PROJECT REVIEW REPORT

This project review report includes findings raised during Verra's review of the project specified below. The VVB must address the findings before the project request can be considered for approval by Verra. The project review report will be made publicly available on the Verra Registry. Confidential information may be provided in separate attachments.

Project ID	2710
Project Name	Soil carbon improvement Project through Grassland Management, in South Africa
Review Type	Verification 1
Program(s)	VCS
Verification Period	01 July 2018 – 31 December 2022
Project Proponent	WeAct Pty Ltd
Methodology	VM0026 Methodology for Sustainable Grassland Management (SGM), v1.1
VVB	4K Earth Science Private Limited (4KES)
Assessment Criteria	*VCS Standard, 4.7*
Date of First Issue	17 April 2025
Date of Second Issue	24 July 2025
Date of Third Issue	26 August 2025
Review Conclusion	Approved
Date of Final Issue	30 September 2025

FINDINGS

#	Finding Description	VVB Response	Status
1	**Insufficient description of project activities implemented**		
	<u>Issue</u> On Section 3.1 of the MR, there is insufficient description of the activities implemented during the monitoring period as part of the project implementation. <u>Action Required</u> 1. The project proponent must provide a **detailed description** of the activities implemented during the monitoring period, addressing how controlled burning and planned rotational grazing were implemented. Specifically, but not limited to: a. **Implementation Details:** ○ A clear and comprehensive	**Round 1** In response to the VERRA comment, the Project Proponent (PP) has submitted a comprehensive and strata-wise description of activities implemented during the monitoring period, covering both rotational grazing and controlled burning. The updated documentation outlines the methodologies adopted, the frequency and timing of activities, and the adaptive management strategies applied. Area coverage for rotational grazing has been reported for each Strata and supported through detailed zone-wise details including the latitude and longitude of the patches where rotational grazing activities were practiced. **1. Implementation Details**	Closed

explanation of how controlled burning and planned rotational grazing were conducted. E.g., the specific methodologies, techniques, plans, frequency, and timelines followed for each activity.

b. **Area Coverage:**
   - The total area where each type of practice (i.e., categories defined via implementation details above) was implemented, with relevant geographical details, which may include maps, figures or spatial data.

2. The VVB must address the update made by the Project Proponent and provide the evidence gathering activities for each item, the evidence checked, and the conclusion of the assessment.

<u>Program Rule(s)</u>

VCS Standard, v4.7, Section 3.2.4

VCS Monitoring Report Template, v4.4, Section 3.1

The Bennidale Trust

IT 1488/2010/PMB *D319 Table Mountain Road, Bishopstowe, PIETERMARITZBURG, 3201* *Vat No 4490259043*

a) FERTILIZER

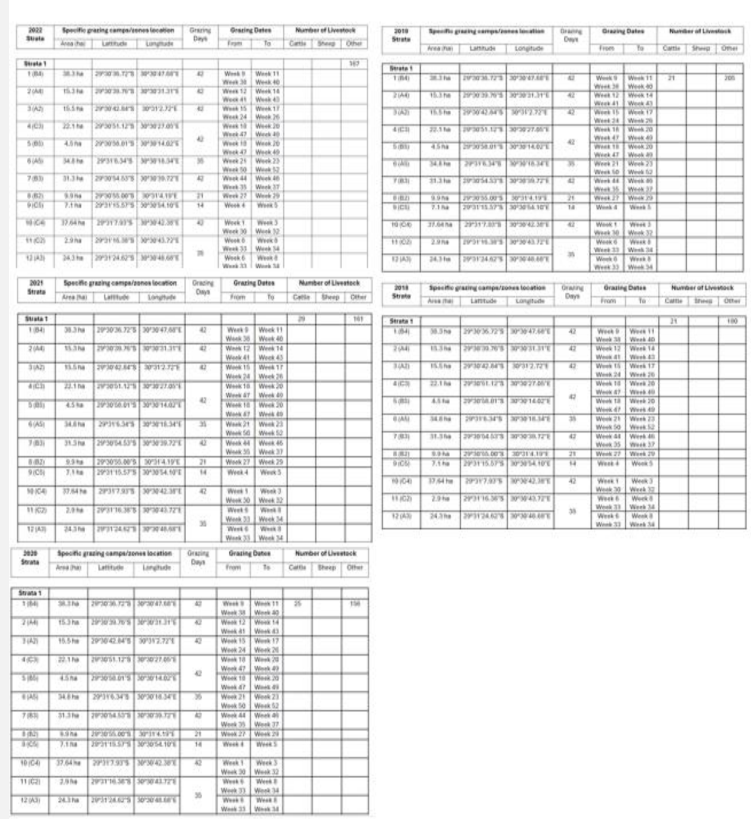
Year	Fertilizer applied (kg/ha)		
	LAN	Urea	Other
2013	0	0	0
2014	0	0	0
2015	0	0	0
2016	0	0	0
2017	0	0	0
2018	0	0	0
2019	0	0	0
2020	0	0	0
2021	0	0	0
2022	0	0	0

b) BURNING

Year	Area burned (ha)	AGB before burning (t biomass/ha)	AGB after burning (t biomass/ha)
2013	69.74	0.333	0.125
2014	69.74	0.341	0.129
2015	69.74	0.332	0.113
2016	70.12	0.327	0.109
2017	73.43	0.335	0.117
2018	36.39	0.512	0.191
2019	0	0.000	0.000
2020	0	0.000	0.000
2021	0	0.000	0.000
2022	0	0.000	0.000

c) LIVESTOCK

Year	Cattle	Sheep	Other
2013-2014	21	0	130
2015-2016	21	0	130
2016-2017	21	0	130
2018	21	0	180
2019	21	0	205
2020	25	0	156
2021	29	0	161
2022	30	0	167



2022 Strata	Specific grazing camps/zones location			Grazing Days	Grazing Dates		Number of Livestock		
	Area (ha)	Latitude	Longitude		From	To	Cattle	Sheep	Other
Strata 1									167
1 (B4)	38.3 ha	29°30'36.72"S	30°30'47.68"E	42	Week 9 Week 38	Week 11 Week 40			
2 (A4)	15.3 ha	29°30'39.76"S	30°30'31.31"E	42	Week 12 Week 41	Week 14 Week 43			
3 (A2)	15.5 ha	29°30'42.84"S	30°31'2.72"E	42	Week 15 Week 24	Week 17 Week 26			
4 (C3)	22.1 ha	29°30'51.12"S	30°30'27.05"E	42	Week 18 Week 47	Week 20 Week 49			
5 (B5)	4.5 ha	29°30'58.01"S	30°30'14.02"E		Week 18 Week 47	Week 20 Week 49			
6 (A5)	34.8 ha	29°31'6.34"S	30°30'18.34"E	35	Week 21 Week 50	Week 23 Week 52			
7 (B3)	31.3 ha	29°30'54.53"S	30°30'39.72"E	42	Week 44 Week 35	Week 46 Week 37			
8 (B2)	9.9 ha	29°30'55.00"S	30°31'4.19"E	21	Week 27	Week 29			
9 (C5)	7.1 ha	29°31'15.57"S	30°30'54.10"E	14	Week 4	Week 5			
10 (C4)	37.64 ha	29°31'7.93"S	30°30'42.38"E	42	Week 1 Week 30	Week 3 Week 32			
11 (C2)	2.9 ha	29°31'16.38"S	30°30'43.72"E	35	Week 6 Week 33	Week 8 Week 34			
12 (A3)	24.3 ha	29°31'24.62"S	30°30'48.68"E		Week 6 Week 33	Week 8 Week 34			

2021 Strata	Specific grazing camps/zones location			Grazing Days	Grazing Dates		Number of Livestock		
	Area (ha)	Latitude	Longitude		From	To	Cattle	Sheep	Other
Strata 1							29		161
1 (B4)	38.3 ha	29°30'36.72"S	30°30'47.68"E	42	Week 9 Week 38	Week 11 Week 40			
2 (A4)	15.3 ha	29°30'39.76"S	30°30'31.31"E	42	Week 12 Week 41	Week 14 Week 43			
3 (A2)	15.5 ha	29°30'42.84"S	30°31'2.72"E	42	Week 15 Week 24	Week 17 Week 26			
4 (C3)	22.1 ha	29°30'51.12"S	30°30'27.05"E	42	Week 18 Week 47	Week 20 Week 49			
5 (B5)	4.5 ha	29°30'58.01"S	30°30'14.02"E		Week 18 Week 47	Week 20 Week 49			
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8 (B2)	9.9 ha	29°30'55.00"S	30°31'4.19"E	21	Week 27	Week 29			
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12 (A3)	24.3 ha	29°31'24.62"S	30°30'48.68"E		Week 6 Week 33	Week 8 Week 34			

2020 Strata	Specific grazing camps/zones location			Grazing Days	Grazing Dates		Number of Livestock		
	Area (ha)	Latitude	Longitude		From	To	Cattle	Sheep	Other
Strata 1									
1 (B4)	38.3 ha	29°30'36.72"S	30°30'47.68"E	42	Week 9 Week 38	Week 11 Week 40	25		156
2 (A4)	15.3 ha	29°30'39.76"S	30°30'31.31"E	42	Week 12 Week 41	Week 14 Week 43			
3 (A2)	15.5 ha	29°30'42.84"S	30°31'2.72"E	42	Week 15 Week 24	Week 17 Week 26			
4 (C3)	22.1 ha	29°30'51.12"S	30°30'27.05"E	42	Week 18 Week 47	Week 20 Week 49			
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8 (B2)	9.9 ha	29°30'55.00"S	30°31'4.19"E	21	Week 27	Week 29			
9 (C5)	7.1 ha	29°31'15.57"S	30°30'54.10"E	14	Week 4	Week 5			
10 (C4)	37.64 ha	29°31'7.93"S	30°30'42.38"E	42	Week 1 Week 30	Week 3 Week 32			
11 (C2)	2.9 ha	29°31'16.38"S	30°30'43.72"E	35	Week 6 Week 33	Week 8 Week 34			
12 (A3)	24.3 ha	29°31'24.62"S	30°30'48.68"E		Week 6 Week 33	Week 8 Week 34			

2019 Strata	Specific grazing camps/zones location			Grazing Days	Grazing Dates		Number of Livestock		
	Area (ha)	Latitude	Longitude		From	To	Cattle	Sheep	Other
Strata 1									
1 (B4)	38.3 ha	29°30'36.72"S	30°30'47.68"E	42	Week 9 Week 38	Week 11 Week 40	21		205
2 (A4)	15.3 ha	29°30'39.76"S	30°30'31.31"E	42	Week 12 Week 41	Week 14 Week 43			
3 (A2)	15.5 ha	29°30'42.84"S	30°31'2.72"E	42	Week 15 Week 24	Week 17 Week 26			
4 (C3)	22.1 ha	29°30'51.12"S	30°30'27.05"E	42	Week 18 Week 47	Week 20 Week 49			
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11 (C2)	2.9 ha	29°31'16.38"S	30°30'43.72"E	35	Week 6 Week 33	Week 8 Week 34			
12 (A3)	24.3 ha	29°31'24.62"S	30°30'48.68"E		Week 6 Week 33	Week 8 Week 34			

2018 Strata	Specific grazing camps/zones location			Grazing Days	Grazing Dates		Number of Livestock		
	Area (ha)	Latitude	Longitude		From	To	Cattle	Sheep	Other
Strata 1							21		180
1 (B4)	38.3 ha	29°30'36.72"S	30°30'47.68"E	42	Week 9 Week 38	Week 11 Week 40			
2 (A4)	15.3 ha	29°30'39.76"S	30°30'31.31"E	42	Week 12 Week 41	Week 14 Week 43			
3 (A2)	15.5 ha	29°30'42.84"S	30°31'2.72"E	42	Week 15 Week 24	Week 17 Week 26			
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Figure 1: Glimpse of details related to rotational grazing, controlled burning and other project activities provided in the declaration submitted by each of the Ranches (22 in numbers) included in the project

Planned Rotational Grazing

For example, in Strata 1, the following were confirmed:

- Practice Adopted: Rotational/controlled grazing, implemented from 2018 under the guidance of Conservation Outcomes.
- Grazing Duration: 365 days/year, 8 hours/day.

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- Dung Management: No collection or management – dung is left on-site.
- Camp-Based Management: Each year (2018–2022), 12 grazing camps were used with defined grazing days and weeks per rotation.
- Zone-Level Data Includes:
  - Camp ID
  - Area (in hectares)
  - GPS coordinates
  - Grazing calendar (week range)
  - Number of grazing days per zone

This system was implemented across all strata, with the area under rotational grazing documented per block. The declarations also record annual livestock numbers per stratum, and seasonal rotation schedules were validated during the audit.

