



**Verified Carbon
Standard**

SOIL CARBON IMPROVEMENT PROJECT THROUGH GRASSLAND MANAGEMENT, IN SOUTH AFRICA

Document Prepared by:
WeAct Pty Ltd.



Project Title	Soil carbon improvement Project through Grassland Management, in South Africa
Version	01
Date of Issue	17 January 2022
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1 PROJECT DETAILS

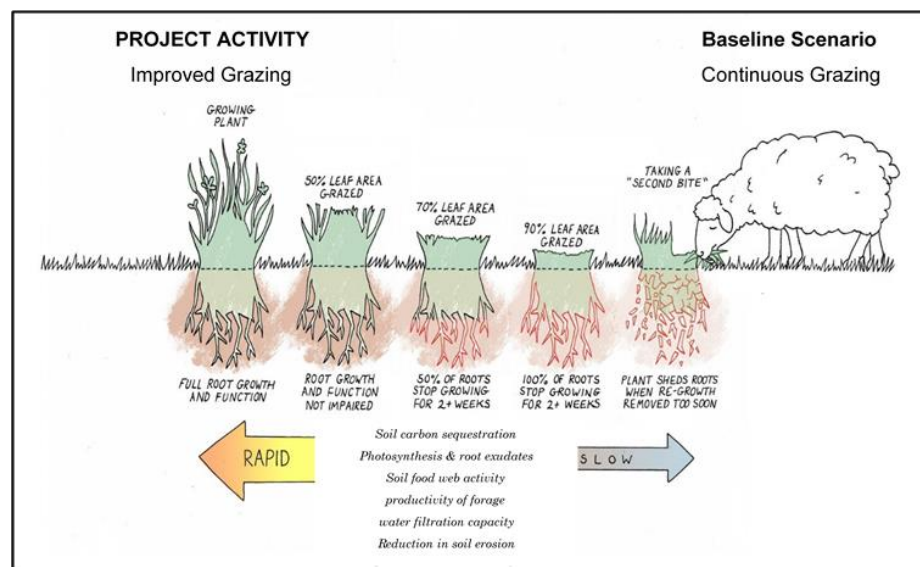
1.1 Summary Description of the Project

The proposed Project Title: Soil Carbon Improvement Project through Grassland Management, in South Africa.

The proposed project aims to remove GHG from atmosphere by implementing sustainable grazing management and controlled fire over a multiple grasslands of Drakensberg area in South Africa. The practice of past over grazing and uncontrolled fire has depleted soil organic matter, greatly reduced perennial vegetation cover and the potential production of forage for livestock.

In the baseline scenario, the pastures are larger and the livestock movement less frequent, allowing for unrestricted and selective grazing of perennial grasses. Loss of perennial grasses in grassland ecosystems results in soil loss and erosion, soil carbon loss, reduced water filtration capacity, and reduced productivity of forage.

Project Activity i.e. planned grazing and controlled burning will increase the rest and rotation on pastures above baseline practices. Smaller pastures implemented by fencing with more rotations allow the recovery of perennial grasses, which foster greater carbon inputs, higher retention of carbon as lignin and cellulose, and greater belowground production. This results in the sequestration of greenhouses gases from the atmosphere to the soil.



The project has been designated as a 'Grouped Project' and plans to increase the number of project instances over a period of time. The first instance includes three land areas "Chrissiesmeer Protected Area" (CPA, 60,230 ha), "Upper Wilge Protected Environment" (UWPE, 500 ha) and "Ladysmith" (9770 ha) and this first instance aims to recover around 70,000 ha of

land degraded by unrestricted grazing and uncontrolled fire through the implementation of planned rotational grazing and controlled burning.

The overall purpose of this initiative is to develop soil carbon storage through improved grassland management and expected to result in significant removal of CO₂ from the atmosphere, as documented using the VCS methodology, “VM0032 – Sustainable Grassland Management through Adjustment of Fire and Grazing”. With expected annual removals of approximately 2,46,773 tCO₂e/year on average (an estimated value based on secondary data), eventually the project is estimated to remove about 7 million tons CO₂e over the crediting period.

However, the project activity is dependent on financial aid to enable such grassland management activities to achieve improvement in soil carbon. Therefore, project has been designed and developed considering carbon revenue to sustain. Thus, these new practices, which would not occur without significant carbon revenues to motivate change in herder behaviour, increase fencing etc., will allow recovery of perennial grasses and the restoration of soil organic carbon in the entire region being targeted under this project.

1.2 Sectoral Scope and Project Type

The project corresponds to VCS sectoral scope 14 “Agriculture, Forestry and Other Land Use (AFOLU)”. The AFOLU project category is Agricultural Land Management (ALM). In the ALM category, the proposed project falls under the “Improved Grassland Management (IGM)”.

The project is a grouped project.

1.3 Project Eligibility

According to the list of eligible AFOLU Projects described in Appendix 1 of VCS Standard Version 4.1, the present project activity falls under “Improved Grassland Management (IGM)” of the project category “Agricultural Land Management (ALM)” category. The project aims at increasing soil organic carbon (SOC) through adjustment of fire and controlled grazing. The justification of eligibility of the project under the scope of the VCS Program are given in the table below.

Table 1: Eligibility conditions for improved Grassland Management (IGM) under VCS	
Eligibility conditions	Justification/Description
This category includes practices that demonstrably reduce net GHG emissions of grassland ecosystems by increasing soil carbon stocks, reducing N ₂ O emissions and/or reducing CH ₄ emissions.	Past overgrazing in large pasture has greatly reduced perennial vegetation cover and the potential production of forage for livestock and thus results in soil loss and erosion, soil carbon loss, depleted soil organic matter reduced water filtration capacity, The project aims to remove greenhouse gases from the atmosphere by developing soil carbon

	storage through implementing sustainable grazing management and controlled fire over a large area of grass land of Drakensberg area in South Africa.
The project area shall not be cleared of native ecosystems within the 10 year period prior to the project start date	The project activity has not cleared any native ecosystem within the 10 year period prior to the project start date. This has been demonstrated through Satellite Imageries. Land title document, Baseline vegetation survey and interviews with the local farmers/communities on land use/cover history and important events during Participatory Rural Appraisal (PRA).

1.4 Project Design

The proposed project has been designed to include a multiple installation of an activity. The project is a grouped project as defined under the VCS Standard 4.1.

Eligibility Criteria

Table 2 : Eligibility criteria under grouped Project		
Sl. No.	Eligibility conditions under grouped Project	Description / Justification
1.	Meet the applicability conditions set out in the methodology applied to the project	The applicability conditions set out in the VCS methodology VM0032 (version 1) applicable to all project instances.
2.	Use the technologies or measures specified in the project description	The technologies or measures are used within the whole project area as specified in the project description for all the instances.
3.	Apply the technologies or measures in the same manner as specified in the project description	The technologies or measures are used within the whole project area and are applied in the same manner as specified in the project description for all the instances.
4.	Are subject to the baseline scenario determined in the project description for the specified project activity and geographic area	The whole geographic project area (Drakensberg area) within which the project instances located is baseline scenario determined in the project description.

5.	Have characteristics with respect to additionality that are consistent with the initial instances for the specified project activity and geographic area	The characteristics with respect to additionality are consistent for the initial instances (Chrissiesmeer Protected Area, CPA, Upper Wilge Protected Area, UWPA & Lady Smith) as well as for the total geographic project area (Drakensberg area).
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1.5 Project Proponent

Organization name	WeAct Pty Ltd
Contact person	Satish Duvvuru
Title	Director
Address	Level 1, 115, Chapel Street Windsor, Victoria 3181, Australia
Telephone	Ph: +61-409 135 580
Email	satish@weact.com.au

1.6 Other Entities Involved in the Project

Organization name	NA
Role in the project	NA
Contact person	NA
Title	NA
Address	NA
Telephone	NA
Email	NA

1.7 Ownership

Legal title of the land:

The land for implementing the proposed project involves a relatively complex arrangement of farm portions, owners and lessees, with different farm portions owned by different entities (people, companies or trusts). The legal title of the land is evidenced through legally registered land certificates (available upon request), issued by the Government Registrar of Land Titles.

Project ownership:

Land owners have agreed to be part of the project activity through a written agreement between WeAct Pty Ltd and the individual land holder. Land holders have agreed that the management process that generates GHG emission reductions or removals which vests project ownership to the project proponent. Under this agreement, the beneficiary community is committed not to assert any property rights over the carbon credits generated and/or to be generated by the Project.

1.8 Project Start Date

Start date of the project activity is considered as: 01/05/2017

The project start date reflects the timing of initiation of yearly sustainable grazing plans by the first project instance i.e. Chrissiesmeer Protected Area (CPA), Upper Wilge Protected Area (UWPA) & Lady Smith and the signing of an agreement/MOU between land owners, EWT and WeAct Pty Ltd administer and finance the implementation of the project.

1.9 Project Crediting Period

The project crediting period is 30 years.

The crediting period starts on 01/05/2017 and ends on 30/04/2047.

1.10 Project Scale and Estimated GHG Emission Reductions or Removals

The project activity under the first instance proposed falls under small-scale project category since the annual average GHG emission reductions are 246,773 tCO₂ which is less than 300,000 tCO₂e. The future instances shall also be considered under 'Project' category.

Project Scale	
Project	✓
Large project	

Year	Estimated GHG emission reductions or removals (tCO ₂ e) ¹
2017-18	238,813
2018-19	238,813
2019-20	238,813
2020-21	238,813
2021-22	238,813
2022-23	238,813
2023-24	238,813
2024-25	238,813
2025-26	238,813
2026-27	238,813
2027-28	238,813
2028-29	238,813
2029-30	238,813
2030-31	238,813
2031-32	238,813
2032-33	238,813
2033-34	238,813
2034-35	238,813
2035-36	238,813
2036-37	238,813
Total estimated ERs	7,403,211
Total number of crediting years	30
Average annual ERs	246,773

¹ This is only a projected value based on secondary data to estimate and present an ex-ante value at the time of initial baseline assessment for the first instance under the grouped activity. For the purpose of finalizing the actual baseline condition, the final baseline emissions shall be conducted using primary data; and conservative value based on comparative of primary & secondary data shall be considered as final baseline emission for the project. The same will be done and presented in due course of validation of the project.

1.11 Description of the Project Activity

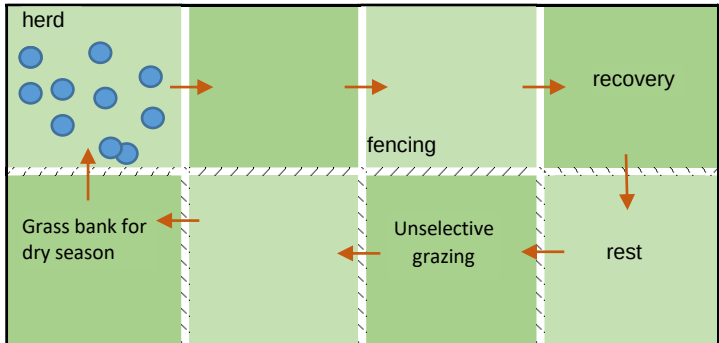
The project activity is dedicated towards removal of GHG from atmosphere by implementing sustainable grazing management and controlled burning over multiple grasslands in ‘Drakensberg’ area in the host country ‘South Africa’. The past over grazing and uncontrolled fire has depleted soil organic matter, greatly reduced perennial vegetation cover and the potential production of forage for livestock.

The ‘Endangered Wildlife Trust’ (also referred to as EWT), will continue to play a support role in the effective implementation of the proposed project i.e. planned rotational grazing practices and controlled fire, as opposed to repeated, permanent grazing simultaneously on all grazing lands and uncontrolled burning sites.

The first project instance has been designed with three land areas namely “Chrissiesmeer Protected Area (CPA)”, “Upper Wilge Protected Area (UWPA)” & “Lady Smith”, which was adopted planned rotational grazing in 2017 with the project boundary, in an estimated land area of about 70,000 ha.

The proposed project activity is following the below mentioned guidelines to achieve soil carbon sequestration.

Table 3 : The Proposed Project Activity	
IGM Activity	Description
Controlled burning	- Burning should not be considered unless the grassland has a grass phytomass of 4 tons/ha or exceeding 4 tons/ha. - Allowing grazers into the burned areas only after grass length is approximately 15 cm or ankle length and control the time spent by grazer

Planned rotational grazing	• Livestock operators will decrease the size of their pastures by using fencing to divide up existing pastures. • Animals will not graze the same location more than once within a wet season or once within a dry season. • Animals will be actively herded and moved to new forage • Animal herds will be moved across the landscape so as to avoid over-use of areas near settlements or water points. • Resting serves the purpose of allowing grass seed reserves to recover. A seed rest is important especially where low forage production is expected. • Resting especially over the wet season is important to allow germination and establishment of decrease species. Resting from October (the beginning of the wet season) until September (end of dry season) is recommended. • Herders follow agreed-upon plans for livestock movement from grazing committees. Grazing “assistants” employed by the project proponent will monitor and advise herders in the field.  The diagram illustrates a rotational grazing system divided into four sections by a central vertical fence line. The top-left section is labeled 'herd' and contains several blue circles representing livestock. An arrow points from the herd to the top-right section, which is labeled 'recovery'. Another arrow points from the recovery section to the bottom-right section, which is labeled 'rest'. A third arrow points from the rest section to the bottom-left section, which is labeled 'Grass bank for dry season'. A fourth arrow points from the grass bank back to the herd. The central vertical fence line is labeled 'fencing'. The bottom-right section is also labeled 'Unselective grazing'.  The photograph shows a real-world example of a rotational grazing system. It features a large, open field with a metal fence running across it. In the foreground, there is a small, dark, rectangular structure, possibly a water point or a feeding station. The field is divided into sections by the fence, and the grass appears to be in different stages of growth or recovery.
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Overall benefit of the project activity :

- The controlled burning can improve grass quality, palatability and availability, because the fire removes dead plant material, causes weed suppression and improves access to new growth,.
- The rotational grazing of animals will allow plants time to re-grow and to produce seed.
- Animals in herds are generally less selective for forage than those moving in looser smaller groups.
- Larger herds also can produce desirable hoof impacts on soils, i.e. breaking up crusts that promote sheet erosion of soil and decrease rainfall infiltration. Previous research has shown that perennial grasses can increase under a shift from continuous to rotational grazing.

Therefore, it can be concluded that decomposition of the permanent roots of perennials, combined with animal dung, can add carbon to the soil, increase water infiltration and soil water holding capacity, increase herbaceous productivity, mitigate climate variability, and enhance pastoralist livelihoods.

