ESKOM TRANSMISSION

PROPOSED GAMMA SUB-STATION
EIA: 12/12/20/873

VEGETATION ASSESSMENT

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SUMMARY

The vegetation of the proposed Gamma Sub-station site on Uitvlugfontein falls in the Nama-Karoo Biome, more specifically in the Upper Karoo Bioregion. The Acocks (1988) Veld Type is Central Upper Karoo (Acocks Veld Type 27). White (1983) mapped the vegetation as Highveld/Karoo Transition in the Kalahari-Highveld Phytochorion while Low and Rebelo (1996) list the Vegetation Type to be Upper Nama-Karoo (Vegetation Type 50). The most recent vegetation map (Mucina *et al.*, 2005) classifies it as **Eastern Upper Karoo**.

The Eastern Upper Karoo Vegetation Type is **Hardly Protected** but it has an ecosystem status of **Least Threatened** (Mucina *et al.*, 2005). The National Spatial Biodiversity Assessment (Rouget *et al.*, 2004) classified the area proposed for the Sub-station as being poor in threatened plant species and moderate in endemics. The site has the lowest level of irreplaceability for vegetation (0.2 = lowest level of conservation importance) and it ranks in the lowest category for vulnerability (Rouget *et al.*, 2004). Overall the Vegetation Type ranks **low for conservation value** (Rouget *et al.*, 2004) and the use of less than 0.004% of the Eastern Upper Karoo for a Sub-station will not jeopardize any conservation plans for the Vegetation Type.

Only one species of special concern was recorded on the Gamma Sub-station site (*Boophone disticha* or gifbol). All other protected species recorded on site are abundant in the areas. *Boophone disticha* is a geophyte that will transplant easily and the few individuals found on site should be translocated before construction.

The vegetation surrounding the proposed study site is highly similar to that on the Gamma Sub-station site and construction camps may be constructed adjacent to the Sub-station site in any direction, avoiding the ridges that are some distance to the north and east.

1. Introduction

Eskom's transmission network to the Eastern Cape is running short of capacity and is likely to develop reliability constraints by 2009. In order to meet projected future electricity demand, Eskom is proposing to increase its transmission network by constructing a 765 kV line from Standerton (Mpumalanga) to Cape Town (Western Cape), with a branch line to Port Elizabeth (Eastern Cape). The latter will be needed to meet current and projected future growth in electricity demand, particularly of development associated with the new Port of Ngqura and its back-of-port activities in the Coega Industrial Development Zone. This branch line is proposed to tap off from the main network around Victoria West (Northern Cape) and a sub-station will be built at this site. The proposed sub-station site is referred to as the **Gamma Sub-station**.

The Gamma Sub-station site is proposed to be located on the farms Uitvlugtfontein No. 233 and Schietkuil No. 3 in the Pixley ka Seme and Central Karoo District Municipalities near Victoria West and covers an area of 172 ha (Figure 1). The Sub-station footprint lies mostly on the farm Uitvlugtfontein with a small extension of approximately 20 m into Schietkuil. Additional area will be impacted by a construction camp at which temporary storage of hazardous substances such as fuels, oils and lubricants will occur during the construction phase. A telecommunication mast will be required, but this will form part of the sub-station infrastructure.

ACER (Africa) has been appointed as the Independent Environmental Consultant (IEC) to deal with the environmental authorisation process for this development. They have been tasked with obtaining environmental authorisation from the Northern Cape Department of Tourism, Environment and Conservation and the national Department of Environmental Affairs and Tourism in terms of the Environment Conservation Act 73 of 1989 with amendments of 2005; the National Environmental Management Act No 107 of 1998 and the National Environmental Management Biodiversity Act 10 of 2004. This report forms part of the environmental impact assessment being done in order to comply with such legislation.

1. Terms of Reference

The terms of reference for the botanical component of the Environmental Impact Assessment are to provide the following information:

- Description of the current state of the vegetation in the study area, outlining important characteristics and components thereof, which may be influenced by the proposed infrastructure or which may influence the proposed infrastructure during construction and operation.
- Identification of Red Data species potentially affected by the proposed Gamma Sub-station.
- The identification of potential impacts (positive or negative, including cumulative impacts if relevant) of the proposed development on vegetation during construction and operation.
- The identification of mitigation measures for enhancing benefits and avoiding or mitigating negative impacts and risks (to be implemented during design, construction and operation of the proposed transmission lines).
- The provision of clear guidelines to reduce vegetation damage and loss, and to assist with rehabilitation where damage and loss are unavoidable, and to reduce the risk of the spread of alien vegetation.
- The formulation of a simple system to monitor impacts, and their management, based on key indicators.