Controlled Burning

Example –

- **Starta 1** - Controlled burning was conducted from 5th July 2018 onwards, in camps such as A4, A5, B2, and B3. This activity was implemented to reduce moribund biomass, promote palatable species, and restore =grassland health.
- Post-2018 (2019–2022): No burning was conducted. This decision was based on ecological conditions and a shift toward non-fire-based management due to improved grazing practices.
- The declaration confirms “No burn” for each camp annually from 2019–2022, with corresponding AGB/BGB data showing 0.000 t/ha burned.
- The absence of burning is supported by:
  - Adequate grazing to manage livestock grazing to reduce the amount of dry or excess vegetation in the landscape, thereby lowering the risk or need

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		for controlled burning or wildfires. ○ Protection of soil and biodiversity, ○ Reduced fire risk, This approach aligns with adaptive management principles, whereby fire is only used if ecologically justified. • **Another example: In case of Strata 21** - The landowner explicitly declares the adoption of controlled burning as part of sustainable grassland management from 02 July 2018 onward, alongside rotational grazing, fencing, and planning. Burning has been consistently applied every year, even after the project started in 2018. The area, timeline, ecological parameters, and fire management records are complete and traceable, satisfying key VCS monitoring expectations. When checked during the audit the controlled burning implemented from 2018 to 2022 under the sustainable grassland management project scenario contributed to ecological restoration, reduced fire risk, improved forage quality, and facilitated rotational grazing efficiency. **Area Coverage** Rotational Grazing: Implemented in all strata. Each declaration includes camp/paddock-level data, area (ha), GPS coordinates, and time of grazing. In some of the ranch it includes number and type if animal grazed as well. Controlled Burning: year wise total area burned. In some of the Ranch declaration, it includes zone-level detail on area burned, date, temperature, and humidity. **The VVB undertook the following steps:** • Reviewed all “Implementation Declaration” submitted by the PP for all the strata for the MP (2018-2022)	

		- Cross-checked livestock counts, grazing days, woody vegetation, fertilizer inputs and burn schedules with declared documents and field data
		- Conducted a site visit audit, during which:
		    ○ Randomly selected strata and camps were physically inspected
		    ○ Local landowners and managers were interviewed to confirm grazing and burn practices
		    ○ Verified presence of firebreaks, no-burn zones, and evidence of adaptive rotation
		Hence, it was concluded that the PP has sufficiently addressed the requirements under Section 3.1 of the Monitoring Report. The PP provided verifiable implementation details, zone-level area coverage, and ecological justification for fire use. The VVB has reviewed and validated this information through documentation review and field evidence.
		Based on the revised details provided by the PP, section 4.3 of the verification report, v2 has now been updated. Detailed assessment regarding controlled burning and planned rotational grazing has been added in the VR.
		
		Documents submitted in response to finding 1:
		MR v3
		VR v2
		ERR v2 (a few values of fertilizer and burning area has been updated)	

		Verra Response Section_3.1 of the MR and 4.1 of the VR were updated to include sufficient description of the activities implemented during the monitoring period as part of the project implementation. This finding is now closed and no further action is required.	

2	**Insufficient monitoring description**		
	Issue	Round 1	Closed

	In Section 4.3 of the MR, the description of the monitoring plan of implemented activities carried out is insufficient. <u>Action Required</u> 1. The project proponent must provide a comprehensive description of how the monitoring plan was implemented (i.e., process and schedule followed) during the monitoring period, rather than simply restating the plan from the project description. The response should address the following: a. An explanation of how and the schedule of monitoring activities for controlled burning and planned rotational grazing were conducted in practice. b. Any deviations from the original monitoring plan and the reasons for such adjustments. c. A detailed timeline and workflow describing how monitored data and parameters (as set out in Section 4.2) were obtained, compiled, and analyzed throughout the monitoring period. d. The competencies of personnel involved in monitoring activities. e. Description of any internal audits performed, including: ○ How audits were conducted. ○ Identification and resolution of non-	<u>VVB Response</u> 1. The PP has now provided a comprehensive description of how the monitoring plan was implemented in the revised section 4.3 of the MR. The response addresses the following: a) The PP has clarified that monitoring of key parameters (livestock numbers, planned rotational grazing, burning events, fertilizer application, woody biomass report and fencing condition) was completed via ranch owner reports, supported by a soil analysis report from accredited laboratories. The VVB has reviewed: a. Ranch owner implementation declarations b. Laboratory soil analysis results c. Biomass monitoring documentation prepared by The Biodiversity Company d. Annual survey report of ranchers The above evidence, the audit site visits and interviews with implementation staff and ranchers confirm that monitoring was conducted in accordance with the registered monitoring plan and in alignment with the applicable methodological requirements. The PP has provided details demonstrating that the monitoring schedule for key parameters was consistently followed during the current monitoring period (01 July 2018 to 31 December 2022).	

conformities or discrepancies in monitored data.

f. A detailed description of the sampling approaches implemented during the monitoring period, including:
   - How the QA/QC procedures were applied to sampling.
   - Whether the required confidence level or precision was achieved.

g. If applicable, provide line diagrams illustrating the GHG data collection and management system to demonstrate how data flows from collection to reporting.

2. The VVB must address the update made by the project proponent and provide the evidence gathering activities for each item, the evidence checked, and the conclusion of the assessment.

<u>Program Rule(s)</u>

VCS Standard, v4.7, Section 3.16

VCS Monitoring Report Template, v4.4, Section 4.3

Parameters/ Activities	Monitoring methods applied	Date/ frequency of monitoring/recording
Project area	GIS mapping	2022
Grazing Days	Project record kept with project participant i.e., livestock owner.	Annually from 2018, (For this monitoring period: 2018-2022)
Grazing hours	Project record kept with project participant i.e., livestock owner	Annually from 2018, (For this monitoring period: 2018-2022)
Project areas of grassland with management practice[1]	Project record kept with project participant i.e., livestock owner	Annually from 2018, (For this monitoring period: 2018-2022)
geographic location of the project area	using geo-referenced spatial data GIS datasets).	2022
Management plan	Questionnaire, interview, field survey	Annually from 2018, (For this monitoring period: 2018-2022)
Fertilizer use	Questionnaire, project record	Annually from 2018, (For this monitoring period: 2018-2022)
Livestock population	Project record,	Annually from 2018, (For this monitoring period: 2018-2022)
Burning	Project record, interview	Annually from 2018, (For this monitoring period: 2018-2022)
Soil sampling & testing	Field sampling and laboratory analysis	July, August, September, October, November, December 2022. Exact date of sampling has been provided in section" sampling framework" and ERR sheet
Above ground woody biomass	Field sampling	October – December, every Year, from 2018 (For this monitoring period: 2018-2022).
Total number of employments	Working contract, payment record	Every year, from 2018 (For this monitoring period: 2018-2022)
Total number of people improved livelihoods or income generated as a result of project activities	Working contracts and payment records Questionnaire and interview Training records	Every year, from 2018 (For this monitoring period: 2018-2022)
Total number of people who have improved skills and/or knowledge resulting from training provided as part of project activities	Training records Questionnaire and interview	Every year, from 2018 (For this monitoring period: 2018-2022)

b) The PP has confirmed (in sections 4.3 and 3.2) there were no deviations from the registered project design's monitoring plan during this period. This has been cross verified by the VVB by comparing the

		current monitoring schedule with the monitoring plan approved in the registered PD. This has also been clearly mentioned by the VVB in section 3.2.2 of the VR that "the project did not apply any project description deviations". A further line to ensure the same has been added in the revised VR, v2 section 4.3. **Evidence checked/reviewed:** Registered PD c) The revised MR includes a detailed timeline and workflow for monitoring and data collection activities. The VVB confirms the presence of a clear stepwise description of: a. Data collection timing per parameter b. Responsible personnel c. Data aggregation and QA review **Evidence checked/reviewed:** The VVB has reviewed the CVs of the management team, conducted one to one interviews and data collection procedure and records and conclude that the timeline and workflow of monitoring are clearly described and traceable d) Monitoring Team and Competency a. The monitoring activities were coordinated by a Joint Task Force, led by WeAct Pty Ltd. b. The VVB has reviewed personnel qualifications and confirms that relevant technical staff (e.g., Area in Charge, office managers, GIS analysts, field supervisors) possess adequate expertise to conduct monitoring as per methodology requirements. **Evidence checked/reviewed:** CVs, role descriptions, organizational chart. All these were also confirmed during the audit site visit and discussions during the complete	

		validation and verification process. e) Internal Audit and NC Handling a. The PP has included a detailed section on the procedure for internal audits and handling of non-conformities in the revised MR. The MR states that monitoring personnel were trained in standardized procedures for data collection and analysis. Random spot checks and remeasurements were conducted by senior members of the monitoring team to ensure data reliability. A three-tier data verification protocol was applied involving - Field crew supervisors, Ranch owners and The Endangered Wildlife Trust (EWT). Multiple personnel reviewed field data and calculations to ensure transparency and quality control. Additionally, data is centrally stored using Microsoft SharePoint, enabling real-time access and cross-verification. The MR also describes how data was reconciled with on-ground observations through supervisory oversight. **Evidence checked/reviewed:** Monitoring records/data, Microsoft SharePoint folder, CVs of technical team involved and on-site interviews with the management team and staff. b. The VVB confirms that the internal audit procedures described by the PP include the following elements: i. Defined frequency and scope of internal audits ii. Clear roles and responsibilities of internal QA/QC personnel iii. Documented steps for identifying,	

		assessing, and resolving non-conformities in monitored data or implementation **Evidence checked/reviewed:** Monitoring records/data, training records (training reports, attendance sheets), SOPs for data collection, management team and staff CVs demonstrating relevant expertise, sampling plan, audit reports, and interviews with the PP and other partners involved in the project. f) Sampling and QA/QC a. The revised MR provides a detailed description of the sampling design used to achieve a precision of ±15% at 95% confidence. b. The VVB has reviewed the statistical basis for stratification, sample size determination, and field sampling protocols. c. QA/QC procedures related to plot re-measurement, supervisor cross-checks, and data verification are described in line with methodology expectations. g) Monitoring Structure Diagram a. The VVB confirms that Section 4.3 of the revised MR includes a visual diagram and tabulated details illustrating the data collection process, responsible personnel/teams, and their respective roles in data collection and reporting. The information presented is consistent with the arrangements observed and discussed during the validation and verification site visit. Relevant organizational representatives and personnel were interviewed during the audit	

		to confirm these arrangements. The diagram added in response to VERRA's finding, enhances the transparency of the monitoring framework and aligns with best reporting practices. The VVB has assessed the updates made by the PP and provided the evidence gathering activities for each item and the evidence checked, and the conclusion of the assessment. Accordingly, sections 4.3 and 4.4 of the verification report has been updated. **Documents submitted in response to finding 2:** MR v3 VR v2	
		Verra Response Section 4.3 of the MR was updated to provide a description of the monitoring plan for implemented activities. This finding is now closed, and no further action is required.	