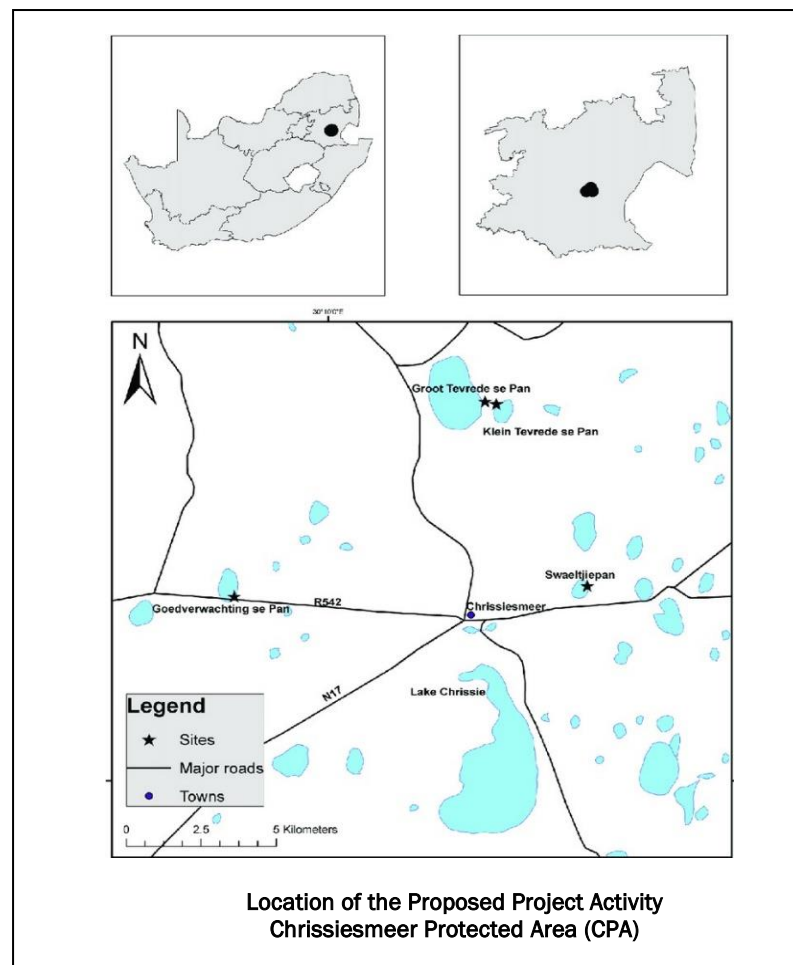
1.12 Project Location

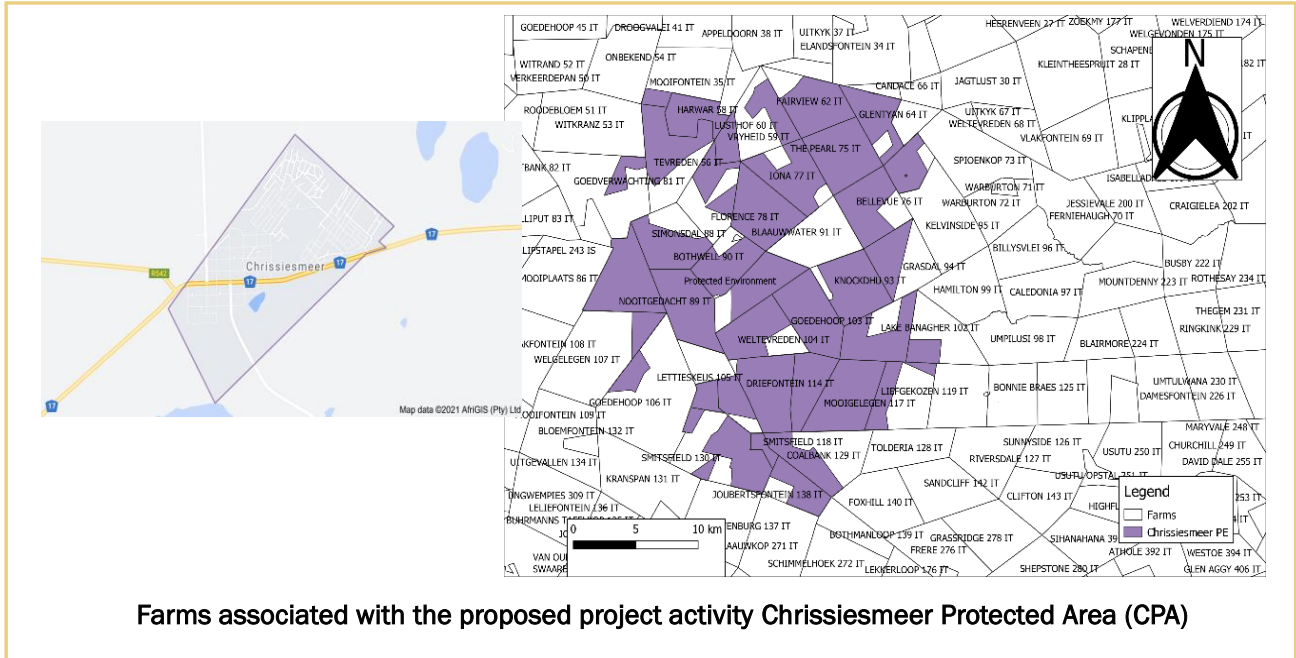
The grouped project activity is expected to have expansion in the large grassland area of Drakensberg Mountain, (Latitude: -28.816641 S, Longitude: 29.529621 E) in the host country the Republic of South Africa (RSA). The project area meets the eligibility criteria described in section 1.4 “Eligibility Criteria for Grouped Projects. This version of the PD includes only the 1st instance considered under the Grouped Project activity, which is demonstrated as follows:

Instance 1:

Project Area: Chrissiesmeer Protected Area (CPA)

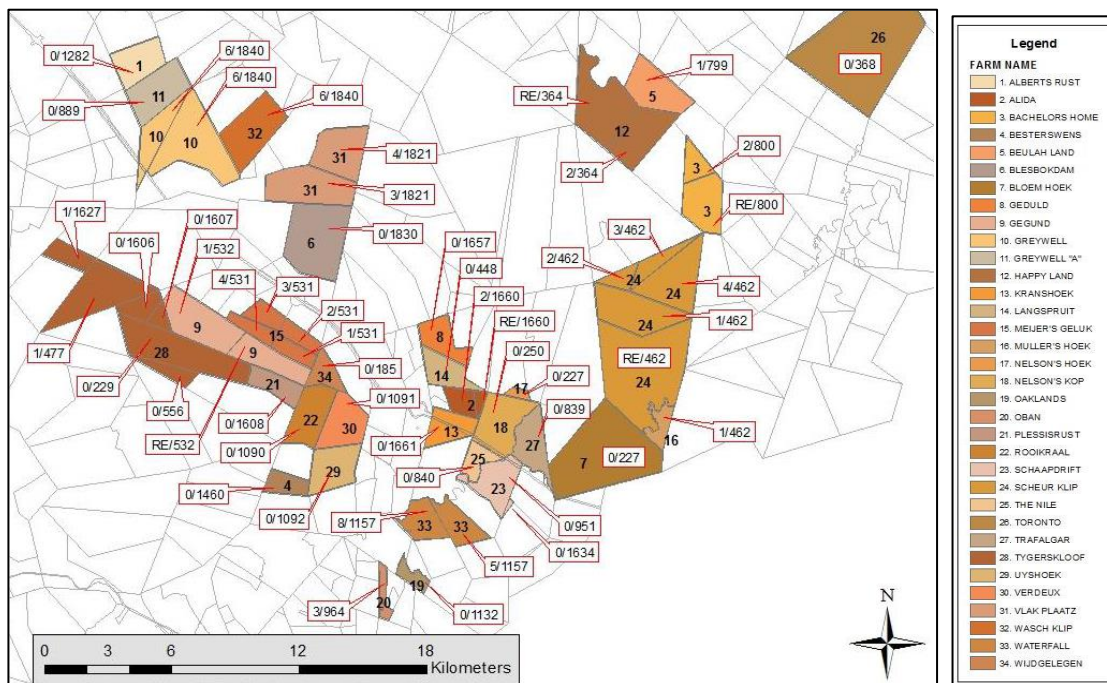
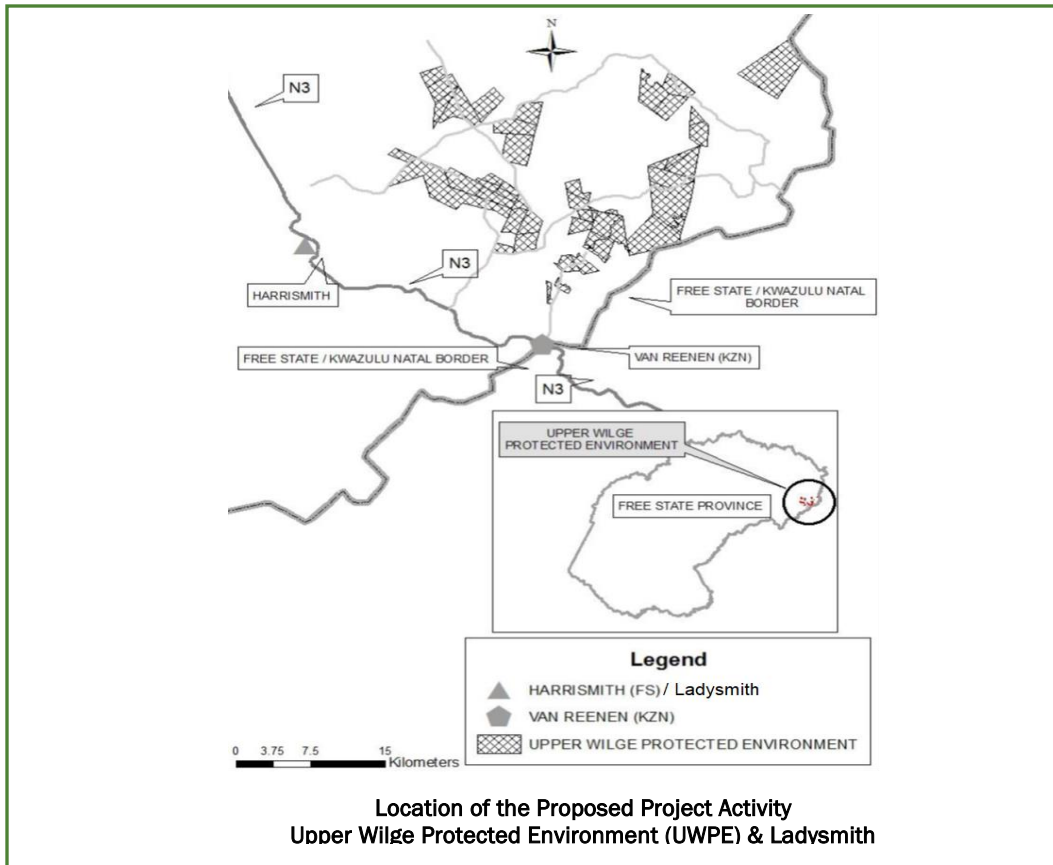
The CPA covers an area of approximately 58353 hectares. The CPA is located in central Mpumalanga within a region known as the Mpumalanga Lakes District which extends over both the Albert Luthuli and Msukaligwa local municipalities. The CPA is located within the Grasslands Biome. Latitude: -26° 15' 60.00" S and Longitude: 30° 12' 60.00" E. Chrissiesmeer town receives annual rainfall between 649 and 725mm, with most rainfall occurring during summer. The temperature regime is described as temperate, with a cool to cold winter and warm summer. The CPA is characterised by slightly undulating plains, including some low hills and low pan depressions. The altitude ranges from just over 1 800 m.a.s.l in the north to 1 650 m.a.s.l in the south-east. The geology consists mainly of sandstone and shales, sediments of the Karoo Supergroup (Johnson et al, 2006, Norman & Whitfield, 2006). Sandstone is the dominant geology and sedimentary rocks within the project area.





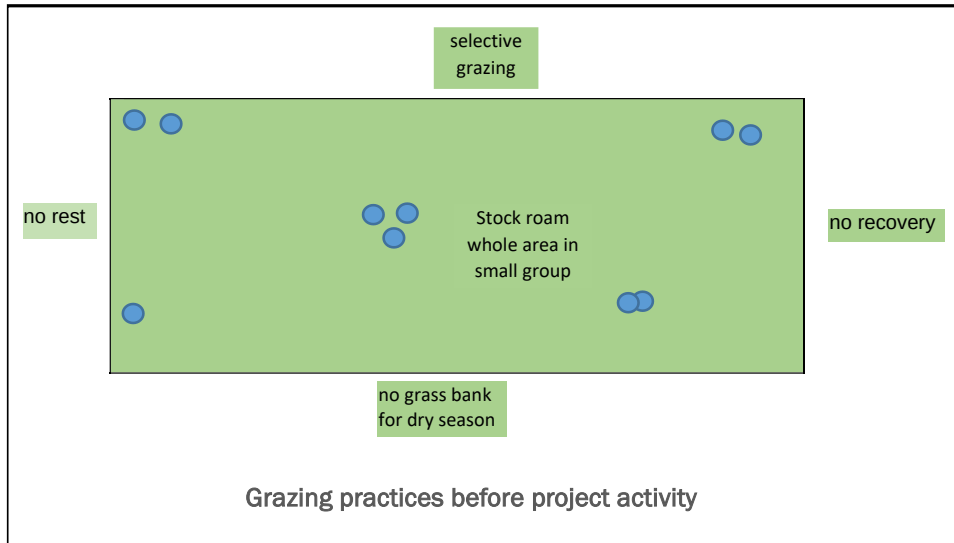
Project Area: Upper Wilge Protected Environment (UWPE) & Ladysmith

The first project instance of UWPE & Ladysmith covers an area of approximately 9770 hectares. The project area is located in Uthukela district of Kwazulu Natal. The project area is located within the Grasslands Biome. Latitude: 28°33'35"S and Longitude: 29°46'50"E. Ladysmith is located on the banks of the Klip River. It is on the foothills of the Drakensberg Mountain, about 26 km from the Van Reenen's Pass. The project area receives average annual rainfall around 639mm, with most rainfall occurring during summer. The temperature regime is described as sub-tropical highland climate, with warm summers and cool dry winters.



1.13 Conditions Prior to Project Initiation

Prior to the project initiation Continuous grazing has been the most popular grazing system since it is simple and requires little labour and management. In the continuous grazing system the pasture is not divided into sub-pastures or paddocks. Livestock are allowed access to all the pasture area at any given time.



In the pre project scenario, animals repeatedly graze the same site in small groups, simply as a consequence of the most convenient and least time and energy demanding deployment of livestock near permanent settlements or persistent water points. Moreover, “continuous” grazing system in which loose herds repeatedly graze the same ground, resulting in selective foraging, continuous animal impacts and no rest or recovery of forage. Animals are moved to different grazing areas seasonally, but often only after forage is reduced by more than 95%. Thus creating areas of both overgrazed forage and areas of underused and wasted forage.

Moreover, due to the continuous grazing uneven distribution of manure and resulting ‘nutrient creep’ toward water and shade; change in pasture botanical composition over time favouring plants that are not readily grazed; Loss of desirable forage species, the invasion of weeds, erosion, summer forage shortages with severe shortages in drier years was the most common scenario prior to project initiation.

Prior to project initiation there is little history of uncontrolled fire in the project area.

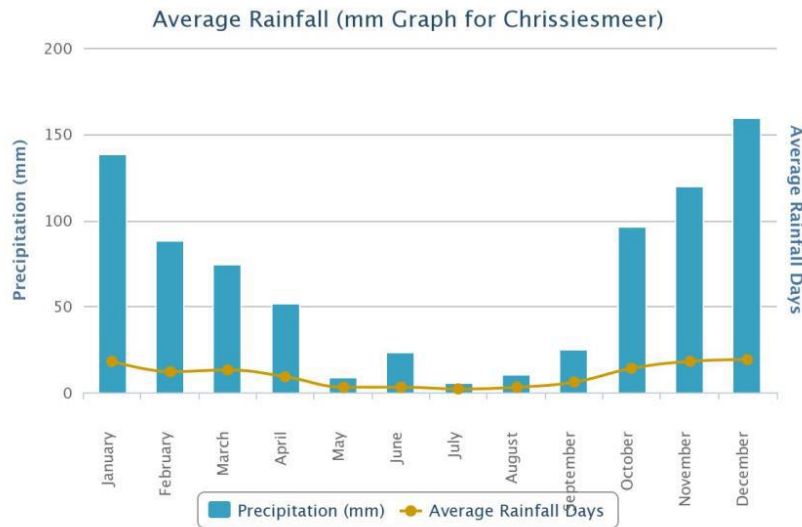
For more detail please refer section 3.4 (Baseline scenario).

Climate

Chrissiesmeer town receives between 649 and 725mm of rain per year, with most rainfall occurring during summer. The chart below shows the average rainfall values for Chrissiesmeer

per month. Chrissiesmeer receives the lowest rainfall in July and the highest in December (World Weather Online).

However, for the larger Chrissiesmeer area the rainfall ranges between 776-1200 mm. The temperature regime is described as temperate, with a cool to cold winter and warm summer.



Topography

The CPE is characterised by slightly undulating plains, including some low hills and low pan depressions. The altitude ranges from just over 1 800 m.a.s.l in the north to 1 650 m.a.s.l in the south-east. The Lake Chrissie pan field differs radically from other pan fields in the country in several respects. Pans in the western fields tend to be large, dry, floodplain-like features, elongated along river courses, whereas those in the Lake Chrissie area are isolated, usually oval in shape, and are perennially flooded. The density of pans is also extremely high. Moreover, whilst drainage within the pan field is essentially closed, several major river systems arise around the fringes of the field, namely the Vaal River , the Komati River (via the Boesmanspruit), the uMpuluzi River and the Usutu River. Thus, the pan field represents a local plateau of elevated ground, amongst the highest in the Highveld region. These various features combine to make the Mpumalanga Lake District (MLD), as the pan field is known, a unique geomorphic entity in the South African landscape.

Hydrology

The Chrissiesmeer Protected Environment, and more broadly the Mpumalanga Lakes District (MLD), is characterised by the presence of numerous unique inland pans. The MLD, centered around the town of Chrissiesmeer, includes more than 270 wetlands within a 20 km radius, representing the highest concentration of pans and wetlands, and the largest freshwater lake in South Africa, Lake Chrissie.

Most of the pans are oval shaped and perennially flooded. The system of pans is essentially a self contained water catchment, with no apparent surface outflows of water. The system is therefore described as a closed water system.

Moreover, whilst drainage within the pan field is essentially closed, several major river systems arise around the fringes of the field, namely the Vaal River, the Komati River (via the Boesmanspruit), the uMpuluzi River and the Usutu River. Thus, the MLD represents a local plateau of elevated ground, amongst the highest in the Highveld region.

Soil :

Red soils are found on dolerite, sandstone and also granite illustrated from the soil maps, but with important differences in terms of drainage depending on the geological substrate applicable.

- Fertile red clays with higher clay content are associated with dolerite, although red soils are found on sandstone as well, but clay content then less and drainage better compared to red soils on dolerite. Rocky outcrops with red clays were often observed, with red sandy clay loams in between the dolerite outcrops. Hutton, Bloemdal and Bainsvlei soil forms are well represented on dolerite substrates, with some on the ecotones with sandstone. Yellowish soils are moist. The Pinedene and the Avalon soil forms were observed. With fieldwork on Appeldoorn, the Avalon, Bloemdal and Pinedene soil forms were classified within short distances (between 60 to 100 m) which points to the complex environment.
- With the red clays on dolerite *Hyparrhenia dregeana* was dominant at under-grazed areas, typically of previously disturbed veld. The abundance of *Themeda triandra* on red clays is observed where grassland is pristine (or where it is well managed) but with overgrazing this palatable grass is poorly represented and will therefore not be easily spotted at overgrazed veld. *Setaria nigrirostris* and *Cynodon dactylon* were often observed on doleritic clays, the latter species dominant at previously disturbed grassland or at severely overgrazed veld.
- Dresden soils were most often observed compared to other soils classified within the study area. The Dresden form occurred on 25.4% of all sites assessed in this study (i.e., on both sandstone and dolerite). The largest class on the soil map, Class 13 illustrates the relationship of relative flat convex terrain with these soils. Flatter convex sloped terrain on the soil maps show a correlation with Dresden soils, together with the Glencoe soil form. Dresden soils were not observed on Dolerite.
- A high occurrence of Dresden soils specifically on sandstone was found - 32.6% of the soils on sandstone were classified as the Dresden form. Shallow ferricrete soils (Dresden soil form) are often found on the crest part of the catena – 80% of the sites on Sandstone with Dresden soils were on crests.
- These shallow ouklop soils are also found on other terrain units (5.1% of the sites on midslopes were observed to have Dresden soils).
- The second common soil found on sandstone was the Glencoe soil form (17.4% of sites assessed). Glencoe soils also occurred mostly on crests, but were also observed on

midslopes (1.2% of sites with Glencoe soils were on midslopes). This in agreement with what is found from the soil maps, with Dresden and Glencoe comprising the largest class.

