KLIPFONTEIN 2 SOLAR PV FACILITY OPEN SPACE MANAGEMENT PLAN

Klipfontein 2 Solar PV Facility

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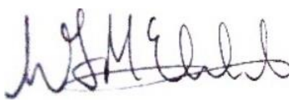

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EXECUTIVE SUMMARY

The project area is located near the town of Dealesville in the western part of the Free State Province The proposed size of the development is 237 ha. It is understood that the current landowners will continue to manage and derive economic benefit from the remaining grasslands within the property once the development becomes operational. The purpose of this document is to provide a management framework for the responsible, sustainable use of the land remaining as open space within the study area.

Responsible livestock (beef, sheep) ranching and game ranching are considered the most “biodiversity-friendly” of land-uses (other than conservation) because of their larger proportion of natural asset and their limited negative impact on many biodiversity integrity indicators. Within the context of this study, the site is well suited to meeting the dual, simultaneous objectives of:

1. The maintenance of local biodiversity integrity, and
2. Deriving a sustainable, economic return from the remaining grasslands within the development area.

The study area has an MAP of 438mm. Sweetveld is classified as rangeland that can support animal production for 12 months of the year due to the low, variable rainfall (<500mm). A Veld Condition Assessment was carried out. The veld is considered to be in ***Moderate*** condition, showing signs of overgrazing. The palatable Decreaser species make up 40% to 50% of the sward.

Biomass rarely accumulates quickly in Dry Highveld Grasslands due to the low and erratic rainfall, and fires are likely to have been rare and localised, occurring only in years of high rainfall. Fires should be applied judiciously to dry grasslands as they are considerably less resilient to fire than their mesic counterparts. A burning interval of approximately 10 years should be applied. Burning too frequently can be damaging to the veld, leading to poor species composition which impacts on animal production.

Rotational grazing systems are recommended for commercial animal production. Current research shows that well-managed veld rotation systems result in improved veld condition, increased livestock production and farm profitability. The commercial grazing of sweetveld grasslands requires a responsive management system that can be adapted to the high level of climatic variability inherent in these systems. The herd composition in areas of variable rainfall should be such that at least a third of the total stock numbers can be sold off or bought in each year, depending on the amount of grazing available. Between eight and ten camps per cattle herd are recommended. This provides sufficient camps for rotational grazing and periodic resting to allow seed production. Some portion of the farm should be given a complete growing season’s rest every year.

Rest is one of the most important factors in conserving plant diversity and maintaining animal production in rangelands. All grasslands respond well to a full growing season of rest, and this should be built into all grazing management plans. The grazing rotation should ideally allow each grazing camp a full-season’s rest every 4-5 years.

A carrying capacity of 1,75 to 5 ha/AU/year for sweetveld is recommended by Tainton (1998), with the lower range suitable for veld in good condition and the greater area per AU for veld in poor condition. The suggested grazing capacity norm for veld at Glen Research Station, near Bloemfontein (75km from the study area) is 6ha/AU. These recommendations are adjusted by 0.7 to factor in biodiversity maintenance.

A method of working out grazing capacity based on standing biomass measurement is provided. The example, a realistic one taken from empirical data for a wet year, indicated a grazing capacity of approximately 7 ha/ AU would be feasible.

Grassland mammal and gamebird populations are severely impacted by people hunting with domestic dogs. This activity is indiscriminate and often results in the local extirpation of faunal species. Access to the site should be strictly controlled and monitored.

Sweetveld rangelands support lower stocking rates than rangelands in higher rainfall areas, although animal production is possible throughout the year. Cattle ranches need to be extensive to be economically viable. As such the open space in the Klipfontein2 project area is likely to form a component of a larger ranching enterprise.

Management should be adaptive, and responsive to changes in rainfall. Tracking standing biomass and maintaining a third of the herd as non-breeding animals should allow cattle numbers to be adjusted quickly according to the amount of forage available. Selective grazing can be as damaging to veld as overutilization, so stocking rates should not be too low and a continuous grazing system is to be avoided.

CONTENTS

ACRONYMS AND ABBREVIATIONS

Acronym / Abbreviation	Definition
ECO	Environmental Control Officer
EMPr	Environmental Management Programme report
NEMA	National Environmental Management Act (Act No.107 of 1998)
VVSG	Vaal Vet Sandy Grassland
WFSCG	Western Free State Clay Grassland
MAP	Mean Annual Precipitation
VCA	Veld Condition Assessment
CBA	Critical Biodiversity Area
AU	Animal Unit

Klipfontein 2 Solar PV Facility Open Space Management Plan

1. INTRODUCTION

This open space management plan has been prepared on behalf of Klipfontein 2 Solar PV PTY LTD as part of the environmental authorisation process for the Klipfontein 2 commercial photo-voltaic (PV) solar power generation facility at Dealesville in the western part of the Free State Province (authorised by way of reference number: 14/12/16/3/3/2/726, as amended).

The proposed development site is 334ha in area and consists of two polygons (**Figure 3.1**). The planned footprint of the solar facility will take up an area of 237 ha, with the rest of the site remaining as intact primary grassland. Open space management efforts will focus on the peripheral sensitive habitats and their buffer zones. It is understood that the current landowners will continue to manage and derive economic benefit from the remaining grasslands within the property once the development becomes operational.

The purpose of this document is to provide a management framework for the responsible, sustainable use of the land remaining as open space within the study area.