3	**Allometric equation appropriateness not demonstrated**		
	Issue 1. The source of the allometric equation used for ex-post woody biomass calculation is not reported. 2. The project does not demonstrate, and the VVB does not assess, the appropriateness of the allometric equation. Action Required 1. The VVB must ensure that Sections 5.1.7 and 5.2.7 of the MR are updated to include details of the allometric	**Round 1** VVB Response 1. The PP has now revised section 5.1.7 and 5.2.7 of the MR and has included the following details: a) Source of Allometric Equation: The source of the allometric equation used for ex-post woody biomass estimation have now been clearly cited. The equation was selected based on peer-reviewed literature relevant to the project region and species composition.[1] b) Appropriateness of the Equation: The applicability of	Closed

[1] Explanation given in the response b of the finding

	equation(s) used to calculate woody biomass. Including, a. The source of equation(s) b. The appropriateness of the equation(s) as required by the AR-TOOL14. 2. The VVB must assess the appropriateness of the equation(s) used and the accuracy of the ERRs in Section 4.3 of the VR. Program Rule(s) AR-TOOL14, v4.2, Appendix 1(7) Background *"For ex-post estimation, the allometric equation used must be demonstrated to be appropriate for the purpose of estimation of tree biomass by applying the tool "Demonstrating appropriateness of allometric equations for estimation of aboveground tree biomass in A/R CDM project activities"[...]".* Further, the GHG ERR spreadsheet tab "PDB_woody perennials" shows the calculation of biomass of tree species, but no description of the calculation, assumptions and justification is provided in the MR.	the selected allometric equation has been assessed in line with the requirements of AR-TOOL14. The MR has been updated to reference the allometric equations developed by Kuyah et al. (2012)[2] based on destructive sampling of trees in Western Kenya. The VVB has assessed the appropriateness of applying these equations to the South African project context in accordance with AR-TOOL14 requirements section 7. According to section 7, of the applied Tool14, for ex-post estimation, the project must justify that the allometric and volume equations used for estimating tree biomass are suitable and scientifically valid, by applying the Tool "Demonstrating appropriateness of allometric equations for estimation of aboveground tree biomass in A/R CDM project activities." Based on v1.0.1[3] of the Tool 18, section 5, a species-specific or group-of-species-specific volume table or volume equation derived from trees growing in edapho-climatic conditions similar to those in the project area is considered appropriate, and hence can be used for ex post estimation of tree stem volume, if at least one of the following conditions is satisfied: a) The equation is used in the national forest inventory, or the national GHG inventory,	

[2] Allometric equations for estimating biomass in agricultural landscapes: I. Aboveground biomass https://www.researchgate.net/publication/256295820_Allometric_equations_for_estimating_biomass_in_agricultural_landscapes_I_Aboveground_biomass

[3] https://cdm.unfccc.int/methodologies/ARmethodologies/tools/ar-am-tool-18-v1.0.1.pdf

		of the host Party; b) The equation has been used in commercial forestry sector of the host Party for 10 years or more; c) The equation was derived from a data set of at least 30 sample trees, and the value of coefficient of determination (R^2) was not less than 0.85. The equation applied by the PP fulfils one of the conditions i.e., condition c - Kuyah et al.'s equation was derived from 72 trees, with $R^2 = 0.977$, showing strong predictive reliability. And the equations are derived from tree stem volume based on DBH. Apart from that the VVB can also see that the project area and the study have the following ecological similarity: • Trees are widely spaced. • Lower Yala, Middle Yala, and Upper Yala (Western Kenya) and the Mpumalanga, Eastern Cape, KwaZulu-Natal, and Free State Provinces (South Africa) primarily relate to climate, land use, and vegetation structure in semi-arid to sub-humid agricultural landscapes. <table><tr><td>Region</td><td>Agroecological Type</td></tr><tr><td>Yala Basin (Western Kenya)</td><td>Semi-arid to sub-humid tropical highlands[4]</td></tr></table>	

[4] Baseline Report Yala and Nzoia River Basins https://apps.worldagroforestry.org/economics_papers/anonymous/WKIEMP/Datasets/Louis%20Verchot/Reports%20for%20KARI/Year%202%20and%203%20deliverables/PDFs/Baseline%20Report%20Yala%20River%20Basin%20final.pdf

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<tr><td>Mpumalanga / KZN / Eastern Cape / Free State</td><td>Semi-arid to sub-humid subtropics & temperate highlands[5]</td></tr>
</table>

Average Annual rainfall - Kenya’s average annual precipitation is 680 mm[6], SA average precipitation 500 mm[7]. Study area specific rainfall – 1028 – 1950 mm and Project area specific rainfall - (KwaZulu-Natal 650 mm - 1400 mm[8]) (eastern cape

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https://www.researchgate.net/figure/The-agro-climate-zone-map-of-Kenya-based-on-LGP-classes_fig6_265236048

[5] Climate and agro-ecological zones of South Africa https://www.fao.org/4/y5998e/y5998e06.htm

[6] https://climateknowledgeportal.worldbank.org/country/kenya/climate-data-historical#:~:text=Kenya's%20average%20annual%20precipitation%20is,is%20the%20productive%20agricultural%20land

[7] https://nccis.environment.gov.za/climate-services/saws-climate-products/maps-and-graphs

https://southafrica.co.za/rainfall-south-africa.html

[8] https://www.researchgate.net/figure/Mean-annual-rainfall-for-the-weather-stations-within-the-three-climatic-regions_fig2_350409353#:~:text=Demlie%2C%202020).-,The%20mean%20annual%20rainfall%20in%20KwaZulu%2DNatal%20ranges%20from%20650,et%20al.%2C%202021)%20

		– 350 – 550 mm[9]) (Mpumalanga – 620 mm[10]) and (Free State – 1020 mm[11]) • Soil type - Dominant soil types along both the regions are comprised of sandy, loamy and clayey[12] with no organic present and acidic pH • Altitude and slope – Yala region 1200 m – 2200	

[9] https://www.researchgate.net/figure/Annual-rainfall-mm-summaries-for-the-stations_tbl1_268458598

[10] https://www.sa-venues.com/weather/mpumalanga.php#:~:text=Nelspruit%2C%20the%20capital%20city%20of,in%20the%20Kruger%20National%20Park

[11] https://www.britannica.com/place/Free-State

[12] PRA study of the project area and Climate and agro-ecological zones of south Africa https://www.fao.org/4/y5998e/y5998e06.htm and for the study area https://www.researchgate.net/publication/256295820_Allometric_equations_for_estimating_biomass_in_agricultural_landscapes_I_Aboveground_biomass and https://apps.worldagroforestry.org/economics_papers/anonymous/WKIEMP/Datasets/Louis%20Verchot/Reports%20for%20KARI/Year%202%20and%203%20deliverables/PDFs/Baseline%20Report%20Yala%20River%20Basin%20final.pdf

		m[13] and project area (1800 m (Free state[14]), Mpumalanga (1200 -1800 m[15]), (Eastern Cape – 2700 m[16]) (KZN avg – 777m – max – 3405 m[17]) Hence, based on: 1. Fulfillment of condition 5 c of the Tool 18 and hence fulfilling the requirements of the applied Tool 14 2. Demonstrated ecological similarity between the study and project areas in accordance with the requirements of Tool 18, VCS methodology requirements, v4.4 section	

[13] Allometric equations for estimating biomass in agricultural landscapes: I. Aboveground biomass https://www.researchgate.net/publication/256295820_Allometric_equations_for_estimating_biomass_in_agricultural_landscapes_I_Aboveground_biomass

https://www.researchgate.net/figure/Smaller-map-shows-the-location-of-the-Yala-River-Basin-in-western-Kenya-Enlarged-maps_fig1_332327177

[14] https://www.britannica.com/place/Free-State

[15] https://www.britannica.com/place/Mpumalanga

[16] https://www.britannica.com/place/Eastern-Cape-province-South-Africa

[17] https://en-ie.topographic-map.com/map-l68hf3/KwaZulu-Natal/?center=-26.08935%2C31.0517&zoom=6

		3.2.7[18] and other internationally accepted studies[19] the VVB considers the applied allometric equation appropriate for ex-post woody biomass estimation in this project context. 3. The VVB has assess the appropriateness of the equation used and the accuracy of the ERRs in Section 4.3 of the updated VR, v2. **Documents submitted in response to finding 3:** MR v3 VR v2	
		<u>Verra Response</u> Sections 5.1.7 and 5.2.7 of the MR were updated to include details of the allometric equation used to calculate woody biomass. Additionally, Section 4.3 of the VR was updated to include the VVB's assessment of the appropriateness of the allometric equation. This finding is now closed, and no further action is required.	

4	**Insufficient demonstration of SOC estimations conservativeness and zero uncertainty**		
	<u>Issue</u> 1. The MR does not follow the procedure to determine a conservative estimate of	**Round 1** <u>VVB Response</u> 1. Section 5.2.8 of the MR: The SOC baseline is estimated based on the laboratory report conducted by the third party, The Biodiversity Company". The report has been	Closed

[18] https://verra.org/wp-content/uploads/2023/08/VCS-Methodology-Requirements-v4.4-updated-4-Oct-2023.pdf

[19] https://winrock.org/wp-content/uploads/2018/08/Winrock-AllometricEquationGuidance-2016.pdf?utm

https://annforsci.biomedcentral.com/articles/10.1007/s13595-014-0415-z?utm

	baseline and project emissions. Specifically, a. The sample size for SOC stocks at t=0 (i.e., $SOC_{S,Baseline}$) is less than 30 as required in the methodology (i.e., 22; Section 4.1 of the PD). b. The sample size for project scenario SOC stocks for each stratum is less than 30, and cannot be considered a "large" sample size per Section 8.2.9 of the methodology. 2. There is insufficient assessment in the VR and description in the PD that demonstrate the conservativeness of SOC stocks and increases: a. The $SOC_{S,Baseline}$ of 8.5 tC/ha is calculated using data from peer-reviewed literature (MR, Section 4.1). However, the calculated value is not within the range of the	submitted for validation and verlification. a. The details related to $SOC_{s,Baseline}$ were previously explained and assessed during the validation of the project. In the Validation PRR (Finding 12), the methods and procedures applied for determining $SOC_{s,Baseline}$ were clearly described and accepted by Verra. However, in response to this finding of VERRA, we are reiterating the information below for clarity. Two sets of baseline soc data were available initially: (i) Internal Survey Data: 1. Conducted by EWT (Endangered Wildlife Trust) over 43 strata. 2. Details are in the 2020 Detailed Project Report (DPR). 3. Not verified or certified by any third party. 4. Used only for internal reference, not officially adopted in the PD. (ii) Literature-based Data: 1. Sourced from Agricultural Research Council (ARC). 2. Reviewed by a third party (The Biodiversity Company). 3. Considered public, credible, and conservative. Therefore, details related to the sampling survey, procedures etc. are not applicable and hence not included for the baseline; whereas details related to the sampling survey can be referred from the detailed project report which was prepared in 2020 for internal references and was also checked by the VVB. However, this will not affect the accuracy or conservativeness of estimated GHG benefits as mentioned below. The estimated GHG benefit unlikely to have significant effect since highest value for baseline SOC (8.5 tC/ha) stock has been considered to calculate the SOC change over the project scenario. As the highest SOC data has been considered, the change between baseline and project SOC stocks could appear to be lower if the samples had been collected in 2018, reducing estimated emissions removals and increasing the conservativeness of estimated GHG benefits.	

SOC stocks reported in the cited literature (see Background).

b. The reported SOC increase rate of 0.64 tC/ha/year appears to be high for grassland management in South Africa, based on existing studies and data (see Background).

Action Required

1. The VVB must ensure that Section 5.2.8 of the PD is updated to calculate uncertainty, unless the sample sizes used to calculate SOC stock in the baseline and project scenario, respectively, are greater than 30 per stratum.
2. The VVB must update Section

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the BIODIVERSITY company

11 January 2023

To whom it may concern

SUBJECT: AN INDEPENT REVIEW FOR SOIL ORGANIC CARBON BASELINE DISTRIBUTIONS IN SOUTH AFRICA BETWEEN 2017- 2018 SEASON.

Dear Sir / Madam,

The Biodiversity Company has been commissioned by WeAct (Pty) Ltd to conduct a Soil Organic Carbon (SOC) baseline review from previous literature studies across South Africa for the period between 2017-2018 season. The findings of the historical data have been presented within this summarized statement report.

Soil organic carbon (SOC) distribution in South African soils

Soil organic carbon concentrations are highly variable through changing time periods as they can either increase or decrease. Variations occur because of several factors such as land use practices, vegetative cover, topographical position, soil texture and the climate interactions (Preez et al., 2011; Paustian et al., 2016; Schulze and Schutte, 2020). In South Africa, studies have reported that, most of the terrestrial carbon pools are built with soil carbon stores (Schulze and Schutte, 2020; Department of Environmental Affairs, 2017; Schulze and Schutte, 2020). South African soil carbon levels are generally low when compared to levels in the Northern Hemisphere (Kucharik et al., 2000; Preez et al., 2011; Department of Environmental Affairs, 2015, 2017; Schulze and Schutte, 2020). About 58% of soils contain less than 0.5% organic carbon and only 4% contain more than 2% organic carbon (Preez et al., 2011). Grasslands and savanna biomes mostly contribute to the South African terrestrial carbon stores through soil carbon storage of up to 100 t/ha of carbon (Stronkhorst and Venter, 2008; Department of Environmental Affairs, 2015, 2017).

