity

Equation 16 is calculated for each growth form group shown in Table 8 based on the inputs:

- mean species richness of the growth form group recorded (observed) from all the plots in the vegetation zone, or
- mean species richness of the growth form group considering the impacts of development, clearing or biodiversity certification in the vegetation zone, or
- mean species richness of the growth form group from estimating the future value of vegetation integrity attributes without management in the vegetation zone, or
- mean species richness of the growth form group from estimating the future value of vegetation integrity attributes with management in the vegetation zone, and
- benchmark richness for that growth form group drawn from the BioNet Vegetation Classification.

Equation 16 Calculate unweighted condition score for each growth form group or relevant function attribute in a vegetation zone

$$UCS_i = 100.68 \times (1 - e^{-5\left(\bar{x}_i/B_i\right)^{2.5}})$$

where:

UCS_i = unweighted condition score for the i^{th} growth form group (composition) or function attribute in the vegetation zone

$\bar{X}_i$ = mean of species richness of the i^{th} growth form group (composition) or function attribute among plots within the vegetation zone (observed or predicted future)

B_i = benchmark value for the i^{th} growth form group for composition or function attribute (from BioNet Vegetation Classification)

The assessor must apply dynamic weights to unweighted compositional condition scores for each growth form group based on the proportional contribution of each growth form group's benchmark richness to the benchmark total richness (sum of benchmark richness across all growth form groups); see Equation 17.

Equation 17 Calculate dynamic weight for each composition growth form group

$$w_i = B_i / \sum_{i=1}^{n} B_i$$

where:

w_i = dynamic weight for the i^{th} growth form group

B_i = benchmark cover value for the i^{th} growth form group

n = number of growth form groups

The composition condition score for the zone is calculated as the sum of the products of unweighted condition scores and their dynamic weights for each growth form group using Equation 18.

Equation 18 Calculate composition condition score for the zone

$$CCS = \sum_{i=1}^{n} UCS_i \times w_i$$

where:

CCS = composition condition score for the zone

UCS_i = unweighted composition condition score for the i^{th} growth form group

w_i = dynamic weight for the i^{th} growth form group

n = number of growth form groups

The composition values measured across all sample sites within each assessment unit should be averaged, and these averaged values used to calculate the ICS. Where attributes are naturally missing in a Conservation Target vegetation community (e.g., tree indicators in treeless vegetation types such as grasslands, wetlands) they do not contribute to the score for that sampling site.

Structure condition score

Each growth form group is initially scored out of 100 for structure condition. The mean of all observed cover values for a growth form group within a vegetation zone is converted to a continuous unweighted condition score using Equation 19 (Weibull function; Figure 5). Where the mean of observed cover values for a growth form group within a vegetation zone is higher than the benchmark value, the mean value is assumed to be equal to the benchmark for that growth form group.

Equation 19 is used to calculate the cover score of each structure growth form group shown Table 8 based on the inputs:

- mean cover for the growth form group recorded (observed) from all plots/transects in the vegetation zone, or
- mean cover for the growth form group taking into account the impacts of development, clearing or biodiversity certification in the vegetation zone, or
- mean cover for the growth form group from estimating the future value of vegetation integrity attributes without management in the vegetation zone, or
- mean cover for the growth form group from estimating the future value of vegetation integrity attributes with management in the vegetation zone, and
- benchmark cover for the growth form group drawn from the benchmarks database.

Equation 19 Calculate unweighted structure condition score for each growth form group in a vegetation zone

$$USS_i = 100.68 \times (1 - e^{-5\left(\bar{x}i/B_i\right)^{2.5}})$$

where:

USS_i = unweighted structure score for the i^{th} growth form group or function attribute in the vegetation zone

$\bar{X}_i$ = mean cover of the i^{th} growth form group or function attribute among plots within the vegetation zone (observed or predicted future cover)

B_i = benchmark value for the i^{th} growth form group for structure or function attribute (from benchmarks database)

Using Equation 20, the assessor must apply dynamic weights to unweighted structure scores for each growth form group, based on the proportional contribution of each growth form group's benchmark cover, to the total benchmark cover (sum of benchmark cover across all growth form groups).