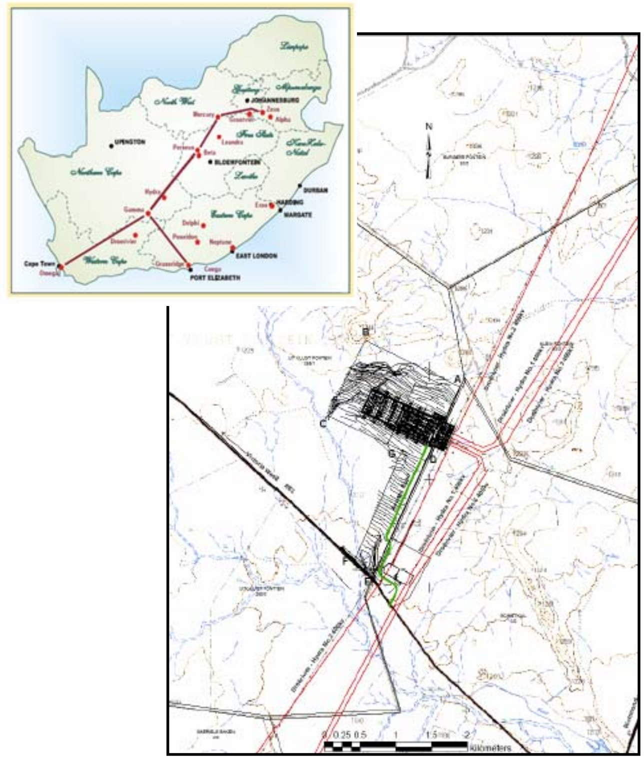

Figure 1. The location of Gamma (inset) and the Gamma Sub-station study site (ABCDEFG) northeast of the R62 to Victoria West.

The botanical report has been drafted in compliance with the guidelines for specialist studies Brownlie (2005).

The vegetation is assessed and evaluated in the following terms:

- Broad ecological characteristics of the site;
- Biodiversity patterns at community and species level;
- Biodiversity processes; and
- Potential for contribution to meeting regional conservation targets for both pattern and process.

2. Approach

The vegetation of the Gamma Sub-station site was assessed in its present, as well as its likely historical composition. It is described in context of the major phytogeographic classifications, with emphasis on most recent ones.

The following activities were undertaken in order to describe the floral diversity of the study area:

- All collection records for the sixteenth degree in which the study site falls (3123CB) were taken from the PRECIS database of the South African National Biodiversity Institute. The database includes historical records and covers collections taken at all times of the year. Unfortunately, the study site area is in an undercollected area and PRECIS only yielded four records for 3123CB.
- Because the area is undercollected, it was necessary to assess the floral diversity of the site by site-specific fieldwork. This was done during May 2007. An exhaustive collection of plant species on the

property and in immediately adjacent natural areas was made. These were identified by comparison with herbarium specimens in the Ria Olivier and Selmar Schonland herbaria.

3. Key sources of information

Phytogeographic evaluations used were those of Acocks (1988); White (1983); Rutherford and Westfall (1985); Low and Rebelo (1996); and the most recent vegetation map of Mucina *et al.* (2005) with descriptions and assessments in Mucina and Rutherford (2006).

Conservation planning evaluations were done using the National Spatial Biodiversity Assessment (Rouget *et al.*, 2004) as the study site falls outside of the domain of the three major regional conservation plans proposed for the Fynbos Biome (*CAPE*; Cowling *et al.* 1999); Thicket Biome (*STEP*; Cowling *et al.* 2003) or Succulent Karoo Biome (*SKEP*; Driver *et al*., 2003).

4. Assumptions, limitations and uncertainties

The botanical survey was conducted over a short period of time during autumn. In the absence of significant collections (PRECIS) in the area, the species-level biodiversity assessment depends almost entirely on the collection done for this study. Although most indigenous terrestrial species occurring on the site would have been captured in this way, it could be that some species were overlooked because they were dormant. Non-emergent dormancy is, however, rare in Nama-Karoo flora (Palmer and Hoffman, 1997). A few specimens taken could not be identified to species level because they were not flowering at the time. However, this is not believed to compromise the conclusions reached in this investigation.