2. BACKGROUND AND OBJECTIVES

The Klipfontein 2 solar PV project, one of several solar PV electricity generation projects planned for the district, is situated on the transition zone between Vaal Vet Sandy Grassland (VVSG) and Western Free State Clay Grassland (WFSCG) (Mucina and Rutherford, 2006), part of the Dry Highveld Grasslands complex of the Grassland Biome (SANBI, 2013). The VVSG vegetation type is considered to be Endangered at a national level, and Critically Endangered at the provincial level (Collins, 2016). The WFSCG is of Least Concern. The grasslands within the site are of high conservation importance, this amplified by their inclusion in a Critical Biodiversity Area (CBA) (Collins, 2016).

The study area has an MAP of 438mm (Water Research Commission, undated, cited by Lantz, 2015). Sweetveld is classified as rangeland that can support animal production for 12 months of the year (Tainton, 1998). This is due to the low, variable rainfall (<500mm) which has two consequences:

- Nutrients are not leached out of the soil and are available for plant uptake, resulting in a more nutritious sward.
- Fires are less frequent because of the lower primary productivity, and plants are not reliant on regrowth following fire events in order to persist. They hence do not translocate resources from the leaves to root storage organs prior to the onset of the dry season. The leaves remain nutritious and palatable when dry and dormant.

The grasslands on site are sweetveld and are well suited to year-round animal production provided management remains responsive according to the variable rainfall (SANBI, 2013).

Scientific perceptions regarding biodiversity have shifted from an initial emphasis on the diversity of species and their endangered status (Forman, 1981; Noss, 1983), which largely ignored interactions among the different elements in a landscape or ecosystem, to a holistic, hierarchical perspective that recognizes the need to conserve the dynamic, multi-scale, inter-connected ecological processes that sustain the entire spectrum of biological components and their supporting natural systems (O' Connor and Kuyler, 2008, citing

Noss, 1990 and Poiani *et al*., 2000). Ecosystem processes such as fire, nutrient cycling or hydrological regime are considered to be as critical to maintaining biodiversity as population processes and trophic relationships are. These concepts are encapsulated in the concept of biodiversity integrity.

In poorly protected vegetation types, or where the protected areas are too small to protect all of the biota, biodiversity conservation can only be achieved through the expansion of the protected area network or the maintenance of biodiversity-compatible land-uses. The expansion of protected area networks in a developing country is constrained by a lack of resources and by competing demands on land. Alternatively biodiversity conservation can be mainstreamed within land uses which are compatible with maintaining biodiversity integrity because a substantial proportion of the area remains as natural asset.

With this in mind, O'Connor and Kuyler (2009) sought to identify the relative compatibility of ten prominent land-uses occurring within the Grassland Biome with maintaining biodiversity integrity. These were: conservation; livestock ranching; game ranching; tourism/ recreation; rural settlement; dryland cropping; irrigated cropping; dairy farming; plantation forestry; and urban settlement. They conducted a multi-criteria analysis of 46 indicators for biodiversity integrity that covered landscape composition, structure and functioning to compare land-uses. The underlying assumption was that a system subjected to external disturbance will retain its integrity provided it maintains all its (i) components, (ii) interactions with the biotic environment, (iii) patterns of processing energy and materials, and (iv) natural patterns of variability of components and processes characteristic of that locale in a pristine state (De Leo and Levin, 1997).

The results indicated that responsible livestock (beef, sheep) ranching and game ranching were considered the most "biodiversity-friendly" land-uses other than conservation because of their larger proportion of natural asset and their limited negative impact on many indicators. The remaining land-uses had a severe impact on biodiversity integrity. Within the context of this study, the site is well suited to meeting the dual, simultaneous objectives of:

1. The maintenance of local biodiversity integrity, and
2. Deriving a sustainable, economic return from the remaining grasslands within the development area.

3. SITE DESCRIPTION

The Klipfontein 2 solar PV project has an area of approximately 334ha and was identified in the terrestrial specialist report as entirely consisting of intact primary grassland. The proposed development is 237 ha in size. The current land-use is grazing for cattle, and the sward appeared to be underutilized given the increase in primary production associated with the recent higher rainfall and the palatability of the grasses.

The underlying geology over most of the southern part of the study area is Ecca Group shale and mudstone covered by wind-blown sand and surface limestone with localised dolerite intrusions. The soils are moderately deep to deep red apedal loamy sands overlying parent material or hard-pan carbonate. The Hutton and Clovelly soil forms predominate, reflecting a softer, more highly weathered sedimentary parent material and the influx of iron and clay particles from the prehistorically higher dolerite intrusions.

The northern parts of the study area are dominated by shallow sandy-clay-loams of the Valsrivier and Swartland soil forms on underlying clay and dolerite parent material. These soils are characterised by a strongly structured, clay-rich pedocutanic B-horizon. The uplands in this area consist of shallow loams of the Mispah and Glenrosa soil forms overlying hard-pan carbonate or hard rock.

The landscape is generally expansive and flat and topographically dominated by scattered low, rocky hills. Slopes across the site are less than 1%. The primary land-uses are commercial beef production and communal livestock grazing. The area has a semi-arid rainfall regime, with a Mean Annual Precipitation (MAP) of 438mm (Water Research Commission, undated) mostly occurring as short, intense afternoon thunder showers (Lanz, 2015).