Equation 20 Calculate dynamic weight for each structure growth form group

$$w_i = B_i / \sum_{i=1}^{n} B_i$$

where:

w_i = dynamic weight for the i^{th} growth form group

B_i = benchmark cover value for the i^{th} growth form group

n = number of growth form groups

Using Equation 21, the assessor can calculate the structure condition score for the zone as the sum of the products of unweighted condition scores and their dynamic weights for each growth form group.

Equation 21 Calculate structure condition score for the zone

$$SCS = \sum_{i=1}^{n} USS_i \times w_i$$

where:

SCS = structure condition score for the zone

USS_i = unweighted structure score for the i^{th} growth form group

w_i = dynamic weight for the i^{th} growth form group

n = number of growth form groups

Function condition score

The assessor must determine a function condition score for PCTs classified under:

- vegetation formations that are rainforests, wet sclerophyll forests, dry sclerophyll forests, forested wetlands, grassy woodlands or semi-arid woodlands
- vegetation classes that are Wallum Sand Heaths, Sydney Coastal Heaths, Northern Montane Heaths or Sydney Montane Heaths.

The assessor does **not** determine a function condition score for PCTs classified under:

- vegetation formations that are freshwater wetlands, saline wetlands, grasslands, alpine complex or arid shrublands
- vegetation classes that are Southern Montane Heaths, South Coast Heaths or Coastal Headland Heaths.

Dynamic weights do not apply to function attributes. Static weights applied are in Table 9.

Table 9: Static weights that apply to the scoring of function attributes

Attribute	Attribute weight
Number of large trees	0.35
Length of logs	0.20
Litter cover	0.15
Tree regeneration	0.15
Tree stem size classes	0.15

Number of large trees. Equation 16 is used to determine the unweighted condition score for the average number of large trees observed among plots within a zone.

Length of logs. Equation 16 is used to determine the unweighted condition score for the average length of fallen logs observed among plots within a zone.

Litter cover. Equation 19 is used to determine the unweighted condition score for average litter cover observed among plots within a zone.

Tree regeneration. When counts at a plot are ≥1, the unweighted tree regeneration score for the plot is 100. When counts at a plot are zero, the unweighted tree regeneration score for the plot is zero. The average unweighted tree regeneration score for the zone is calculated as the sum of scores divided by the number of plots.

Tree stem size classes is based on the number of stem size classes present within the plot. The unweighted score for tree stem size classes is scored as per Table 10. The average unweighted tree stem size classes score for the zone is calculated as the sum of scores divided by the number of plots.

Table 10: Tree stem size classes scores

Number of stem size classes present (not including large trees or regenerating trees)	Large tree benchmark size (≥80cm DBH)	Large tree benchmark size (≥50cm DBH)	Large tree benchmark size (≥30cm DBH)	Large tree benchmark size (≥20cm DBH)
None	0	0	0	0
One	9	15	28	59
Two	40	59	85	100
Three	76	92	100	n/a
Four	95	100	n/a	n/a
Five	100	n/a	n/a	n/a

DBH = diameter at breast height over bark; n/a = not applicable

The function condition score for the zone is calculated as the sum of the products of unweighted condition scores and their static weights (Table 9) for each attribute, using Equation 22.

Equation 22 Calculate function condition score for the zone

$$FCS = \sum_{i=1}^{5} UFS_i \times w_i$$

where:

FCS = function condition score for the zone

UFS_i = unweighted function condition score for the i^{th} attribute

w_i = weight for the i^{th} attribute

Calculating the Vegetation integrity score

The assessor must determine a vegetation integrity score for each vegetation zone identified in Subsection 4.3.1 of the BAM.

The assessor must use Equation 23 to determine the vegetation integrity score for PCTs classified under:

- vegetation formations that are rainforests, wet sclerophyll forests, dry sclerophyll forests, forested wetlands, grassy woodlands or semi-arid woodlands
- vegetation classes that are Wallum Sand Heaths, Sydney Coastal Heaths, Northern Montane Heaths or Sydney Montane Heaths.

Equation 23 Calculate current vegetation integrity score for treed systems

$$VI = \sqrt[3]{CCS\ x\ SCS\ x\ FCS}$$

where:

VI = current vegetation integrity score for the zone

CCS = composition condition score for the zone

SCS = structure condition score for the zone

FCS = function condition score for the zone

The assessor must use Equation 24 to determine the vegetation integrity score for PCTs classified under:

- vegetation formations that are freshwater wetlands, saline wetlands, grasslands, alpine complex or arid shrublands
- vegetation classes that are Southern Montane Heaths, South Coast Heaths or Coastal Headland Heaths.

