Gateway Regeneration Checks for Human Induced Regeneration projects

ANUE Project #1-1035 (Phase 5)

C.L. Brack. Tuesday, Friday, 12 December 2025

Summary

This is my fifth independent review (2023 – 2025) of the Clean Energy Regulator's (CER) processes for verifying progress in Human Induced Regeneration (HIR) projects. This review adds another 10 projects that have formally reported and passed their relevant threshold audits. To date, I have evaluated 85 projects, which includes field data from about 400 transects measured by independent, professional ecologists or foresters. The data, collected on privately managed land, is confidential but has been independently audited for quality and reliability.

This review includes an analysis of the enhanced data collection methods now being used by HIR proponents or their agents and comparisons between that data, the national scale data that is publicly available over the HIR areas and the data collected by independent auditors. The analysis confirms that the national scale data is underestimating canopy cover on CEAs but that CER use of that data to focus on areas of potentially high risk is useful.

My findings in this report support earlier conclusions that the CER processes, supported by the independent s215 audits and increasingly accurate data provided by proponents, provide confidence that reported HIR projects are being managed in line with legislative and methodological requirements and that forest cover is increasing in the Carbon Estimation Areas (CEAs).

Introduction

This is the 5th report in the series starting in 2023 that independently reviews the processes of the Clean Energy Regulator (CER) as they evaluate progress in the Human Induced Regeneration (HIR) program. The most recent, previous report[1] summarised the results of 75 projects that had reported and passed the relevant 5-yearly thresholds and conditions. This report adds another ten projects that have reported and passed their respective thresholds to the review (Figure 1).

[1] Brack, C.L. (2025) Gateway Regeneration Checks for Human Induced Regeneration projects https://cer.gov.au/document_page/independent-review-gateway-checks-july-2025

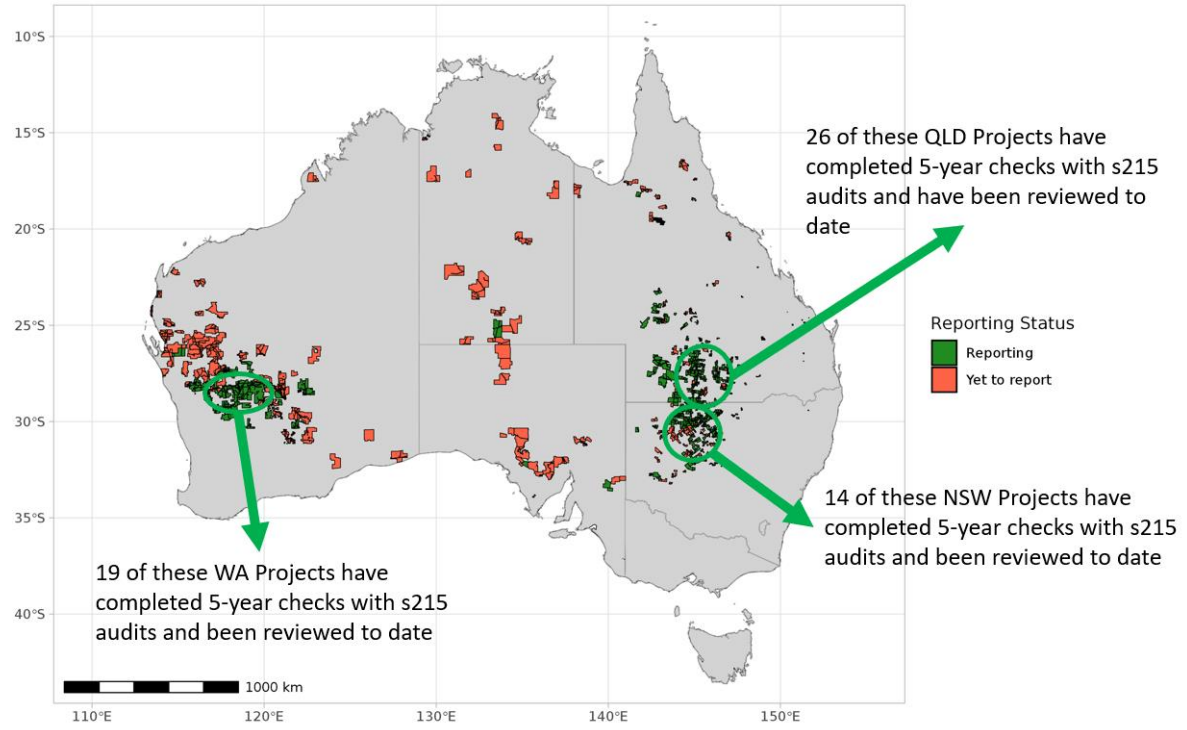


Figure 1: Map of HIR project areas with reporting status and general locations where projects have passed their 5-year reports, s215 audits and been reviewed. "Reporting" projects have submitted an offsets report and have received ACCUs. "Yet to report" projects have not received any ACCUs. A number of additional projects have also been reviewed but are not included as circled areas as they are too isolated to avoid being identified thus break confidentiality requirements

