# Working Paper:

## Response to research on Human Induced Regeneration Method

Prepared by HIR Method Review Sub-Committee

April 2022

**Two research papers were released on 16 March 2022 containing analysis related to the Emissions Reduction Fund's (ERF) Human Induced Regeneration (HIR) Method:**

1. **Macintosh, A., Butler, D., Evans, M.C., Larraondo, P.R., Ansell, D., Gibbons, P. (2022) The ERF's Human-induced Regeneration (HIR): What the Beare and Chambers Report Really Found and a Critique of its Method. The Australian National University, Canberra. (paper 1)**
2. **Macintosh, A., Butler, D., Ansell, D. (2022) Measurement Error in the Emissions Reduction Fund's Human-induced Regeneration (HIR) Method. The Australian National University, Canberra. (paper 2)**

**This Working Paper provides a response to some of the foundational assumptions in these papers from the Carbon Market Institute's member-led HIR Method Review Sub-Committee, and some suggestions on practical next steps to a) affirm the integrity of the HIR method, b) facilitate continuous improvement of carbon farming methods, and c) support enhanced data transparency, with appropriate privacy protections.**

**The Working Paper has been prepared by the Sub Committee to support further public discussion and does not necessarily represent an approved policy position of CMI or any of its individual members.**

## A Simple Guide: The Human Induced Regeneration Method

HIR projects involve regenerating native forests by changing land management. Projects are carried out on areas where regenerating seedlings were previously being impacted by grazing, clearing or other land management practices which prevented them from growing into forests.

Under the ERF, the term "forest" has a very specific technical definition. It refers to a cluster of trees which are

a) taller than 2m;
b) cover an area of more than 0.2 hectares; and
c) combined have a canopy cover greater than 20% of that area.

To be eligible to be credited for carbon abatement, regenerating trees must meet several conditions:

1. They must have been subject to "suppression" (such as heavy grazing or clearing) in a business-as-usual scenario.
2. Verifiable, third-party evidence must be provided to demonstrate this suppression during a ten-year project baseline period.
3. The land manager must be willing to make a practice change to actively enable the immature trees to keep regenerating (for example, stopping clearing or changing grazing practices to ensure livestock and feral animals are not impacting regrowth), and they must provide auditable evidence that changes are being implemented.
4. The regenerating trees must have the potential to form a "forest" within 15 years (as per definition above). This means there must be sufficient juvenile tree stems in the carbon estimation area (CEA) at project commencement, and it must be tree species capable of attaining forest cover within a 15-year period and sustaining forest cover for the project permanence period.
5. The regenerating areas must be areas of at least 0.2 Ha and must not contain areas that already meet the definitions of "forest" at project commencement. Parts of the property that already contain forest at project start must be identified as "baseline forest" and excluded from CEA maps.
6. The regenerating trees must be frequently monitored and must pass increasingly stringent five-yearly regeneration checks. These checks verify that the trees are growing as planned and remain likely to meet the 15-year forest attainment gateway. If they do not meet these checks or gateways, these areas must be removed from the project and carbon abatement adjusted accordingly.

HIR projects, as with all ERF carbon farming project methods, undergo independent third-party audits at regular intervals, with at least three audits over a project life. The first audit occurs before any carbon credits are issued to a project. Carbon credits are only issued incrementally for carbon storage that has already occurred in

regenerating trees, and any initial carbon stocks (carbon stored in the regenerating area at the start of the project) is deducted from issued credits.

If any areas are subsequently removed from a project at gateway checks, a reconciliation occurs, and carbon credits are only issued for incremental gains in abatement. More generally, HIR projects are subject to broader ERF checks and balances, as well as overall conservativism which is built into the ERF through retention of crediting buffers and other mechanisms. A more detailed HIR method explanation is available in CMI's HIR Fact Sheet.