Equation 24 Calculate vegetation integrity score for non-treed systems

$$VI = \sqrt[2]{CCS\ x\ SCS}$$

where:

VI = current vegetation integrity score for the zone

CCS = composition condition score for the zone

SCS = structure condition score for the zone

Output of Step 6

- A **Data Table** (e.g. a spreadsheet) containing all the data (including calculated Indicator Condition Scores)

Step 7. Calculate the Econd®

The Econd® is an index between 0 and 100, where 100 describes the 'ideal' or 'undisturbed' reference condition of an environmental asset, and 0 indicates the asset is completely degraded.

The Econd is calculated as the product of the Quantity (extent) times the Quality (composition and configuration). As the condition and type of native vegetation typically varies over an area, the Account must adequately express these differences. In the simplest example, if an area contained 90% intact native grassland, and 10% non-native pastures (assumed to have an Econd of 0), then the highest Econd the Account can get is 90.

This Method prescribes instructions for calculating Econd indices for each Assessment unit, and then aggregating these into an Econd for each sub-asset (vegetation class) and then aggregating these into the overall Econd for the native vegetation Environmental Asset. The following steps must be taken to calculate the Econd®:

1. First, an Econd index must be calculated for each Assessment unit (AU) by calculating the weighted average of the configuration ICS (weighted 25%) and the average of all composition ICS (weighted 75%).
2. Second, the sub-asset (vegetation class) Econd is calculated as the area-weighted average of the Assessment unit Econd. Note: Area weightings for Assessment units should be calculated as a proportion of the Assessment unit area (ha) to the total accounting area (ha). The sum of all Assessment units should equal the total accounting area. As an example, if a 1,000-ha BCT Private Land Conservation agreement comprised only two Assessment units, one covering 800 ha and the other covering 200 ha, then the sub-asset Econd would be: (Econd AU1 x 0.8) + (Econd AU2 x 0.2).
3. Lastly, the Econd for the native vegetation asset is calculated for the Account as a whole as an area-weighted average of the sub-asset Econd indices.

A worked example of how to organise your Environmental Account, and calculate the Assessment unit Econd, sub-asset Econd, and overall Econd® is shown in Appendix A.

In addition to generating an account Econd® for each Sub-asset (state-wide), separate Econd® scores will be calculated for each Sub-asset at Control sites to attribute change in condition to management activities undertaken within BCT agreements. This is done by generating a 'control Econd®' for Sub-assets within control sites and comparing it to a 'account Econd' at Agreement sites.

Output of Step 7

- A **data table** (e.g. a spreadsheet) containing all the raw data for each indicator for each sample, including the calculations for the ICS and Econd®.
- A **summary table** showing the Econd® scores.

3. Compile Environmental Account and submit for certification

Steps five to seven should be repeated at regular intervals (a minimum of every five years or where Base Year recalculation is required, as specified under the *Accounting for Nature*® Framework) to establish a trend over time.

If you wish for your account to be certified, it must be verified in accordance with the *Accounting for Nature® Standard*, which outlines the criteria that must be satisfied. The benefit of having an account certified is that AfN allows you to display the Trustmark, and you are able to make public claims in accordance with the *AfN Claims Rules*. AfN Certified Accounts require the Information Statement to be publicly available on the Environmental Account Registry before any public claims can be made.

A Certified Environmental Account may incorporate multiple environmental assets and always needs to include the following information:

- Information Statement,
- Environmental Account (including raw data tables); and;
- An **Independent Audit** or **AfN Technical Assessment** that determines whether the account was prepared in accordance with the approved Method(s), the *Accounting for Nature® Standard* and *Accounting for Nature® Audit Rules*.
    - An **Independent Audit** is completed by an AfN Accredited Auditor and is required if you are seeking to have your account Certified – Independent Audit OR
    - An **AfN Technical Assessment** is required if you are seeking to have your account Certified – AfN Verified.

4. References

BCT (2020). Ecological Monitoring Module. Biodiversity Conservation Trust, Sydney, Australia.

BCT (2021). Ecological Monitoring Module Operational Manual. Biodiversity Conservation Trust, Sydney, Australia.