- The footslope/valley bottom ecotones had the Katspruit soil form present.
- Moist sandy loamy yellow soils were present, with concave slopes characterized with the Pinedene and Avalon forms, mostly on midslopes, but also on crests and on lower footslope parts on the ecotones towards wetlands. Convex shaped terrain had Clovelly soil form present.

Ecosystem & Vegetation

The CPE falls within the Grassland Biome and within the CPE two vegetation types dominate, namely the Eastern Highveld Grasslands (31108 ha) and Eastern Temperate Freshwater Wetlands (3541 ha) (Mucina and Rutherford, 2006).

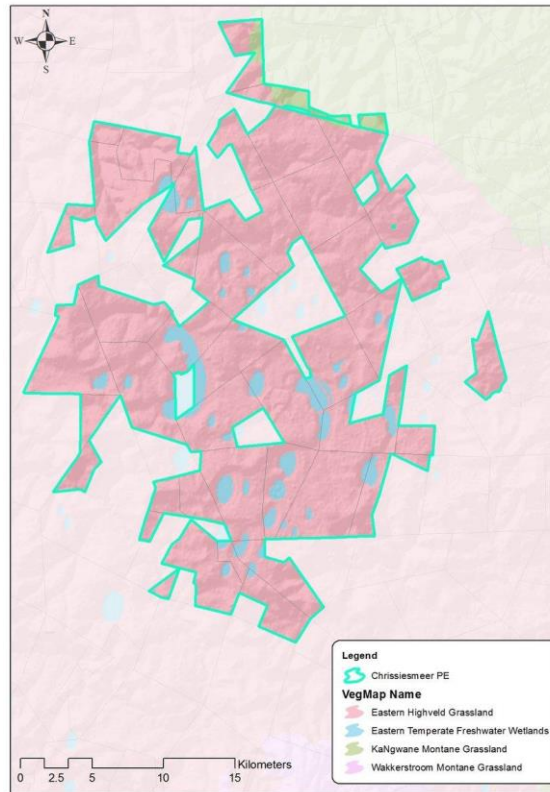
The importance of the CPE as a grassland priority area is demonstrated primarily through the fact that 10.52 % and 93.70 % of the outstanding vegetation conservation targets for Eastern Highveld Grasslands and for Eastern Temperate Freshwater Wetlands respectively will be achieved in this protected environment. Table 2 (Annexure 2) provides information of the importance and contribution of the CPE towards biodiversity targets for the two dominant vegetation types occurring.

Eastern Highveld Grasslands

The vegetation type occurs in Gauteng and in Mpumalanga province centered around Bethal, Ermelo and west of Piet Retief. Slightly to moderately undulating plains, including low hills and pan depressions. Altitude ranges from between 1 520 – 1 780 m. The vegetation is short dense grassland dominated by the usual highveld grass composition, with small, scattered rocky outcrops with wiry, sour grasses and some woody species. The area is dominated by strongly seasonal summer rainfall, with very dry winters.

These grasslands are categorised as near endemic with a vulnerable threat status, however current assessments indicate a much higher threat due to higher transformation than previously assessed and this vegetation type will be re-classified as endangered. The vegetation type is also highly transformed by some 65% - primarily by cultivation and plantations. The current protection status is poorly protected where only 13% of the target is secured in protected areas.

The vegetation type occurs throughout the country and is characterised by flat landscape or shallow depressions filled with seasonal water bodies supporting aquatic and hygrophilous vegetation of temporarily flooded grasslands and ephemeral herblands. Exclusively in summer rainfall region. Due to high elevation, frost is a frequent phenomenon. The vegetation type is categorised as vulnerable threat status.



Vegetation types in the CPE

Plant species of conservation concern occurring within the CPE		
TAXON	Common name	Status
<i>Alepidea longeciliata</i>	-	Endangered
<i>Eucomis montana</i>	Pineapple Lily	Declining
<i>Eucomis pallidiflora</i>	Giant Pineapple Lily	Near Threatened
<i>Boophone disticha</i>	Tumbleweed / Gifbol	Declining
<i>Eulophia zeyheriana</i>	Wetland orchid	Rare
<i>Khadia carolinensis</i>	Carolina vygie	Vulnerable
<i>Gunnera perpensa</i>	Wild Pumpkin	Declining

Historical & Cultural Environment

Bushman paintings in the Chrissiesmeer area are proof of a long Bushman habitation. Indeed, until recently, people of pure Bushman descent were still to be found in the area. Linguistically they belonged to the Bushmen of the Cape and the Free State. Exactly from where and when their ancestors came remains a mystery. The intrusion of Swazi pastoralists led to much conflict between the groups. When these pastoralists started entering the area, the raiding of Swazi cattle

and attacks on the Swazi herders by the elusive Bushmen led to impis being sent from central Swaziland to sweep the area, at times leading to massacres, like the one at Murder Rock, just outside of the Chrissiesmeer area. In 1856 the Chrissiesmeer area came under the control of the Zuid-Afrikaansche Republiek and European settlers started occupying the land. This led to the loss of the Bushmen's hunting grounds and freedom of movement. They were absorbed as farm labourers and domestics and intermarried with workers of African descent to the point of extinction.

In 1855, during the reign of Swazi King Mswati II a tract of land along the Pongola River and upwards, including the present area of Chrissiesmeer, ceded to the Voortrekker Boers of Lydenburg. It followed upon an earlier cession, in 1846, of all the land from the Crocodile River to the Oliphants River. The Swazis' aim with the land cession was to create an effective barrier between themselves and the Zulus. The ceded areas became part of the new Zuid-Afrikaansche Republiek ("ZAR") which covered the entire territory of what would later be known as Transvaal. A few years earlier, Boer farmers from the Lydenburg area had started to move away from their malaria-infested environment to the Highveld, but once arrived there, never ventured further eastwards than the Groot Zeekoepan, the present Lake Chrissie.

The ZAR, critically short of European inhabitants and in dire financial straits, was delighted when, in 1864, a Scot by the name of Alexander McCorkindale came with a proposal to develop, with the help of Scottish immigrants, the area, which had been ceded by the Swazis in 1855. The Scottish settlement given the official name of New Scotland. McCorkindale's plans for it included sheep farming, mining enterprises and even an industrial hub. New Scotland divided into three sections. The northern section called Industria. The Groot Zeekoepan, which fell within Industria's boundaries renamed after Christina Pretorius, the daughter of President Pretorius, the then president of the ZAR. On a map of Industria, drawn by land surveyor Magnus Forssman and dated 27 August 1867, the lake's new name is given as "Miss Chrissies Lake".

The settlement's first commercial venture was sheep farming. This is one of the primary farming practices in the area until the present day. The settlers also introduced wattle from Australia, used to treat animal skins, for a tanning industry. What remains of the area's Scottish connection to this day manifests itself in the names of farms and villages, such as Bothwell, Iona, Knockdhu, Lothair, Hamilton, Jessievale, etc. The farm Bothwell was where the trading post – later the village of Chrissiesmeer – was established. Street names within the village were formally adopted in 1904.

The ZAR went to war against Britain for a second time in 1899. The Anglo-Boer War, as it is known, has one date in particular that is of significance to Chrissiesmeer: the Battle of Lake Chrissie was fought on 6 February 1901 in Camp Bothwell.

The history and old sandstone buildings, as much as the Scottish farm names, form a link between Chrissiesmeer's history and its present. The main economic activity for the area remains agriculture (including sheep farming). Since 1994 tourism, largely based on the scenic beauty of the area, has slowly grown.

1.14 Compliance with Laws, Statutes and Other Regulatory Frameworks

The specific legislations that could be applicable for the present project activity and their relevance with the present project are mentioned as below.²

Table 4: Relevant legislation for the management of the 1 st Project Instance	
Criteria	Relevant Statutes
Resource Management	Natural Resource Management: ▪ Animals Protection Act [No. 71 of 1962] ▪ Atmospheric Pollution Prevention Act [No. 45 of 1965] ▪ Conservation of Agricultural Resources Act [No. 43 of 1983] ▪ Constitution of the Republic of South Africa [No. 108 of 1996] ▪ Environment Conservation Act [No. 73 of 1989] ▪ Forest Act [No. 122 of 1984] ▪ Hazardous Substances Act [No. 15 of 1973] ▪ Mpumalanga Nature Conservation Act [No. 10 of 1998] ▪ National Environmental Management Act [No. 107 of 1998] ▪ National Environmental Management: Biodiversity Act [No. 10 of 2004] ▪ National Environmental Management: Protected Areas Act [No. 57 of 2003] ▪ National Forests Act [No. 84 of 1998] ▪ National Water Act [No. 36 of 1998] ▪ National Water Amendment Act [No. 45 of 1999] ▪ National Veld and Forest Fire Act [No 101 of 1998] ▪ Nature Conservation Ordinance [No. 15 of 1974] Cultural Resource Management: ▪ National Heritage Resources Act [No. 25 of 1999] ▪ World Heritage Convention Act [Act No, 49 of 199]
	Financial Resource Management: • Public Finance Management Act. [No. 1 of 1999] Human Resource Management: ▪ Basic Conditions of Employment Act [No. 75 of 1997] ▪ Broad-Based Black Economic Empowerment Act [No. 53 of 2003] ▪ Compensation for Occupational Injuries and Diseases Act [No. 130 of 1993] ▪ Employment Equity Act [No. 55 of 1998] ▪ Labour Relations Act [No. 66 of 1995] ▪ Occupational Health and Safety Act [No. 85 of 1993] ▪ Pension Funds Act [No. 24 of 1956] ▪ Skills Development Act [No. 97 of 1998] ▪ Skills Development Levies Act [No. 9 of 1999] ▪ Unemployment Insurance Act [No. 63 of 2001]
Utilization Management	▪ Criminal Procedures Act [1977] ▪ Water Services Act [No. 108 of 1997] ▪ National Building Standards Act [No. 103 of 1977] ▪ National Road Traffic Act [No. 93 of 1996] ▪ Disaster Management Act [No. 57 of 2002] ▪ Development Facilitation Act [No. 67 of 1995]

² More information will be provided during validation

General Management	▪ Mpumalanga Tourism and Parks Agency (MTPA) Act [2005] ▪ MTPA Regulations ▪ Fire Brigade Services Act [No. 99 of 1987] ▪ Local Government: Municipal Systems Act [No. 32 of 2000] ▪ Occupational Health and Safety Act [No. 85 of 1993]
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Grazing and grazing resource (water, soil) rights are conferred by land ownership of South Africa via Native Land Act of 1913. These rights are further conferred and superseded by the Communal Land Rights Act 11 of 2004. Rights to benefit from soil conservation are conferred by the right to register lands by the Nature Conservation Ordinance [No. 15 of 1974].

The relevant labour laws include the Employment Equity Act [No. 55 of 1998]; Labour Relations Act [No. 66 of 1995], Occupational Health and Safety Act [No. 85 of 1993], Pension Funds Act [No. 24 of 1956], Unemployment Insurance Act [No. 63 of 2001]. These have been and will continue to be implemented in the project through implementation of PP's hiring policies.

National Environmental Management Act [No. 107 of 1998]. Additional laws protect the integrity of project participants and their ability to engage in contracts

Companies Act. EWT is a registered non-profit organization and WeAct Pty Ltd is registered as limited company and are in good standing to operate in South Africa.

The Trespass Act of 1959. Project participant could use this law to enforce the project area borders and reduce project livestock encroachment outside the project boundary.

Occupational Health and Safety Act [No. 85 of 1993], which ensures medical care for employees in the event of accidents or harm related to exposure, wildlife hazards, and violence associated with enforcing livestock protection laws and grazing rights.

The project activity is in complete compliance with the aforementioned applicable legislations.

1.15 Participation under Other GHG Programs

1.15.1 Projects Registered (or seeking registration) under Other GHG Program(s)

The Project has not been registered, or is seeking registration, under any other GHG programs.

1.15.2 Projects Rejected by Other GHG Programs

The project is not rejected by other GHG Programs.

1.16 Other Forms of Credit

1.16.1 Emissions Trading Programs and Other Binding Limits

The project activity involves in grassland management, project credits are ineligible under existing Emissions Trading programs.

1.16.2 Other Forms of Environmental Credit

The VCS is the only standard that allows carbon credits under agricultural land management to adjust grazing. The project will not pursue other forms of environmental credit.

1.17 Additional Information Relevant to the Project

Leakage Management

Leakage can result from displacement of livestock off the project area (displacement leakage) and from replacement of livestock outside the project area to meet market demand (market leakage)

Displacement leakage : Movement of livestock could result in losses of carbon from higher levels of overgrazing out of the project area, or displacement leakage. Displacement leakage can be determined by using the tool VMD0040. Refer section 4.3 for detail.

Market Leakage : Methodology VM0032 prohibits accounting for reduced methane emissions by livestock from reduced livestock numbers in order to avoid market leakage.

Commercially Sensitive Information

No commercially sensitive information has been excluded from the public version of this Project Description.

Sustainable Development

Sustainable development is defined in South Africa's NEMA (Act 107 of 1998) as "the integration of social, economic and environmental factors into planning, implementation and decision making so as to ensure that development serves present and future generations" (Government of South Africa, 1998). This is consistent with the United Nation's definition that reads "Development that meets the needs of the present without compromising the ability of future generations to meet their own needs"³. In particular, sustainable development will be achieved through:

- Improvement of soils
- water availability from project grazing management activities
- production of meat and milk through dry periods

³ <http://www.un.org/esa/sustdev/index.html>.

- forage production
- Creating skilled and unskilled employment opportunities
- allow and increase alternative community revenues through increases in wildlife populations and ecotourism revenues
- Building institutional capacity related to grazing management, ecological training etc.
- Contributing to local capacity building, environmental education, adaptation to climate change, awareness and knowledge transfer.

Further Information

To be provided in due course of validation

2 SAFEGUARDS

2.1 No Net Harm

There is no potential negative environmental and socio-economic impacts associated with the project activity.

2.2 Local Stakeholder Consultation

As a preliminary approach for the way forward, a series of stakeholder consultation meeting was conducted in each project sites.

The primary stakeholders include:

- WeAct Pty Ltd (Project Proponent)
- The Endangered Wildlife Trust (local NGO)
- Landowners
- Herder
- Grazing coordinator
- Grazing Chairperson

Secondary stakeholders include:

- the Msukaligwa and Chief Albert Luthuli Local Municipality
- Birdlife South Africa
- The Mpumalanga Tourism and Parks Agency (MTPA)

In the preliminary meetings, Project proponent introduced the concept of Improved Grass Land Management (IGM) practices through rotational grazing & controlled fire in the Village land parcels, shared the impact of other Agricultural Land Management (ALM) Projects, and defined and discussed priorities for strengthening the long term sustainable development in the project area under the Voluntary Carbon Standard (VCS). The project proponent explained the process of VCS Program validation and verification and the validation/verification body's site visit.



The aim of these meetings was to share the key objectives of the proposed project i.e. the adoption of improved grazing & controlled fire in the grassland, their cost-benefit analysis, individual challenges during the implementation phase of the project activities and to solicit stakeholders' contributions on ways forward for the project.

During the meetings it was also discussed the implementation of grazing management training and education, resolve disputes due to encroachment from offsite project herders. Effort was also applied to developing a regional grazing plan to allow herders from within-project area to use grazing lands from other within-project area.

The meetings were successful in discussing the project objectives with the landowner & herder, creating awareness on the benefit of implementing IGM practices and also to share their interest on the IGM activities for the long term project development.

(Additional details related to all the stakeholders' consultations shall be submitted during the validation process).

2.3 Environmental Impact

This project activity does not have any negative environmental impact. According to the Environmental Impact Assessment Regulations 2010 (NEMA EIA 2010) neither an EIA nor Basic Assessment is required as the project activities do not trigger any of the Environmental Impact Regulation listed activities published in Government Notice No. R 385 of 2006 (No. R. 386 and 387, 21 April 2006 including amendments 3 July and 9 October 2009). The project activity is completely environmentally friendly and has positive impacts on environment.

2.4 Public Comments

This is the first version of the Project Design of the activity, which will be listed on the Verra website for 30 days for public comments. Any public comments received shall be considered during the validation process.

2.5 AFOLU-Specific Safeguards

In association with EWT, the Project proponent, WeAct Pty Ltd, has identified all of the major landowners of the area those are willing to participate in the carbon project. The project area is dominated by households whose majority income is from livestock sales or products (e.g., milk, meat). In addition, there are other stakeholders including government offices and communities outside the project area.