Increased scrutiny of HIR has resulted in improvements in the way HIR proponents and their agents collect information to verify their projects and show that they are meeting legislative and regulatory requirements. For example, the original HIR guidance allowed proponents to use national-scale maps of forest cover to confirm the absence of existing forest in the Carbon Estimation Areas (CEAs) their projects were intending to regenerate and did not require field-based measurements of regeneration to meet progress thresholds. However, there was always an expectation that proponents will "*…select techniques that best increase certainty in their situation for assessing pre-existing forest cover, the forest potential and its subsequent regeneration toward forest cover (collectively forest regeneration) and attainment of forest cover"* (Australian Government (2019), page 9[2]). Over the last few years therefore, proponents have relied less on national-scale forest cover data (e.g., the National Forest and Sparse-Woody – NFSW – datasets developed using Landsat-based remote sensing data at 25 – 30 m resolution)[3] and more on improved precision satellite data (e.g., Sentinel-2 at 10 m or SPOT at 1 m), field-based measurements and georeferenced photographs to demonstrate attainment of forest cover thresholds. Sometimes these high precision and more accurate data result in CEAs being re-stratified to exclude area now identified as having been forest prior to project commencement or areas that are now found to be unlikely to

[2] 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. 8 May 2019. https://cer.gov.au/document/guidelines-stratification-evidence-and-records-hir-and-nfmr .

[3] Australian Government (2019) National Inventory Report 2017: Volume 2.

attain forest cover. Some agents employed by the proponents are voluntarily proving high levels of quality field data to provide added confidence in their projects. Agents have also been adopting more modern inventory techniques - including terrestrial and airborne LiDAR with AI-supported analysis - and have made formal presentations of their proposed approaches to an audience including myself and CER representatives to ensure the approaches are well understood and acceptable.

HIR projects are all on private property or privately managed leasehold land and documents and data, including field-based measurements and geospatial photographs are collected by HIR proponents or their agents as a HIR requirement. As such, these data are classified as confidential. The data and collection techniques were quality assured by independent, professional auditors. These confidential data have been made available to me to undertake this independent review. The set of data provided to support my review and the way I use it is summarised in the table from my earlier 2025 report (Appendix 1). Similar data was provided for the additional 10 projects included in this report.

Results and Discussion

CER procedures to verify progress towards attainment of forest cover include checking that the CEAs exceed increasing levels of canopy cover at increasingly precise scales, or that there are sufficient plants (of appropriate species) present in the CEA to be defined as a "forest". The current HIR Methods and Guidelines describe three alternatives of "thresholds" to be used to demonstrate acceptable progress towards forest cover:

1. Evidence that canopy cover has increased by 5% in the past 5 years; **or**
2. Evidence that canopy cover has met an age-dependent threshold:
    a. Canopy cover of at least 7.5% in each 100 ha cell at age 5;
    b. Canopy cover of at least 10% in each 10 ha cell at age 10;
    c. Canopy cover of at least 20% in 90% of all 0.2 ha cells at its Forest Cover Attainment Date (age 15 – 20); **or**
3. Evidence that there are sufficient numbers of trees (stocking) that have the potential to reach 2 m and 20% canopy cover at their maturity.

Areas that fail to meet the threshold conditions at the five-yearly gateway checks may be "paused" to await further growth or removed from the CEA along with any accrued ACCUs.

Proponents provide maps of their CEA to CER at each gateway check and details reasons for any changes in stratification. These CEAs exclude non-project areas and areas that were forested or had been forested within a decade of the project starting. Most of the proponents reviewed in this report used supervised classification of Sentinel-2 data[4] (10 m

[4] https://www.esa.int/Applications/Observing_the_Earth/Copernicus/Sentinel-2

resolution) although some used SPOT[5] (1 m resolution) and one used Worldview-2[6] (0.5 m resolution). Training data for the classification was collected with physical measurement on site, high-resolution aerial photography or LiDAR. Class characteristics vary but generally are grouped into canopy cover bins (e.g., 0-5%, 5-7.5% 7.5-15%, 15-20%, greater than 20%) or height of tree canopies for fine resolution pixels (non-woody, tree canopy < 2 m, tree canopy > 2 m). The accuracy of the original CEA stratification is required to be at least 85% and success at this level was confirmed by auditors. Re-stratification occurring during the regeneration checks also report high levels of accuracy (often 95%) with those using modern techniques reporting the root mean square error at pixel resolution of the remotely sensed imagery. Updated proponent-developed strata are intersected with 100 or 10 ha cells and compared with the 7.5% or 10% minimum canopy cover (depending on the age-dependent threshold). If the threshold fails, proponents may exclude some of the underperforming CEA.