Butler, D. Thackway, R. and Cosier, P. (2020). Technical Protocol for Constructing Native Vegetation Condition Accounts Version 1.0 – May 2020. Accounting for Nature Limited, Sydney, Australia.

OEH (2020). Biodiversity Assessment Method. Office of Environment and Heritage, NSW.

Oliver I, Dorrough J, Yen JDL, McNellie MJ and Watson CJ (2019) Native Vegetation Integrity Benchmarks: Release notes supporting Static Benchmarks June 2019 (Version 1.2). Department of Planning, Industry and Environment, Sydney

Appendix A – Worked example/Case Study

Step 1 and 2:	Step 3:	Step 4:				Step 5:	Step 6:		Step 7:		
Sub-asset Vegetation Class [VC] * IBRA)	Assessment unit (Vegetation Zones) (Cons. Agree identifier * Veg. Class * Cond. category)	Indicator Class: Indicator : sub-indicator			Reference Benchmark Value[13] (VC * IBRA)	Average Measure across sites	Indicator Condition Score (ICS)		Assessment unit Econd®	Sub-asset Econd®	Asset Econd®
SEH – Eastern Riverine Forests (48ha)	CA047 – SEH - Eastern Riverine Forests - G (45ha)	Configuration	Configuration – site context (%)		100	67	67		*Configuration*0.25 + Composition * 0.75* *67 * 0.25 + 38 * 0.75 =* *45.3* Weighted average of Assessment Unit Econd®	(45.3 *45/48) + (18 * 3/48) = 43.55 Area weighted average of Assessment Unit Econd®	=43.6 * (48/93) + 33.7*(45/93) = 38.78 Area weighted average of each Sub-asset Econd®
		Composition (VI)	Richness	Tree	4	2	51 Weighted Richness Condition score	38 Vegetation Integrity (range 0-100) x 0.6 multiplier			
				Shrub	7	4					
				Grass & grasslike	8	4					
				Forb	11	3					
				Fern	2	2					
				Other	2	1					
			Structure	Tree	25	6	11 Weighted Structure Condition score				
				Shrub	4	1					
				Grass & grasslike	44	10					
				Forb	7	1					
				Fern	0	1					
				Other	0	1					
			Function	Tree stem size class	4	3	97 Weighted Function Condition score				
				Number of large trees	5	4					
				Tree regeneration	1	40					
				Fallen logs	36	30					
				Litter cover	24	40					
	CA047 – SEH - Eastern Riverine Forests – P (3ha)	Configuration	Configuration – site context (%)		100	36	36		*Configuration*0.25 + Composition * 0.75* *36 * 0.25+ 12 * 0.75 =* *18* Weighted average of Assessment Unit Econd®		
		Composition (VI)	Richness	Tree	4	0	4 Weighted Richness Condition score	12 Vegetation Integrity (range 0-100)			
				Shrub	7	1					
				Grass & grasslike	8	1					
				Forb	11	2					
				Fern	2	0					
				Other	2	0					
			Structure	Tree	25	10	24 Weighted Structure Condition score				
				Shrub	4	2					
				Grass & grasslike	44	10					
				Forb	7	2					
				Fern	0	0					
				Other	0	0					
			Function	Tree stem size class	4	1	20 Weighted Function Condition score				
				Number of large trees	5	2					
				Tree regeneration	1	0					
				Fallen logs	36	10					
				Litter cover	24	2					

[13] Note Benchmarks are derived for each combination of Vegetation Class * IBRA bioregion.