An exhaustive literature search (du Preez et al., 2011; Paustian et al., 2016; Department of Environmental Affairs, 2015, 2017, 2019; Schulze and Schutte, 2020; Odebiri et al., 2022) was conducted using online search engines and electronic bibliographic databases on soil carbon content of grassland in the year 2017-2018 of the study area (KZN, FS, MPL, EC). A quantitative database was then established in below table based on the published literature and also on interpretated value for baseline degraded land condition as well as the current soil analysis report.

Table 1. Literature review based SOC baseline contents and soil physical properties for the study Stratas between 2017-2018.

Strata No.	SOC content (g C/kg soil)	Bulk Density (gm/cm^3)	Percentage (%) of rocks larger than 2mm
1	1.9	1.42	24.1
2	0.8	1.59	12.03
3	1.1	1.4	9.51
4	0.5	1.53	9.17
5	0.9	1.4	1.93
6	0.7	1.53	44.13
7	1.1	1.52	2.59
8	0.7	1.5	22.55

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4.3 of the VR to

a. Provide an unbiased assessment that the SOC baseline and increase rates are reasonable (e.g., based on available peer-reviewed literature),
b. Include an assessment of the uncertainty calculation (see Action 1), or changes the sample size to calculate a conservative estimate per the methodology.

Program Rule(s)

VM0026, v1.1, Section 8.2.9

VCS Standard, v4.7, Sections 2.2.1 and 4.1

VCS Verification Report Template, v4.4, Section 5.2

Background

Issue 1.

- *"Where **conservative estimates are used that are based on verifiable literature sources or expert judgment**, for the purposes of calculating uncertainty, it is not required to estimate a confidence interval for the parameter and*

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9	0.9	1.54	11.14
10	1.0	1.52	3.81
11	1.1	1.45	16.27
12	0.8	1.4	12.6
13	1.3	1.42	30.99
14	0.8	1.53	2.31
15	2.1	1.42	4.94
16	0.5	1.54	19.13
17	0.9	1.49	34.63
18	1.1	1.53	5.51
19	0.6	1.53	10.58
20	0.71	1.53	25.51
21	0.8	1.4	12.6
22	1.1	1.52	2.59

The data revealed that a sigmoidal decrease in SOC with the linear decrease in grass aerial cover. The stock depletion was accompanied by an increase in soil bulk density, a decrease in soil aggregate stability and a decrease in chemical elements such as Ca, Mg, K, Mn, Cu, and Zn essential for soil aggregate stability and plant growth.

It is found that continuously grazed communal farms were generally depleted of nutrient stocks, and nutrient depletion generally increased with increasing grazing intensity. Grassland management practices substantially influence the amount, distribution and turnover rate of soil organic matter and nutrients in soils (Blair et al., 1995). Moreover, because the larger proportion of SOC and nutrient stocks in grassland soils is concentrated in the top 0.3 m (Gajri et al., 1999), any external disturbance is likely to cause dramatic soil fertility and SOC depletion, which in turn will constrain grassland productivity, including biodiversity loss and forage production (Ruiz-Sinoga and Romero Diaz, 2010; Dong et al., 2012).

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Project Manager
SACNASP (*Pr. Sci Nat* 400213/11)

Dr Matthew Mamera
Soil Scientist
SACNASP (*Pr. Sci Nat* 116356)

In Section 3.5 of the SOC Report, the PP presents a detailed literature review specific to South African grasslands and savannas (sources include du Preez et al., 2011; Schulze & Schutte, 2020; Department of Environmental Affairs, 2015, 2017, 2019).

Key findings from the secondary literature includes:

- 58% of soils in South Africa have <0.5% organic carbon, and only 4% exceed 2%
- SOC stocks in grasslands of South Africa reportedly upto 100 tC/ha, but this wide range includes protected or well-managed areas
- Communal grasslands under continuous grazing pressure are often heavily degraded with nutrient depletion, increased bulk density, and reduced SOC and fertility

However, the PP specifically identified the project area as consisting of heavily degraded communal rangelands, corroborated by field data from 2017–2018. Given the Tier 3 data collected by the PP, most strata had baseline SOC levels between 1.5 and 5.5 Mg C/ha. Table

	uncertainty may be considered to be zero." • *"Where parameter values are derived from sample surveys undertaken within the project area, and the* ***sample size is large (ie, >30)****, a conservative estimate of baseline carbon sequestration by carbon pools or project emissions by GHG sources is given by adopting a value that represents the upper bound of the 95 percent confidence interval (ie, sample mean + 1.96 × standard error), while a conservative estimate of baseline emissions by GHG sources or carbon sequestration by carbon pools in the project scenario is given by adopting a value that VM0026, Version 1.1 Sectorial Scope 14 Page 39 represents the lower bound of the 95 percent confidence interval (ie, sample mean - 1.96 × standard error)."* Issue 2. a. For example, [Odebiri *et al.*, 2022] (cited by the project) report a range of SOC stocks for grasslands from 9.096 to 87.44 tC/ha. b. For example, [Phukubye, K., *et*]	1 of the SOC lab report shows that the 2017–2018 SOC values (baseline) per stratum were all less than 6.14 Mg C/ha (Strata 1), which would convert to ~22.5 tCO_2e/ha, significantly below the applied 8.5 tC/ha value (~31.2 tCO_2e/ha), thereby supporting its conservative nature. Also, per IPCC GPG Tier 3 referred to as higher tier methods and are generally considered to be more accurate on condition that adequate data are available to develop, evaluate and apply a higher tier method. The submitted laboratory report for estimating SOC is robust enough and based on standard practice and hence considered reasonable in the VVB's opinion a. **Compliance of SOC Sampling with VM0026 Requirements**: Methodological Reference: Section 9.3.3 and Section 9.2 of VM0026 v1.1 outline the requirements for sampling and uncertainty treatment when project removals are estimated using the measurement-based approach (Option 2).The PP followed a structured and statistically valid sampling framework based on the CDM "Tool for the Calculation of the Number of Sample Plots for Measurements within A/R CDM Project Activities", as referenced in VM0026. A preliminary estimate of the mean and standard deviation of SOC stocks across representative strata was conducted, and based on this, a minimum sample size of 41 plots was calculated to achieve a 15% precision at the 95% confidence level. The PP adopted a conservative approach by increasing the actual sample size to 123 plots, thereby tripling the stratum-level sampling effort and ensuring a minimum of 3 samples per stratum across 22 strata. As per VM0026 Section 9.3.3, when the total sample size for the project area exceeds 30, the use of the normal distribution (z = 1.96) is permitted for calculating the 95% confidence interval for SOC sequestration. The PP correctly applied this in estimating conservative SOC removals (i.e., mean – 1.96 × SE). hence, the sampling approach implemented by the PP is methodologically compliant and provides a statistically robust basis for estimating SOC stock changes. The sample size exceeds the required threshold for treating the uncertainty at the project level using the normal distribution, and the spatial coverage across strata ensures representativeness of the project area. The minimum necessary sample size was evaluated using the 'CDM Tool for the Calculation of the number of sample plots for measurements within A/R CDM project activities' as prescribed by VM0026. The project area is stratified and approximate area	

al., 2022 report an average annual SOC increase of 5.9% due to rotational grazing. Considering the initial SOC stock calculated by the project, the annual increase will not be higher than 0.5 tC/ha/year (i.e., 8.5*5.9%).

of each stratum is determined. Total number of sample plot has been calculated and the calculated sample plot has been distributed among the stratum as per the tool.

The calculated sample size for the project area is 41 by using a precision of 15 percent at the 95 percent confidence level. Considering the large area of the project boundary, the actual sample size has been increased into 123 by tripling the individual sample size of each stratum with a minimum number of 3. Therefore, total 123 soil samples have been collected from 22 strata during this monitoring period.

This sampling framework has been approved by the registry during project registration.

Uncertainty calculation for SOC has already provided In section 5.2.8 of the MR.

SOC Project: The PP engaged The Biodiversity Company, a third-party specialist consultancy, to conduct the field-level sampling, for the period of 2017-18 for the 22 strata and 123 samples covering total project area.

Strata	Actual sample size
Strata 1	3
Strata 2	9
Strata 3	6
Strata 4	3
Strata 5	3
Strata 6	6
Strata 7	3
Strata 8	3
Strata 9	9
Strata 10	3
Strata 11	9
Strata 12	3
Strata 13	6
Strata 14	6
Strata 15	3
Strata 16	9
Strata 17	3
Strata 18	3

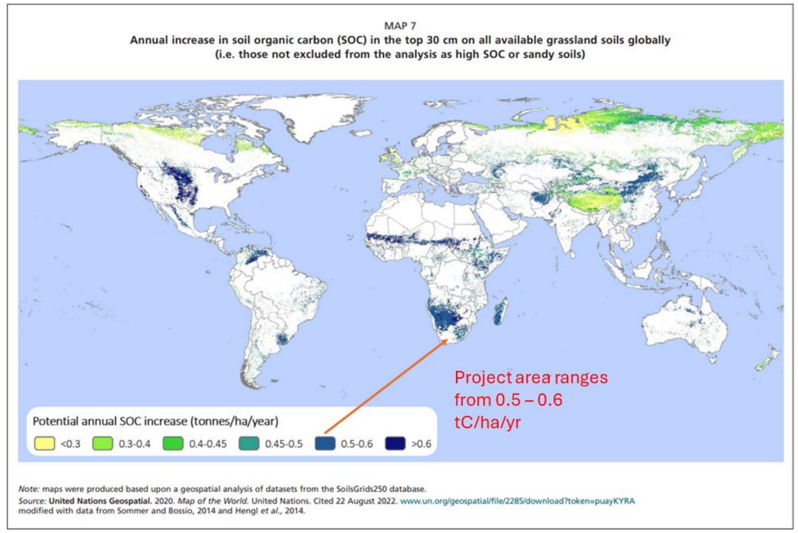
Strata 19	9
Strata 20	3
Strata 21	3
Strata 22	18
Total	123

.

2. Per a research paper in SA, rotational grazing reduced CO_2 emissions by 17% compared to free grazing and increased SOC by 50% and plant biomass by 93%.[20] Another studies conducted in South Africa shows that improved grazing management practices can lead to increases in topsoil SOC stocks ranging from 0.11 tC/ha/yr to 1.00 tC/ha/yr.[21]

[20] https://bsssjournals.onlinelibrary.wiley.com/doi/pdf/10.1111/sum.12790

[21] https://bsssjournals.onlinelibrary.wiley.com/doi/10.1111/sum.12790#:~:text=In%20their%20latest%20global%20synthesis,CO2%20emissions%20so%20far.



Adapted from: FAO's Global assessment of soil carbon in grasslands[22]

Hence, based on the secondary literature evidence and the third party laboratory report the VVB concluded that the annual increase of 0.65 tC/ha/year and can be higher than 0.5 tC/ha/year. Also, per IPCC GPG Tier 3[23] referred to as higher tier methods and are generally considered to be more accurate on condition that adequate data are available to develop, evaluate and apply a higher tier method. The submitted laboratory report for estimating SOC is robust enough and based on standard practice and hence considered reasonable in the VVB's opinion.