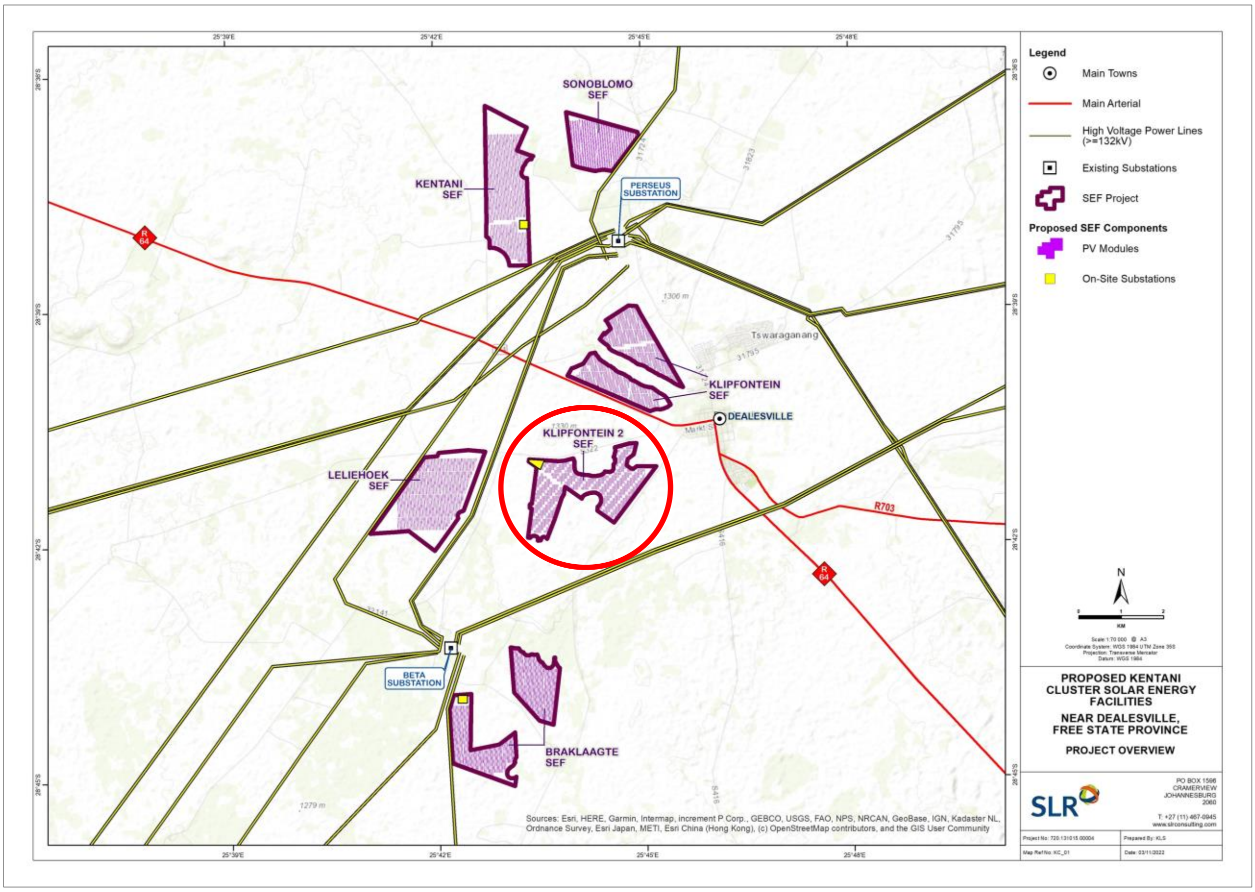

Figure 3.1: Location of the Klipfontein2 development site in relation to Dealesville, in the western part of the Free State Province.

4. ECOLOGICAL CONTEXT

The Dry Highveld Grasslands group of vegetation types (SANBI, 2013) are dominated by Central Free State Grassland and Vaal-Vet Sandy Grassland and include shrublands on rocky outcrops and ridges. The group includes five threatened vegetation types, with few areas under formal protection. The distribution of these rangelands coincides with important areas for maize production, gold mining (and the urban expansion associated with this), and intensive sheep and cattle production, and hence much of the primary vegetation has been irreversibly transformed. Most of these rangelands consist of semi-arid sweetveld that is drought-adapted and shows a significant amount of reproduction from seed. The plants are perennial, persisting vegetatively from year-to-year. However, new plants are able to establish from dormant seeds following droughts (known as serotiny).

The plant communities are adapted to a climate that is temperate with a moderate to high frequency of winter frost. These grasslands occur where rainfall is low (400-500mm MAP), strongly seasonal (in summer), and highly variable particularly as one moves west. The defining climatic characteristic is the low and highly variable summer rainfall. In these semi-arid ecosystems water, not the duration and temperature of the growing season, is the limiting factor to growth. The unpredictable, semi-arid climate and nutrient-rich (unleached) soils result in nutritious year-round grazing. The rangelands are slow-growing due to low rainfall but are able to support animal production year-round. Grazing is also an important 'driver' of these ecosystems because it influences fire fuel load.

The plant life-history strategies in Dry Highveld Grassland ecosystems are driven by adaptation to drought. Most species are perennial and long-lived, persisting vegetatively for long periods, although a significant amount of reproduction takes place through seed production. Species are able to bridge drought periods by persisting as dormant seeds in the seed bank. This results in interesting cyclical shifts in species composition, such as when karroid shrubs spread into the more arid western parts of these grasslands during drier cycles but are replaced by grasses again when periods of higher rainfall return. Since seeds can remain dormant, these grasslands are resilient to impacts over the short-term (5 years) and may be expected to recover from inappropriate management over several growing seasons provided topsoil has not been lost.