The primary stakeholders include:

- WeAct Pty Ltd (Project Proponent)
- The Endangered Wildlife Trust (NGO)
- Landowners;
- Herder
- Grazing coordinator
- Grazing Chairperson

Secondary stakeholders include:

- The Msukaligwa and Chief Albert Luthuli Local Municipality
- Birdlife South Africa
- The Mpumalanga Tourism and Parks Agency (MTPA)

3 APPLICATION OF METHODOLOGY

3.1 Title and Reference of Methodology

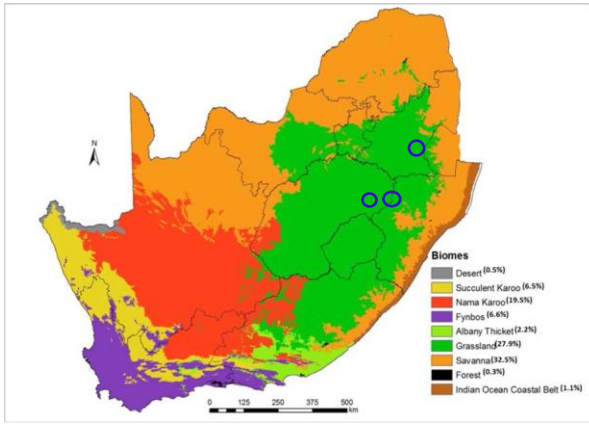
The project applies the “Methodology for the Adoption of Sustainable Grasslands through Adjustment of Fire and Grazing” (VM0032, Version 1.0).

Tools :

1. Methods for stratification of the project area (X-STR), VMD0016, v1.2
2. Tool for the Demonstration and Assessment of Additionality in VCS AFOLU Project Activities, VT0001 version v3.0
3. Leakage from Displacement of Grazing Activities, VMD0040, v1.0:

3.2 Applicability of Methodology

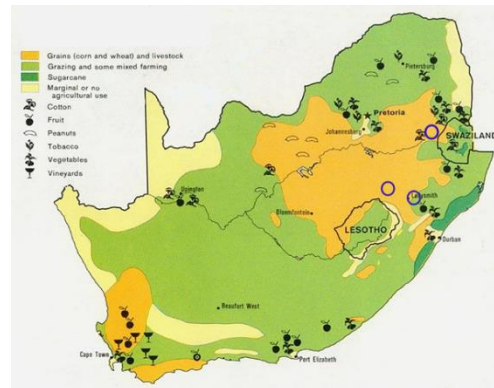
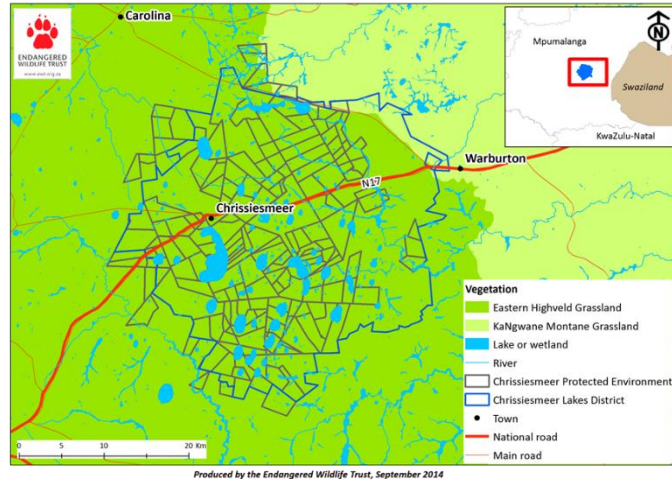
The project activity complies with the applicability conditions of the VCS VM0032 methodology Version 1 as follows:

Table 5 : Justification for Methodology Applicability	
Applicability conditions	Justifications
The project area must be classified as grasslands	The 1st Project instance is located within the Grasslands Biome. So, the project area is broadly classified as grassland. Mean tree canopy cover is less than 50% and the project zone is not classified as forest⁴. 

⁴ <http://www.fao.org/forestry/country/en/zaf/>

Table 5 : Justification for Methodology Applicability

Figure depicts the project area not included within the forest area.



Project activities will not alter the land classification as they are not expected to affect tree cover or convert grasslands to some other land cover.

Lands are grazed and/or subject to fires in the baseline and/or project scenarios. Lands may be used for different purposes, such as livestock production, conservation, hunting or tourism :

The project will modify the husbandry (herding) practices used with livestock. Wildlife conservation occurs in the project zone.

Table 5 : Justification for Methodology Applicability	
The project must be structured to keep livestock within the project area, and the project proponent must be able to enforce the boundaries of the project area :	The establishment of community based grazing plans & management and the recognition of clear boundaries outside the project area are sufficient to keep livestock generally within the project boundaries. Each site of the project area has a boundary fence line. Site project borders are patrolled by coordinators and their assistants. Animal censuses are conducted by the grazing coordinators, using some combination of interviews, contacting a phone network of herders, and direct counts. Details are available.
The project must result in no net increase in the density of, or time spent by animals in confined corrals where dung can pile up and begin to decompose anaerobically and result in CH₄ and N₂O emissions, such as an increase in the number of livestock aggregated (e.g. kept in corrals or pens) that would result in more than 50 percent of the ground area covered by dung.	No corral practices are known to be in place. So will not lead to increased penning of cattle that exceeds the anaerobic threshold of dung deposition. The goal of the project is for communities to achieve greater sustainability in animal numbers rather than accumulate more animals in poorer condition.
Baseline emissions derived from livelihood-driven human impacts on aboveground woody biomass (e.g. cutting for fuel wood, charcoal or timber sales) must be deemed de minimis (i.e. not included in the cumulative 95 percent of total baseline emissions)	This applicability condition was modified in an issued Errata and Clarifications⁵ to VM0032 and restated as “...must be deemed de minimis (not greater than 5% of the total greenhouse gas benefit of the project)...”. No record has been made in the social situational analysis summary (2014) in relation to the livelihood woody biomass although in some areas invasive are being removed and will continue to be removed. The main species are black wattle (<i>Acacia mearnsii</i>) and poplar (<i>Populus</i> sp.).

⁵ <https://verra.org/wp-content/uploads/2019/04/VM0032-Errata-and-Claifications-1APR2019.pdf>

Table 5 : Justification for Methodology Applicability	
and project activities cannot significantly alter such livelihood-driven activities.	
For projects that propose to modify grazing, the maximum individual project size is 3 million ha or 5 percent of a country's land area currently or potentially used to graze livestock, as judged by national government land use inventories or other documentation.	Approximately 35.6 million ha⁶ land is under grazing land category out of total land area of South Africa 122.5 million ha. The total project size of the first instance is 0.07 million ha, which is less than 3 million ha.
The methodology is not applicable under the following conditions: • Project activities that involve mechanical vegetation removal or soil tillage • The project area receives a net import of inorganic or organically-derived fertilizer	• There will be no indigenous vegetation removal within the grasslands. • The people in the project area do not import fertilizer from outside the project area. The unimproved grasslands are mainly used for grazing by livestock.

⁶<http://www.statssa.gov.za/?p=13144#:~:text=Commercial%20agricultural%20land%20comprised%20mainly,is%20used%20for%20crop%20production.>

3.3 Project Boundary

Geographic boundary

The project area generally is the sum of all farms where Improved Grassland Management (IGM) practices are adopted over time. Therefore, the project area is increasing over time depending on how many farms are under IGM adoption. Following the guidance on grouped projects under the VCS (VCS Standard 4.1) the map below figure delineates the total project area within which all project activity instances occur during the crediting period.

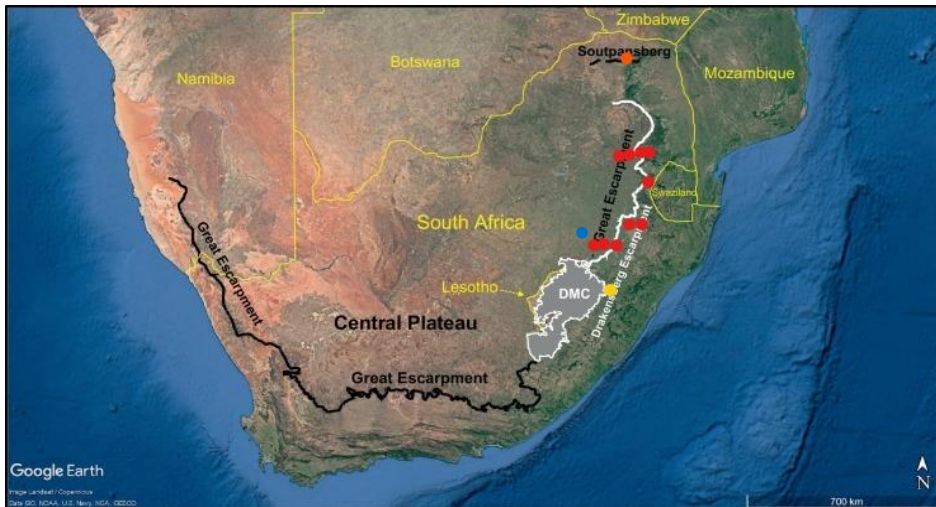


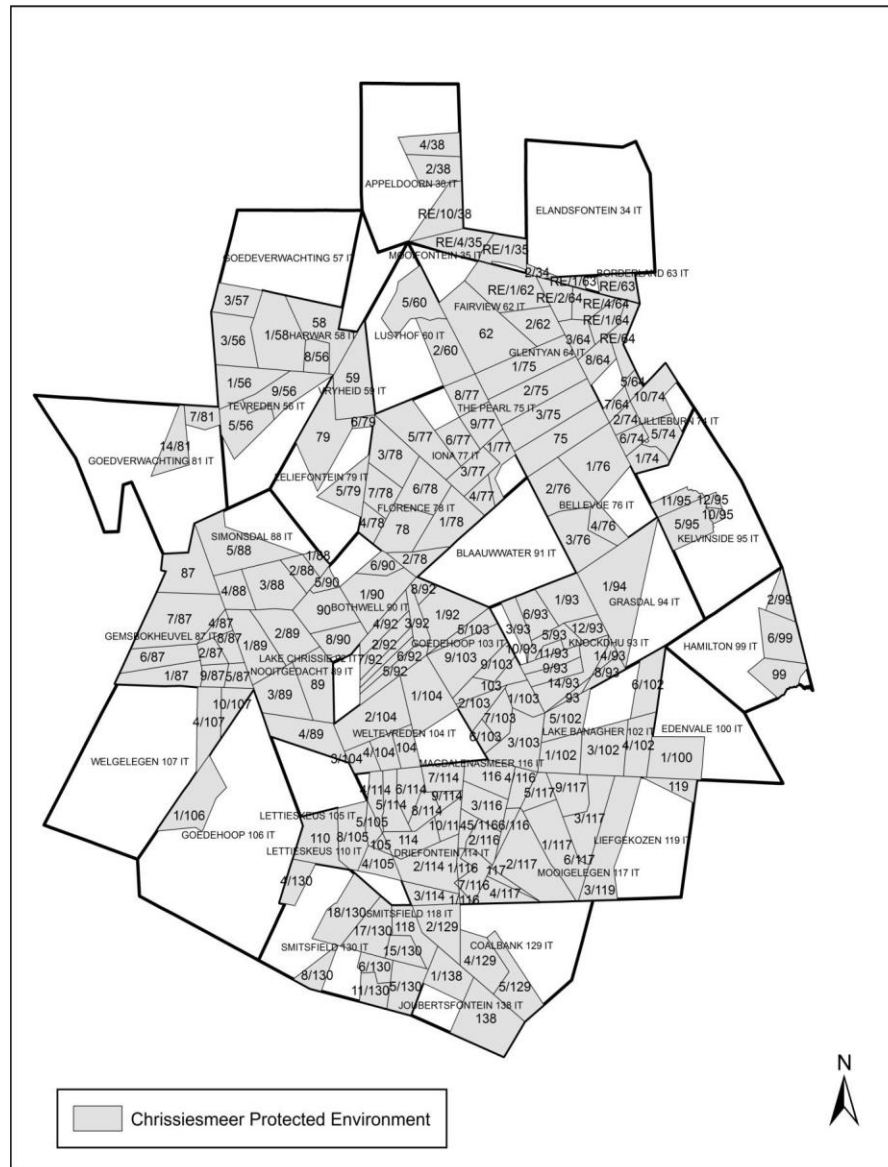
Figure : Extended Project Area

●	Chrissiesmeer Protected Area (CPA)
● ●	uMsonti Private Nature reserve II
● ● ●	Upper Wilge Protected Environment
● ● ● ●	Greater Lakenvlei Protected Environment
●	Ladysmith
●	Grassfed Farmers Underberg
●	Soutpansberg or Glen Annie

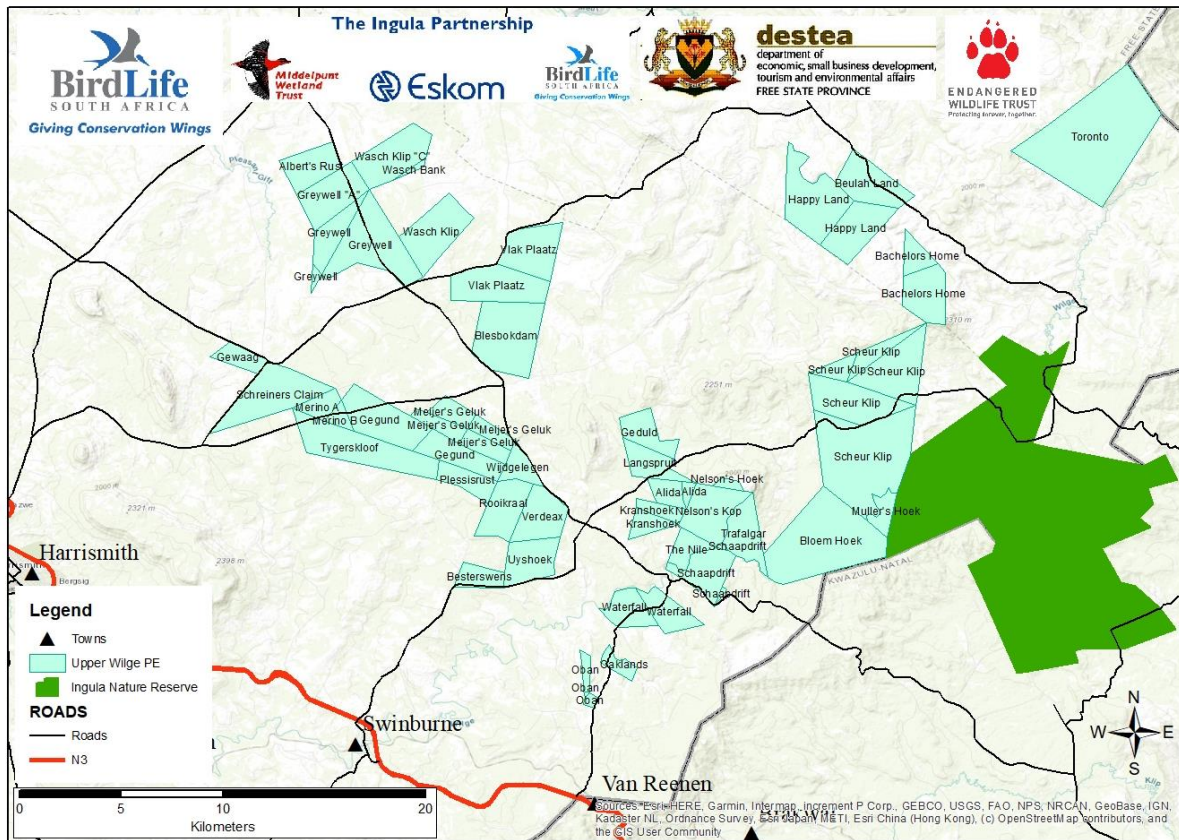
Initial project activity instances

The initial project activity instances included in this project description and subject to validation where IGM practices are already adopted or are being planned to adopt and for which the farm boundaries have been tracked.

1 st project instances	Total No of Landowners	Total Area (ha)
Chrissiesmeer	48	60,230
Upper Wilge	13	500
Ladysmith	34	9,270



Farm and farm portions within CPA



Farm and farm portions within Upper Wilge

GHG Sources Included In or Excluded From the Project Boundary				
Source	Gas	Included?	Justification/Explanation	
Baseline	Grazing Animals	CO ₂	N	balance with CO ₂ uptake, respiration by plants, and annual decomposition ⁷
		CH ₄	Y	Enteric fermentation by livestock
		N ₂ O	N	No increase in concentration of dung and forage is not fertilized (applicability conditions)
		Other	-	-
	Burning biomass	CO ₂	Y	The project activity practices controlling fire, so, biomass burning in baseline emission calculations included.
		CH ₄	N	balance with CO ₂ uptake
		N ₂ O	N	Negligible under applicability conditions
		Other	-	-
	Soil emission	CO ₂	N	Assumed to be in balance with C inputs to SOC (SOC at equilibrium)
		CH ₄	N	Negligible since project is not in wetland
		N ₂ O	N	Negligible under applicability conditions
		Other	-	-
Project	Grazing animals	CO ₂	N	Balance with CO ₂ uptake by plants
		CH ₄	Y	Removals conservatively excluded, Increases from baseline must be counted
		N ₂ O	N	No increase in concentration of dung and forage is not fertilized (applicability conditions)
		Other	-	-
	Burning biomass	CO ₂	N	The project activity practices controlling fire, so CH ₄ may be conservatively excluded.
		CH ₄	N	The project activity practices controlling fire, so CH ₄ may be conservatively excluded.
		N ₂ O	N	Negligible under applicability conditions

⁷ IPCC. Grasslands. Guidelines for Greenhouse Gas Inventories: IPCC; 2006. p. 1-49.