### Summary HIR Sub-Committee Review of the papers

The HIR Method Review Sub-Committee is concerned that inaccurate foundational assumptions in both papers 1 and 2 are leading to over-statements on the potential for, and the widespread nature of, any HIR method integrity concerns. The detailed analysis contained in the papers does not support related public statements that "*70 to 80 per cent of the ACCUs issued to these projects are devoid of integrity – they do not represent real and additional abatement*". Neither paper 1 or 2 attempts to quantify the amount of Australian Carbon Credit Units (ACCUs) that are claimed to be "devoid of integrity".

Instead, the papers identify potential technical issues which are acknowledged as either stemming from challenges with access to project level data, or the analysis highlights that the problems relate only to a small subset of projects or parts of projects, rather than all projects.

Beyond these concerns, appendixes 1 and 2 contain more detailed responses to statements in the papers and related public statements. These appendices highlight three main concerns with the analytical approach and foundational assumptions in the papers.

1. **The papers inaccurately focus on an assessment of whether the projects have already achieved forest cover.**
   HIR projects are still in the early years of implementation given the first set of projects were registered around 2015. This means the focus on attainment of forest cover to date is not an appropriate metric, rather assessments of project impact must focus on the transition towards forest cover to ensure the projects are progressing towards forest attainment within a 15-year period as required by the method.
2. **The papers suggest that regenerating projects are being credited for pre-existing forest.**
   Projects are required to exclude areas of pre-existing forest from carbon estimation areas and are only credited for incremental storage of carbon following project commencement.
3. **The papers suggest that management activities are non-additional and grazing does not impact regeneration.**
   There is significant literature that documents the impact of both heavy grazing and clearing on regenerating landscapes. Projects must provide auditable third party evidence of suppression of vegetation prior to project commencement, as well as evidence of practice changes to facilitate regeneration after project start.

**A practical way forward**

- Affirmation of the integrity of the HIR method.
  CMI stands ready to participate in any further reviews on HIR method improvements and to support independent analysis on the impact of the method based on appropriate data inputs.
- Continuously improve carbon farming.
  CMI is committed to continuous improvement of Australia's carbon market and welcomes both scheme wide and method specific proposals for ongoing improvement, along with measures to strengthen governance.
- Enhance national data transparency.
  A key theme arising from the papers is availability of data for independent research and analysis. CMI, through its Landscape Taskforce, has been raising the importance of improved national data sharing frameworks that would improve transparency for some time and welcomes further collaboration on these frameworks as a practical next step.