5. SUMMARY OF VELD CONDITION ASSESSMENT RESULTS

Veld condition can be defined as a measure of the state of health of a rangeland in term of ecological status, resistance to soil erosion and the potential for producing forage for sustained livestock production (Trollope *et al*., 1990). The analysis of species composition, vigour and basal cover of a sample site allows conclusions to be drawn regarding the current productive state of the sward, and the response of the sward to historic management. This allows the management regime to be adjusted adaptively to best achieve the objectives of the manager within a dynamic environment.

It should be noted that the Veld Condition Assessment concept is an agricultural one and concerns the management of natural veld with the objective being to sustainably optimise meat production. Within the context of the study, a key assumption is that veld considered to be in good condition is also assumed to be maintaining ecological and biodiversity integrity. Optimising meat production and maintaining biodiversity integrity are considered to be compatible objectives.

Most methods of veld condition scoring are based on the ecological status of various grass species (or their response to defoliation by grazing or fire). Each grass species is assigned to a category as follows:

1. **Decreaser**: grass species that decrease (or die out) in veld that is (i) too heavily grazed, (ii) too leniently grazed or where fire is excluded, or (iii) selectively grazed. These species are palatable and desirable for animal production and tend to dominate swards that are in good condition.
2. **Increaser 1**: grass species which increase in abundance where veld is leniently grazed and fire is excluded. This category is further divided into **Increaser 1a**: species which increase in relative abundance in veld which is moderately underutilized and fire is infrequent; and **Increaser 1b**: species which increase in abundance where defoliation by grazing is minimal or absent and fire is excluded from the system.

3. **Increaser 2**: species which increase in abundance when veld is overgrazed and are not abundant in veld which is in good condition. This category is further divided into **Increaser 2a**: species which increase in relative abundance with moderate overutilization and indicate the initial stages of overgrazing; **Increaser 2b**: species which increase in relative abundance in veld which is heavily overgrazed; and **Increaser 2c**: pioneer and invader species which increase in relative abundance with severe over-grazing and usually when soil loss has also occurred.
4. **Increaser 3**: species that increase in relative abundance in veld that is selectively over-grazed.

A veld condition assessment of the site was carried out by Ross Goode during April 2022. Two transects were sampled, each with one hundred sample points taken (**Figure 5.1**). At each point the distance from the yardstick to the nearest plant was measured, as well as the species of that plant.

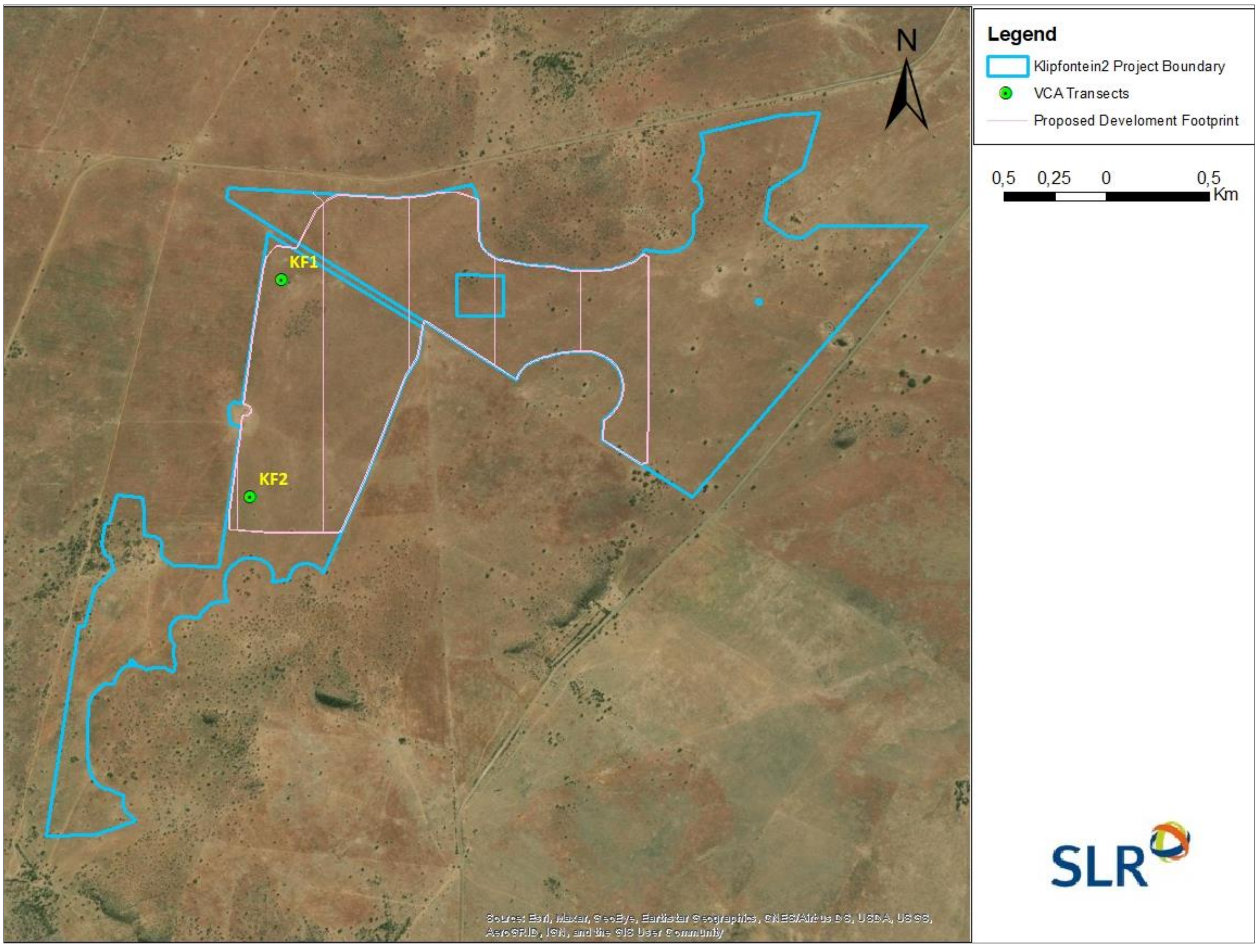

Figure 5.1: Location of the Veld Condition Assessment transects within the Klipfontein 2 study area.