Based on the above assessment provided, the VVB has updated Section 4.3 of the VR, v2 to

- Provide an unbiased assessment that the SOC baseline and increase rates are

[22] https://openknowledge.fao.org/server/api/core/bitstreams/b9039c44-16bc-4031-9958-64c83dddb440/content

[23] https://www.ipcc.ch/site/assets/uploads/2019/12/19R_V0_01_Overview.pdf?utm

		reasonable (e.g., based on available peer-reviewed literature) • Included an assessment of the uncertainty calculation (see Action 1) and concluded that the PP has done a conservative estimate per the applied methodology. **Documents submitted in response to finding 4:** MR v3 VR v2	
		<u>Verra Response</u> While further information has been presented above, the VVB does not provide sufficient independent assessment on the baseline SOC stock estimates and, inconsistencies remain in the project scenario estimates. Therefore, this finding cannot be closed. <u>Issue</u> 1. Several issues were identified in the estimation of project SOC stocks: a. **Incorrect mean calculation**: The average SOC stock in the project scenario per stratum is calculated using the difference between project and baseline data. This is inconsistent with Equation 47 (parameter $P_{SOCmG,s,t}$). b. **Incorrect statistical method**: The project uses population standard deviation (STDEVP) instead of sample standard deviation (STDEV.S), which is inappropriate given the use of sample data and undermines the reliability of uncertainty estimates. 2. The VVB response to Issue 2 describes the PP's process of arriving at 8.5 tC/ha value as the baseline SOC stock. However, the VVB does not describe how they have independently verified how 8.5 tC/ha has been obtained. Further, the VVB has not discussed the findings of the Odebiri *et al.* 2022 paper in the context of the conservative baseline SOC stock value determination. <u>Action Required</u> 1. The VVB must revise the SOC stock estimation approach. Specifically: a. Calculate the average carbon stock per stratum under the project scenario prior to applying any baseline deduction, in accordance with Equation 47. b. Replace population standard deviation with sample standard deviation. c. Clearly document the revised approach and supporting statistical evidence in the monitoring report. 2. The VVB must update the verification report to	

		a. Describe how they independently verified how the 8.5 tC/ha baseline SOC stock has been obtained, including crosschecks against literature used to determine the value. b. Discuss the findings of Odebrir *et al.* 2022, and why the SOC stocks reported is more conservative but not used in the project. c. The VVB must assess and reflect these updates of Issue 1 and Action 1 in the Verification Report, as applicable. Program Rule(s) *VM026, v1.1,* Sections 8.2.8, 8.2.9 and Foot note 6 Background 1) **Issue 1(a):** Equation 47 is the sum of the difference of average carbon stock and baseline SOC stock in each stratum, multiplied by the stratum area. However, the GHG ERR calculation spreadsheet sums the difference between each sampled carbon stock (rather than the average per stratum) and the baseline SOC stock in each stratum. See Column 'G', Tab 'Project removal_SOC' in '2710_MP 1 ERR_v2.xlsx.' 2) **Issue 1(b):** The project uses of STDEVP instead of STDEV.S	
		Round 2	
		VVB Response 1. Finding1 a. The average SOC stock in the project scenario is now calculated based on the average carbon stock per stratum prior to applying baseline deduction which is in line with Equation 47 b. Population standard deviation has been replaced with sample standard deviation in the revised ER version 4. Per the required changes, PD v4, ERR v4, NPRR V3 and VR v3 have been updated to reflect the changes. 2. Finding 2: The following responses has been added in line with the findings raised for the VVB a) **Independent Verification of the 8.5 tC/ha Baseline SOC Stock Value** The VVB independently assessed the baseline SOC stock of 8.5 tC/ha by reviewing project-specific site data and comparing it with findings from relevant scientific studies. This process included the following steps:	

i) Review of Project-Specific Field Data

The PP gathered soil data in 22 plots located in degraded and overgrazed communal rangelands. The SOC values, corrected for bulk density and rock fragments, ranged from 1.79 to 8.5 tC/ha. The value of 8.5 tC/ha, being the max. observed among these degraded sites, was chosen as the baseline. This ensures a conservative yet verifiable estimate based on real field conditions.

Number of sampling plot	Depth (cm)	SOC content (g C/kg soil)	Bulk Density (gm/cm^3)	Percentage (%) of rocks larger than 2mm, roots, and other dead residues with a diameter in the top 30 cm of soil	SOC stock in the top 30 cm (or greater depth if required) of soil for management practice mG, stratum s, sampling site i under project in year t	
1	30	1.9	1.42	24.1	6.143346	
2	30	0.8	1.59	12.03	3.3569352	
3	30	1.1	1.4	9.51	4.180638	
4	30	0.5	1.53	9.17	2.0845485	
5	30	0.9	1.4	1.93	3.707046	
6	30	0.7	1.53	44.13	1.7951031	
7	30	1.1	1.52	2.59	4.8860856	
8	30	0.7	1.5	22.55	2.439675	
9	30	0.9	1.54	11.14	3.6947988	
10	30	1	1.5	22.55	3.48525	
11	30	1.1	1.45	16.27	4.0064805	
12	30	0.8	1.4	12.6	2.93664	
13	30	1.3	1.42	30.99	3.8217738	
14	30	0.8	1.53	2.31	3.5871768	
15	30	2.1	1.42	4.94	8.5040676	
16	30	0.5	1.54	19.13	1.868097	
17	30	0.9	1.49	34.63	2.6298351	
18	30	1.1	1.53	5.51	4.7708001	
19	30	0.6	1.53	10.58	2.4626268	
20	30	0.71	1.53	25.51	2.42755461	
21	30	0.8	1.4	12.6	2.93664	
22	30	1.1	1.52	2.59	4.8860856	
					MAX	8.50407

ii) Cross verification using through secondary literature

Dlamini et al. (2014) (Land degradation impact on soil organic carbon and nitrogen stocks of sub-tropical humid grasslands in South Africa[24]

This study examined how SOC levels change with grassland degradation in South Africa. It reported that in severely degraded areas with only 0–5% grass cover (Cov5), SOC decreased by a depletion rate of 1.25 kg C/m^2, or 12.5 tC/ha[25], which was about an 89% reduction compared to non-degraded areas (Cov100). The study estimates SOC dropping from 13.9 tC/ha in Cov100 to about 1.4 tC/ha in Cov5. Compared to this, the

[24] https://www.sciencedirect.com/science/article/abs/pii/S0016706114002870

[25] 1.25*0.001C/0.0001= 12.5tC/ha

selected 8.5 tC/ha value is conservative and lies well within the range expected in degraded grasslands.

The SOC content and stocks in the 0.05 m soil layer decreased with decreasing grass aerial cover in the following order: Cov100 (19.87 g kg^{-1}; 1.39 kg m^{-2}) > Cov75 (11.19 g kg^{-1}; 0.79 kg m^{-2}) > Cov50 (5.17 g kg^{-1}; 0.40 kg m^{-2}) > Cov5 (1.73 g kg^{-1}; 0.14 kg m^{-2}), with differences significant at $P < 0.05$ level (Fig. 2). Similarly, N

Odebiri et al. (2022) (Dissertation: The application of deep learning for remote sensing of soil organic carbon stocks distribution in South Africa)[26]

Odebiri et al. (2022) estimated SOC stocks in South African grasslands at 30.72 tC/ha, with decreases under different future climate scenarios, with mostly impacted in the worst climate scenario i.e., SSP 5-8.5 to appx. 26 tC/ha.

Table 7.5. Mean SOC stocks density (t/h) for current and future predictions, the values in parenthesis shows the difference in mean density. The negative sign represents a loss.

Land cover type	Current (t/h)	SSP126 (t/h)	SSP245 (t/h)	SSP370 (t/h)	SSP585 (t/h)
Grassland	30.72	29.62 (-1.10)	27.01 (-3.71)	26.05 (-4.67)	26.42 (-4.30)
Natural Forest	45.01	51.22 (6.21)	51.14 (6.13)	48.65 (3.64)	49.25 (4.24)
Commercial Forest	46.95	52.50 (5.55)	53.05 (6.10)	50.55 (3.60)	50.64 (3.69)
Cropland	34.55	33.11 (-1.44)	30.45 (-4.10)	31.22 (-3.33)	29.53 (-5.02)
Shrubland	24.28	25.41 (1.13)	22.55 (-1.71)	21.65 (-2.63)	19.56 (-4.72)
Barren land	18.56	12.66 (-5.90)	13.25 (-5.31)	12.02 (-6.54)	10.11 (-8.45)
Built-up vegetation	38.32	39.44 (1.12)	38.89 (0.57)	36.44 (-1.88)	33.56-4.76)

However, it is important to note that this estimate is for general grasslands. There is no indication that the study focuses on communal, overgrazed, or fire-degraded lands, as is the case for the project area, which could significantly influence SOC stock values. Furthermore, the projections are based on climate emission scenarios, not land degradation scenarios. Therefore, the SOC range of 30–26 tC/ha cannot be assumed to represent conditions in the project area, which consists of highly degraded grasslands.

[26] https://core.ac.uk/reader/541929100

		While the study emphasizes that South African grasslands have high SOC sequestration potential, it also acknowledges that 60% of these grasslands have been irreversibly transformed, and only 2% are under official conservation. Additionally, the report also include a high level of uncertainty with a Root Mean Square Error (RMSE) of 10.15 tC/ha, which limits their reliability for localized assessments. Odebiri et al. (2024) Mapping sub-surface distribution of soil organic carbon stocks in South Africa's arid and semi-arid landscapes: Implications for land management and climate change mitigation In this study it can be seen that that remote sensing (RS) and machine learning (ML) approaches like Sentinel-3 and deep neural networks (DNN) often miss localized variations in degraded areas. RMSE values in this study ranged from 7.12 to 31.10 tC/ha, reinforcing the need for field-based SOC measurements in degraded and heterogeneous landscapes. Table 3 SOC stock data summary statistics (t/ha); new skewness and kurtosis for the log transformed in brackets. SOC depths(cm) / Min / Max / Mean / Standard deviation / Coefficient of variation (%) / Kurtosis / Skewness 0-30 / 8 / 45 / 19.37 / 5.78 / 29.84 / 2.22 (0.23) / 0.85 (0.15) 30-60 / 6 / 86 / 19.72 / 11.91 / 60.40 / 10.81(0.38) / 2.67(0.63) 60-100 / 7 / 109 / 25.56 / 16.20 / 63.38 / 7.70(0.27) / 2.20(0.22) 100-200 / 18 / 318 / 77.76 / 48.27 / 62.08 / 6.50(0.21) / 2.04(0.14) Both the papers support the conclusion that regional models cannot replace ground-truthed data, especially in degraded environments. Therefore, using field-sampled data from the project site is more appropriate and conservative. Most of the approach including the FAO[27] approach uses global-scale models and generalized assumptions, which may not capture localized degradation, soil type, or management effects. Hence it was concluded that the baseline SOC stock value of 8.5 tC/ha reflects a conservative and scientifically justified estimate, consistent with the VCS requirements. **b) Discuss the findings of Odebrir et al. 2022, and why the SOC stocks reported is more conservative but not used in the project.**	

Table 3 (reproduced): SOC stock data summary statistics (t/ha); new skewness and kurtosis for the log transformed in brackets.

SOC depths(cm)	Min	Max	Mean	Standard deviation	Coefficient of variation (%)	Kurtosis	Skewness
0-30	8	45	19.37	5.78	29.84	2.22 (0.23)	0.85 (0.15)
30-60	6	86	19.72	11.91	60.40	10.81(0.38)	2.67(0.63)
60-100	7	109	25.56	16.20	63.38	7.70(0.27)	2.20(0.22)
100-200	18	318	77.76	48.27	62.08	6.50(0.21)	2.04(0.14)

27 https://openknowledge.fao.org/server/api/core/bitstreams/b9039c44-16bc-4031-9958-64c83dddb440/content

		As explained in the response of point 2a above, the VVB considered the findings of Odebiri et al. (2022) but chose not to directly apply the reported average SOC stock to this project, due to the following reasons: a. Different context - The reported SOC values are for general grasslands under climate scenarios, not for communal, degraded lands. The land in this project is severely overgrazed and fire-affected, which the Odebiri study does not specifically address. b. The SOC model has a high RMSE of 10.15 tC/ha, which means the results can vary a lot. This makes the model less reliable in disturbed or degraded areas, where using actual field measurements is more accurate. c. As also emphasized in the author (both in 2022 and 2024) studies, remote sensing and machine learning approaches may not adequately capture localized heterogeneity in SOC distribution. Therefore, the use of field-sampled SOC data, as adopted by the project, offers a more reliable and conservative basis for baseline determination, aligning with the VCS principle of conservativeness and ensuring that emission reductions are not overestimated. The assessment has now been elaborated in section 4.3 of the VR, v3	
		<u>Verra Response</u> The formula for calculating project SOC stock has been revised to follow Equation 47, and the standard deviation is now corrected. The VVB has provided details on how baseline SOC stock was assessed. However, inconsistencies remain, and the finding cannot be closed. <u>Issue</u> Inconsistencies persist in the estimation and documentation of SOC stocks under the project and baseline scenarios: 1. **Unexplained data changes.** The project proponent has made multiple changes to raw data in the “soil analysis data_Project” sheet, including 17 modifications to ‘Sampling depth’ and one change to ‘Bulk density’ values, without explanation. These changes affect net GHG emission reductions and were not reported and assessed by the VVB. 2. **Conflicting baseline stocks assessment.** The MR and the VVB’s assessment present conflicting sources and methods for determining baseline SOC stocks:	

		a. The MR cites peer-reviewed literature (Odebiri et al., 2022 – *Modelling soil organic carbon stock…*) that reports a minimum SOC stock of 9.096 tC/ha for grasslands. However, the VVB assessed a different paper by Odebiri, which is a dissertation titled *"The application of deep learning…"* b. The VVB states that the proponent collected soil data from 22 plots in degraded communal rangelands and selected a baseline value of 8.5 tC/ha. However, the MR states that the data was verified by The Biodiversity Company who assessed peer-reviewed literature to determine the baseline value of 8.5 tC/ha. <u>Action Required</u> The VVB must: 1. **Clarify and justify data changes:** Review and explain all changes made to sampling depth and bulk density values in the "soil analysis data_Project" sheet and assess their impact on emission reductions. These changes must be transparently documented in the MR and VR. 2. **Resolve baseline SOC Stock inconsistencies:** a. Confirm the method used to derive the 8.5 tC/ha baseline SOC stock. b. Reconcile the use of different versions of Odebiri *et al*. (2022) and assess how the minimum SOC stock value of 9.096 tC/ha reported in the journal article (see Background) compares to the selected baseline value of 8.5 tC/ha, including justification for the latter's conservativeness. c. Document the rationale for both points above in the VR. <u>Background</u> Issue 2c: • MR: "Soil data for baseline was gathered from peer reviewed literature[22,23][…]. Footnote 23: "*Odebiri, O, Mutanga, O, Odindi J and R Naicker, 2022. Modelling soil organic carbon stock distribution across different landuses in South Africa: A remote sensing and deep learning approach. ISPRS Journal of Photogrammetry and Remote Sensing Volume 188, June 2022, Pages 351-362.*" This paper reports a minimu SOC stock of 9.096 tC/ha for grasslands (see Table 4). [Odebiri et al., 2022](#). • VR: Odebiri et al. (2022) (Dissertation: *The application of deep learning for remote sensing of soil organic carbon stocks distribution in South Africa*) https://core.ac.uk/reader/541929100.	