CER repeats the process of intersecting the CEAs with 100 or 10 ha cells but then estimates the canopy cover using publicly available national-scale databases like NFSW and Persistent Green[7] (PG). For projects in Queensland, they can also use SLATS. Because NFSW only groups areas into ordinal classes, canopy cover values are estimated for each class: non-woody – 2.5%; sparse-woody – 12.5%; woody – 20%. CER also uses a custom-designed program (MegaForest) to estimate canopy cover change over the preceding 5-years from publicly available databases. Areas identified that appear to be at risk of failure may be examined using a time-series of ESRI World Imagery (Wayback[8]), which can have a resolution as fine as 30 cm, to see if regeneration or canopy growth since project commencement appears to have been likely. In some cases, CER will also examine areas using the Woody Cover Fraction[9] (WCF) model. Proponents are required to provide further evidence of progress if the above processes suggest a high likelihood of failure. Often, this additional evidence includes georeferenced photographs of the areas in doubt that show the number of regenerating stems relative to the number required to exceed 20% canopy cover. From 2024, enhanced s215 audits could require additional field-based data collected by independent auditors if the CER processes suggest a high risk of failure and the added evidence supplied by the proponents was not considered sufficient.

Most projects reviewed for this report did not have any consistency in the national scale estimates of canopy cover or progress towards forest attainment. For example, in one

[5] https://earth.esa.int/eogateway/missions/spot

[6] https://earth.esa.int/eogateway/missions/worldview-2

[7] Gill, T., Johansen, K., Scarth, P., Armston, J., Trevithick, R., Flood, N. (2015). Persistent Green Vegetation Fraction. In A. Held, S. Phinn, M. Soto-Berelov, & S. Jones (Eds.), AusCover Good Practice Guidelines: A technical handbook supporting calibration and validation activities of remotely sensed data product (pp. 134-154). Version 1.1. TERN AusCover, ISBN 978-0-646-94137-0.

[8] https://livingatlas.arcgis.com/wayback/

[9] Liao, Z., VanDijk, A.I.J.M., He, B., Larraondo, P.R and Scarth, P.F. (2020) Woody vegetation cover, height and biomass at 25-m resolution derived from multiple site, airborne and satellite observations. Int J Appl Earth Obs Geoinformation 93: 102209.

project, almost all the 100 ha grids failed to achieve 7.5% cover when using PG while almost all of them passed when examined under NFSW and MegaForest estimated an increase in woody area from 7% to 19% over the past 5-years. In another example, CER found that 90% of the 100 ha cells passed 7.5% cover under PG while only just over half passed under NFSW but MegaForest estimated an increase of 14% in forest cover. This inconsistency is not unexpected as earlier reports also concluded that the various national scale models were imprecise and had varying biases although all of them significantly underestimated canopy cover of sparse-woody areas compared to on ground measurements.

Given the inaccuracies in the national scale models, CER relies more on higher precision imagery or expanded field observations collected during s215 audits when reviewing CEAs. CER identify Points of Interest (*PoI*) to help confirm the accuracy of the proponents' CEA strata or otherwise focus on areas where the national scale suggests risk of failure to attain forest cover. For the 10 projects in this report, a total of 90 sites were selected for on ground measurement by the independent, professional foresters or ecologists engaged to undertake the s215 audits. In addition to measuring the canopy cover along transects (usually dividing woody canopy into above or below 2 m height), the auditors would also compare the site with the proponent's mapping of canopy cover, comment on how representative the site appears to be of the 100 / 10 ha cell and offer expert judgements on whether the numbers and species of regeneration on site provide confidence that forest cover could be attained (see Table 1 for examples).

State	NFSW	PG	Mea-sured	Auditor Comment (extract)	My Comment
NSW	Non-woody	9%	1%	***Possible CEA*** *- shrub vegetation abundant and dense (22.5%), however very few canopy trees*	Species are appropriate, but height growth in next few years is needed to attain forest cover
NSW	Non-woody	3%	15%	***Possible CEA*** *- Abundance of shrub species (13.6%), canopy trees few*	Species are appropriate, but height growth in next few years is needed to attain forest cover
QLD	Non-woody	5%	7%	***likely to progress to forest cover****. Agent's regeneration map estimated crown cover of less than 20%. In the 1,000 m² area, we observed 7 trees/shrubs of various species, with a height of 2 m or more, averaging 3.1 m, and one tree reached a height of 4.5 m. Along the 100 m transect line, we identified one Mulga and one Narrow Lead Mulga, both of 2 m or more in height, contributing to a crown cover of 6.6% based on overlapping crowns*	Transect close to achieving 7.5% threshold cover. Sufficient species present to attain forest cover
QLD	Forest	1%	0%	***Unlikely to progress****. established at the waypoint where the crown cover in the Proponent Agent classified less than 20%*	Substantial over-estimate by