## Appendix 1: Review and response on foundational assumptions in papers 1 & 2.

| Statements in Papers | CMI Sub-Committee Response |
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| **Topic 1: how progress of regenerating areas is monitored as they transition to forest** | |
| *Despite forest cover barely increasing, almost 17.5 million ACCUs were issued to these projects from project commencement up until the end of the 2019-20 financial year.* *(paper 1: pg 23)*<br><br>*The HIR method is intended to credit the abatement associated with projects that involve the regeneration of native forests. Due to this, a key measure of the success of HIR projects should be the extent to which they have increased forest cover.* *(paper 1: pg 6)*<br><br>*…yet most of the sequestration that has been credited to the analysed projects is unlikely to have even occurred.* *(paper 1: pg 6)*<br><br>*[The Beare and Chambers] report defines successful regeneration in terms of a transition from a non-woody state to a sparse woody or forest state ('woody plus forest' or WF) rather than the transition to forest cover – which is the basis for crediting under the method;* *(paper 1: pg. 5)*<br><br>*The report assesses the impact of the project activities on the basis of trends in woody cover in control areas where sparse woody and forest cover may have been declining – whereas the method credits on the assumption of* | The papers repeatedly point to achievement of forest cover as being the focal metric for measuring project impact and success to date.<br><br>It is expected that up to 15 years are required for a CEA to reach forest attainment. Most projects would not yet have large areas of CEA that have reached forest. Areas will reach the technical definition of "forest" at different times depending on local resources, such as soil type, water availability (rainfall can vary significantly within a property), vegetation species etc. It would be most unexpected to see CEA all hitting forest attainment simultaneously, and un-expected to see projects in these early years of implementation having already reached forest across large areas of a CEA.<br><br>Instead, the HIR method credits incremental regeneration or carbon accumulation in regenerating trees as they progress toward forest attainment. Contrary to key assumptions in the papers, the HIR method does not credit based on a point in time attainment of "forest" cover.<br><br>During the early phases of the project, much of the regeneration occurs within the sparse woody category, as canopy cover progressively increases towards forest cover (20% canopy cover). Progression of previously non-forest areas (including areas classified as bare/open or sparse woody) to forest condition necessarily involves a transition through several stages of regeneration.<br><br>HIR projects don't only monitor success based on a change in forest class (i.e., from bare class (<5% canopy cover) to sparse woody (5-19% canopy cover) to forest (>20% canopy cover)) as the indication of regeneration being 'on track'. Regeneration checks look for changes in canopy cover occurring within each vegetation class (e.g. increase from 6% to 10% canopy cover within sparse woody class).<br><br>Consequently, the results of the analysis in the papers are not surprising given their focus on achievement of forest cover as the key metric. Most of the regeneration occurring across the projects has been inappropriately discounted in the analysis because of this focus. It is much more relevant to look for changes in canopy cover within the sparse woody category, and not just rely on the attainment of forest cover before a project's 'forest cover attainment date' has been reached.<br><br>Table 2 in Beare and Chambers (2021) identifies a simple method for showing the number of forest pixels on average in each CEA, including showing a clear transition from bare state through to sparse woody through to forest state. This better reflects how regeneration occurs and is measured. |