GHG Sources Included In or Excluded From the Project Boundary				
Source	Gas	Included?	Justification/Explanation	
	Other	-	-	
	CO ₂	N	Accounted for in measured ΔSOC	
	CH ₄	N	Negligible since project is not in wetland	
	N ₂ O	N	Negligible under applicability conditions	
	Other	-	-	

Carbon Pools

Soil organic carbon is the major pool of carbon, considered by the methodology. Also carbon stocks from changes in woody biomass are considered project activity intends to control fire in the project scenario and there may an incremental effect in removal from woody biomass. Though people use a negligible amount of woody (only the invasive sp.) carbon for fuel. As per the methodology, the following sources and sinks are included in the estimation of net GHG emission reductions.

Carbon pools considered in this project		
Pool	Selected (Y/N/O)	Explanation/ Justification
Above ground woody Biomass	Y	The project activity intends to control fire in the project scenario, so there may be increases in removal from woody biomass. So this pool will be quantified & monitored. Though in the baseline people use a negligible amount of woody carbon (only the invasive sp.) for fuel.
Above ground non woody biomass	N	This is typically burned or decomposed within the same year of its production and therefore is not a major sink and is considered in balance with CO ₂ uptake, respiration by plants, and annual decomposition
Below ground biomass	N	This is not considered a major sink in grasslands because it is considered in balance with CO ₂ uptake, respiration by plants, and annual decomposition. As tillage is not allowed according to applicability conditions, any increase from project activities may be conservatively excluded.
Dead wood	N	Negligible in grasslands, particularly those with fire.
Litter	N	In grasslands, litter exhibits high turnover which further reflects balance with CO ₂ uptake, respiration by plants, and annual decomposition

Soil Organic Carbon (SOC)	Y	Major carbon pool covered by VM0032 version 1
Wood products	N	An optional pool for VCS ALM projects, it is considered negligible for untilled grasslands.

3.4 Baseline Scenario

The baseline scenario is identified as the existing or historical land management practices, under the assumptions that this would continue in the absence of the project. Methodology VM0032 requires multiple information sources to establish the baseline scenario for the allowable pools as described in the project boundary.⁸

1. Fire history: There is a few history of fire in the project area for last few years and the fire is not affected by the project activity. CO2 emission from fire determined from hand-drawn maps accompanied by records of where and when land parcels burned.
2. Grazing history: Grazing history for 10 years before start of the project activity need to determine using MODIS NDVI satellite imagery.
3. Baseline methane emission: Baseline methane emissions were determined from past (last 10 years before start of the project activity) livestock numbers as measured in household survey and livestock grazing animals census in multiple communities within the project area.
4. Aboveground woody biomass sampled at the project start from many locations in the project area
5. Initial soil carbon was measured across the project area
6. a methodological (VM0032) approach was used to estimate soil carbon removals under the project scenario and maximum SOC in the previous 10 years as baseline SOC.
7. uncertainty calculated

3.5 Additionality

The steps as outlined in the VCS tool VT0001 “Tool For The Demonstration And Assessment Of Additionality In VCS Agriculture, Forestry And Other Land Use (AFOLU) Project Activities” (Version 03) were followed to demonstrate that the proposed project activity is additional and not the baseline scenario.

⁸ More information will be provided during validation

STEP 1. Identification of alternative land use scenarios to the AFOLU project activity;**Sub-step 1a. Identify credible alternative land use scenarios to the proposed VCS AFOLU project activity**Scenario 1: Continuous, unplanned/selective grazing and uncontrolled burning.

In this scenario livestock (domestic herbivores) are released on open pastures throughout the grazing season and allowed to overgraze choice of grasses and plants, preventing regeneration of perennial grasses. This is the scenario in the project area which is continuing since their forefathers. Each family is responsible for the livestock they own and makes its own decisions about where to graze and find water. Livestock are moved according to family-determined thresholds of forage availability. Animals repeatedly graze the same site in small groups, simply as a consequence of the most convenient and least time and energy demanding deployment of livestock near permanent settlements or persistent water points. Animals are moved to different grazing areas seasonally, but often only after forage is reduced to a great extent.

Scenario 2: Conversion to cropland

Child grants provided by the government were reported as a major source of income for the majority of households in the project area. Child grants were said to be a consistent form of income and many households depended on it. The landowners would not afford the costs for preparation of land (tilt, ploughing etc.) for carrying cultivation. There would be significant soil carbon losses in the conversion of grassland to cropland. Moreover, through the implementation of a Zoning Plan for the 1st project instance, protect all the remaining natural areas within the CPA, UWPA & Ladysmith and ensure that no primary grasslands are transformed to planted pasture or croplands.

Scenario 3: Management of land as a Wildlife Conservancy.

Under this scenario, effort would be devoted to the wildlife conservation value of the land with livestock greatly reduced in number. Funds for this protected environment would come from distributed tourism revenues. Declining forage and water resources appear to be driving a decline of wildlife across the 1st project instance area indicating that the land may lack the capacity to support thriving tourism regardless of protection.

Scenario 4 : Increased rotation and rest on smaller pastures (Project activity) on the land within the project boundary performed without being registered as a VCS AFOLU project

Livestock operators will decrease the size of their pastures by using fencing to divide up existing pastures. More labour is required to move the cattle from pasture to pasture to ensure each pasture receives sufficient rest during the growing season.

Animals will be grouped into herds of mixed animals. Herds will be actively guided and moved throughout a day and from day to day by a trained herder, either one of the owners or a hired herder. Animals will not graze the same location more than once within a wet season or once within a dry season and will be moved to a new site. Areas near settlements or water points will be used similarly to other areas in the grazing plan. Some areas will be rested to allow recovery from past grazing or to provide grass banks during the dry season or droughts.

These new practices, needs more labour, infrastructural cost for fencing, water developments may be needed to supply water to those pastures or to open new pastures, employment of experienced staff & workers to monitor the grazing activity regularly etc. motivate change in herder behaviour which would not occur without significant external revenue (carbon revenues).

Outcome of Sub-step 1a

- Continuation of the pre-project land use: Continuous, unplanned/selective grazing and uncontrolled burning.
- conversion to crop land
- Management of land as a Wildlife Conservancy
- Increased rotation and rest on smaller pastures (Project activity) on the land within the project boundary performed without being registered as a VCS AFOLU project:

Sub-step 1b. Consistency of credible land use scenarios with enforced mandatory applicable laws and regulations

All specific legislations that could be applicable for the present project activity and their relevance with the present project are mentioned in section 1.14.

All the above policies are taken into consideration while evaluating the alternatives to the project activity and the following alternatives listed are in compliance with the applicable laws and regulations.

Sl. No.	Identified Alternatives	Permitted / Not Permitted
1.	Continuation of the pre-project land use: Continuous, unplanned/selective grazing and uncontrolled burning	Permitted
2.	conversion to crop land	Not Permitted
3.	Management of land as a Wildlife Conservancy	Permitted
4.	Increased rotation and rest on smaller pastures (Project activity) on the land within the project boundary performed without being registered as a VCS AFOLU project	Permitted

Outcome of Sub-step 1b

The following list are the credible land use scenarios :

- Continuation of the pre-project land use: Continuous, unplanned/selective grazing and uncontrolled burning
- Management of land as a Wildlife Conservancy
- Increased rotation and rest on smaller pastures (Project activity) on the land within the project boundary performed without being registered as a VCS AFOLU project

Step 2. Investment analysis

Investment analysis will be skipped as barriers and common practice analysis provide a better basis for additionality.

Step 3. Barrier analysis**Sub-step 3a. Identify barriers that would prevent the implementation of the type of proposed project activity**

The proposed project activity faces a number of investments, technological, infrastructural, institutional and social barriers to its implementation described as below:

a) Investment barriers

The proposed project activity, needs more labour, infrastructural cost for fencing, water developments may be needed to supply water to those pastures or to open new pastures, employment of experienced staff & workers to monitor the grazing activity regularly. Investment barrier is faced because of huge initial investment required for changing the pattern of grazing activity.

Child grants provided by the government were reported as a major source of income for the majority of households in the project area. Child grants were said to be a consistent form of income and many households depended on it. So, the landowners do not have capital to invest. High initial investment without quick return is beyond the means of the land owners.

b) Technological barriers:

It is found from the household survey that the level of education of landowners in the project area are very poor. They are far poorly educated to have access to information and knowledge about the benefit of planned rotational grazing. For successful implementation of the project activity, grazing consultants need to be appointed and workshops need to arrange to educate and share the knowledge regarding planned grazing with the locals. EWT and WeAct Pty encourages the landowners and livestock owners and provides technical support for the planned grazing activity.

c) Barriers due to local ecological conditions:

Due to overgrazing for decades, the land remained barren with no/very little vegetation cover causing undesired compactness of soil. Due to direct exposure to wind and water erosion, topsoil is almost eroded. Unfavourable metrological conditions like frequent drought in the region are not allowing agriculture to flourish in the area of project activity. The topography of land is undulated, soil is rocky, deficient in necessary nutrients making the land unfit for agriculture uses.

d) Barriers due to social conditions:

The barriers due to social conditions are identified as under

- Lack of skill and proper training: The technical know-how and skill for planned rotational grazing on forage production and climate change aspect is lacked with most of the grazers as most of them are illiterate. There is no mechanism for training and demonstration on planned grazing, controlled fire, harvesting, and soil conservation techniques available in the area.

- Lack of organisation: The local communities lack the organisational structure to put together a volunteer effort for planned grazing.

Sub-step 3b: Elimination of land use scenarios that are prevented by the identified barriers.

S. No.	Alternatives	How identified barriers prevent implementation of credible alternatives identified at step 1a.	Prevented /Not prevented by barrier
1.	Continuation of the pre-project land use: Continuous, unplanned/selective grazing and uncontrolled burning	Investment barrier : Letting livestock grazing openly across the landscape requires no additional costs for fencing, water, or labour to move the livestock to new areas to graze.	Not prevented by any barrier
		Technological/social condition/local ecological condition: There are no educational or workshop resources needed to manage is this way, as it is the most conventional method.	
2.	Management of land as a Wildlife Conservancy	Investment Barrier	Not Prevented by this barrier
		Technological barrier	Not Prevented by this barrier
		Barrier due to social condition Barriers exist to reducing livestock, as livestock act as personal wealth to provide revenues and represent assets that can be quickly converted to cash when needed.	Prevented by this barrier
3.	Increased rotation and rest on smaller pastures (Project activity) on the land within the project boundary performed without being registered as a VCS AFOLU project:	Investment Barrier Investment is needed in the fencing and water to divide pastures. Labour is continually needed to move the livestock more frequently. As the land takes 5 to 7 years to begin to respond to improved grazing practices, any financial benefit from improved soil health is remote. Necessary payments to professional herders to move large herds of livestock over large distances	Prevented by this barrier

		Technological barrier Livestock operators must first have access to the knowledge and educational resources to understand how to best manage their livestock to ensure maximum productivity of perennial grasses.	Prevented by this barrier
		Barrier due to social condition Lack of skill and proper training and Lack of organisation	Prevented by this barrier
		Lack of confidence in the safety of animals kept far from permanent field, due to risks of wildlife predation and cattle theft.	Prevented by this barrier

Conclusion:⁹

From the above discussion it was found that the present land use; characterized by unplanned/ selective grazing activity but with very low yield, and unplanned burning is the most realistic scenario available to project participants.

The proposed AFOLU project activity is not the baseline scenario and, hence, it is additional.

STEP 4: Common Practice Analysis

Planned rotational grazing and controlled burning is not a common practice in the region. The Grazers are lack of financial resources as well as technical knowledge to coordinate such planned grazing as described in scenario 3. Consequently, scenario 3 would not occur in the absence of revenues from the proposed grassland management soil carbon project.

3.6 Methodology Deviations

There is no deviation from the methodology.

⁹ Further information will be provided during validation

4 QUANTIFICATION OF GHG EMISSION REDUCTIONS AND REMOVALS

4.1 Baseline Emissions

This is the first version of the Project Design document, presented as the draft of the project activity for the initial public listing. Therefore, the baseline emissions were estimated based on the secondary data available from the reliable source like Govt. published data, prior to the commencement of the project and are representative for the total project area. Whereas, for the purpose of finalizing the actual baseline condition and final baseline emissions from the primary data¹⁰, a detailed baseline assessment and estimations will be conducted based on comparative data with primary data sets and existing secondary data, the most conservative estimation shall be considered as final baseline emission for the project. Thus, the following sections provide the estimations based on secondary data for an initial baseline assessment.

Baseline Emissions from Grazing Animals (BEM):

Baseline methane emissions from grazing animals must be estimated from data on total numbers for different livestock categories that reflect species, age, sex and their respective weights, in the project area. Calculations are based on estimating daily methane emissions as a function of the body weight (kg) of each major animal category (Table 0: Daily Methane Emissions Data), and then multiplied by the number of animals in each animal category and 365 days in a year. Emissions from all categories may then be summed to provide the total annual methane emissions for the project area.

$BEM = \sum_{C=1}^K (BN_C \times DMEF(W_C)) \times GWP_{CH_4} \times 365 \times 6.26 \times 10^{-7}$	
BEM	Baseline annual emissions from grazing animals (tCO _{2e})
BN _c	Baseline number of animals of category c (head)
DMEF(W _c)	Daily emission factor as a function of animal weight for category c (L CH ₄ / day)
WC	Average body weight during the baseline period for animals of category c (kg)
GWP _{CH₄}	Global warming potential for methane (tCO _{2e} / tCH ₄)
C	category of grazing animals
K	number of categories of grazing animals, eg. species, gender, age combinations
365	Conversion factor for days to years
6.26 x 10 ⁻⁷	Conversion factor for L CH ₄ / day to t CH ₄ / day

Table 6 : Allometric Equations, with Uncertainty, for Daily Methane Emissions for Three Animal Types: Ruminants, Equids, And Pigs

¹⁰ A primary data collection and baseline assessment shall be undertaken.

Animal Type	Equation	n	R ²	Uncertainty Percent
Ruminants	$0.66 \times WC^{0.97}$	62	0.88	9.5%
Equids	$0.18 \times WC^{0.97}$	23	0.76	28.2%
Pigs	$0.07 \times WC^{0.99}$	12	0.93	18.6%

BN_c, is the harmonic mean number of animals of each category during the 10 years prior to the project start date, calculated as below. The harmonic mean conservatively weights lower values of methane emissions in a sample.

$BN_c = \left(\frac{1}{n}\right) \times \left(\frac{1}{\sum_{i=1}^n \frac{1}{N_{c,i}}}\right)$	
BN _c	Baseline number of animals of category c (head)
N	Number of counts
N _{c,i}	Animals in category c during count i (head)

Table 7: Baseline livestock animal censuses and baseline methane emissions.						
Grazing Animal Category			Animal Counts (Head)			Methane Emissions
Species	Sex/Age	Weight (kg)	Year 1	Year 2	Harmonic Mean	Methane Emissions for Category (tCO ₂ e)
Cattle	Adult	450	624930	693672	657509	928687
	Juvenile	275	267827	297288	281790	246848
Sheep	Adult	36	390983	433991	411365	53866
	Juvenile	18	167564	185996	176299	11623
Goat	Adult	250	140445	155894	147766	118013
	Juvenile	175	60191	66812	63328	35785
Pigs	Adult	70	80402	89246	84593	2269
	Juvenile	38	34458	38248	36254	531
Total Animals					1858907	Total Emissions (tCO ₂)
						1397622

Baseline Emissions of Methane from Burning of Biomass (BEBB)

The current project activity project activity decreases fire, so, biomass burning in baseline emission calculations included as equation below:

$BEBB = \frac{\sum_m (FFREQ_{m,b} \times APB_{m,b} \times PA_{m,b}) \times BC_G \times EF_{BG} \times GWP_{CH_4}}{1000000}$	
BEBB	Baseline annual emissions of methane from burning of biomass (tCO _{2e})
FFREQ _{m,b}	Proportion of area of stratum m burned annually (percent)
APB _{m,b}	Mean total aboveground biomass at the end of the growing season in stratum m (kg biomass/ha)
PA _{m,b}	Baseline area in stratum m (ha)
BC _G	Baseline combustion factor for savanna/grassland (kg biomass burned/kg biomass)
EF _{BG}	Emission factor for the burning of grassland (g CH ₄ /kg biomass burned)
GWP _{CH₄}	Global warming potential of CH ₄ (tCO _{2e} / tCH ₄)
1,000,000	Converts g CH ₄ into Mg (tons)

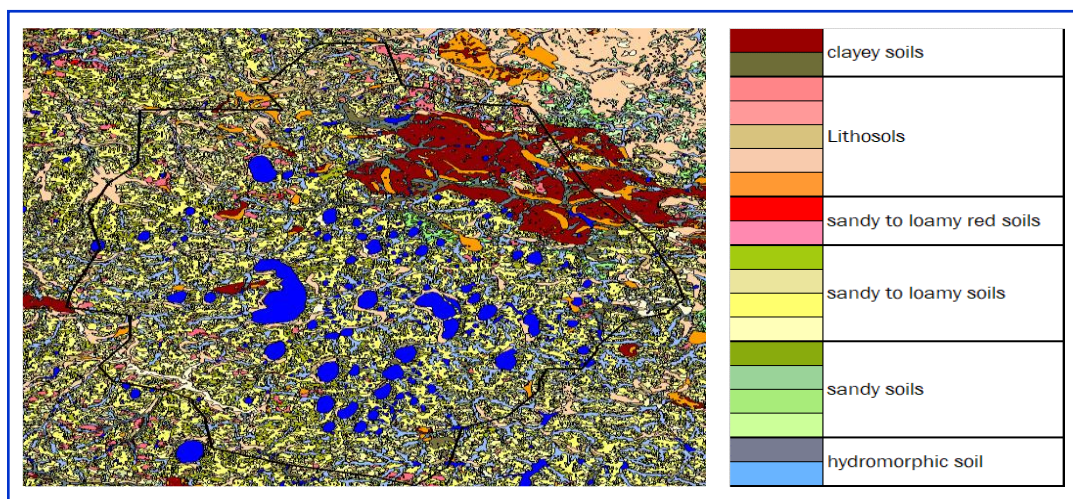
Baseline Changes in SOC Density:

Baseline soil organic carbon for the proposed project activity is as per the VCS VM0032 methodology.