Conservation value assessments require information on distribution of biodiversity features across a landscape. The available species datasets limit the quality of the information due to taxonomic, temporal and spatial gaps in knowledge. It is difficult to assess the conservation value of areas if we do not have data on biodiversity for the region in its entirety. This is a severe shortcoming, particularly for conservation efforts in the Nama-Karoo. It is clearly not feasible to attempt to address this shortcoming in existing datasets at Eskom’s expense. Clearly conservation planning in the Nama-Karoo will remain in the domain of expert opinion rather than based on empirical data for some time to come.

5. Vegetation

The vegetation of the study site is described in terms of major biogeographic assessments with emphasis on the most recent. These are presented at large scale followed by smaller-scale evaluations.

5.1 Biome

The vegetation of the proposed Gamma Sub-station site on Uitvlugfontein falls in the Nama-Karoo Biome (Rutherford and Westfall, 1985; Low and Rebelo, 1996, Mucina and Rutherford, 2006) (Figure 2).

The Nama-Karoo covers an extensive part of the south-central plateau of South Africa - an area of 248 284 km^2 (Mucina and Rutherford, 2006). The biome is characterized by low rainfall (70 and 500 mm a^{-1}) that falls mostly in later summer (Mucina and Rutherford, 2006) resulting in a high summer aridity index (Rutherford and Westfall, 1985) and the biome is classed as arid (Mucina and Rutherford, 2006). Summers are hot (maximum >30^{o}C) and winters are cold (minimum close to 0^{o}C) and frost is common. This climate delivers a short growing season and biomass is generally low (1 – 7 ton ha^{-1} produced at 500 to 1 500 kg ha^{-1} a^{-1}; Rutherford and Westfall, 1985).