		Round 3 VVB Response 1. The data provided in the 'soil analysis data_Project" sheet was not consistent with the soil report because of submission error in PRR1. These errors have been fixed during submission of PRR 2, and it is now consistent with the soil report. Soil analysis result has been included in the MR version 05 and the soil report has been attached for your reference. During the submission of the PRR 1, the calculated project removals due to SOC change were 21,6,871.53 tCO2e/yr per year. Upon rectifying the depth and bulk density error during PRR 2, calculated project removals due to SOC change were 21,2,677.79 tCO2e/yr per year. Thus, Project removal (ER) due to SOC change has decreased by 4,193.74 tCO2e/yr per year after rectifying the error (i.e. the submission error in PRR1). The change does not result in an increase in the NERs, it only reflects corrections to the reported values that were erroneously included during the verification review submissions to VERRA. These corrected values were discussed between the PP and the VVB, and subsequently cross-checked and verified by the VVB during PRR Rd2. However, the VVB missed reporting/highlighting this correction in the PRR Rd2 response. VVB believes that this justification (with the background information about the error) will clarify any confusion or misinterpretation that might have caused leading to this finding 1. Additionally, the Soil analysis data has been included in the MR version 05 and all the changes transparently documented in VR during the PRR Rd2 submission. 2. Baseline SOC Stock: a. **Method used to derive the 8.5 tC/ha baseline SOC stock:** PP outsourced the baseline study assessment to an independent credible agency named "The Biodiversity Company (TBC)". The baseline SOC stock of 8.5 tC/ha was established by TBC using a mix of published research and field sampling - Tier 2 and Tier 3. i. Tier 2 – TBC reviewed national and regional studies on grassland soil in South Africa. These studies provided reference values for SOC levels and other variables required for SOC estimations expected under similar land conditions. ii. Tier 3 – TBC also collected soil samples from 22 degraded plots	

		within and around the project area. For each sample, they measured bulk density, SOC content, and % rock content. These data were then rendered with assessment that combined with (i) published literature and (ii) interpreted values for degraded land conditions to build a quantitative baseline database. From the assessment, it was found that the value of 8.5 tC/ha was the highest observed/conservative value among the samples, hence was selected as the value for the baseline. The PP has chosen a reliable, and project-centric approach, which is in line with the requirements of Section 9.1 of the applied methodology VM0026, v1.1. [28] All the peer reviewed literature which has been referenced by TBC to finalise the baseline SOC has now been included in MR version 05.	

Number of sampling plot	Depth (cm)	SOC content (g C/kg soil)	Bulk Density (gm/cm³)	Percentage (%) of rocks larger than 2mm, roots, and other dead residues with a diameter in the top 30 cm of soil	SOC stock in the top 30 cm (or greater depth if required) of soil for management practice mG, stratum s, sampling site i under project in year t	
1	30	1.9	1.42	24.1	6.143346	
2	30	0.8	1.59	12.03	3.3569352	
3	30	1.1	1.4	9.51	4.180638	
4	30	0.5	1.53	9.17	2.0845485	
5	30	0.9	1.4	1.93	3.707046	
6	30	0.7	1.53	44.13	1.7951031	
7	30	1.1	1.52	2.59	4.8860856	
8	30	0.7	1.5	22.55	2.439675	
9	30	0.9	1.54	11.14	3.6947988	
10	30	1	1.5	22.55	3.48525	
11	30	1.1	1.45	16.27	4.0064805	
12	30	0.8	1.4	12.6	2.93664	
13	30	1.3	1.42	30.99	3.8217738	
14	30	0.8	1.53	2.31	3.5871768	
15	30	2.1	1.42	4.94	8.5040676	
16	30	0.5	1.54	19.13	1.868097	
17	30	0.9	1.49	34.63	2.6298351	
18	30	1.1	1.53	5.51	4.7708001	
19	30	0.6	1.53	10.58	2.4626268	
20	30	0.71	1.53	25.51	2.42755461	
21	30	0.8	1.4	12.6	2.93664	
22	30	1.1	1.52	2.59	4.8860856	
					MAX	8.50407

b. The VVB acknowledges that, in the previous submission, the response to VERRA's finding was not communicated in a clear and concise manner. The intention was not to present multiple versions of Odebiri's work but rather

28

Data Unit / Parameter	$SOC_{s,Baseline}$	Where Option 2 is applied to estimate project removals due to changes in SOC, the project proponent must follow the procedures for the sampling and measurement of soil properties, including bulk density and organic carbon concentrations, that are outlined in Option 2 in Section 8.2.8to determine the value of $SOC_{s,Baseline}$, less than two years prior to the project start time.

The project use Option 2 (measurement approach) to estimate project removals due to changes in SOC.

to provide a broader context of the overall assessment. However, this approach created unnecessary confusion. The following section of the response intends to give a clear presentation of the assessment conducted by VVB.

We would like to bring the reference of the peer reviewed literature cited in MR i.e. "Modelling soil organic carbon stock distribution across different land-uses in South Africa: A remote sensing and deep learning approach" which is the title of Chapter 5 of dissertation titled as "The application of deep learning for remote sensing of soil organic carbon stocks distribution in South Africa" (as referred by VVB). This paper reports SOC stocks 9.096 tC/ha.

In order to directly address VERRA's point regarding the SOC value of 9.096 tC/ha reported in Odebiri et al. (2022), we now focus specifically on Chapter 5 – the published paper cited by PP and referenced by VERRA in its finding. This ensures that our response is aligned with the exact source under consideration, while it also clarifies why the project's chosen SOC baseline remains more accurate, project centric and in line with the applied methodology. Please refer the assessment below:

Odebiri et al. (2022) Modelling soil organic carbon stock distribution across different land-uses in South Africa: A remote sensing and deep learning	The SOC model used in this study/chapter 5 of the dissertation report referred by the VVB is a Deep Neural Networks (DNN) built on remotely sensed Sentinel-3 data and evaluated with three different metrics. These included the root mean square error (RMSE), the coefficient of determination (R^2) and Lin's concordance correlation coefficient (LCCC) using 10-fold cross-validation approach to ensure that the model did not over-fit the data. It provides maps of the 'mean SOC' and also the 5th and 95th percentiles (at 90% interval), so users can read a range of plausible values, not just one number. The study also checks this interval against field data: 88% of samples fall inside the 5–95% band (close to the expected 90%) and notes that this uncertainty is model-based. The soil depth considered is 0-30 cm.

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<td>approach[29] [30]</td>
<td>This paper reports a model error around 10.15 tC/ha RMSE (the dissertation abstract reports appx 10.35 tC/ha for the national model, which is same order of magnitude).

Table 5.3. The SOC DNN model result summary for both train and test data
<table>
<tr><th>Evaluation metrics</th><th>Train data</th><th>Test data</th></tr>
<tr><td>R^2</td><td>0.685</td><td>0.642</td></tr>
<tr><td>RMSE (t/h)</td><td>10. 15</td><td>11.96</td></tr>
<tr><td>LCCC</td><td>85.46</td><td>79.67</td></tr>
</table>

Per table 5.4 of the report , Grasslands cover about 28.83% of South Africa's land area and store about 31.36% of the total SOC stock of the country. The minimum observed SOC stock in grasslands was 9.096</td>
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29 https://www.sciencedirect.com/science/article/abs/pii/S0924271622001290

30 ***Which is also included as*** chapter 5 of Odebiri et. al. 2002 -Dissertation: The application of deep learning for remote sensing of soil organic carbon stocks distribution in South Africa)[30]: VVB will discuss the result of the overall dissertation results which is directly related to the SOC content measured in South Africa using different techniques. So we will first explain the paper that PP has directly referred in the TBC report as well as in the MR and which is also chapter 5 of the dissertation report assessed by the VVB in Rd2 of the PRR

Chapter Five:

Modelling soil organic carbon stock distribution across different land-uses in South Africa: A remote sensing and deep learning approach

This chapter is based on;

Odebiri, O., Mutanga, O., Odindi, J., & Naicker, R. (2022). Modelling soil organic carbon stock distribution across different land-uses in South Africa: A remote sensing and deep learning approach. *ISPRS Journal of Photogrammetry and Remote Sensing, 188*, 351-362.

tC/ha. The report also provides values in brackets, which are the 5th and 95th percentiles. This tells us that while extreme lows exist (as low as appx. 9.096 tC/ha), in this low-end category most grasslands fall between 4.8-13 tC/ha.

Table 5.4. Summary statistics of the spatial distribution of SOC stocks across important land use types in South Africa. Values in square parentheses are the 5th and 95th percentile values

Land class type	Class area (%)	Total SOC (%)	Min SOC (t/h)	Mean SOC (t/h)	Max SOC (t/h)
Grassland	28.83	31.36	9.096 [4.8, 13]	31.72 [27.6, 36]	87.44 [85, 94]
Shrub land	27.33	20.97	6.5 [2.7, 11]	22.6 [18.7, 27.1]	60.6 [57, 65]
Natural forest	15.87	19.41	12.56 [8, 16.4]	44.34 [38.6, 48.3]	145.17 [139, 149]
Cropland	15.04	17.02	6.87 [2.8, 11]	33.46 [29, 37.4]	86.88 [84, 93]
Barren land	11.15	8.45	6.30 [2.3, 10.3]	20.41 [16.4, 24.4]	58.95 [54, 61.4]
Commercial forest	1.74	2.75	14.61 [10.5, 19]	46.06 [42, 50.8]	98.55 [94, 103]
Urban vegetation	0.04	0.04	28.31 [24.3, 32.2]	33.72 [29.8, 38]	44.72 [41, 50]

The values in brackets are the 5th and 95th percentiles: this range allows degraded patches can fall below 9.096 tC/ha, consistent with the project baseline of 8.5 tC/ha.

The review team has assessed and confirmed that PP considered the findings of Odebiri et al. (2022) but chose not to directly apply the reported average SOC stock to this project, due to the following reasons:

a. Different context - Odebiri's results represent grasslands in general, without specifically addressing communal, degraded, fire-affected rangelands such as those in the project area.
b. The SOC model has a high RMSE of 10.15 tC/ha, which means the results can vary a lot, making them less reliable for disturbed and degraded landscapes.
c. As also emphasized in the author's reference as well as in his other published studies, remote sensing and machine learning approaches may not

		adequately capture localized heterogeneity in SOC distribution. Therefore, the SOC data (based on Tier 2 + Tier 3 data analysis) provided by the PP is more reliable, project-specific, and verifiable, consistent with the requirements of the applied methodology. . **Assessment of other studies included in the TBC report** *du Preez, C.C., van Huyssteen, C.W., Mnkeni, P.N.S., 2011. Land use and soil organic matter in South Africa 1: A review on spatial variability and the influence of rangeland stock production.*[31] — About 58% of South African soils contain less than 0.5% organic carbon, and only 4% of that exceeds the value beyond 2%. This indicates that most rangeland soils in South Africa are inherently poor in SOC compared to the Northern Hemisphere. The report clearly mentions that degradation of rangeland on account of overgrazing results in significant losses of soil organic matter, which is mainly attributed to lower biomass production. The use of fire in rangeland management decreases soil organic matter because the primary source of organic matter, the plant litter, is destroyed with burning. *IDENTIFICATION AND MAPPING* — The Bulk density considered by the TBC is in line with the average value considered and estimated by the report at the national level	

[31] S. Afr. J. Sci. 107, 27–34. https://doi.org/10.4102/sajs.v107i5/6.354 - pdf of the report is submitted with the response. As the complete paper is not available on the given weblink

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<td>OF SOILS RICH IN

ORGANIC CARBON IN SOUTH AFRICA

AS A CLIMATE CHANGE MITIGATION OPTION

Stefanie Schütte, Prof Roland Schulze and Dr Garry Paterson

Published by Department of Environmental Affairs, SA[32]</td>
<td>A column for soil bulk density was added to the Soil Carbon Database worksheet, based on the formula above and the clay content given in the database. Where no clay content was in the database (in 1 471 samples), the soil bulk density was also left blank. An analysis of the bulk density values thus calculated for qualifying samples in the Soil Carbon Database showed a range from 0.969 to 1.724 t/m³, with an average of 1.524 t/m³.