				crown cover. In the 1,000 m2, we did not see any trees/shrubs and no trees/shrubs of 2 m or above high observed on the 100 m transect line	NFSW. Scale problem?
QLD	Sparse-woody	16%	60%	***Forest***	More common underestimate by NFSW and PG
QLD	Non-woody	11%	7%	*Correctly identified CEA, regen 0.8%. Open Area, but regenerating Mulga* ***with forest potential****. Turkey Bush present. Stem Count per/ha = 460* *Tree height ranges are 0.2m – 1.8m in regenerating mulga species. The average tree height is 2.06m and the average crown area is 1.59m from the tree species sampled.* *Cattle disturbance present with broken trees, but only mild / moderate browsing*	Transect close to achieving 7.5% threshold cover. Sufficient species present to attain forest cover
QLD	Non-woody	0	0	***Not CEA (removed)****. heavily drought-affected area with high tree mortality. There is insufficient regeneration (0.82%) necessary to enable future forest cover attainment*	Correctly identified area to be removed from CEA
QLD	Non-woody	0%	6%	***Risky CEA****. extensive area characterised as an elevated ridge with a rock basement with minimal soil substrate. Tree growth has been affected by grazing and drought. Tree mortality was observed in the broader area. Mature mulga trees accounted for 6.0% of the forest cover, whilst only 3 regenerating trees <2m in height were recorded within the transect, accounting for 0.53% forest cover. Forest cover attainment is unlikely in this area throughout the duration of the carbon project*	Overall, 2% removed from CEA and 250 ha paused pending further evidence of progress.
QLD	Sparse-woody	6%	24%	***Probably baseline forest*** *with little regen (1.8%). dominated by Gidgee (Acacia cambagei), which occupy height cohorts greater than 2 metres and account for approximately 50% of trees recorded within this transect (23.7% of the forest canopy). Younger trees (<2m in height) account for only 1.8% of the canopy and are likely a result of natural forest regeneration rather than a response to project grazing activity changes implemented after project registration.* *Given that nearly 75% of large trees are > 4m in height, it would be reasonable to conclude that this location had attained forest cover at the project commence date, or within the baseline period*	Overall, about 9% of CEA area removed from this project due to improved mapping of ineligible CEA.
QLD	Non-woody	4%	0%	***Potential forest****. Large difference between transect data and [agent's] mapping.* *Review of imagery and video from site shows that whilst the transect did not exhibit similar coverage to [agent's] mapping, there are numerous trees observed in the near distance. Therefore, transect may not be representative of 10 ha grid.*	Agent's canopy models are based on very high quality data (high resolution remote sensing and LiDAR). Sufficient species

				Majority of stems are Acacia sibirica, and have a crown diameter of 3-6 m. Therefore, with 46 stem per 0.1 ha, this transect ***does exhibit forest potential***	present to attain forest cover
QLD	Non-woody	5%	2%	***No potential****. Large difference between transect data and ■■■■ mapping.* *Review of imagery and video from site shows that whilst the transect did not exhibit similar coverage to ■■■■ mapping, there are only few trees observed in the distance.* *Only nine stems observed in transect area as well.* *This area may not exhibit forest potential and may be mapped incorrectly. Recommend removing this area from mapping (below de minimus).*	Overall, about 1% of CEA area removed from this project due to improved mapping of ineligible CEA
WA	Non-woody	0%	12%	*Accurately mapped as CEA and* ***has forest potential****. Aligns with [agent's]regeneration assessment (16%)*	Agent's mapping and modelling is based on very high quality data (high resolution remote sensing and LiDAR) and much more accurate than NFSW and PG estimates in WA.
WA	Non-woody	0%	34%	*Accurately mapped as CEA and* ***has become forest****. Exceeds [agent's] regeneration assessment (20%)*	
WA	Non-woody	0%	20%	*Accurately mapped as CEA and* ***has become forest****. Exceeds [agent's] regeneration assessment (13%)*	
WA	Non-woody	0%	16%	*Accurately mapped as CEA and* ***has forest potential****. At lower end of [agent's] regeneration assessment (22%)*	
WA	Non-woody	0%	15%	***Unlikely to achieve forest cover****. observed limited regeneration (0.25%). Most existing trees are mature relative to the site conditions (Average height 3.4m for trees >2m). The site has been affected by drought, and tree mortality was evident. Trees recorded within the transect that were <2m likely resulted from drought recovery*	NFSW and PG continue to underestimate cover, but further evidence required for CEA eligibility
WA	Sparse-woody	2%	16%	***Forest cover potential****. observed trees in poor health, senescing, evidence of historic cattle suppression, and close proximity to a water point. 24 trees were recorded <2m in height. If the management of grazing is to change moving forward, this site has forest cover potential.*	Proponent advised of requirements to manage overstocking damage