Stratification & Sample size determination:

Stratification:

Obtaining precise estimates of soil organic carbon requires careful stratification. The project area stratified according to soil type. The major soil types are clayey soils (covering 11.8%), Lithosols (covering 11.9%), sandy to loamy red soils (covering 3%), sandy to loamy soils (covering 56.4%), sandy soils (covering 1.4%) and hydromorphic soil (covering 15.6%). Therefore, the project area composed of 6 strata.



Sample size determination:

Sampling stations must be selected to encompass as much of the variability in these factors as possible in order to test that the model is appropriate for use in the project area. As per the methodology VCS VM0032, the total number of sampling station for the project area must be determined by using online calculator. A-priori Sample Size Calculator calculate the minimum required sample size for a multiple Regression study, given the desired probability level, the number of predictors in the model, the anticipated effect size, and the desired statistical power level. The effected size calculated as $f^2 = R^2/(1-R^2)$. The VM0032 methodology requires a minimum power, corresponding roughly to required R^2 , of 0.8, which confers a P-value < 0.01.

There is only one predictor, the predicted model value given grazing intensity, soil texture, lignin of dominant plants, and mean annual rainfall. With these inputs, the calculator (Using the online calculator Free Statistics Calculators Version 4.0) recommends the number of sampling sites to be $n = 156$.

Location of Sampling Stations

Once each stratum is defined and mapped and the total number of sampling stations determined, then a representative number of sample points, z_m , are chosen within each stratum. The number of stations per stratum must be proportional to the proportional area of each stratum in the project area.

The n of 156 sampling stations were apportioned across the landscape in a hierarchical fashion to meet the requirement of VM0032 that as large a range of soil carbon densities as possible be sampled on the project area and also to ensure representative sampling across the project area as would be expected from a measurement approach.

Estimation of Baseline SOC

Projects applying a modelled approach, must apply the maximum SOC in the previous 10 years as the baseline SOC stocks.

Baseline Emission Removals from Existing Woody Perennials (BRWP)

Under the applicability condition of VM0032, baseline emissions derived from livelihood-driven human impacts on aboveground woody biomass must be negligible and project activities cannot significantly alter such livelihood-driven activities, it is likely that fire and grazing are the main drivers of change in aboveground woody vegetation. Where a reduction in fire frequency is a project activity, woody plant carbon stocks will increase as a consequence, and reversals of past and ongoing losses of woody plant biomass may be conservatively excluded (ie, BRWP = 0).

Uncertainty in Baseline Emissions

For the calculation of baseline emissions and reductions, BER, uncertainty arises in the calculation of methane emissions only, because all other net emissions are conservatively assumed to be zero, unless increasing fire frequency is a proposed management activity.

So, for the project activity

UBE = UBEM

UBE	Uncertainty in baseline emissions (%)
UBEM	Uncertainty in baseline methane emissions from grazing animals (%)

Uncertainty in baseline methane emissions from grazing animals (UBEM)

$UBEM = \frac{(\sum_{c=1}^k (BEM_c \times UBEM_c)^2)^{\frac{1}{2}}}{\sum_{c=1}^k BEM_c}$	
UBEM	Uncertainty in baseline methane emissions from grazing animals (%)
UBEM _c	Uncertainty in baseline methane emissions from animals in category c (%)
BEM _c	Baseline emissions from animals in category c (tCO _{2e})

UBEM_c is the uncertainty in methane emissions from animals in category c, as dictated by whether the animals are ruminants, equids, or pigs. UBEM_c is calculated from the uncertainty, for each animal category, in the regression equations predicting per animal daily methane emission (DME_c) based on the mean body weight (UDME_c) and the uncertainty in the harmonic mean of animal counts (UBN_c) during the baseline period.

To obtain UBN_c, first find SEBN_c, the standard error of the harmonic mean BNC of the series' N_{c,i} of animals in category c in count i of n counts or censuses.

$SEBN_c = (BN_c)^2 \times \frac{SD\left(\frac{1}{N_{c,i}}\right)}{(n-1)^{1/2}}$	
SEBN _c	Standard error of the harmonic mean of animal counts in category c
SD(1/N _{c,i})	Standard deviation of the inverses of the count I of animals in category c
N _{c,i}	Animals in category c in census i (head)
BN _c	Harmonic mean number of animals in category c (head) during the baseline period (head)
n	Number of censuses

The 95% confidence interval-based uncertainty in the estimated number of animals in category c is:

$UBN_c = 3.84 \times 100 \times \frac{SEBN_c}{BN_c}$	
UBN _c	Uncertainty in the harmonic mean of animal counts (%)
SEBN _c	Standard error of the harmonic mean of animal counts
BN _c	Baseline number of animals of category c (head)

3.84	Multiplier converts expression into a 95% confidence interval
100	Multiplier converts expression into percent

$UBEM_c = (UBN_c^2 + UDME_c^2)^{1/2}$	
UBEMc	Uncertainty in baseline methane emissions from animals in category c (%)
UBNc	Uncertainty in the baseline harmonic mean of animals of category c (%)
UDMEc	Uncertainty in the regression for predicting daily methane emissions for animals of category c (%)

Uncertainty in Baseline methane emissions from burning of biomass (BEBB)

In the case of project activities that increase fire frequency, uncertainty in BEBB (UBEBB) is driven by uncertainty in fire frequency (UFFREQ_m) in stratum m (or mean proportion of area burned), and uncertainty in mean within-stratum aboveground plant biomass at the end of the growing season, UAPB_m. UFFREQ_m arises from either the 95 percent confidence interval in annual variation in proportion of area burned over a period of 10 or more years prior to the start date or from uncertainty in the interpretation of satellite images in burned area mapping in stratum m resulting from mis-identification or classification errors of burned versus unburned areas

$UFFREQ_m = 3.84 \times \frac{SD(FFREQ_{m,BY})}{FFREQ_m \times (BY - 1)^{1/2}} \times 100$	
UFFREQ _m	uncertainty (%) in fire frequency within stratum m
SD(FFREQ _{m,t})	standard deviation in fire frequency in stratum m over BY years in the baseline period.
BY	number of years in baseline period for which burned area is measured
FFREQ _m	mean proportion of area burned during the baseline period
100	converts the expression into percent
3.84	converts the numerator into a 95% confidence interval

UAPB_m arises from the 95 percent confidence interval among permanent sampling stations in clipped, dried, and weighed biomass.

$UAPB_m = 3.84 \times 100 \times \frac{SD(APB_{z_m})}{APB_m \times (Z_m - 1)^{1/2}}$	
UAPB _m	uncertainty in aboveground plant biomass within stratum m
SD(APB _{z_m})	standard deviation in aboveground plant biomass among z _m permanent sampling stations in stratum m
z _m	number of sampling stations in stratum m
APB _m	mean aboveground plant biomass in stratum m (kg/m ²)

Combining two source of uncertainty,

$UBE_{BB} = \frac{(\sum_m^s (BA_m \times (UFFREQ_m^2 + UAPB_m^2)^{1/2})^2)^{1/2}}{PA}$	
UBE _{BB}	Uncertainty in baseline methane emissions from burning of biomass
UFFREQ _m	Uncertainty in the fire frequency in stratum m
UAPB _m	Uncertainty in mean within-stratum aboveground plant biomass at the end of the growing season in stratum m
BA _m	Baseline area of stratum m (ha)
PA	size of the project area (ha)
s	number of strata

4.2 Project Emissions

Project emissions and removals depend on the principal set of project activities. Projects that applies planned grazing and reduce fire events, for the current project scenario, need to account for changes in methane emissions by grazing animals and changes in SOC and removals from woody biomass. For the current project activity project data taken from secondary sources like Govt. published data.

Project Methane Emissions from Grazing Animals (PEM_t)

If project activities will include reduction in livestock numbers, then accompanying removals from reduced methane emissions must be conservatively excluded from project removals. This avoids potential leakage from shifting of animals to adjacent grasslands or from market leakage whereby other producers increase livestock numbers to replace project livestock reductions and meet market demand. However, whether or not methane emissions from livestock are reduced, calculations must be based on project data from animal counts or censuses and emission factor data based on project area-applicable body weight of each category from the equations in Table 6

$PEM_t = \sum_{c=1}^k (PN_{c,t} \times DMEF(W_{c,t})) \times GWP_{CH_4} \times 365 \times 6.26 \times 10^{-7}$	
PEM _t	Project emissions of CH ₄ from grazing animals at year t (tCO _{2e})
PN _{c,t}	Number of animals of each category c in year t (head)
DMEF(W _{c,t})	Daily emission factor as a function of animal weight for category c (L CH ₄ / day)
W _{c,t}	Average body weight during year t for animals of category c (kg)
GWP _{CH₄}	Global warming potential for methane (tCO _{2e} / tCH ₄)
365	Conversion factor for days to years
6.26 x 10 ⁻⁷	Conversion factor for L CH ₄ / day to tCH ₄ / day

The parameters are similar to those used for calculating baseline methane emissions. The number of grazing animal must be measured, because new animal categories may result due to project activities (e.g. there is a shift to using different breeds or species of livestock).

Table 8 : Methane emissions from animals under the project scenario.				
Grazing Animal Category			Animal Counts (Head)	Methane Emissions
Species	Sex/Age	Weight (kg)	Year 1	Methane Emissions for each Category (tCO _{2e})
Cattle	Adult	450	833240	928687
	Juvenile	275	357103	246848
Sheep	Adult	36	521310	53866
	Juvenile	18	223419	11623
Goat	Adult	250	187260	118013
	Juvenile	175	80254	35785
Pigs	Adult	70	107203	2269
	Juvenile	38	45944	531
Total Animals		1858907	Total Emissions	1397622

Project Emissions from Burning of Biomass (PEBB_t)

Where project activities reduce the frequency of fire, this emission may be conservatively excluded, in which case PEBB_t = 0.

Project Changes in SOC Density

Methodology VM0032 allows emissions reductions and greenhouse gas removals to be credited on the basis of activity. Grazing intensities and fire frequencies under project activities will combine in the model with other parameters as needed for the chosen soil carbon model to generate PSOC_{eqm,j} for each sampling station. The model is used to estimate the future equilibrium soil carbon under the assumption of long-term execution of improved grazing and controlled fire practices.

The annual increment in SOC is determined by the difference in SOC between the conservative baseline maximum from 10 years prior to the project start (MSOC_{m,j,0}) and project modelled equilibrium (PSOC_{eqm,j,t}) divided by the time necessary to achieve project equilibrium (D). The project equilibrium must be determined assuming that project activities will be implemented. Thus, multiplying the annual increment in SOC (tons/ha), by the conversion of C to CO₂ 44/12 yields CO₂e at that station.

$PRS_{m,t} = 44/12 \times \frac{PSOC_m^{eq} - MSOC_{m,0}}{D}$	
PRS _{m,t}	Annual project removals due to changes in SOC stocks in stratum m in year t (tCO ₂ e /ha)
PSOC _{eqm}	Project modeled equilibrium SOC at station j in stratum m (tC/ha) based on parameter values from zm sampling stations in stratum m
MSOC _{m,0}	Modeled SOC for stratum m at time t =0 (tC/ha)
D	Years required to achieve equilibrium
44/12	Conversion factor from tC to tCO ₂ e

$PRS_t = \sum_m^s (PA_{m,t} \times PRS_{m,t})$	
PRS _t	Project removals due to changes in SOC stocks in year t (tCO ₂ e)
PA _{m,t}	Project area of stratum m in year t (ha)
s	Number of strata in the project area
zm =	Number of sampling stations in stratum m

PRSm,j,t	Annual project removals due to changes in SOC stocks at station j in stratum m in year t (tCO ₂ e / ha)
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Project Emissions and Removals from Existing Woody Plants (PERWP_t)

Project activities involve changes in fire management, the project proponent must monitor changes in aboveground woody plant biomass (AWPB) to quantify sequestration of GHG in aboveground woody plant carbon from reductions in fire or to ensure that losses of woody biomass from increased fire do not outweigh potential gains from soil carbon sequestration.

$PERWP_t = \frac{44/12 \times C \times \sum_{m=1}^s \frac{PA_{m,y}}{z_m} \times \sum_{j=1}^{z_m} AWPB_{m,j,0} - AWPB_{m,j,Y}}{1000 \times Y} \pi r^2$	
PERWP _t	Project emissions from changes in aboveground woody biomass in year t (tCO ₂ e)
44/12	Conversion factor from C to CO ₂ e
C	Proportion of wood composed of carbon (kg C/kg biomass)
PA _{m,Y}	Project area of stratum m in year Y (ha)
zm	Number of sampling stations in stratum m
s	Number of strata in the project area
AWPB _{m,j,0}	Aboveground woody biomass at the project start date or beginning of the monitoring period at station j in stratum m; (kg biomass/ha)
AWPB _{m,j,Y}	Aboveground woody biomass at station j in stratum m in year Y (kg biomass/ha)
Y	= Length of the monitoring period (years)
1000	Conversion factor from kg to t

Uncertainty under the project scenario

Total uncertainty can be calculated by weighting uncertainties according to the magnitude of emission or removal.

$UPE_t = \frac{((PEM \times UPEM)^2 + \sum_{m=1}^s (PEBB_{m,t} \times UPEBB_{m,t})^2)^{1/2}}{PEM + \sum_{m=1}^s PEBB_{m,t}}$	
UPE _t	Uncertainty in project emissions (%)

UPEM _t	Uncertainty in project methane emissions from grazing animals (%)
UPEBB _{m,t}	Uncertainty in project methane emissions from burning of biomass (%)
PEM	project methane emissions by animals during the monitoring period (tCO ₂ e)
PEBB _{m,t}	project emissions from biomass burning in stratum m at time t (tCO ₂ e)

$UNCCS_t = \frac{(\sum_{m=1}^s (PRS_{m,t} \times UPRS_{m,t})^2 + \sum_{m=1}^s PERWP_{m,t} \times UPERWP_{m,t})^{1/2}}{\sum_{m=1}^s PRS_{m,t} + \sum_{m=1}^s PERWP_{m,t}}$	
UNCCS _t	Uncertainty in net changes in carbon stocks (%)
UPRS _{m,t}	Uncertainty in project reductions from soil sequestration (%)
UPERWP _{m,t}	Uncertainty in project emissions or removals from woody plants (%)
PRS _{m,t}	Removals from changes in soil carbon stocks in stratum m at time t (tCO ₂ e)
PERWP _{m,t}	Removals from changes in woody plant carbon stocks in stratum m at time t

Uncertainty in Project Methane Emissions

$UPEM = \frac{(\sum_{c=1}^k (PEM_c \times UPEM_c)^2)^{1/2}}{\sum_{c=1}^k PEM_c}$	
UPEM	= Uncertainty in project methane emissions from grazing animals during the monitoring period (%)
UPEM _c ,	= Uncertainty in project methane emissions from animals in category c (%)
PEM _c =	project methane emissions from animals in category c (tCO ₂ e)

UPEM_c, is the uncertainty in methane emissions calculated from the uncertainty, for each animal category, in the regression equations for per animal daily methane production and the uncertainty in the arithmetic mean of animal censuses for category c, PN_c, during the monitoring period.

$UPEM_c = (UPEN_c^2 + UDME_c^2)^{1/2}$	
UPN _c =	Uncertainty in the project mean of animals of category c

$UPN_c = 3.84 \times 100 \times \frac{SD(PN_{c,Y})}{PN_c \times (Y-1)^{1/2}}$	
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SD(PN _{c,Y})	Standard deviation of animal counts in category c across Y years of the monitoring period
PN _c	Arithmetic mean of animal numbers in category c (head)
Y	Years in the monitoring period
3.84	Multiplier that converts the numerator into a 95% confidence interval
100	Multiplier that converts the expression into percent
UPME _c	Uncertainty in the regression, taken from the literature (Table 6) for predicting daily methane emissions for animals of category c

Uncertainty in Project Soil Removals

Under a modelled approach, UPRS_{m,t} is obtained from the calculated 95 percent confidence interval, as required by the VCS [47, 49] from a Monte Carlo simulation of modelled changes in soil carbon averaged across n model runs in stratum m.