RIV – Inland Floodplain Woodlands (45ha)	CA121 – RIV - Inland Floodplain Woodlands – G (20ha)	Configuration	Configuration – site context (%)		100	51	51		*Configuration * 0.25 + Composition * 0.75* *=51 * 0.25 + 62 * 0.75* *=59.25* Weighted average of Assessment Unit Econd®	(59.3 * 20/45) + (13.3 * 25/45) = 33.69 Area weighted average of Assessment Unit Econd®
		Composition (VI)	Richness	Tree	2	2	84 Weighted Richness Condition score	62 Vegetation Integrity (range 0-100)		
				Shrub	8	4				
				Grass & grasslike	3	4				
				Forb	8	7				
				Fern	0	0				
				Other	0	0				
			Structure	Tree	16	6	30 Weighted Structure Condition score			
				Shrub	19	6				
				Grass & grasslike	2	10				
				Forb	8	2				
				Fern	0	0				
				Other	0	0				
			Function	Tree stem size class *	4	3	94 Weighted Function Condition score			
				Number of large trees *	1	1				
				Tree regeneration *	1	1				
				Fallen logs	50	30				
				Litter cover	35	40				
	CA121 – RIV - Inland Floodplain Woodlands – P (25 ha)	Configuration	Configuration – site context (%)		100	20	20		*Configuration * 0.25 + Composition * 0.75* *=20 * 0.25 + 11 * 0.75* *=13.25* Weighted average of Assessment Unit Econd®	
		Composition (VI)	Richness	Tree	2	0	11 Weighted Richness Condition score	11 Vegetation Integrity (range 0-100)		
				Shrub	8	1				
				Grass & grasslike	3	1				
				Forb	8	2				
				Fern	0	0				
				Other	0	0				
			Structure	Tree	16	8	29 Weighted Structure Condition score			
				Shrub	19	2				
				Grass & grasslike	2	8				
				Forb	8	2				
				Fern	0	0				
				Other	0	0				
			Function	Tree stem size class *	4	1	4 Weighted Function Condition score			
				Number of large trees *	1	0				
				Tree regeneration *	1	0				
				Fallen logs	50	10				
				Litter cover	35	2				

Appendix B – Supporting Documentation Checklist for Verification

The following supporting documents are supplied to assist in verification of this Method.

- ☐ Step 1: Define purpose, scope and accounting area
- ☐ Step 2: Compile existing data
    - A map, table and description of sub-assets (vegetation classes)
- ☐ Step 3: Stratify accounting area into assessment units and identify sample sites
- ☐ Step 4: Describe indicators and define reference benchmarks
    - A table describing the **environmental indicators** to be measured in the account
    - A table that includes the **Reference Benchmark value** for each indicator for each sub-asset.
- ☐ Step 5: Collect and analyse data
    - A **data table** (e.g. a spreadsheet) containing all the raw data for each environmental indicator for each sample
    - For photopoints, a **folder** (preferably stored on the cloud) containing all photographs appropriately labelled according to the sample.
- ☐ Step 6: Calculate indicator Condition Scores
    - A **Data Table** (e.g. a spreadsheet) containing all the data (including calculated Indicator Condition Scores)
- ☐ Step 7: Calculate the Econd®
    - A **data table** (e.g. a spreadsheet) containing all the raw data for each indicator for each sample, including the calculations for the ICS and Econd®.
    - A **summary table** showing the Econd® scores.
    - A series of **summary maps** showing the Econd® scores for each:
        - Assessment units
        - Asset.

Appendix C – How to conduct the spatial analyses for configuration

Configuration

Configuration is measured as the site context is taken to be the percent of retained remnant woody and non-woody native vegetation within the combined area of the Assessment Unit as well as a 1500m buffer surrounding the outside edge of the Assessment Unit.