The results are shown in **Table 5.1**, with the data presented in **Appendix A**.

Usually grass biomass would also be measured using a disc pasture meter as part of the VCA process. This data was not collected because it was considered to be outside the scope of the study (which was to confirm the extent of VVSG within each project area). The transects revealed similar trends, namely:

- Decreasers (desirable and palatable grass species) such as *Themeda triandra, Digitaria argyrogapta* and *Panicum stapfianum*, comprised approximately 34% in the northern part of the site, and 56% in the southern parts. This is substantially lower than desired in the proposed Benchmark condition.

- The number of grass species recorded at each transect 18 for KF1, and 11 for KF2.
- Transect KF1 had a prominently high percentage of Increaser 1 grass species, with *Cymbopogon propschilli* being the dominant. This indicates marked under-utilization of the veld and prolonged selective grazing. This trend is not present in KF2, which has an inconsequential proportion of Increaser 1 species.
- The percentage of Increaser 2 grass species ranged from 42% to 54% of the sward. The dominant species of this group were *Eragrostis lehmanniana (2b), Eragrostis superba (2b*), *Aristida congesta (2c),* and *Pogonarthria squarrosa (2c).* The prominence of Increaser 2b species indicates veld that has been overgrazed, while the Increaser 2c species indicate pioneer grasses that have colonised the bare patches within heavily-utilized veld. The presence of these species indicates a degree of degradation where severe overgrazing has occurred. This is localised, however, creating patches of degraded rangeland. The distribution of the patches, and their proportion of the entire veld area, has led to a substantial decline in veld condition away from the proposed Benchmark.
- The veld over much of the site is considered to be in ***Moderate*** (or medium) condition.
- The fuel load is high to very high. This grass biomass can also be grazed.
- Tuft distance (a measure of basal cover gained by estimating the distance of the nearest tuft to the yardstick) was 2.9cm in KF1 and 3.38cm in KF2. Vegetation cover is high consequently the risk of soil loss is low. The results indicate that both transect areas have been overgrazed, but this utilization is more localised in KF1 and more sustained in KF2.

Table 5.1. Summary of Veld Condition Assessment Results

Ecological Status	Transect KF1	Forage Score	Transect KF2	Forage Score	Proposed Benchmark	Forage Score
Decreasers (%)	34	207	56	360	80	640
Increaser I (%)	12	42	2	4	7	28
Increaser II (%)	54	116	42	74	13	39
Total	100	**365**	100	**438**	100	**707**
Veld Score (%)		52		62		
Tuft distance (cm)	2,9		3,38		/	
Condition		Moderate		Moderate		

6. CONTROLLED BURNING RECOMMENDATIONS

Fire is probably the single most important ecological factor determining the presence and extent of the grassland biome in South Africa (O'Connor and Bredenkamp, 1997). The biome's biota are well adapted to repeated fires, but community organization and ecosystem functioning are markedly influenced by variation in the fire regime (Mentis and Tainton, 1984). The reasons for burning veld are as follows:

- To enhance the primary productivity of grasslands by maintaining tuft vigour.
- To remove dead top-growth, preventing the shading out of basal tillers which results in a moribund sward.
- To release nutrients and organic material back into the soil.
- To reduce the suppressive competitive effect of grasses, allowing the opportunity for geophytic forbs to flourish.
- To control woody invasive species.

- To increase habitat diversity by forming a mosaic of structurally differing micro-habitats.

Biomass rarely accumulates quickly in Dry Highveld Grasslands due to the low and erratic rainfall, and fires are likely to have been rare and localised, occurring only in years of high rainfall (SANBI, 2014). There is competition between fire and herbivory for biomass, and fires would have occurred in the absence of heavy grazing pressure.

Fires should be applied judiciously to dry grasslands as they are considerably less resilient to fire than their mesic counterparts (SANBI, 2014). The low rainfall results in low primary productivity, and plants may take a long time to recover following a fire event. Bare soil may also be exposed for a long time if rainfall is low or late, increasing the risk of wind erosion. There is little evidence to suggest that withholding fire in the dry grasslands is detrimental to plant diversity.

A challenge in formulating burning frequency rules for Dry Highveld Grasslands is the unpredictability of rainfall and primary productivity. However, the following rules of thumb may be applied (SANBI, 2013):

- Fire should only be used where there is a clear management objective to be achieved.
- As semi-arid systems, these grasslands should only be burnt when the build-up of the grass sward reaches a predetermined biomass (as measured with a disc pasture meter).
- A burning interval of approximately 10 years should be applied. Burning too frequently can be damaging to the veld, leading to poor species composition, plant vigour and low basal cover. This impacts on animal production and increases the risk of soil losses due to wind and water erosion.
- The most important rule in implementing a controlled burn is: only burn when it is safe to do so (**Figure 6.1**). All ecological burning considerations, such as season and intensity of burn, need to fit into the primary requirement of safety. All burning programmes need to comply with the National Veld and Forest Fire Act 101 of 1998.