Table 1: Examples of the Points of Interest (PoI) identified during CER reviews with the canopy cover measured compared to estimated national scale estimates and commentary after s215 audits

If s215 audits confirm issues that areas may not meet CEA criteria, proponents will need to exclude those areas or "pause" their modelled growth until regeneration is sufficient. All the projects in this review restratified their CEA before the gateway checks, during discussions with CER or after the s215 audits to exclude areas that improved data suggested was not eligible or where regeneration was insufficient. In one project, CER concern over the classification incorrectly including shadow as canopy led to the proponent redeveloping their classification approach and re-stratification. Over the 10 projects, re-stratification reduced the CEA area by 0.4% to 14% with a mean reduction of 4%. These reductions are

similar to those in the 75 projects reviewed previously (half of those projects had less than a 5% reduction in CEA area) and well within the expected range.

The 10 projects reviewed in this report all passed their gateway checks based on the above checks (after incorporating any required reduction in CEA) and had an average estimated 1.1 tC $CO_{2\text{-}e}$ net abatement yr^{-1} ha^{-1} of CEA for the most recent period available (slightly less than the average 1.4 tC $CO_{2\text{-}e}$ estimated for the 75 projects reviewed previously). This net abatement is discounted before credited for ACCUs to account for the permanency period and a *risk of reversal buffer*. No credits are issued if the net abatement is negative for a period due to reductions in CEA or pauses in growth and will not be resumed until further growth has occurred to return the overall abatement to positive values.

One of the projects in the latest tranche was reporting at the 10-ha grid scale and CER allocated more attention to this project as it was relatively close to its "Forest Cover Attainment Date". This extra attention was justified on the basis that there was limited opportunity to net out any potential over-crediting due to CEAs failing to regenerate as required before the final attainment date. However, the agent provided "*high quality data*" to provide "*a high level of confidence in their process*", including site photography; stem count and size information; airborne drone imagery; classification results; and LiDAR data. The extra attention and work with auditors emphasised the importance of estimating tree heights accurately as several areas were "close to" the 2 m height threshold and only 20 – 50 cm growth could result in the difference between "forest attained" or non-forest. Landsat is not reliable at this level of required precision and even Sentinel-2 would require particularly good training data and/or LiDAR.

National-scale comparisons

My earlier report compared over 300 field observations collected by independent auditors at PoI and other representative points with national scale models/maps of canopy (i.e., PG, NFSW and WCF). The conclusions from that report were that the national scale models all significantly underestimated the canopy cover of CEAs in the lower canopy classes – i.e., NFSW classes non-woody and sparse-woody. The bias in the national scale models reduced as the canopy cover increased to over about 30% or well into the woody/forest class of NFSW. These biases and the lack of a significant difference between the canopy cover in the sparse-woody class and either non-woody or woody/forest meant that the national scale models are not appropriate for making conclusions about canopy cover or its increase in HIR projects.

The additional field-based measurements made available for this review do not significantly change my previous conclusions. NFSW has a poor accuracy rate when classifying non-woody (44%, 37% and 18% correct for Qld, NSW and WA respectively) or sparse-woody (44%, 13% and 53% correct for Qld, NSW and WA respectively) in the CEAs and consistently underestimates canopy cover (Figure 2).

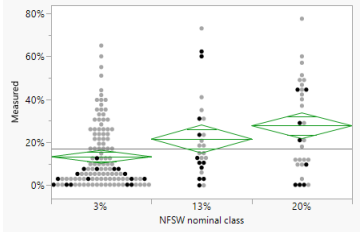
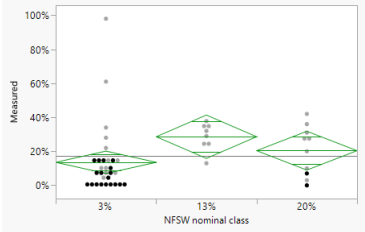
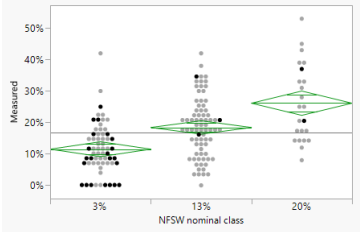
Queensland	New South Wales	Western Australia
		