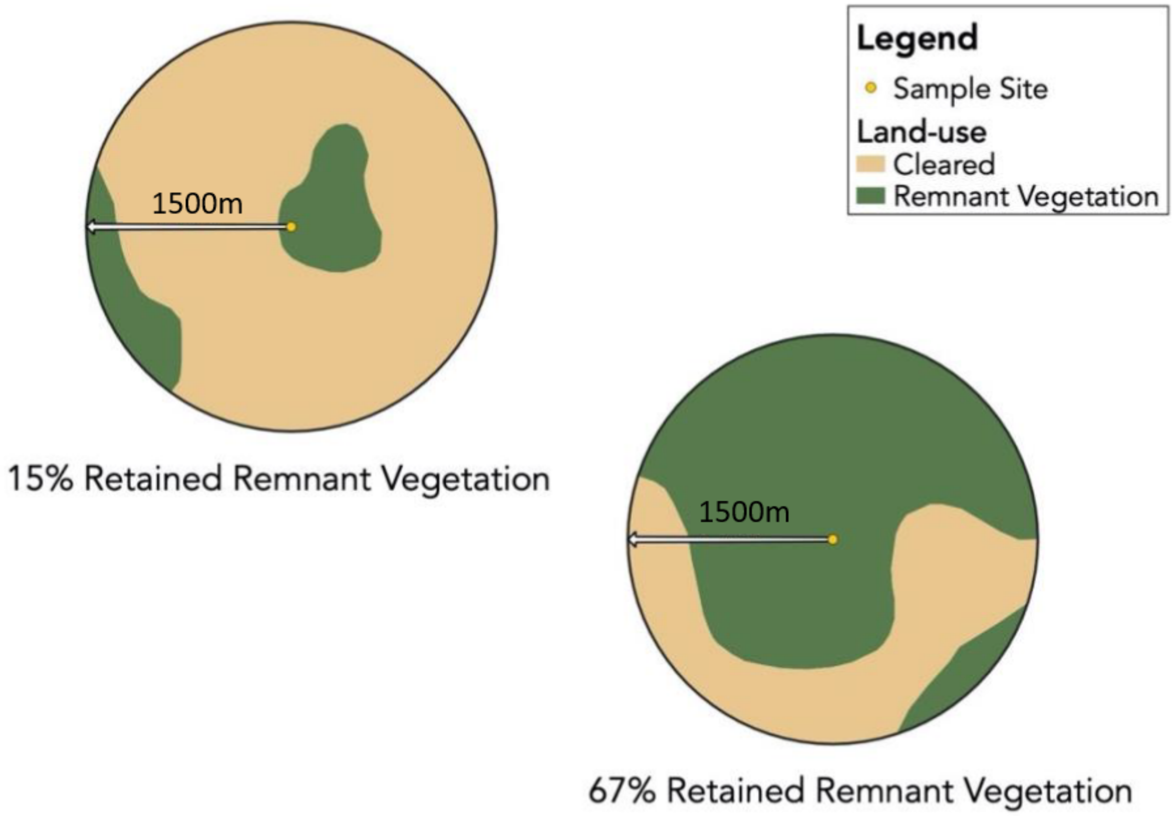

Figure 6: Depiction of the configuration assessment applied around the perimeter of a Conservation Agreement

Appendix D – Field Equipment List

Required

- Mobile data collection tool (e.g. tablet) with Collector and Survey123 installed
- Hard-copy data sheets (backup)
- External battery pack
- 2 x star pickets or 1500mm fibreglass posts
- 2 x 20m tape
- 1 x 50m tape
- Survey flags
- 0.5x0.5 lightweight quadrat
- DBH tape
- Compass
- Ruler
- Rigid pole (e.g. dowel) marked at 1m and 1.3m
- Laser distance measure (e.g. DeWalt DW033)
- Collection bags and jewellers' tags or envelopes (plant specimens)
- First aid kit

Optional

- 1 x 100m tape
- Flagging tape
- Binoculars
- Small spirit level (for point-intercept tool)
- GPS (backup)
- Plant ID reference materials

Appendix E – Field data sheets for Compositional analysis

Full-floristic (BAM) plot

Start Time:	End Time:	MP ID	Agmt/Ctrl	Recorders	
Date	__/__/__				
Zone	Datum	**Site Name**		**Plot dimensions**	
Easting	Northing	**IBRA region**	In m	**Plot bearing**	Magnetic °
Vegetation Class / Condition State					Confidence:

Growth Form Code	Genus and species name	N, E or HTW	Cover	Abund	Voucher
	1				
	2				
	3				
	4				
	5				
	6				
	7				
	8				
	9				
	10				
	11				
	12				
	13				
	14				
	15				
	16				
	17				
	18				
	19				
	20				

BAM Attribute (1000 m² plot)	
DBH	Present?
80 + cm	
50 – 79 cm	
30 – 49 cm	
20 – 29 cm	
10 – 19 cm	
5 – 9 cm	
< 5 cm	
Length of logs (m)	Tally space

Dung assessment											
1 x 1 m or 0.5 x0.5 m (SSCA) plots											Count cow pats (400 m² plot)
Species	Count pellets										

BAM Attribute (1 x 1 m plots)	Litter cover (%)	Bare ground cover (%)	Cryptogam cover (%)	Rock cover (%)
Subplot score (% in each)				
Average of the 5 subplots				

[1] Variable for DBH size classes <1, 1-5 and 5-9cm only; all size classes >10cm to be assessed within 20x50m plot
[2] If/where observable evidence of stem loss/degradation (e.g. dieback [drought, BMAD], disease, logging, browsing)
[3] Seedlings, persistent lignotubers, mature resprouting (e.g. epicormic)