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| *absolute increases in forest cover from a baseline of zero biomass.* *(paper 1: pg. 15)*<br><br>*Using the transition from non-woody (open) to either sparse woody or forest as a measure of successful regeneration is inappropriate for the purposes of assessing the additionality of the abatement credited under the method.* *(paper 1: pg. 16)*<br><br>*Given these factors, using the transition to sparse woody cover as a measure of the effects of HIR project activities introduces a significant source of uncertainty about the drivers of cover change.* *(paper 1: pg 16)* | The progression of regenerating trees is credited as an incremental accumulation as land transitions towards forest, with regular checks and increasing accuracy requirements. There are triggers in the combination of legislation, rule, method and HIR guidelines that progressively deal with any over-estimations in abatement due to mapping or otherwise.<br><br>Forest attainment is validated with auditable project data to provide additional assurances. New HIR Guidelines were introduced in 2019 by the CER in response to the ERAC HIR method review in 2018. These guidelines added additional requirements whereby projects need to show at more frequent intervals that vegetation is continuing to transition towards forest cover. At each progressive 5 yearly check, the scale at which this is assessed is increasingly precise, with number of tree stems, increases in canopy cover and distribution of cover all being validated needs. Forest cover must be achieved by the 15-year gateway, or areas must be excluded and project crediting adjusted accordingly. *(*Australian Government (2019) *Guidelines on stratification, evidence and records)* |
| **Statements in Papers** | **CMI Sub-Committee Response:** |
| Topic 2: how carbon equations are applied to calculate abatement from regenerating areas | |
| *In colloquial terms, proponents are being issued ACCUs for growing trees that were already there when the projects started. This is resulting in the substantial over crediting of HIR projects and is distorting the Australian carbon market.* *(paper 2: pg7)*<br><br>*The Clean Energy Regulator's interpretation includes as eligible vast areas that already contain mature native vegetation at project commencement, so long as that vegetation is not currently forest. This approach is represented by Figure 1(b). Under this interpretation, at project commencement, HIR CEAs can consist of a mix of juvenile regeneration and mature trees and shrubs, provided the crown cover is less than 20%.*<br>*One of the eligibility requirements for land to be included in HIR CEAs is that it must not have had forest cover in the 10 years prior to the project application (the 'baseline period'). Data presented in the Beare and Chambers report suggest that 11-13% of the average hectare of HIR CEAs in NSW and QLD met the crown cover thresholds for forest cover (≥20%) over the so-called 'pre-start' period; the period from 1988 until project commencement.* *(paper 1: pg 5)* | Forest cover assessments by the papers appear to be based solely on National Forest and Sparse Woody Vegetation Data (Version 5.0 - 2020 Release). Since the ERAC review in 2018 and the subsequent introduction of the HIR Guidelines, this national dataset cannot be used in HIR projects as the sole source of information. *(Australian Government (2021) National Forest and Sparse Woody Vegetation Data (Version 5.0 - 2020 Release))*<br><br>*The Clean Energy Regulator notes that proponents have to date substantially relied on the use of the maps that form the basis of the National Inventory Report to determine pre-existing forest cover for the purposes of excluding it from CEAs. In many cases, the use of higher resolution data at the project scale can improve upon the precision of this national-scale dataset. The National Inventory Forest Extent Data is subject to continuous improvement, and this may include future adoption of higher resolution satellite imagery. The methods do not specify that the maps that form the basis of the National Inventory Report is the exclusive means to determine the absence or presence of pre-existing forest cover* ***and going forward we do not consider the maps that form the basis of the National Inventory Report sufficient to determine the absence or presence of pre-existing forest at initial stratification, without supporting evidence****. (emphasis added,* Australian Government (2019) *Guidelines on stratification, evidence and records, pg 7)*<br><br>National forest data (NFSW data) is broadly accepted as suitable at a national scale but is not sufficiently accurate at a project scale. It is inappropriate to make assumptions based on data that project proponents, or their service providers cannot use as the basis for the project because of a lack of accuracy in that data set at the spatial scale required. Stratifications of HIR projects now involve a much more sophisticated process of supervised classifications, training algorithms, machine learning, accuracy assessments, and calibration and/or validation with field data. This rigour is built into HIR project reporting since the Guidelines were released, but the same processes and testing do not appear to be used in the critique of the HIR methodology and projects.<br><br>Further, Beare and Chambers provide a distribution of pixel counts for each class on a per hectare of CEA basis. For NSW projects, the distribution of forest pixels between the 25th to 75th percentile is 0.38 and 1.48 pixels, or 2.4 - 9.3% of every hectare of CEA. For Qld, this range is slightly larger at 2.5 – 12.9% of every hectare of CEA. However, this has been mis-extrapolated in paper 1. Each forest pixel is classes as |