Classification accuracy: Non-woody: 43% Sparse-woody: 44% Woody/Forest: 57%	Classification accuracy: Non-woody: 37% Sparse-woody: 13% Woody/Forest: 60%	Classification accuracy: Non-woody: 18% Sparse-woody: 52% Woody/Forest: 61%
Canopy Cover (class mean): Non-woody: 13% Sparse-woody: 22% Woody/Forest: 28%	Canopy Cover (class mean): Non-woody: 14% Sparse-woody: 29% Woody/Forest: 20%	Canopy Cover (class mean): Non-woody: 12% Sparse-woody: 18% Woody/Forest: 26%

Figure 2: ANOVA for field measurements of canopy copy against NFSW classes (Version 8.0 – 2023,2024 Release). The diamonds represent ANOVA means and error ranges. Classification accuracy = number of samples within correct canopy cover range / total number classified. Bold points indicate new observations.

Similarly, PG estimates significantly underestimates the measured canopy cover in Qld and WA although the additional data for NSW indicates even though the relationship is imprecise, there is a lack of bias with no significant difference to a 1:1 relationship (r^2 = 0.13, RMSE = 17%) (Figure 3). The improvement for NSW, where previously no significant relationship was found although most measurements were greater than PG estimates, may be due to the increased sample size or improved modelling in the more recent PG data.

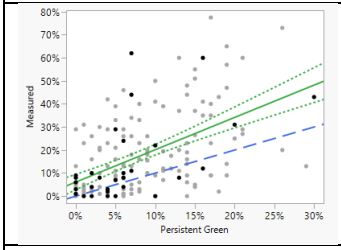
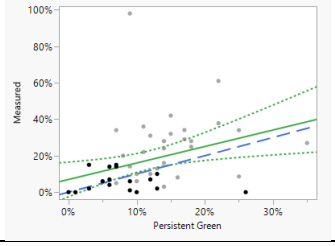
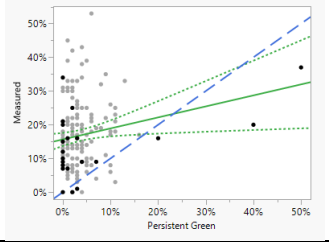
Queensland	New South Wales	Western Australia
		
R^2 = 0.30 RMSE = 0.15 N = 174 p < 0.001	R^2 = 0.13 RMSE = 0.17 N = 48 p = 0.012	R^2 = 0.03 RMSE = 0.17 N = 160 p = 0.023

Figure 3: Plot of Persistent Green estimates (Landsat, JRSRP Algorithm Version 3.0, Australia Coverage) against in situ measurements of canopy cover. Dashed line is 1:1. Solid line represents the line of best fit and dotted lines are the prediction intervals for best fit (p<0.05). Bold points indicate new observations.

Relationships based on WCF are significant for all States (p<0.001) but significantly different to a 1:1 relationship and underestimate canopy cover, especially in the lower cover areas (the intercepts are all significantly greater than 0 and reach as high as 16% for WA). These biases are impacted by a disproportionate number of observations where WCF equals 0 – 1% but the measured canopy is, on average, closer to 10% (Figure 4). Interestingly, there are

a few points in the new Qld data where the field measurement is only about 1% while the WCF-based estimate is over 26%. The s215 auditors noted that their transect measurements were very low and quite different from the proponent's mapping. However, in each case they concluded that the area did "exhibit forest potential" and that there were "numerous trees observed in the near distance" which suggests the difference may have just been due to sampling error or scale.

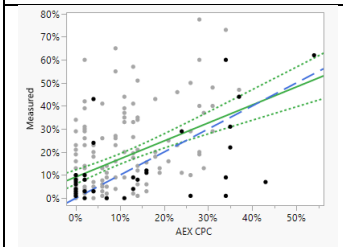
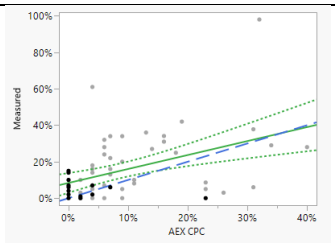
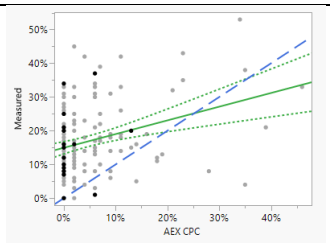
Queensland	New South Wales	Western Australia
		
R^2 = 0.24 RMSE = 0.17 N = 174 p < 0.001	R^2 = 0.19 RMSE = 0.15 N = 60 p < 0.001	R^2 = 0.09 RMSE = 0.17 N = 160 p < 0.001

Figure 4: Plot of Canopy Cover estimates (transformed from WCF estimated by Australia's Environment Explorer) against in situ measurements of canopy cover. Dashed line is 1:1. Solid line represents the line of best fit and dotted lines are the prediction intervals for best fit (p<0.05). Bold points indicate new observations.