Please refer to page 24 of the report</td>
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The VVB further provides its assessment on why the baseline value applied by the PP is conservative, more accurate, and in line with the applied methodology.
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[32] https://www.international-climate-initiative.com/en/iki-media/publication/identification_and_mapping_of_soils_rich_in_organic_carbon_in_south_africa_as_a_climate_mitigation_option/

		Independent assessment of other peer published literature by the VVB |	
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Grassland rehabilitation significantly increases soil carbonstocks by reducing net soil CO2 emissions[33]	The study by Abdalla et al. (2022) was conducted in one of the project areas, i.e. KwaZulu-Natal (which is the area with highest SOC recorded both in secondary literature as well as during project monitoring data). The study found that in degraded grasslands involving free grazing or annual burning, the top 0–5 cm of soil stored only 4.3–5.0 tC/ha, while better practices like rotational grazing or exposure with fertilizer increased it to 7.4–7.5 t C/ha. They also recorded that degraded soils had higher bulk density (appx. 1.60 g/cm³) compared to rehabilitated soils (appx. 1.48–1.50 g/cm³), which is in line with the values TBC used (1.40-1.59 g/cm³). This supports that the project baseline reflects the reality of degraded communal rangelands in South Africa and is backed by field data of other studies as well.		

[33] https://bsssjournals.onlinelibrary.wiley.com/doi/epdf/10.1111/sum.12790

TABLE 2. Changes in aboveground biomass (AGB), soil organic carbon stocks (SOCs) and soil bulk density (ρb) in the topsoil (0–0.05 m) for the treatments (rotational grazing (RG), livestock exclosure with NPK fertilizer application (EF), annual burning (AB) and traditional free grazing (FG) under degraded grasslands) from season 2012–2013 to 2014–2015 (N = 9)

		SOCs (kg m^{-2})					ρb (g cm^{-3})				
015	% change	2012–2013		2014–2015		% change	2012–2013		2014–2015		% change
SE		Mean	SE	Mean	SE		Mean	SE	Mean	SE	
0.04	93.33[a]	0.50[a]	0.04	0.75[a]	0.10	50.00[b]	1.60[a]	0.02	1.48[b]	0.30	−8.12[a]
0.06	64.29[b]	0.46[a]	0.03	0.74[a]	0.04	60.86[a]	1.55[a]	0.03	1.50[b]	0.02	−3.33[b]
0.03	7.69[d]	0.44[a]	0.03	0.43[c]	0.02	−2.33[c]	1.60[a]	0.02	1.58[a]	0.02	−1.26[c]
0.01	15.38[c]	0.50[a]	0.04	0.50[b]	0.03	0.00[c]	1.59[a]	0.01	1.60[a]	0.04	0.06[d]
0.03		0.47	0.03	0.56	0.03		1.58	0.02	1.56	0.03	

[34]

The main limitation of this study is that it only considered the 0–5 cm soil layer, which typically stores the highest SOC concentration and can therefore lead to overestimated values. However, when deeper layers are included “0-30 cm”, it avoids overestimating SOC and aligns with carbon accounting guidelines (the IPCC GPG or the depth which the applied methodology). ***Refer to pages 9 and 10 of the report.***

To illustrate this, VVB referred to a U.S.-based study ([“Accurate Quantification of 0–30 cm Soil Organic Carbon in Croplands over the Continental United States Using Machine Learning”](https://www.mdpi.com/2072-4292/16/12/2217))[35]. The average SOC for the full 0–30 cm profile is lower than the ‘surface-only value’ because the deeper soil (i.e. 5–30 cm) contains less carbon, and when this low-carbon layer is mixed with the rich surface layer, it pulls the overall average down.

[34] 10 tons/ha is 1 kg/m2

[35] https://www.mdpi.com/2072-4292/16/12/2217

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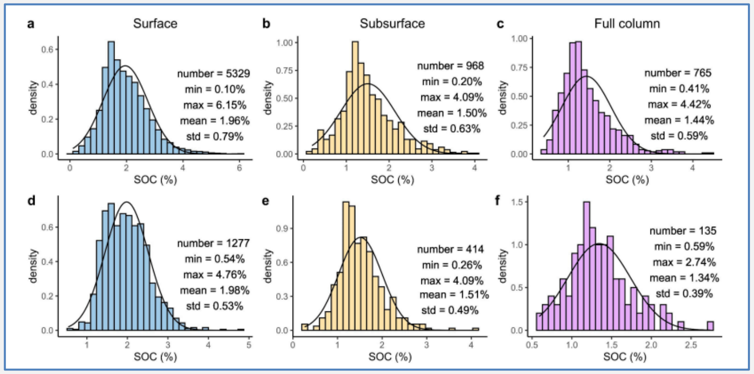
0–5 cm (surface layer): Mean SOC% = **1.96**

5–30 cm (subsurface layer): Mean SOC% =**1.50**

0–30 cm (full column): Mean SOC% = **1.34**



The analysis was cross-validated using both model outputs and field-collected soil samples. ***Refer to pages 8, 13 and 14.***

Therefore, even if the 0–5 cm data are considered in isolation, it does not compromise the conservativeness of the project baseline, which remains 8.5 tC/ha.

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<td><u>Dlamini et al. (2014) (Land degradation impact on soil</u></td>
<td>This study examined how SOC levels change with grassland degradation in South Africa. It reported that in severely degraded areas with only 0–5% grass cover (Cov5), SOC decreased by 1.25 kg C/m², or 12.5 tC/ha[37], which was about an 89% reduction</td>
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</table>

[37] 1.25*0.001C/0.0001= 12.5tC/ha

			<u>organic carbon and nitrogen stocks of sub-tropical humid grasslands in South Africa</u>[36]	compared to non-degraded areas (Cov100). The study estimates SOC dropping from 13.9 tC/ha in Cov100 to about 1.4 tC/ha in Cov5. Compared to this, the selected 8.5 tC/ha value is conservative and lies well within the range expected in degraded grasslands The SOC content and stocks in the 0.05 m soil layer decreased with decreasing grass aerial cover in the following order: Cov100 (19.87 g kg^{-1}; 1.39 kg m^{-2}) > Cov75 (11.19 g kg^{-1}; 0.79 kg m^{-2}) > Cov50 (5.17 g kg^{-1}; 0.40 kg m^{-2}) > Cov5 (1.73 g kg^{-1}; 0.14 kg m^{-2}), with differences significant at $P < 0.05$ level (Fig. 2). Similarly, N . Again, the limitation of this study is that sampling was restricted to the 0–5 cm soil depth. The relevance of using this study to validate the PP's data has already been explained in the justification above. Since SOC concentration is generally highest in the top few centimeters and declines with depth, values reported at 0–5 cm may appear inflated relative to integrated 0–30 cm stocks. Also, when interpreting Dlamini et al. (2014), the focus is not on absolute stock equivalence, but on the magnitude of depletion (%) due to land degradation. Their reported up to 89% SOC loss provides an important benchmark for vulnerability of these soils, independent of depth.		
			<u>The Impact of Land Degradation on the Quality of Soils in a South African</u>	Confirms the bulk density values considered by TBC are consistent with national assessments.		

[36] https://www.sciencedirect.com/science/article/abs/pii/S0016706114002870

			Communal Rangeland[38]	Penetrometer resistance, an important mechanical property used as an indicator of soil compaction [33], increased with decreasing grass cover from an average of 11.3 kg cm^{-2} in non-degraded grassland to 19.5 kg cm^{-2} in heavily degraded grassland, corresponding to an increase of 42% (Figure 3A). In agreement with our study, Snyman and du Preez [26] found that rangeland degradation decreased soil compaction by 65% from 18.3 kg cm^{-2} in non-degraded fine sandy loam soil to 6.4 kg cm^{-2} in heavily degraded fine sandy loam soil in a semiarid region in Bloemfontein, South Africa. One of the profound effects of soil compaction is the reduction in pore space and macroporosity, which is associated with increased bulk density [34, 35]. Such was the case in the present study, as soil bulk density increased by 12% from an average of 1.43 g cm^{-3} in non-degraded grassland to 1.61 g cm^{-3} in heavily degraded grassland, indicating increasing compaction (Figure 3B). Similarly, Hiltbrunner et al. [36] observed a 20% increase in soil bulk density on degraded grassland in a Swiss subalpine grassland, and this led to changes in biomass production.		
			Mapping Sub-surface Distribution of Soil Organic Carbon Stocks in South Africa's Arid and Semi-Arid Landscapes: Implications for Land Management and Climate Change Mitigation.[39]	This study by Odebiri et. al. (2024), uses remote-sensing methods to estimate soil organic carbon (SOC) in South Africa's arid and semi-arid regions, which make up about 60% of the country. The goal was to understand how SOC is distributed at different depths (0–30 cm, 30–60 cm, 60–100 cm, and 100–200 cm) and how environmental factors affect it. The study area includes grasslands, savannas, shrublands, and thornveld. In the study, field data show that SOC stocks in the top 0–30 cm layer can be as low as 8 tC/ha (Table 3).		

[38] https://www.intechopen.com/chapters/50695

[39] https://pmc.ncbi.nlm.nih.gov/articles/PMC7616233/

Table 3. SOC stock data summary statistics (t/ha); new skewness and kurtosis for the log transformed in brackets.

SOC depths(cm)	Min	Max	Mean	Standard deviation	Coefficient of variation (%)	Kurtosis	Skewness
0-30	8	45	19.37	5.78	29.84	2.22 (0.23)	0.85 (0.15)
30-60	6	86	19.72	11.91	60.40	10.81(0.38)	2.67(0.63)
60-100	7	109	25.56	16.20	63.38	7.70(0.27)	2.20(0.22)
100-200	18	318	77.76	48.27	62.08	6.58(0.21)	2.04(0.14)

To improve predictions, two machine learning models, 1) Random Forest (RF), and 2) Extreme Gradient Boosting (XGBoost) were tested. XGBoost consistently performed better, especially at 0-30 cm, giving lower errors and stronger fits than RF. For example, at 0–30 cm depth, XGBoost had an RMSE of 7.12 t/ha and R^2 values of 0.671 (training) and 0.617 (testing) (Table 4).

Table 4. Summary of the SOC stocks RF and XGBoost models at four different soil depths (0-30cm, 30-60cm, 60-100cm, and 100-200cm), for both the train and test data.

SOC depths(t/ha)	Random Forest (RF)				Extreme Gradient Boosting (XGBoost)			
	Train data		Test data		Train data		Test data	
	RMSE	R^2	RMSE	R^2	RMSE	R^2	RMSE	R^2
0-30cm	5.64	0.664	7.36	0.603	5.42	0.671	7.12	0.617
30-60cm	7.14	0.613	7.89	0.578	7.41	0.609	7.69	0.580
60-100cm	10.99	0.526	11.23	0.501	10.48	0.568	10.74	0.543
100-200cm	27.98	0.611	31.10	0.579	26.66	0.652	29.55	0.601

In table 5 the report demonstrates the diverse SOC stocks within arid and semi-arid regions, as evident from the varying SOC distribution across different depth ranges. For instance, within the

0-30 cm depth range, SOC stocks contribute 15.98% of the total, with a minimum value of 6.24 t/ha.