Figure 6.1: Implementing a controlled burn (Photo: www.arrivealive.org.za)

- Not all of the veld should be burnt at once (although this is unlikely as cured grass has grazing value). Veld should rather be burned over successive years with a suggestion being to burn one third of the camps over a three-year period. This introduces variation to the burning regime, always a good principle for biodiversity maintenance. It also ensures that there is sufficient cover nearby for fauna and insects to easily access and take refuge in during and after a fire.

- During periods of above-average rainfall there is a rapid accumulation of biomass with a relatively low nutritional value because of the excess lignin content in the standing mass. Animals respond to this by grazing selectively, and non-palatable species are able to build-up and suppress the growth of the frequently-grazed palatable species the following year. Burning during these conditions can suppress unpalatable species and equalise inter-specific competition. The following season's growth may also be more nutritious, boosting animal production. Burning should be considered during those periods where grass growth has become too rank for animals to graze satisfactorily (SANBI, 2014).
- Burning should take place in late winter, and only in seasons that have been wet enough to ensure enough biomass to support an intense fire.

7. GRAZING RECOMMENDATIONS

Sweetveld is veld that is able to maintain animals in good condition for the entire year. Unlike sourveld it does not have an inherent protective mechanism of low palatability in the mature growth stage that forces animals to move on, thereby reducing grazing pressure (Tainton, 1998). Indicators of degradation are a decline in plant basal cover, a concomitant increase in soil loss, and a replacement of palatable grass species by annual weeds, unpalatable grass species and woody species. Sweetveld areas are primarily suited to the breeding and fattening of cattle.

7.1 GRAZING SYSTEM

Rotational grazing systems are recommended for commercial animal production. Current research shows that well-managed veld rotation systems result in improved veld condition, increased livestock production and farm profitability. Grazing intensity should be manipulated by adjusting camp numbers, the stocking rate and periods of stay/ rest (SANBI, 2013). Carrying (or Grazing) Capacity refers to the number of large animal units that an area of rangeland can support over a period of time and is a measure of the amount of forage available. Stocking rate refers to the number of animal units using an area of rangeland over a certain period of time (Tainton, 1998).

The commercial grazing of sweetveld grasslands requires a responsive management system that can be adapted to the high level of climatic variability inherent in these systems. The herd composition in areas of variable rainfall should be such that at least a third of the total stock numbers can be sold off or bought in each year, depending on the amount of grazing available (**Figure 7.1**). A quarterly or half-yearly adjustment allows animal numbers to be more closely equated with the available feed supply at any time. Even annual adjustment of animal numbers, preferably at the end of a normal rainy season, works effectively in many sweetveld areas.

Between eight and ten camps per cattle herd are recommended as close to the ideal (Tainton, 1998). Camps of less than 100ha are manageable if they do not include different veld types, and camp sizes often vary from 20ha to 96ha. This provides sufficient camps for rotational grazing and periodic resting to allow seed production. Some portion of the farm should be given a complete growing season's rest every year. Animals should be moved into whichever camp is in the most advanced growth stage. In sweetveld areas a rotation involving two weeks grazing followed by about ten weeks of absence (in an eight-camp system in which 2 camps are in rest), although lengthening this period to 14 weeks (and 9 camps per herd) may be advantageous during years of lower rainfall.

Rest is one of the most important factors in conserving plant diversity and maintaining animal production in rangelands. All grasslands respond well to a full growing season of rest, and this should be built into all grazing management plans. To achieve rest it is important to move the livestock through a series of camps in such a way that 60-75% of the farm every year is being utilised during the growing season, with the remainder being rested. The rested veld can be grazed during the dormant winter period. The grazing rotation should ideally allow each grazing camp a full-season's rest every 4-5 years.

Stocking rate (the number of animals grazing on a given area over a predetermined period of time, measured in animal units (AU)/area (ha)/ time) should never exceed the carrying capacity. This will result in excessive grazing pressure on the veld, which causes loss of biodiversity, reduced animal productivity and a deterioration in veld condition. The stocking rate should err on the light rather than the heavy side and many case studies have shown that net farm income is increased by running fewer animals due to better animal performance. Biodiversity-friendly stocking rates should be particularly conservative since the aim is to conserve plant and faunal diversity as well as animal production. It is possible to get higher performance per animal at lower stocking rates. It is also possible to maintain an equivalent farm-scale level of animal production (kg of beef per hectare) at a stocking rate reduced to 70% of the agricultural carrying capacity (SANBI, 2014). Grazing half by volume of the amount of material produced by tufted grasses at any time during the growing season is a realistic degree of utilization to aim for.

Figure 7.1: Typical beef herd constituents (Photo: Chris Nel).

Low stocking rates can also be a problem. A conservatively stocked camp that is continuously grazed, or a camp that is too large relative to the number of grazers, can result in selective grazing and an increase in tall Increaser 1 grass species which can outcompete many desirable species. This is a particular problem where fire is not used frequently.

Dry matter production on sweetveld varies between 200kg/ha during dry years and 1600 kg/ha during the wetter periods. At Glen Research Station, near Bloemfontein (70km away from the study area), MAP of 807mm, 760mm, 408mm and 477mm corresponded to dry matter production of 1614 kg/ha, 1243 kg/ha, 527kg/ ha and 572 kg/ha respectively (De Waal, 1990).