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| *Figures 4 and 5, which provide illustrative examples of the potential magnitude of the resulting over-estimation of sequestration on a per hectare basis, based on a collection of randomly selected FullCAM plots in semi-arid regions in Queensland and New South Wales. Both examples assume that 30% of the land contains mature vegetation and that the remaining 70% of the land matches the modelled assumption of near zero biomass at project commencement.* *(paper 2; pg. 20)*<br>*Further rule changes may be necessary to prevent the continued crediting of non-additional and non-existent abatement*<br>*paper 1: pg 28)* | forest if it contains canopy cover between 20-100%, so only in the very worst-case scenario would forest cover in CEAs be anywhere near the levels suggested by the report (11-13%). In fact, it may be as low as 0.5% if canopy in forest pixels is closer to the minimum cover of 20%.<br><br>Additionally, carbon estimation areas must be a minimum size of 0.2Ha, which requires at least three pixels contiguous pixels (or in the case where higher resolution imagery such as Sentinel satellites are used, this involves aggregation of 21 pixels). Given this area requirement, it is not possible to remove a single forest pixel from a CEA, likewise it is not possible to remove a single sparse woody or regenerating pixel from a baseline forest area. This aggregation process typically nets out across a property, with some human induced regeneration occurring in baseline forest areas and some existing tree cover being contained in a CEA, and hence this still leads to a conservative crediting approach. As per the Beare and Chambers analysis, the total proportion of canopy cover in CEA is low (potentially as low as 0.5%).<br><br>Other key considerations related to crediting include:<br>a) Method equations require removal of any initial carbon stock on the site for regeneration that occurred prior to project start. Carbon credits are only issued incremental abatement generated after project start in areas subject to a management change.<br>b) Regenerating areas will not achieve site productivity limits until well after the 25-year project crediting period, meaning competition of existing and regenerating trees is not an issue in the project cycle. (see Box 1 for further details)<br>c) FullCAM does not credit for mature trees in the carbon estimation areas, it only credits for regenerating trees.<br><br>Even though findings from Beare and Chambers provide 11-13% of pixels are classified as forest, the worked example in paper 2 assumes a higher level of forest pixels of 30% across all projects. This significantly inflates the assessment of any potential for over-crediting beyond what is suggested as possible based on either Beare and Chambers or the papers analysis. It also applies this assumption uniformly across all projects, which is not supported by the analyses. |
| **Statements in Papers**<br>**Topic 3: how changes in clearing and grazing practice regenerate vegetation** | **CMI Sub-Committee Response:** |
| *All ERF methods are meant to be 'supported by clear and convincing evidence' – yet the existing scientific literature suggests grazing control has relatively limited impact on the biomass of uncleared woody vegetation in rangeland areas and is unlikely to result in areas attaining forest cover that have not previously been deforested. This view is consistent with the evidence on the changes in woody cover associated with the analysed HIR projects.* *(Paper 1; Pg 6.)*<br><br>*Additionality. The suggestion the method is crediting non-additional abatement because it is based on a flawed assumption that grazing control has a significant influence on woody cover across all eligible lands, whereas the evidence suggests rainfall is the primary determinant in areas that have not previously been cleared* | There are repeated statements that regeneration that is occurring is primarily a result of rainfall and not grazing management. While there can be no disagreement that rainfall supports vegetation growth, it is surprising that the impact of grazing management is quickly dismissed by the co-authors.<br><br>There has been considerable attention amongst the academic community, land management and natural resource management sector, and land managers over decades to address the imbalance between grazing and rangeland vegetation, and there is a long list of peer reviewed science on this issue, including several papers which that some of the co-authors themselves contributed to.<br><br>*Refer to Appendix 2 for a selection of key references, with some examples in the text below.*<br><br>Rainfall will be a major driver of vegetation growth –that is not in dispute. The project activities in the HIR methodology are designed to ensure that the suppressive force of grazing and/or clearing or other growth suppressors are managed to allow regeneration to occur when the environmental and climatic conditions are conducive for growth. Repeated grazing (and trampling), even at modest stocking densities, can suppress new growth because of the selective and learnt grazing behaviour of livestock.<br><br>*… both grazing and drought reduce vegetation cover, and its response to precipitation. Drought exacerbates the grazing impact on NDVI-precipitation response. These results imply that grazing in arid and semi-arid rangelands can* |