Table 5. Summary of estimated soil organic carbon (SOC) content and stocks across four soil depths (0-30 cm, 30-60 cm, 60-100 cm, and 100-200 cm).

SOC depths(cm)	Total SOC (%)	Min (t/ha)	Mean(t/ha)	Max(t/ha)
0-30	15.98	6.24	18.98	44.97
30-60	19.33	5.58	19.14	89.98
60-100	23.68	7.25	28.44	103.64
100-200	41.01	15.57	64.30	299.21

Hence, during the validation process it was concluded that the baseline SOC stock of 8.5 tC/ha is satisfactory, conservative and supported by both project-specific field data and independent studies.

The higher national minimum of 9.096 tC/ha reported by Odebiri et al. (2022) was ruled out, as it was not aligned with the applied methodology requirements and has key limitations, including model uncertainty and lack of degraded-land specificity.

Furthermore, Odebiri et al. (2024) (authored by the same group of researchers.) reported SOC values as low as 6.24 tC/ha in semi-arid and arid regions, reinforcing the appropriateness of the project's assumption.

<u>**Consolidation of Baseline SOC Assessment:**</u>

1. This is the combination of tier 2 and tier 3 data. By combining Tier 2 and Tier 3 data, project can achieve greater accuracy and confidence in its soil carbon stock change estimates.

2. As discussed above, remote sensing and machine learning approaches may not adequately capture localized heterogeneity (because of uncertainty of model, model

		error etc.) in SOC distribution. Therefore, the validation using the field-sampled SOC data offers a more reliable and baseline value determination. 3. TBC's baseline SOC report also covers field measure data of the 2017–2018 period, i.e., within two years of the project start, and is consistent with Section 9.1 of VM0026 v1.1. This meets the methodological requirement under Option 2 (measured approach), which the PP has applied to estimate project removals from SOC changes. 4. In contrast, the minimum SOC stock value of 9.096 tC/ha reported by Odebiri et al. (2022) does not meet the methodological requirements and has key limitations including model uncertainty and a lack of degraded land specificity. 5. The SOC baseline value is third-party assessed and certified and has been independently reviewed by the VVB. Hence, the baseline SOC value of 8.5 tC/ha is considered reasonable, conservative and is further substantiated in the updated verification report. c. The VR section 4.3 has been updated to document the derivation of the 8.5 tC/ha baseline SOC stock and to reconcile it against Odebiri et al. (2022) and other literature assessed, with justification provided for the conservativeness of the selected value. All required clarifications from 2(a) and 2(b) have been incorporated to ensure transparency.	
		<u>Verra Response</u> The changes to sampling depth and bulk density data were well justified. Baseline SOC stock inconsistencies were resolved, and additional justification and evidence for the baseline value was provided. This finding is closed, and no further actions are required.	

5	**Insufficient assessment of zero leakage**		
	<u>Issue</u> The VVB does not present sufficient details on how they assessed and confirmed zero leakage during this monitoring period.	**Round 1** <u>VVB Response</u> Section 4.3 of the VR has been revised and a detailed assessment for considering zero leakage has been added. The following assessment has been added:	Closed

<table>
<tr>
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<td>
<u>Action Required</u>
The VVB must include in Section 4.3 of the VR a description of how they assessed and verified that the project had zero leakage during this monitoring period against the scope of VMD0033 and VMD0044.

<u>Program Rule(s)</u>
VM0026, v1.1, Section 8.3
VMD0033, v1.0, Step 1
VMD0044, v1.0, Section 5.1.1
VCS Standard, v4.7, Section 4.1

<u>Background</u>
VR, Section 4.3: “Leakage emissions is zero PP has identified two leakage forms they are livestock displacement leakage and Market Leakage. PP has provided enough justification in Section 1,18 why the identified leakages are negligible.” – But Section 1.18 is a Section of the PD.
</td>
<td>
<table>
<tr><th>Leakage Type</th><th>PP’s justification</th><th>VVB’s Assessment</th></tr>
<tr>
<td>Market leakage (LEM,t)</td>
<td>Market leakage is considered negligible as the project does not aim to reduce livestock numbers. Livestock population is stated to be governed by land capacity and rainfall, not by external market demand.</td>
<td>
The methodology allows market leakage to be considered negligible if no significant reduction in livestock production occurs (VM0026, Section 8.3).

The PP clarifies that livestock numbers are maintained or managed based on ecological carrying capacity, not reduced for commercial reasons. No evidence of herd downsizing or market-driven destocking is reported. The same was cross checked and verified during the site visit and the supporting evidence submitted.

e.g., in the declaration letter from landowner of Greg Martindale (Strata 1) reports the livestock count from 2013 to 2022

c) LIVESTOCK
<table>
<tr><th>Year</th><th>Cattle</th><th>Sheep</th><th>Other</th></tr>
<tr><td>2013-2014</td><td>21</td><td>0</td><td>130</td></tr>
<tr><td>2015-2016</td><td>21</td><td>0</td><td>130</td></tr>
<tr><td>2016-2017</td><td>21</td><td>0</td><td>130</td></tr>
<tr><td>2018</td><td>21</td><td>0</td><td>180</td></tr>
<tr><td>2019</td><td>21</td><td>0</td><td>205</td></tr>
<tr><td>2020</td><td>25</td><td>0</td><td>156</td></tr>
<tr><td>2021</td><td>29</td><td>0</td><td>161</td></tr>
<tr><td>2022</td><td>30</td><td>0</td><td>167</td></tr>
</table>

in the declaration letter from landowner of Pieter Botha (Strata 2) reports the livestock count from 2013 to 2022

c) LIVESTOCK
<table>
<tr><th>Year</th><th>Cattle</th><th>Sheep</th><th>Other</th></tr>
<tr><td>2013-2014</td><td>132</td><td>2750</td><td>35</td></tr>
<tr><td>2015-2016</td><td>135</td><td>2755</td><td>41</td></tr>
<tr><td>2016-2017</td><td>135</td><td>2755</td><td>35</td></tr>
<tr><td>2018</td><td>140</td><td>2849</td><td>40</td></tr>
<tr><td>2019</td><td>140</td><td>2800</td><td>40</td></tr>
<tr><td>2020</td><td>115</td><td>2755</td><td>40</td></tr>
<tr><td>2021</td><td>195</td><td>2924</td><td>40</td></tr>
<tr><td>2022</td><td>140</td><td>2830</td><td>40</td></tr>
</table>
No
Reduction in Livestock Numbers:

• Cattle numbers have increased steadily from in 2016–201) to in 2022.
</td>
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				• "Other" livestock (goats, poultry, etc.) has also remained stable or increased slightly compared to the baseline years. • Sheep numbers are consistently zero in Strata 1 suggesting no change or involvement and increased in Strata 2 suggesting steady increase. Similar trends have been observed in other Strata. Hence, there is no decline in livestock that would impact market supply. On the contrary, an increase suggests improved carrying capacity or better grazing management. ***Conclusion:*** This qualifies for zero market leakage.	
		Grazing displacement leakage (LEGD,t)	**Grazing displacement** is considered negligible due to physical containment: fencing, private land boundaries, and patrol mechanisms (game scouts) effectively prevent livestock movement across the	As referred in section 8.3 of the applied methodology and defined in Module VMD0040, v1[40], activity-shifting leakage may occur in projects implementing Sustainable Grassland Management (SGM) practices if grazing activities are displaced from the project area. Such displacement could lead to increased livestock-related GHG emissions and potential decreases in carbon pools outside the project boundary, particularly due to overgrazing.	

[40] https://verra.org/wp-content/uploads/imported/methodologies/VMD0040-Leakage-from-Displacement-of-Grazing-Activities-v1.0.pdf

			project boundary.	In this case, the PP has stated that all livestock remain confined within the project boundary, with containment ensured through physical controls such as fencing and regular monitoring. These measures are consistent with the expectations outlined in the methodology for demonstrating that grazing displacement does not occur. Supporting evidence includes: • Site visit observations, discussions with the landowners and photographs confirming the presence of fenced boundaries.  • A third-party fencing declaration submitted by the PP during validation, prepared by Bahori Consulting Pty Ltd, verifying the implementation of fencing.	

Farm Name	Fencing completion date
Bennidale Trust	05 July 2018
DavMar Agri	23 July 2018
Petrus Jacobus Loots	15 July 2018
Tillietudlum Nature Reserve	12 July 2018
KZN Crane Foundation	01 July 2018
Bergplaats Irene Properties (Pty) Ltd	10 July 2018
Ken Dorning Family Trust	16 July 2018
Field and Stream Pty Ltd	15 July 2018
Allandale Trust	17 July 2018
Riverdene Farming Co	15 July 2018
Longacres CC	22 July 2018
Tandjiesberg Trust	01 July 2018
Thorncliff Trust	07 July 2018
The Fairfield Trust	01 July 2018
Donovale Farming Company (Pty) Ltd	11 July 2018
Blaauwater Trust	31 July 2018
R J Combrink & Seun Familie Trust	19 July 2018
Kleinfontein Trust, KZN	15 July 2018
Kleinfontein Trust, FS	12 July 2018
Giel Beukes Aandele Trust	29 July 2018
The Waterfall Trust	02 July 2018
Die Triangle Trust	15 July 2018

Conclusion: Based on the implemented containment measures and supporting evidence, it is concluded that there is no displacement of grazing activity outside the project boundary, and thus no activity-shifting leakage is expected.

Documents submitted in response to finding 5:

MR v3

VR v2

Verra Response

The VVB described sufficiently how they assessed and verified that the project had zero leakage during this monitoring period: (1) livestock numbers did not reduce; (2) fencing, land boundaries, and patrol prevented displacement. This finding is now closed, and no further action is required.

6	Incorrect value used for yearly baseline ERRs		
	Issue The calculation of Net GHG ERRs for the monitoring period in Tab “Emission Removal_MR1” incorrectly uses the average of baseline ERRs for all years, rather than the yearly value. See cells ‘I32 to I36.’ Action Required	**Round 1** VVB Response With reference to the Baseline Year definition in Section 3.1 and the guidance in Section 8.1 on *Quantification of Baseline Emissions*, the methodology permits the use of average baseline emissions calculated over the baseline period to determine the crediting baseline.	Closed

	The VVB must ensure that the ERR spreadsheet is revised to correctly include the yearly value of baseline ERRs in the calculation of Net GHG ERRs. <u>Program Rule(s)</u> *VCS Standard, v4.7*, Section 2.2.1 (Accuracy)	**Baseline Year b** The year for which baseline emissions for a parameter are calculated as an average of emissions over the baseline period or as a result of sample surveys Accordingly, in line with the methodological requirements, the estimation has been conducted using the average of baseline ERRs across all baseline years. <u>Verra Response</u> The VVB confirmed the project complies with the methodology for calculating Net GHG ERRs. This finding is now closed, and no further action is required.	

7	**Incomplete and inconsistent reporting of VCUs**		
	<u>Issue</u> 1. The vintage table in Section 5.4 of the MR does not include ‘Reductions VCUs.’ 2. The vintage table of Section 5.2 of the VR: a. Does not include ‘Removals VCUs” b. ‘Reductions VCUs’ are incorrect as they reflect the net GHG ERRs (i.e., before buffer). 3. Section 4.2 of the non-permanence risk report (NPRR) does not include the VCUs for the current monitoring period and the number of buffer credits to be deposited in the AFOLU pooled buffer account. <u>Action Required</u> The VVB must ensure that the MR, VR, and NPRR accurately report the VCUs vintages, adhering to the templates and maintaining consistency across all documents. <u>Program Rule(s)</u> *VCS Monitoring Report Template, v4.4,* Section 5.4 *VCS Verification Report Template, v4.4,* Section 5.2 *AFOLU Non-Permanence Risk Report Template, v4.0*, Section	**Round 1** <u>VVB Response</u> 1. Reduction VCU has been included in section 5.4 of the revised MR. However, the methodology does not provide any method to segregate reductions and removals. 2. The corrections have been made in section 5.2 of the VR. Following corrections are made: i. The ERR table now include ‘Removals VCUs” ii. The vintage ERR table of the VR has now been corrected. 3. The PP has now included the number of buffer credits to be deposited into the AFOLU pooled buffer account, as well as the VCUs to be issued for the current monitoring period, in Section 4.2 of the NPRR. The revised NPRR has been submitted to Verra for review. **Documents submitted in response to finding 7:** MR v3 VR v2 NPRR v2	Closed

	4.2	Verra Response The VCUs vintages have been updated per the templates in the MR, VR and NPRR. This finding is now closed, and no further action is required.	