$UPRS_{m,t} = 3.84 \times 100 \times \frac{SDMOD\Delta SOC}{MOD\Delta SOC \times (n - 1)^{1/2}}$	
UPRS _{m,t}	Uncertainty in project removals through increased soil carbon in stratum m at time t (%)
SDMODΔSOC _m	Standard deviation of more than 100 modelled SOC estimates for stratum m from Monte Carlo simulation.
MODΔSOC _m	Mean modelled project equilibrium SOC for stratum m from more than 100 simulations of project equilibrium SOC, (tC/ha)
n	Number of times simulation is run (must be greater than 100)
3.84	Multiplier to convert standard error into a 95% confidence interval
100	Multiplier to convert to percent

Uncertainty in Project Emissions and Removals from Woody Plant Biomass

$UPERWP_{m,t} = (UAWPB_{m,t-1}^2 + UAWPB_{m,t}^2 + UWD_m^2)^{1/2}$	
UPERWP _{m,t}	Uncertainty in project emissions and removals from woody plants in stratum m in year t
UAWPB _{m,t-1}	Uncertainty in project emissions and removals from woody plant biomass in stratum m at the project start date or the previous (year = t-1)

UAWPB _{m,t}	Uncertainty in project emissions and removals from woody plant biomass in stratum m in year t-1
UWD _m	Uncertainty in wood density in stratum m

$UAWPB_{m,0} = \frac{SD(AWPB_{m,z_m}) \times 100 \times 3.84}{AWPB_m \times (Z_m - 1)^{1/2}}$	$UAWPB_{m,t} = \frac{SD(AWPB_{m,t,z_m}) \times 100 \times 3.84}{AWPB_{m,t} \times (Z_m - 1)^{1/2}}$	$UWD_m = \frac{SD(WD_{m,z_m}) \times 100 \times 3.84}{WD_m \times (Z_m - 1)^{1/2}}$
UWD _m = Uncertainty in wood density in stratum m	SD(AWPB _{m,t,zm}) = standard deviation of aboveground woody plant biomass across zm sampling stations in stratum m at time t since the project start or last verification.	SD(WD _{m,zm}) = standard deviation of wood density across zm sampling stations in stratum m at time t since the project start or last verification.
AWPB _m = Mean woody plant biomass across zm sampling stations in stratum m (kg/m ²)	AWPB _{m,t} = mean woody plant biomass across zm sampling stations in stratum m at time t since the project start or last verification (kg/m ²).	WD _m = mean wood density across zm sampling stations in stratum m (g/cm ³)
3.84 = Multiplier to convert expression to 95% confidence interval	3.84 = multiplier to convert numerator to 95% confidence interval	3.84 = multiplier to convert expression to 95% confidence interval
100 = Multiplier to convert expression to percent	100 = multiplier to convert expression to percent	100 = multiplier to convert expression to percent

4.3 Leakage

Methodology VM0032 considers two types of leakage. Displacement leakage from the movement of livestock off the project area where they may reduce soil carbon, and market leakage, where reductions in livestock numbers as a project activity would create market incentives to replace the lost livestock.

LE _t = LD _t + LM _t	
LE _t	total leakage emissions in year t (tCO ₂ e)
LD _t	leakage emissions from displaced livestock in year t (tCO ₂ e)
LM _t	emissions from market leakage in year t (tCO ₂ e)

Leakage Emissions from Displaced Livestock

Movement of livestock could result in losses of carbon from higher levels of overgrazing outside the project area. Where the project area is not fenced, such as in pastoralist systems, the movement and excursion of livestock to more than two kilometers from the project area boundary is considered leakage. Displacement leakage can be determined by using the tool VMD0040 (Leakage from Displacement of Grazing Activities) for measured approach or by using penalty approach. This project activity will use penalty approach as it is a more conservative option (leakage calculations will likely be larger) but no monitoring of soils and/or vegetation outside the project area is required and off-project area use of grasslands, croplands, and forests is not differentiated. Displacement leakage calculated as follows:

$LD_t = \frac{\sum_{x=1}^d \sum_{c=1}^k DN_{c,x}}{365 \times \sum_{c=1}^k PN_{c,t}} \times PRS_t$	
LD _t	Leakage emissions from displaced livestock (tCO ₂ e)
DN _{c,x}	Number of livestock of each category c that were off the project area on day x (head)
d	Total number of days livestock were off the project area
k	Total number of livestock categories
PN _{c,t}	Number of animals of each category c in year t (head)
PRS _t	Project removals due to changes in SOC stocks in year t (tCO ₂ e)

Market Leakage Emissions

Market leakage was judged to be negligible since livestock reductions were not a project activity and livestock numbers are driven by grassland capacity and rainfall rather than markets.

So, for the project activity, total leakage calculated as LE_t = LD_t considering market leakage zero (LM_t = 0)

Uncertainty in Leakage Emissions and Removals

$ULE_t = (ULD_t^2 + ULM_t^2)^{1/2}$	
ULE _t	uncertainty in total leakage (%)
ULD _t	uncertainty in displacement leakage (%)
ULM _t	= uncertainty in market leakage (%)

$$ULE_t = ULD_t = UPRS_t$$

UPRS_t = Uncertainty in project removals due to changes in soil carbon stocks in year t (%).

Displacement leakage affects only soil carbon removals, and thus is subject to uncertainty associated with predicting impacts project activities on soil carbon removals.

4.4 Net GHG Emission Reductions and Removals

The estimation of net project emission reductions, PER_t and net change in carbon stocks, $NCCS_t$, each year of the monitoring period is calculated using the following equation:

$PER_t = PEM_t + PEBB_t - BEM - BEBB$	
PER_t	Net project emission reductions in year t (tCO ₂ e)
PEM_t	Project methane emissions from livestock in year t (tCO ₂ e)
$PEBB_t$	Project emissions from biomass burning in year t (tCO ₂ e)
BEM	Baseline methane emissions from livestock (tCO ₂ e)
$BEBB$	Baseline emissions from biomass burning (tCO ₂ e)

$NCCS_t = PRS_t \pm PERWP_t$	
$NCCS_t$	Net change in carbon stocks in year t (tCO ₂ e)
PRS_t	Project removals due to sequestration of soil carbon in year t (tCO ₂ e)
$PERWP_t$	Project removals due to loss or gain of carbon stocks in woody biomass in year t (tCO ₂ e)

The net GHG benefit is calculated using the following equation:

$R_t = PER_t + NCCS_t - LE_t$	
R_t	Net GHG emission reductions and removals in year t (tCO ₂ e)
PER_t	Net project emission reductions in year t (tCO ₂ e)
$NCCS_t$	Net change in carbon stocks in year t (tCO ₂ e)
LE_t	Total leakage changes in soil carbon in year t (tCO ₂ e)

Total project uncertainty is given by

$UT_t = \frac{((NR_t \times UNR_t)^2 + (LE_t \times ULE_t)^2)^{1/2}}{NR_t + LE_t}$	
UT_t	Total project uncertainty (%)
UNR_t	Uncertainty in net emissions and removals, not including leakage (%)
ULE_t	Uncertainty in leakage emissions and losses from soil carbon stocks at time t (%)
NR_t	Net emissions reductions and removals at time t, not including leakage (tCO ₂ e)
LE_t	Leakage emissions and losses from soil carbon stocks at time t (tCO ₂ e)

Year	Estimated baseline emissions or removals (tCO ₂ e)	Estimated project emissions or removals (tCO ₂ e)	Estimated leakage emissions (tCO ₂ e)	Estimated net GHG emission reductions or removals (tCO ₂ e)
¹¹ 2017-18	373,539	613,698	1345.83	238,813
2018-19	373,539	613,698	1345.83	238,813
2019-20	373,539	613,698	1345.83	238,813
2020-21	373,539	613,698	1345.83	238,813
2021-22	373,539	613,698	1345.83	238,813
2022-23	373,539	613,698	1345.83	238,813
2023-24	373,539	613,698	1345.83	238,813
2024-25	373,539	613,698	1345.83	238,813
2025-26	373,539	613,698	1345.83	238,813
2026-27	373,539	613,698	1345.83	238,813
2027-28	373,539	613,698	1345.83	238,813
2028-29	373,539	613,698	1345.83	238,813
2029-30	373,539	613,698	1345.83	238,813
2030-31	373,539	613,698	1345.83	238,813
2031-32	373,539	613,698	1345.83	238,813
2032-33	373,539	613,698	1345.83	238,813
2033-34	373,539	613,698	1345.83	238,813
2034-35	373,539	613,698	1345.83	238,813
2035-36	373,539	613,698	1345.83	238,813
2036-37	373,539	613,698	1345.83	238,813
Total	7,844,310	12,887,651	28,262	4,776,260

¹¹ Considered from the start date of commissioning, i.e. 01/05/2017 and presented for a yearly estimation. Please refer to footnote #1 for further reference.

5 MONITORING

5.1 Data and Parameters Available at Validation

Data / Parameter	PAm,g
Data unit	Ha
Description	Project area in stratum m
Source of data	Measured in project area
Value applied	70,000 (proposed)
Justification of choice of data or description of measurement methods and procedures applied	Using shape files in a GIS or from known coordinates of stratum boundaries or from legal descriptions of the property included in the project area.
Purpose of Data	Determination of baseline and project emissions
Comments	This is an approximate value proposed for the first instance; final value shall be confirmed at the time of validation process.

Data / Parameter	GWPC _{CH₄}
Data unit	t CO ₂ e/t CH ₄
Description	Global-warming potential for CH ₄
Source of data	obtained from the IPCC Second Assessment Report
Value applied	25
Justification of choice of data or description of measurement methods and procedures applied	
Purpose of Data	Calculation of baseline emissions Calculation of project emissions
Comments	

Parameters for calculation of Baseline Methane Emission

Data / Parameter	$W_{c,t}$
Data unit	Kg
Description	Average body weight for animals of category c in year t
Source of data	Measured in project area
Value applied	To be applied
Justification of choice of data or description of measurement methods and procedures applied	Necessary to estimate emission factor for grazing animals using allometric equations. Refer Table 6
Purpose of Data	Calculation of baseline emissions
Comments	-

Data / Parameter	$N_{c,i}$
Data unit	Number
Description	Baseline number of animals of category c in census i
Source of data	Measured in project area
Value applied	Different for each category of animals
Justification of choice of data or description of measurement methods and procedures applied	The number of animals in each census i must be measured to calculate the harmonic mean of the multiple counts i of n censuses of animals in category c. At least four measurements within the baseline period, with at least two during the period 5- 10 years prior to the project start, must be available. Measurements must be taken in accordance with the procedures described in Section 9.1.2 of methodology (VM0032).
Purpose of Data	Calculation of baseline emissions
Comments	This document will provide a table of historical estimates for number of grazing animals, BN_c , for each year in which counts or estimates are available, sorted by the c categories of animals in the project area: species, breed, sex, and age, plus the respective live body weights (W_c) of each category, with 95% CI and uncertainties). The project description also provides a data table showing calculations of methane emissions based on the equations in VM0032 for each animal category for each year the data are available. The table includes calculated total emissions for that year

and a cell containing the harmonic mean of total annual calculated methane emissions. This is the baseline BEM. The harmonic mean appropriately and conservatively weights the average methane emissions towards the lower values of a time series of measurements. The table also shows the uncertainty in daily methane emissions and the harmonic mean and its uncertainty.

Parameters for Baseline Calculation of Emissions from Burning of Biomass

Data / Parameter	APBm,b
Data unit	kg dry mass/ha
Description	Mean total aboveground plant biomass in stratum m in year t at the end of the growing season (summer or wet season)
Source of data	Measured
Value applied	To be applied.
Justification of choice of data or description of measurement methods and procedures applied	Measured at permanent sampling stations within each stratum m by clipping, drying (at 25-50 °C) and weighing aboveground vegetation from one or more small quadrats. Measured at the beginning of the dry season in the tropics or beginning of the cold or burning season in temperate climates. Must be measured in the project area 1-2 years before the project start date, or within the first year of the monitoring period and prior to the first prescribed burn if fire frequency is to be increased to manage vegetation to increase soil carbon.
Purpose of Data	Calculation of baseline emissions
Comments	-

Data / Parameter	FFREQm
Data unit	Dimensionless proportion
Description	Average proportion of area burned in stratum m in past 10 years
Source of data	Measured
Value applied	To be applied
Justification of choice of data or description of measurement methods and procedures applied	Measured by mapping burned areas with aerial photography or in projects with extensive area (> 10,000 ha), interpreting satellite images, such as MODIS, with published algorithms for assessing burned area. Photography or satellite image interpretations must

	be verified by records of known burned areas or ground assessments of burns in the past year
Purpose of Data	Calculation of baseline emissions
Comments	-

Data / Parameter	BCG
Data unit	kg biomass / kg biomass burned
Description	Baseline combustion factor for savanna/grassland
Source of data	Hoffa et. al., 1999
Value applied	0.5
Justification of choice of data or description of measurement methods and procedures applied	It is unlikely that all aboveground biomass is combusted in fire, but this fraction is difficult to measure accurately during past years because biomass remaining after fire must be measured immediately following fire [42]. The fraction of biomass combusted usually averages around 0.75 and setting BCG = 0.5 makes the potential impact of increasing fire under the project scenario conservative in its likelihood to reduce emissions.
Purpose of Data	Calculation of baseline emissions
Comments	-

Data / Parameter	EF _{BG}
Data unit	g CH ₄ /kg biomass burned
Description	Emission factor for the burning of grassland
Source of data	Akagi, S.K., et al., Emission factors for open and domestic biomass burning for use in atmospheric models. Atmospheric Chemistry and Physics, 2011. 11(9): p. 4039-4072.
Value applied	1.9
Justification of choice of data or description of measurement methods and procedures applied	Published value considered
Purpose of Data	Calculation of baseline emissions, and Calculation of project emissions
Comments	-

Parameters for Calculation of Baseline SOC

Data / Parameter	DEPTH _{m,j,0}
Data unit	cm
Description	Soil core depth at station <i>j</i> in stratum <i>m</i> at time <i>t</i> = 0 (ie, at the start of the project or since the last verification)
Source of data	Measured in project area
Value applied	20
Justification of choice of data or description of measurement methods and procedures applied	At each sampling station <i>j</i> , according to standard methods[52, 54], soil must be taken from at least 3 soil cores (with 10 cores at each site recommended to reduce uncertainty) to a depth that accounts for the vast majority (> 80 percent) of SOC in the soil column, reflects depth to hardpans or bedrock, or matches calculations from soil carbon models. Multiple cores may be well-mixed into a single composite sample for analysis.
Purpose of Data	Calculation of baseline emissions
Comments	-

Data / Parameter	SOC _{%j,m,0}
Data unit	Dimensionless proportion
Description	Proportion soil organic carbon at station <i>j</i> in stratum <i>m</i> at time <i>t</i> = 0 (ie, at the start of the project or since the last verification)
Source of data	Measured in project area
Value applied	To be applied
Justification of choice of data or description of measurement methods and procedures applied	The baseline for the measured offset approach is based on increasing SOC. Tracked at the level of <i>j</i> = 1 to individual sampling stations in each stratum. Offset will be based on demonstrating changes in SOC at individual stations and then summing increments. At each sampling station <i>j</i> , according to standard methods, soil was taken from at least 3 soil cores to a depth that accounts for the vast majority (> 80 percent) of SOC in the soil column, reflects depth to hardpans or bedrock, or matches calculations from soil carbon models. Multiple cores were mixed into a single composite sample for analysis. Multiple stations were sampled within each stratum to determine a 95 percent confidence interval.
Purpose of Data	Calculation of baseline emissions

Comments	Organic carbon concentrations were measured at an academic laboratory using chemical combustion
Data / Parameter	BULK _{m,j,0}
Data unit	Mg/m ³ or, equivalently, g/cm ³
Description	Bulk density at station j in stratum m at time t = 0 (i.e., at the start of the project or since the last verification)
Source of data	Measured in project area
Value applied	To be applied
Justification of choice of data or description of measurement methods and procedures applied	At each sampling station j, according to standard methods soil was taken from at least 3 soil cores and known volumes of soil from the cores were sieved to remove rocks, pebbles, and coarse fragments. The remainder was dried (5 days at 45°C or equivalent) and weighed to determine bulk density.
Purpose of Data	Calculation of baseline emissions
Comments	-

Parameters for Soil Carbon Models

Data / Parameter	MAP _m
Data unit	mm/yr
Description	Mean annual precipitation in stratum m
Source of data	Precipitation maps from government or peer-reviewed published
Value applied	To be applied
Justification of choice of data or description of measurement methods and procedures applied	A key variable that affects a number of processes driving SOC
Purpose of Data	Calculation of baseline emissions
Comments	-

Data / Parameter	ST _{j,m,y}
Data unit	°C

Description	Soil temperature at station j in stratum m in month y
Source of data	Measured in project area
Value applied	To be applied
Justification of choice of data or description of measurement methods and procedures applied	Must be measured monthly or at least seasonally with a digital thermometer with probes inserted to at least ½ the depth at which SOC will be sampled (ie, to 10 cm if soil will be sampled and modeled to 20 cm)
Purpose of Data	Calculation of baseline emissions
Comments	-

Data / Parameter	SAND _{%i,m} and/or CLAY _{%i,m} and/or SILT _{%i,m}
Data unit	Dimensionless proportion expressed as percent
Description	Proportion of soil that is sand, silt, and or clay at station j in stratum m
Source of data	Measured in project area
Value applied	To be applied
Justification of choice of data or description of measurement methods and procedures applied	Soil collected to desired depth at each sampling station must be mixed, and subsample analyzed for clay, silt, and sand fractions in a professional laboratory. Some models require percent sand, some percent clay and some percent of all three particle classes, sand, silt and clay.
Purpose of Data	Calculation of baseline emissions
Comments	-