These updated relationships confirm the previous conclusions that:

a) NFSW is unreliable for monitoring canopy cover or change in the CEAs. It is noteworthy that the National Forest Inventory proposes to update the modelling of NFSW to replace LandSat remotely sensing data with Sentinel-2 data (matching most HIR proponents), which should improve NFSW accuracy in future;
b) Both PG and WCF-based estimates significantly underestimate canopy cover, especially when cover is less than about 30%, although the positive linear relationship suggests that an increase in PG or WCF is correlated to an increase in canopy cover.
c) CER reviews should continue to use the above national scale sources to identify possible high-risk areas, but cannot rely on them to make definitive conclusions about the failure of areas to progress towards attaining forest cover. Higher precision remote sensing, LiDAR and/or field measurements are needed to verify the precision of the proponent's mapping in these high-risk areas to improve confidence in CEA success.

Conclusions

The additional data provided for this review do not change any of the discussions made previously.

After reviewing 85 Projects that have reported and passed their 5-yearly check, including about 400 independently measured field transects, I conclude that:

- The independent audit reports, CER reviews and s215 audits provide strong assurance that projects are being managed as per the HIR requirements;
- Appropriate methods have been used by the proponents or their agents in classifying their CEA and confirming regeneration canopy cover is meeting threshold levels;
- Minor areas of potential regeneration issues identified by ecologists/foresters during the expanded S215 audits appear to be within the guidelines for stratification accuracy but are required to be reviewed and potentially removed before the next reporting period;
- The CER reviews continue to appropriately utilize multiple sources of data, including national-scale models, to check whether regeneration thresholds at relevant scales are being met;
- National-scale models often result in conflicting conclusions and tend to significantly underestimate the canopy cover in CEAs;
- Substantive discrepancies between the models and the high-resolution data being used by proponents in stratification led to further information being required by CER before the regeneration check is accepted. Many proponents are now providing this additional data as a routine part of their regeneration checks and have formal methods to establish POPs, TOPs and FOPs.
- On average, stratification by proponents or their agents into CEA that are regenerating is reliable with an acceptable accuracy rate and accords with good practice.

Appendix 1: List of data / datasets provided for Brack 2023, 2024, 2025 reviews (extracted from Brack (2025))

Data, documents	**Description**	**Source**	**Use in Brack reviews**
Reasonable Assurance Audits of projects Note: Audits are peer reviewed by a third party to "*support the audit approach, findings and conclusions of the Audit Team*"	Auditors review documentation, data and processes to confirm the proponent met requirements of the HIR methodology; reported appropriately; and that the project has been implemented in accordance with the relevant methodology determinations and requirements of the CFI Act and CFI Rule, and associated guidelines (including the CFI Mapping Guidelines and HIR and NFRM Stratification Guidelines.	Independent greenhouse and energy auditors	Audit reports for each project were reviewed and any "issue/risk" identified by the auditors noted and impacts considered. Areas considered by Auditors were extensive and ranged from legal eligibility; stratification; modelling and calculations; documentation; and controls to prevent fraud. No project passed its 5-year review if there were unaddressed medium- or high risk- issues
Documentary evidence of management activities	Various documents, including invoices, sales dockets and other material to demonstrate project proponents met their requirements to fence, trap or otherwise remove feral animals; reduce/manage grazing/browsing to demonstrably safe level; etc.	Proponents (also sighted by auditors)	Examples sighted to confirm evidence that appropriate management action existed
Maps of stratification into baseline/pre-existing forest; non-project; and CEAs	Physical and/or digital maps along with details of map construction: satellite resolution (usually 1.5 – 10 m), supervised/unsupervised techniques, training sites and *in situ* data collection	Proponent / Agents	Physical maps sighted (or GIS layers accessed) to compare/contrast with other sources of evidence, especially AEX. Test accuracy with s215 field data.
Estimation of proponent's map accuracy,	Confusion / error matrix or other description of map accuracy. Description of accuracy analysis.	Proponent / Agents	Confirm accuracy evaluation and that accuracy exceeds acceptable threshold (85%). Noted any "justification" if poorer levels of accuracy were observed. Identified potential areas for further analysis