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| *(Paper 1: pg 9)*<br><br>***… there is considerable climate-induced variability in sparse woody cover and greater uncertainty about the accuracy of the data concerning sparse woody cover relative to forest cover… Given these factors, using the transition to sparse woody cover as a measure of the effects of HIR project activities introduces a significant source of uncertainty about the drivers of cover change.***<br>*(Paper 1: pg 16)*<br><br>***[…] there seems little doubt that there was a substantial amount of mature woody vegetation in the CEAs of these projects when they started. This sense is reinforced by the fact that 97% of the area of HIR projects is 'extant' native vegetation (i.e. essentially intact native vegetation) based on data from the Commonwealth's Native Vegetation Information System.***<br>*(Paper 2; Figure 2, pg. 12)*<br><br>***Consequently, there is a strong financial incentive for proponents to include all areas that have forest potential within CEAs and to include as much area that is close to the forest threshold as possible within CEAs.***<br>*(Paper 1; pg. 18)* | *reduce the capacity of ecosystems to assimilate atmospheric CO2 during wet years and episodic wet events*. (Long et al (2019))<br><br>There is significant peer reviewed literature on the impact of grazing on palatable woody vegetation species, which commonly occur in the Australian rangelands. For example, grazing has well documented impacts on palatable regenerating plants below the browse line (generally 1.2 m for sheep, 1.4 m for cattle, higher for goats which browse in established veg).<br><br>Commentary on lack of clearing in project regions from which regeneration should occur is simplistic and not supported by detailed peer reviews on degradation caused by overstocking and poor management in the rangelands, including significantly by Peeters and Butler (2014b) in *Mulga: regrowth benefits management guideline.*<br><br>A central goal of the HIR method was to incentivise a positive change to grazing management to reverse this degradation and to ensure regenerating trees were able to progress to forest attainment.<br><br>'Pulses' of growth are typical in the rangelands, where seasonal patterns are often not annual. Consequently, in any given year, the simulation model might be under or over actual growth rates as the model is fed by historic climate data, but over the 25 years of a project, these year-to-year fluctuations will tend to even out.<br><br>If there is evidence that regeneration in CEAs is not occurring and the requirement to show 'forest potential' is not met at any time during the crediting period, then those areas need to be excluded and adjustments to the project abatement must be made, or the model can be paused, with consequences on the abatement calculations.<br><br>In practice, adjustments are made to project abatement estimates whenever new evidence comes to hand, which most notably occurred following the 2019 Guidelines, but occurs regularly throughout the life of a project. The papers have assumed projects are simply trying to maximise returns, as opposed to carbon storage impact and other benefits that result from project management changes.<br><br>As per current regulatory guidance, projects are required to provide detailed, auditable, and verifiable reporting on management activities and long-term plans for ensuring permanent retention of regenerated forest:<br><br>• at project registration (for projects registered after June 2018); and<br>• as part of the first offsets report following years 8 and 24 of the crediting period (for all projects).<br><br>In contrast to Fig. 1a provided in paper 1, Fig 1b – The Vegetation Assets, States and Transitions[1] analysis presented in the 2016 State of Environment Report[2] illustrates the extent of modification of each of the major vegetation groups, with modified communities (yellow) as having regenerative capacity and transformed communities (brown) having significantly altered regenerative capacity. These areas align well with the spatial distribution of registered HIR projects, demonstrating that degradation and semi-cleared land is a predominant state in the region where projects are being undertaken, and that land in these regions is capable of regeneration and improvement (see Figure 1 below). |

[1] Thackway, R., & Lesslie, R. (2005). *Vegetation assets, states and transitions: accounting for vegetation condition in the Australian landscape*. Bureau of Rural Sciences.

[2] Cresswell, I. D., & Murphy, H. T. (2017). Australia state of the environment 2016: biodiversity, independent report to the Australian Government Minister for the Environment and Energy. *Australian Government Department of the Environment and Energy, Canberra*.

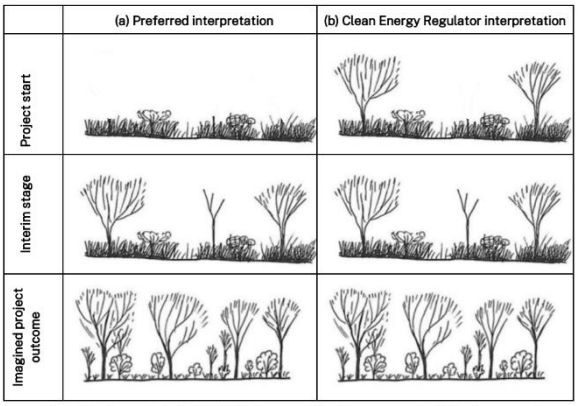
## Box 1: Transition of Regenerating areas towards Forest

Regeneration projects start with land in the bare or sparse woody category, and must progress to the forest category within 25 years. Figure 1 in paper 2 (to the right) suggests much higher starting carbon stocks (or volume of trees) in project areas .