A carrying capacity of 1,75 to 5 ha/AU/year for sweetveld is recommended by Tainton (1998), with the lower range suitable for veld in good condition and the greater area per AU for veld in poor condition. The suggested grazing capacity norm for veld at Glen Research Station is 6ha/AU. These recommendations are adjusted by 0.7 to factor in biodiversity maintenance.

A problem encountered is that the study area does not seem to have a benchmark score against which to compare the results of the VCA. A common practice is to assume that the benchmark condition consists of 100% Decreasers with a palatability score of 10. Hence the benchmark score is 1000. However, this is not a realistic assumption since natural veld will never consist of a monospecific stand of *Themeda triandra*. There will always be a component of Increaser species. A more realistic assumption is that the benchmark veld contains 80% Decreasers, and a benchmark score of 707 is more likely (extrapolated from sweetveld areas with a known Benchmark). The two sample transects yielded VCA scores of 365 (52%) and 438 (62%) respectively (**Table 5.1**).

7.2 ESTIMATING GRAZING CAPACITY

It is recommended that the Herbaceous Phytomass Method of Moore and Odendaal (1987) be used to calculate the grazing capacity of the various veld camps. A conventional VCA is undertaken, recording species composition and comparing this to a benchmark. Standing biomass (kg/ha) is also measured using a disc pasture meter (**Figure 7.2**), with 100 readings taken at set intervals along a series of representative transects. The following equation is used to convert the disc pasture meter readings into an estimate of standing herbaceous biomass (Botha, 1999).

$$Y = -3340 + 2323 \sqrt{X} \quad \text{where,}$$

Y = Standing herbaceous biomass (kg/ha)
X = Averaged disc meter reading (cm)

This is then inserted into the following equation (from Moore and Odendaal, 1987):

$$y = d \div \frac{[\,DM \times f\,]}{r} \quad \text{where,}$$

y = grazing capacity (ha/ AU)
d = number of days in the year
DM = dry matter (biomass) in kg/ha
f = utilization factor (between 0.2 and 0.5 based on veld condition), derived from VCA%
r = daily dry matter required by one grazing animal (2.5% of bodyweight or 11.25 kg/AU/day)

Figure 7.2: Farmer operating a disc pasture meter to estimate standing biomass (Photo: Amber Wood).

For example, let us assume that it has been a particularly wet year, and the standing biomass calculated for a camp is 1600 kg/ha. For sweetveld we calculate forage requirements based on an entire year's grazing time, i.e. 365 days. The utilization factor is estimated to range between 0.3, based on the percentage veld condition score for each transect. The stocking rate calculated for the Klipfontein2 site would be approximately 7 ha/AU, lower than the recommended norm because the veld is in moderate condition. Subsequent improvements in grass species composition would allow the stocking rate to be increased accordingly. One third of the herd should consist of young animals being grown and fattened by grazing the veld. The area should be divided into eight camps, and the animals moved between camps on a rotational basis. Movement should be triggered by the removal of 50% of the standing biomass in the camp through grazing.

7.3 ADDITIONAL RULES OF THUMB

- If possible, plan a camp and water point configuration that varies the time of impact so that camps are grazed at different seasons in different rotations.
- Limit sheep or Blesbok grazing in areas of high biodiversity importance, such as rocky ridges which are often refugia for remnant plant diversity.
- Avoid high-intensity or selective grazing systems in areas important for biodiversity. There is at present insufficient evidence to suggest that High Density Grazing is compatible with the maintenance of plant diversity, the main impact being extensive trampling of grassland forbs.

8. FURTHER RECOMMENDATIONS

- Night-lighting at the site should be kept to a minimum. Artificial lights affect invertebrates and migrating birds. Lighting that is necessary for security reasons should be downward-directed low-UV type lights which do not attract insects.
- No parts of the site should be fenced with electrical fencing as this can be harmful to smaller mammal and tortoise populations.
- Many animals are vulnerable to being hit by motor vehicles. Vehicle speed should be controlled, adhering to a maximum speed limit of 40km/hour. Mammals, snakes, tortoises and birds all have right of way when crossing the road. Particular care should be taken while driving at night.
- Grassland mammal and gamebird populations are severely impacted by people hunting with domestic dogs. This activity is indiscriminate and often results in the local extirpation of faunal species. Access to the site should be strictly controlled and monitored. This would also prevent the potential for poaching of other less obvious species, such as plants and reptiles.

9. MONITORING RECOMMENDATIONS

- It is recommended that veld condition assessments (which refers to surveying grass species composition) of the camps be undertaken at five-year intervals. This is regarded as sufficient time for the vegetation to respond to the prevailing management regime. Subsequent monitoring iterations will identify positive or negative trends in the vegetation, informing the subsequent review of management objectives and interventions.
- Standing biomass should be measured at 6 monthly intervals to determine the grazing capacity. Animal numbers may be adjusted according to the amount of forage available for the next 6 months.
- All data concerning controlled burns should be logged and stored on a database, the information being used to contribute to the refinement of the management plan. This includes (i) which camps where burnt, (ii) date of burn, (iii) standing biomass at the time of burn, (iv) climatic data at the time of the burn.
- The same data should be kept for any uncontrolled burns that may occur. Data on uncontrolled fire events should be maintained.
- Data on faunal mortality should be collected, with remedial action taken should frequent instances and their causes be detected.
- Data should also be kept on the occurrence of grassland faunal species of significance or interest, such as Secretarybirds, Cranes, Korhaans and Bustards, Serval, Honeybadgers, Aardvark and Aardwolf. The frequent presence of these species would indicate intact trophic levels within the grassland ecosystem.
- The data should be managed by the responsible regional Environmental Control Officer for the development cluster.