Maps of CEA strata with canopy cover (CC%)	Maps generated by agent's stratification and modelling. Aggregated into 100 ha cells for comparison with minimum threshold values	Proponent / Agents	Check to confirm CEAs meet 5-year thresholds, i.e. at least 7.5% canopy cover at 100 ha scale; or 5% increase in canopy cover. Access if any restratification occured to exclude portions of CEA that were insufficiently regenerating and failing to meet thresholds
Photographs and field measurements of CEA	Georeferenced photographs, measurements and descriptions of Permanent Observation Points (POPs) or Temporary Observation Points (TOPs) as volunteered	Proponent / Agents	Samples sighted to provide "overall" feeling for the projects [Note TOPs not included in statistical analyses to avoid perception/potential for biased sample point selection]
Maps of canopy cover estimates derived from NFSW[10] Various versions and release dates to match the reporting period	CPC estimated for 100 ha cells using conservative estimates of average CPC in each NFSW strata.	NFSW / National Inventory through DCCEEW, and accessed via data.gov.au	Compare/contrast canopy cover estimates with the Agent produced maps. Note patterns; any substantive difference in maps; and areas where 100 ha cell fail to meet minimum thresholds.
Maps derived from Persistent Green[11] (PG), (Auscover) Various versions and release dates to match the reporting period	Persist vegetation coverage estimates in 100 ha cells.	TERN, physical maps provided by CER	As for NFSW, but noting PG theoretically includes estimates of vegetation cover regardless of vegetation height

[10] Australian Government (2019) National Inventory Report 2017: Volume 2 [page 149]

[11] Gill, T., Johansen, K., Scarth, P., Armston, J., Trevithick, R., Flood, N. (2015). Persistent Green Vegetation Fraction. In A. Held, S. Phinn, M. Soto-Berelov, & S. Jones (Eds.), AusCover Good Practice Guidelines: A technical handbook supporting calibration and validation activities of remotely sensed data product (pp. 134-154). Version 1.1. TERN AusCover, ISBN 978-0-646-94137-0.

Mega Forest Cover Tool	A purpose-built analytical spreadsheet tool tracking change in vegetation cover within CEAs and project area using multiple data sources including each version of the maps that inform the National inventory from 2015 to present	CER, using National inventory data accessed via data.gov.au	Check whether project meets the 5% increase in canopy cover threshold
Documents and emails on CER comparisons of canopy maps	Analysis and comment on any substantive differences between NFSW, Persistent Green and Proponent values at 100 ha scale, and requests for further evidence as required	CER	Check whether CER analysis agree with mine and what additional evidence would be needed to provide assurance
Historic / archive remote sensing images	Sequences of images for sample areas where there is concern that thresholds not being met	Wayback imagery via CER	Samples checked to see if I agree with CER conclusions about the temporal images indicating increases in cover
Additional evidence provided in response to CER identification of "points of interest"	Georeferenced photographs and/or in-situ measurements of canopy cover / number of trees capable of achieving 2+ m height for areas, including those selected by CER for follow-up	Proponent / Agents	Used in statistical analyses given CER assign POI locations and proponents/agents have restricted potential to bias sampling.
Australian Environment Explorer (AEX) integrated data visualization and modelling via TERN) Estimates of current/historic weather; soil condition; fire; social/management; environmental condition and	20 – 30 points / project (600 points overall) systematically examined using remotely sensed imagery in 2023 250+ points of interest across about 50 projects in 2024, 2025.	https://ausenv.tern.org.au/aex/ ANU Water and Landscape Dynamics	WCF used in accuracy estimates of agent estimates (2023) and comparisons with all other canopy cover estimates available to CER in 2024, 2025 AEX also provides comprehensive contextual information to improve interpretation of estimates

Woody Cover Fraction[3] (WCF)			
TreeChange	Estimates of WCF, vegetation height and biomass over user nominated areas	http://www.wenfo.org/tree/ ANU Water and Landscape Dynamics	Comprehensive contextual information about vegetation dynamics surrounding project areas. Provides confidence forest cover can be achieved if vegetation in neighbouring regions has reached minimum heights and cover
Offsets reports	Details of modelling, any changes in stratification, offset calculations and modelling	Proponent / Agents	Data to support statistical analyses
s215 audits	Reports and raw data including georeferenced photographs, in situ measurements of tree canopy, regeneration and comments on likelihood of achieving forests status at Points of Interest (identified by CER) and Temporary or Permanent Sample Points selected by auditors	Independent and registered audit teams (including ecologists/foresters with relevant expertise) 2024, 2025	Used in statistical analyses and independent accuracy assessment of agent stratification given CER assign POI locations and proponents/agents have restricted potential to bias sampling. Review of auditors' expert assessments on the accuracy of proponent's mapping and whether CEAs are meeting regulation conditions

[3] Liao, Z., VanDijk, A.I.J.M., He, B., Larraondo, P.R and Scarth, P.F. (2020) Woody vegetation cover, height and biomass at 25-m resolution derived from multiple site, airborne and satellite observations. Int J Appl Earth Obs Geoinformation 93: 102209