This illustration of "CER interpretation" is closer to a starting point of 50% tree cover, transitioning to closer to 100% cover in the graphic. Additionally, the approach labelled as "preferred approach" is an illustration of broad scale clearing management practices.

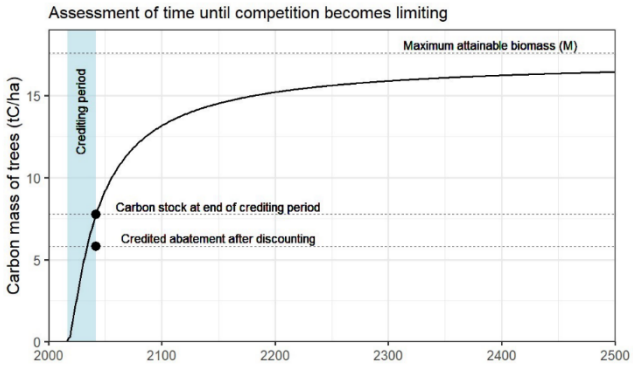
The approach labelled "CER interpretation", while overestimating starting tree cover, is illustrative of heavy grazing where there are some taller paddock trees and some regeneration that is supressed by grazing, or partial clearing of an area where some paddock trees are left standing to provide shade.

Figure 1. Assumed progression of regeneration under HIR and NFMR methods



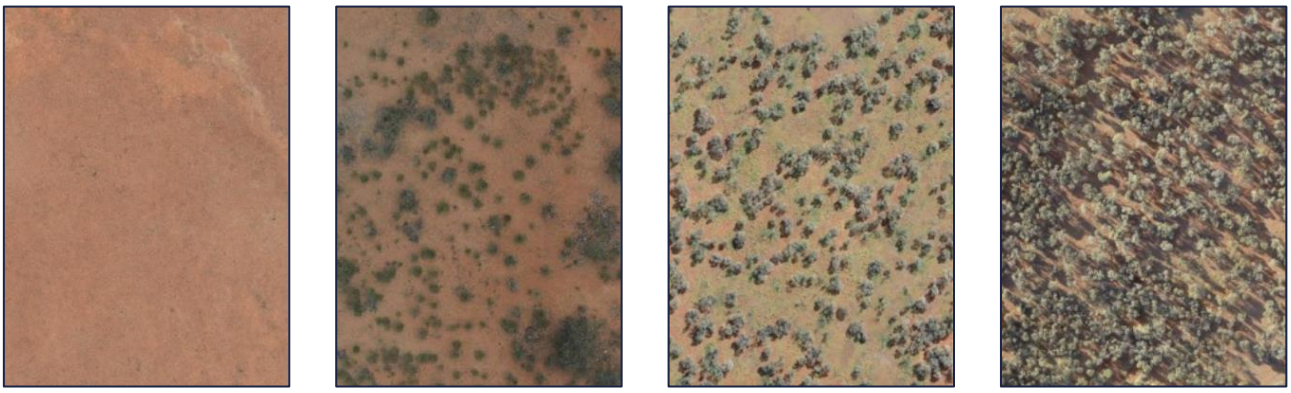

Source: Adapted from Peeters, P., Butler, D. (2014) Mulga: regrowth benefits management guideline. Department of Science, Information Technology, Innovation and the Arts, Brisbane.

Both the "preferred interpretation" and "CER interpretation" (subject to project start illustration being amended to have less than 20% cover) are valid technical approaches. All three management practices are eligible under the HIR method, subject to ability to provide auditable evidence of the suppression, change in management practice and the exclusion of "baseline forest" areas from the carbon estimation area at project commencement (i.e. areas greater than 20% canopy).