Data / Parameter	G _{lj,m}
Data unit	Dimensionless proportion
Description	Mean annual grazing intensity at station j in stratum m
Source of data	Measured
Value applied	To be applied
Justification of choice of data or description of	Measured at each sampling station prior to validation by either 1) Comparing clipped biomass at least at the end of the growing season, or more frequently for some models, inside and outside

measurement methods and procedures applied	small (1 m ²) fences. $GI_{j,m} = 1 - (\text{biomass outside/biomass inside})$. Biomass is clipped, dried at 25 – 50°C, and weighed. 2) Visually estimating historical grazing intensity from a calibrated observation method ($R^2 > 0.80$ correlation between measured GI (from option 1 above and observational method)) based on species composition, bare ground, and vegetation height.
Purpose of Data	Calculation of baseline emissions
Comments	-

Data / Parameter	MAPLC _{j,m}
Data unit	Dimensionless proportion
Description	Mean aboveground plant cellulose plus lignin at sampling plot j in stratum m
Source of data	Measured in project area
Value applied	To be applied
Justification of choice of data or description of measurement methods and procedures applied	SOC is often closely related to inputs of these forms of carbon because they resist microbial decomposition.
Purpose of Data	Calculation of baseline emissions
Comments	-

Data / Parameter	FFREQ _m
Data unit	Dimensionless proportion
Description	fire frequency
Source of data	Measured in project area and fire map
Value applied	To be applied
Justification of choice of data or description of measurement methods and procedures applied	
Purpose of Data	Calculation of baseline emissions

Comments	-
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Data / Parameter	MSOC _{m,j,b}
Data unit	tC/ha
Description	Modeled SOC at station <i>j</i> in stratum <i>m</i> for each year <i>b</i> during the baseline period
Source of data	SOC model
Value applied	To be applied
Justification of choice of data or description of measurement methods and procedures applied	SOC models applied must meet with the modeling requirements
Purpose of Data	Calculation of baseline emissions
Comments	-

Data / Parameter	PSOCeqm,j,
Data unit	tC/ha
Description	Modeled SOC at equilibrium at station <i>j</i> in stratum <i>m</i>
Source of data	SOC model
Value applied	To be applied
Justification of choice of data or description of measurement methods and procedures applied	SOC models applied must meet with the modelling requirements
Purpose of Data	Calculation of project emissions
Comments	-

Data / Parameter	D
Data unit	years
Description	Years required to achieve SOC equilibrium

Source of data	SOC model
Value applied	To be applied
Justification of choice of data or description of measurement methods and procedures applied	SOC models applied must meet with the modelling requirements
Purpose of Data	Calculation of project emissions
Comments	-

Parameters for calculation of Removals from Woody Plant Biomass

Data / Parameter	C
Data unit	kg C/kg biomass
Description	Proportion of wood composed of carbon
Source of data	CDM, <i>A/R Methodological Tool: Estimation of carbon stocks and change in carbon stocks of trees and shrubs in A/R CDM project activities</i> , and MacDicken, 1997
Value applied	0.45
Justification of choice of data or description of measurement methods and procedures applied	Published value
Purpose of Data	<i>Calculation of project emissions</i>
Comments	-

5.2 Data and Parameters Monitored

Parameters monitored are those needed to calculate removals from reduced methane emissions from animals and/or removals from soil carbon sequestration plus any increases in emissions of methane from burning of biomass and leakage.

Data / Parameter	PA _{m,t}
Data unit	Ha
Description	Project area in stratum m in year t

Source of data	Measured in project area
Description of measurement methods and procedures to be applied	Using shape files in a GIS or from known coordinates of stratum boundaries or from legal descriptions of the property included in the project area.
Frequency of monitoring/recording	Measured annually
Value applied	70,000
Monitoring equipment	None
QA/QC procedures to be applied	Areas must be determined from accurate GIS layers of classified project area or from legal descriptions of property included in the project area. Verification should be with Global Positioning VM0032, Version 1.0 Sectoral Scope 14 Systems (GPS) with an accuracy of 10 m or less. Ground points may include permanent sampling stations but also may be necessary to include points at defined stratum boundaries or along roads.
Purpose of data	Calculation of project emissions
Calculation method	Measured directly
Comments	The value is given for 1st instance. Projects must ensure that the following information in regards to the project area of each stratum is provided within the relevant area of the project description: 1) Map(s) of the locations of the permanent sampling plots overlaid on a map of project strata. 2) Results of cluster analysis to determine project strata. 3) Table of all project strata, their description, and area, PA_m 4) Results of analysis to determine the number of sampling units and their allocation among strata

Project Animal Methane Emissions

Calculations of methane emissions based on the equations provided in Table for each animal category in each year of the project start or verification.

Data / Parameter	$PN_{c,t}$
Data unit	number
Description	Mean number of animals of category c in the project area during year t
Source of data	Measured in project area

Description of measurement methods and procedures to be applied	Measured as the arithmetic mean of one or more years' animal censuses during the verification period
Frequency of monitoring/recording	Annual
Value applied	To be applied
Monitoring equipment	-
QA/QC procedures to be applied	Monthly reports of livestock numbers are reviewed by project administrators
Purpose of data	Calculation of project emissions
Calculation method	Measured directly
Comments	-

Project Emissions from Burning Biomass

Data / Parameter	PFFREQ _{m,t}
Data unit	Dimensionless proportion
Description	Average proportion of area burned in stratum <i>m</i> during project year <i>t</i> .
Source of data	Average proportion of area burned in stratum <i>m</i> during project year <i>t</i> .
Description of measurement methods and procedures to be applied	Measured by mapping burned areas with aerial photography or in projects with extensive area (> 10,000 ha), interpreting satellite images, such as MODIS with published algorithms for assessing burned area ^[19] . Photography or satellite image interpretations must be confirmed by records of known burned areas or ground assessments of burns in the past year.
Frequency of monitoring/recording	Every 15 days during the burning season
Value applied	To be applied
Monitoring equipment	-
QA/QC procedures to be applied	-
Purpose of data	Calculation of project emissions

Calculation method	-
Comments	-

Data / Parameter	APB _{j,m,t}
Data unit	kg dry mass/ha
Description	Aboveground plant biomass at station <i>j</i> in stratum <i>m</i> in year <i>t</i> at the beginning of the dry/cold or burning season
Source of data	Measured
Description of measurement methods and procedures to be applied	Measured at permanent sampling stations within each stratum <i>m</i> by clipping, drying (at 25-50 °C) and weighing aboveground vegetation from one or more small quadrats. Measurements from all quadrats must be averaged for each sampling station <i>j</i> . Measured at the beginning of the dry/cold/burning season in temperate climates
Frequency of monitoring/recording	Annually
Value applied	To be applied
Monitoring equipment	Laboratory analysis
QA/QC procedures to be applied	Samples must be dried in a professional drying oven for 3 days at 45-60°C or be air-dried in sunshine for 4-7 days to a constant mass
Purpose of data	Calculation of project emissions
Calculation method	Laboratory analysis
Comments	-

Data / Parameter	APB _{j,m,f}
Data unit	kg dry mass/ha
Description	Aboveground plant biomass in stratum <i>m</i> in year <i>t</i> at immediately after fire
Source of data	Measured
Description of measurement methods	Measured at permanent sampling stations within each stratum <i>m</i> by clipping, drying (at 25-50 °C) and weighing aboveground vegetation from one or more small quadrats. Measurements from all quadrats must be averaged for each sampling station <i>j</i> .

and procedures to be applied	Measured immediately following the occurrence of fire
Frequency of monitoring/recording	Once in 1-2 years prior to project start or before the first prescribed burn in the first year of the project
Value applied	To be applied
Monitoring equipment	Laboratory data
QA/QC procedures to be applied	Samples should be dried in a professional drying oven for 3 days at 45-60°C or be air-dried in sunshine for 4-7 days to a constant mass
Purpose of data	Calculation of project emissions
Calculation method	Laboratory analysis
Comments	-

Parameters for Calculating SOC Removals

Data / Parameter	$DEPTH_{m,j,t}$
Data unit	cm
Description	Soil core depth at station j in stratum m, at time $t = 0$ (i.e. at the start of the project or since the last verification)
Source of data	Measured at sampling stations
Description of measurement methods and procedures to be applied	Soil must be taken from at least three soil cores (with 10 cores at each site recommended to reduce uncertainty) at each station j to a depth that accounts for the vast majority (> 80 percent) of SOC in the soil column, reflects depth to hardpans or bedrock, or matches calculations from soil carbon models. Multiple cores may be well-mixed into a single composite sample for analysis.
Frequency of monitoring/recording	During each soil sampling at permanent plots
Value applied	20
Monitoring equipment	Measuring tape
QA/QC procedures to be applied	Depth cored must be the same as for baseline soil carbon sampling. However, the depth used in calculating SOC after Y years of project activities must be adjusted to account for changes in bulk density such that $DEPTH_{m,j,Y} \times BULK_{m,j,Y} = DEPTH_{m,j,0} \times BULK_{m,j,0}$. This

	ensures that equal masses of soil are compared between year 0 and year Y
Purpose of data	Calculation of project emissions
Calculation method	Not calculated
Comments	-

Data / Parameter	SOC _{m,j,t}
Data unit	Dimensionless proportion
Description	Proportion soil organic carbon at station <i>j</i> in stratum <i>m</i> at time <i>t</i>
Source of data	Measured in project area
Description of measurement methods and procedures to be applied	Soil must be taken from at least three soil cores (with 10 cores at each site recommended to reduce uncertainty) at each station <i>j</i> to a depth that accounts for the vast majority (> 80 percent) of SOC in the soil column, reflects depth to hardpans or bedrock, or matches calculations from soil carbon models. Multiple cores may be well-mixed into a single composite sample for analysis.
Frequency of monitoring/recording	Measured once at the beginning of the project and then at 5-10 year intervals thereafter
Value applied	To be applied
Monitoring equipment	Equipment for taking soil cores is metal pipes etc and laboratory equipment
QA/QC procedures to be applied	
Purpose of data	Calculation of project emissions
Calculation method	Not calculated, data from the Laboratory
Comments	-

Data / Parameter	BULK _{m,j,t}
Data unit	Mg/m ³ , or, equivalently, g/cm ³
Description	Bulk density in stratum <i>m</i> , station <i>j</i> , year <i>t</i>
Source of data	Measured in project area
Description of measurement methods	Soil must be taken from at least three soil cores (with 10 cores at each site recommended to reduce uncertainty) at each station <i>j</i> to

and procedures to be applied	a depth that accounts for the vast majority (> 80 percent) of SOC in the soil column, reflects depth to hardpans or bedrock, or matches calculations from soil carbon models. Multiple cores may be well-mixed into a single composite sample for analysis. Known volumes of soil from the cores must be sieved to remove rocks, pebbles, and coarse fragments, and then the remainder dried (5 days at 45oC or equivalent) and weighed to determine bulk density.
Frequency of monitoring/recording	Measured once at the beginning of the project and then at 5-10 year intervals thereafter
Value applied	To be applied
Monitoring equipment	-
QA/QC procedures to be applied	However, the depth used in calculating SOC after Y years of project activities must be adjusted to account for changes in bulk density such that $DEPTH_{m,j,Y} \times BULK_{m,j,Y} = DEPTH_{m,j,0} \times BULK_{m,j,0}$. This ensures that equal masses of soil are compared between year 0 and year Y
Purpose of data	Calculation of project emissions
Calculation method	Total dry mass of soil / (Volume of pipe – volume of rocks)
Comments	-

Parameters for Project Soil Carbon Models

Data / Parameter	MAP _{m,Y}
Data unit	mm/yr
Description	Mean annual precipitation in stratum m over the project crediting period Y years.
Source of data	Precipitation maps or nearby weather stations
Description of measurement methods and procedures to be applied	A key variable that affects a number of processes driving SOC
Frequency of monitoring/recording	Annually if obtained from government sources or local weather stations, Daily if collected on the project area
Value applied	To be applied
Monitoring equipment	-
QA/QC procedures to be applied	Data should be obtained from government sources or local official weather stations, or, if not available, from weather data collected on the project area.
Purpose of data	Calculation of project emissions

Calculation method	Not calculated
Comments	-

Data / Parameter	ST _{j,m,Z}
Data unit	°C
Description	Soil temperature at station j in stratum m in month Z
Source of data	Measured in project area
Description of measurement methods and procedures to be applied	Must be measured with a digital thermometer with probes inserted to at least ½ the depth at which SOC will be sampled (ie, to 10 cm if soil will be sampled and modeled to 20 cm)
Frequency of monitoring/recording	monthly
Value applied	To be applied
Monitoring equipment	Thermometer
QA/QC procedures to be applied	1. Norman, J.M., R. Garcia, and S.B. Verma, <i>Soil surface CO2 fluxes and the carbon budget of a grassland</i> . . Journal of Geophysical Research-Atmospheres, 1992. 97 (D17): p. 18845-18853. 2. Rajan, N., S.J. Maas, and S. Cui, <i>Extreme drought effects on carbon dynamics of a semiarid pasture</i> . Agronomy Journal, 2013. 105 (6): p. 1749-1760.
Purpose of data	Calculation of project emissions
Calculation method	Not calculated
Comments	-

Data / Parameter	GI _{j,m,z}
Data unit	Dimensionless proportion
Description	Mean annual grazing intensity at station j in stratum m in year t
Source of data	Measured in project area
Description of measurement methods and procedures to be applied	Measured at each sampling station at least twice each growing season prior to verification by comparing clipped biomass at least at the end of the growing season, or more frequently for some models, inside and outside small (1 m ²) fences. GI _m = 1 -

	(biomass outside/biomass inside). Biomass is clipped, dried at 25 – 50 °C, and weighed.
Frequency of monitoring/recording	Must be at least twice per year, but preferably monthly
Value applied	To be applied
Monitoring equipment	-
QA/QC procedures to be applied	Samples should be dried in a professional drying oven for 3 days at 45-60°C or be air-dried in sunshine for 4-7 days to a constant mass,
Purpose of data	Calculation of project emissions
Calculation method	-
Comments	-

Parameters for Project Removals from Woody Plant Biomass

Data / Parameter	AWPB _{m,j,0}
Data unit	kg/ha
Description	Aboveground woody plant biomass at the project start or the year of last verification at station j and stratum m in the beginning of the monitoring period
Source of data	Measured in permanent sampling plots
Description of measurement methods and procedures to be applied	Circular quadrats centered at each permanent sampling station j must be sampled for number and diameter at breast height (dbh) of each woody stem within a specified diameter. Radius must be 5-50 cm depending on woody stem density, with smaller radii appropriate for more dense woody vegetation
Frequency of monitoring/recording	During the beginning of the monitoring period
Value applied	To be applied
Monitoring equipment	-
QA/QC procedures to be applied	MacDicken, K.G., A guide to monitoring carbon storage in forestry and agroforestry projects. 1997, Winrock International
Purpose of data	Calculation of project emissions
Calculation method	-
Comments	-

Data / Parameter	AWPB _{m,j,Y}
Data unit	kg/ha
Description	Aboveground woody plant biomass at station j and stratum m in year Y at the end of the monitoring period
Source of data	Measured in project area at permanent sampling stations
Description of measurement methods and procedures to be applied	Circular quadrats centered at each permanent sampling station j must be sampled for number and dbh of each woody stem within a specified diameter. Radius must be 5-50 m depending on woody stem density, with smaller radii appropriate for more dense woody vegetation
Frequency of monitoring/recording	Once at the end of the monitoring period
Value applied	To be applied
Monitoring equipment	-
QA/QC procedures to be applied	MacDicken, K.G., <i>A guide to monitoring carbon storage in forestry and agroforestry projects</i> . 1997, Winrock International
Purpose of data	Calculation of project emissions
Calculation method	-
Comments	-

Parameters for calculation of Leakage

Data / Parameter	DNC _x
Data unit	Number of animals
Description	Number of livestock of each category c that were outside the project area (outside the fence defining the boundary of the project area)
Source of data	Measured in project area from reports from grazing coordinators regarding the number and location of livestock
Description of measurement methods and procedures to be applied	Determined from records of livestock distributions, as recorded from interviews with grazing managers, coordinators, herders, or other administrative staff
Frequency of monitoring/recording	Monthly

Value applied	To be applied
Monitoring equipment	None
QA/QC procedures to be applied	Records should be kept as paper and electronic copies
Purpose of data	Calculation of leakage
Calculation method	Not calculated
Comments	-

Data / Parameter	D
Data unit	Days
Description	Total number of days livestock were off the project area
Source of data	Measured
Description of measurement methods and procedures to be applied	Based on records of livestock numbers and their distribution on and off the project area, based on interviews of grazing managers, coordinators, herders or other administrative staff.
Frequency of monitoring/recording	Monthly
Value applied	To be applied
Monitoring equipment	None
QA/QC procedures to be applied	Records should be kept as paper and electronic copies, with at least one electronic copy kept off the project as an online database
Purpose of data	Calculation of leakage
Calculation method	Not calculated
Comments	-

5.3 Monitoring Plan

A detailed monitoring plan shall be developed at the time of final VCS-PD and validation. However, as per the requirement it is envisaged that the monitoring plan features four main components, which will remain applicable for all instances to be included under the Group Project activity.

First, monitoring of livestock numbers and movements is necessary to establish that Planned Rotational grazing has been successfully implemented for at least a majority of cattle in the project area.

Secondly, vegetation cover and composition need to be monitored to establish a new, reduced grazing intensity and new values for lignin and cellulose, so that the change in soil carbon (CO₂ removals) can be calculated with the model.

Thirdly, fire history needs to be monitored.

Finally, the impacts of the project on communities and key groups) will be measured through focus groups and household surveys.

APPENDIX

Not Applicable for this version