10. CONCLUDING REMARKS

- Sweetveld rangelands support lower stocking rates than rangelands in higher rainfall areas, although animal production is possible throughout the year. The low, erratic rainfall translates into low primary production in dry and average rainfall seasons. Cattle ranches need to be extensive to be economically viable. As such the open space in the Klipfontein2 project area is likely to form a component of a larger ranching unit.

- Management should be adaptive, and responsive to changes in rainfall. Tracking standing biomass and maintaining a third of the herd as non-breeding animals should allow cattle numbers to be adjusted quickly according to the amount of forage available.
- There is competition between grazing and fire for the same biomass. Fire should be applied at 10-year intervals to suppress the Increaser species and allow the palatable and more frequently grazed Decreaser species to compete.
- Veld should be given a full growing season's rest every 4 to 5 years. The veld can be grazed during the dormant season.
- Fire can also be used as a tool to control woody species encroachment, with the biomass produced during a rest season burned at the end of winter.
- An increase in Increaser grass species or karroid shrubs indicates veld degradation and should result in a reduction is stock numbers. However, a cyclical shift to karroid shrub dominance is to be expected during dry cycles, with grass species becoming dominant during the wetter cycles. This therefore may also be an indication in naturally shifting weather cycles. The response should be similar, namely the reduction in stock numbers and close monitoring of grass basal cover, species composition and tuft size. The management priority should be in supporting the grass component through drier periods, in this way limiting overgrazing and severe veld degradation. A grass sward in good health at the start of a wetter cycle will allow the farmer to better capitalise on the increased palatable biomass available for meat production.
- A conservative stocking rate (70% of that recommended) should be applied to sustain grassland biodiversity. This should equate to better per animal performance and result in higher and more sustainable economic returns for the farm.
- Selective grazing can be as damaging to veld as overutilization, so stocking rates should, not be too low and a continuous grazing system is to be avoided.

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12. APPENDIX A: VELD CONDITION ASSESSMENT DATA

KLIPFONTEIN 2 VCA TRANSECT KF1							
CATEGORY	***GRASS SPECIES***	**% FREQUENCY**	**FORAGE FACTOR**	**FORAGE SCORE**	**FUEL FACTOR**	**FUEL SCORE**
DECREASER SPECIES	*Digitaria argyrograpta*	7	2	14	2	14
	Heteropogon contortus	1	6	6	7	7
	Panicum stapfianum	7	5	35	6	42
	Themeda triandra (highveld)	19	8	152	8	152
DECREASER TOTAL		34		207		215
INCREASER I SPECIES	*Aristida diffusa*	1	**1**	1	**4**	4
	Cymbopogon pospischilii	7	4	28	8	56
	Eragrostis curvula	2	4	8	9	18
	Eragrostis micrantha	1	2	2	6	6
	Sporobolus pyramidalis	1	**3**	3	**8**	8
INCREASER I TOTAL		12		42		92
INCREASER II SPECIES	*Aristida congesta ssp barbicollis*	6	1	6	2	12
	Aristida congesta ssp congesta	5	1	5	2	10
	Chloris virgata	1	1	1	2	2
	Cynodon incompletus	3	2	6	3	9
	Eragrostis lehmanniana	11	3	33	4	44
	Eragrostis obtusa	9	2	18	4	36
	Eragrostis surperba	14	3	42	4	56
	Microchloa caffra	1	1	1	1	1
	Trichoneura grandiglumis	4	1	4	2	8
INCREASER II TOTAL		54		116		178
TOTAL		**100**	**Forage Score**	**365**	**Fuel Score**	**485**

KLIPFONTEIN 2 VCA TRANSECT KF2							
CATEGORY	***GRASS SPECIES***	**% FREQUENCY**	**FORAGE FACTOR**	**FORAGE SCORE**	**FUEL FACTOR**	**FUEL SCORE**
DECREASER SPECIES	*Digitaria argyrograpta*	12	2	24	2	24
	Heteropogon contortus	6	6	36	7	42
	Setaria sphacelata	2	6	12	7	14
	Themeda triandra (highveld)	36	8	288	8	288
DECREASER TOTAL		56		360		368
INCREASER I SPECIES	*Eragrostis micrantha*	2	2	4	6	12
INCREASER I TOTAL		2		4		12
INCREASER II SPECIES	*Aristida congesta ssp barbicollis*	6	1	6	2	12
	Aristida congesta ssp congesta	6	1	6	2	12
	Eragrostis lehmanniana	12	3	36	4	48
	Eragrostis surperba	4	3	12	4	16
	Pogonarthria squarrosa	10	1	10	3	30
	Trichoneura grandiglumis	4	1	4	2	8
INCREASER II TOTAL		42		74		126
TOTAL		**100**	**Forage Score**	**438**	**Fuel Score**	**506**

Table A1: Summary of Results for Klipfontein 2

	KF2.1	KF2.1
% Decreasers	34	56
% Increaser I	12	2
% Increaser II	54	42
# Grass species	18	11
Forage potential	**Medium**	**High**
	365	438
Fuel potential	**High**	**Very High**
	485	506
Soil Erosion potential	**Low**	**Low**
Tuft distance (cm)	2,94	3,38
Fuel load (kg/ha)	NA	NA
Trend/Utilisation Condition	**Moderate**	**Moderate**
Recommendation	Burn	Graze
Management Action	Controlled Burn	Stocking Rate

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