Further, an area of land transitioning from bare category or sparse category to forest category will not be limited in its ability to store additional carbon until well after the 25 year project crediting periods, even if it had starting forest pixels of 11-13% as suggested as possible by the Beare and Chambers analysis (graph to the right).

An example of different realistic project vegetation growth stages are outlined below, using satellite photos:



**Bare Land**
(0% Canopy Cover)

**Sparse Woody**
(>5%, <20% Canopy Cover)

**Forest**
(~20% Canopy Cover)

**Forest**
(~70% - 100% Canopy Cover)

**Project start**

**Interim stage**
**(i.e. after Regeneration check 1)**

**Imagined project outcome**
**(i.e. after Forest gateway)**

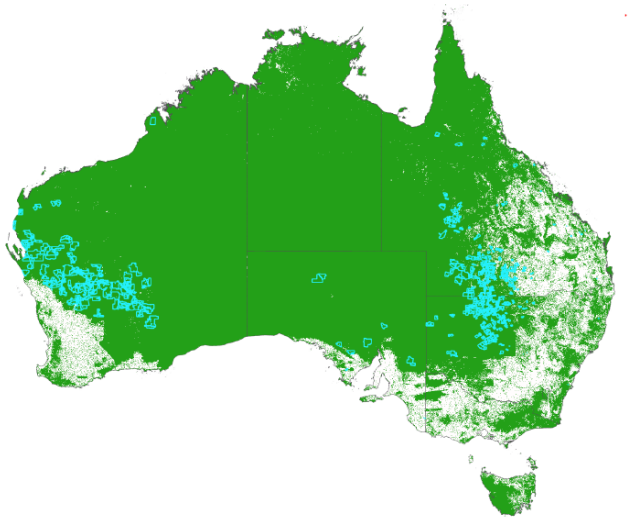
## Working Paper Figures

Outlined below are Figures 1a and 1b as referred to in the above Working Paper responses on topic 3.

**Figure 1:**

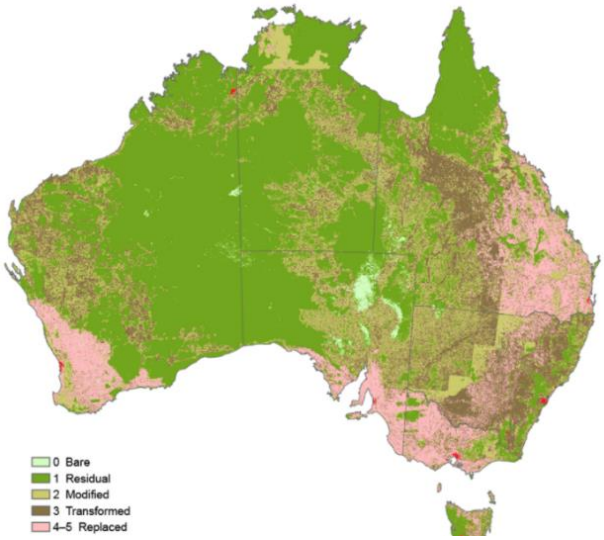
### Figure 1a

HIR project boundaries (turquoise outlines) and 'extant' native vegetation (Paper 2: Fig 2, pg 12).



### Figure 1b

Extent of modification of each of the major vegetation groups, with modified communities (yellow) as having regenerative capacity and transformed communities (brown) (Cresswell & Murphy; 2017)



## Appendix 2: Key references


Australian Government (2019) Guidelines on stratification, evidence and records: For projects under the Human-Induced Regeneration of a Permanent Even-Aged Native Forest and Native Forest from Managed Regrowth methods.

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The Carbon Market Institute is the independent industry association for business leading the transition to net zero emissions. Its over 130 members include primary producers, carbon service providers, Indigenous corporations, legal, technology and advisory services, insurers, banks, investors, corporate entities and emission intensive industries developing decarbonisation and offset strategies.

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