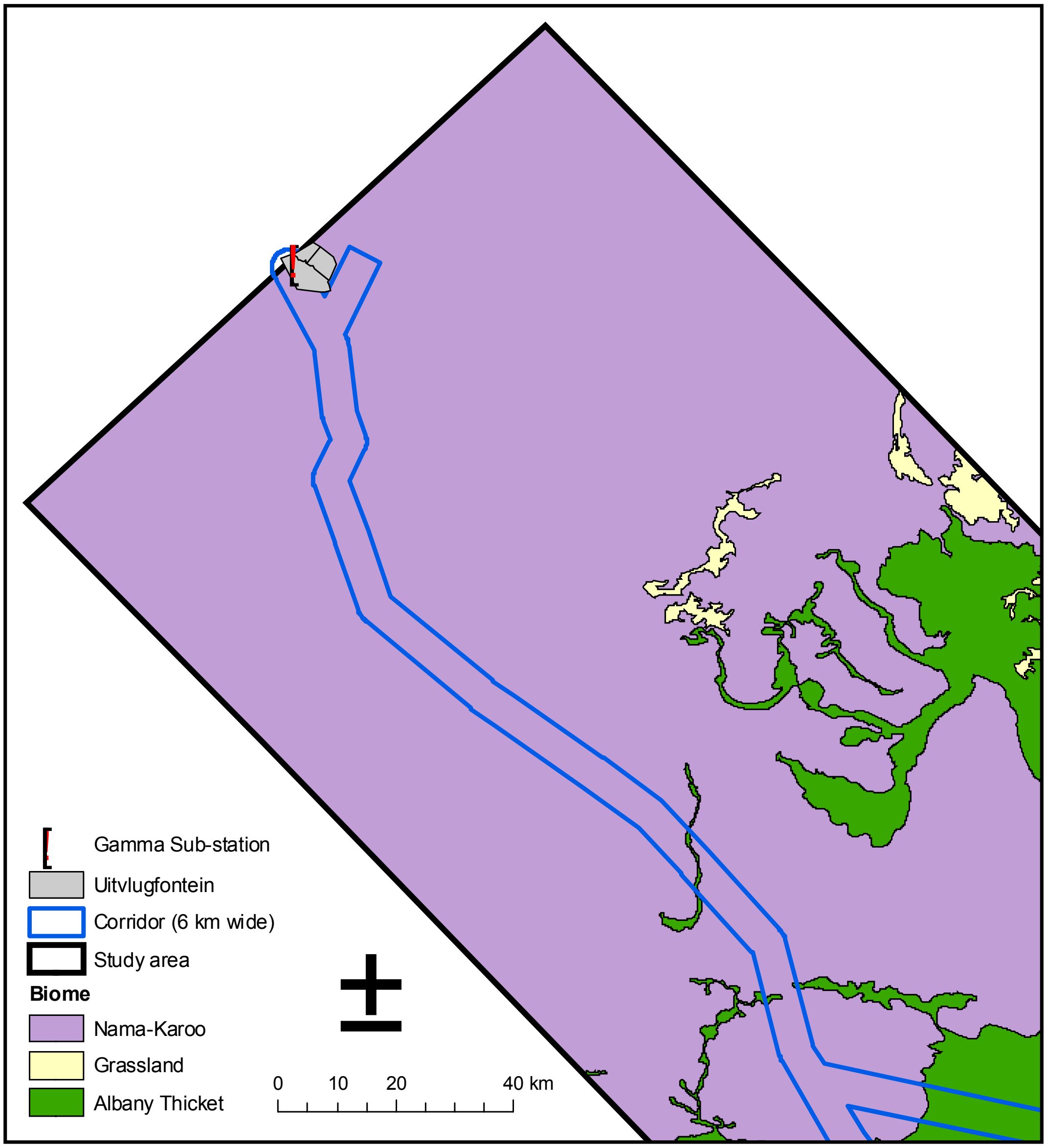

Figure 2. The Biomes (Mucina *et al.*, 2005) of the area surrounding the Gamma Sub-station study site.

The Nama-Karoo is underlain by marine Cape Supergroup sedimentary rocks, Carboniferous Dwyka tillites and the fossil-rich Karoo Supergroup (Meadows and Watkeys, 1999). Soils are generally base-rich, weakly structured and skeletal (Ellis and Lambrechts, 1986).

The Nama-Karoo flora developed after the lifting of the eastern Nama-Karoo plateau (Partridge 1997) and its origins are considered to be Sudano-Zambezian from the north-east and Cape from the south-west (Werger, 1978).

The desertification and/or spreading of the Nama-Karoo is another contested topic. Most modern arguments appear to suggest that the arrival of stock farming in the Nama-Karoo did not cause the observed spread/de-grassing of the Nama-Karoo (Hoffman and Cowling, 1990). Changes in shrub:grass ratios appear rather to follow meso-climatic cycles.

The vegetation of the Nama-Karoo is dominated by chamaephytes (low-growing shrubs) and hemicryptophytes (graminoids) in a grassy, dwarf shrubland (Edwards, 1983). Graminoids are mostly C_4 (Vogel *et al.* 1978) and shrubs are mostly asteraceous (daisy-family; Mucina and Rutherford, 2006).

The Nama-Karoo flora is depauperate (not particularly species rich; Mucina and Rutherford, 2006) and the biome contains no centre of endemism (Van Wyk and Smith, 2001). Dominant families are Asteraceae, Fabaceae and Poaceae (Mucina and Rutherford, 2006). The frequency and seasonality of rainfall is too unpredictable for succulents to develop (as in the Succulent Karoo) and the presence of grasses is generally controlled by patchy soil characteristics (sand) and moisture availability.

5.2 Bioregion

Bioregions have been defined based on climatic data using a topo-moisture analysis (Palmer and Hoffman, 1997). The Gamma Sub-station falls in the Upper Karoo Bioregion (Figure 3). This bioregion has higher altitudes than the Lower Karoo in the south and frost is more common (Mucina and Rutherford, 2006).

The Upper Karoo has been much modified by grazing with Mucina and Rutherford (2006) proposing five stages in its degradation: Phase 1 was the primary and dramatic degradation of the vegetation ending up to 1920s and resulting in a decrease of perennial palatable grasses. Phase 2 was a primary denudation phase (until the 1950s) with further decrease of palatable species at a rate exceeding their growth. Phase 3 was a revegetation phase by the species that remained (ending in 1980s). Phase 4 is a secondary degradation phase during which one or two species became dominant (ending 2000s). Mucina and Rutherford (2006) predict Phase 5 to be desertification leading to “near-complete degradation”.

5.3 Phytochorion

White (1983) mapped the vegetation as Highveld/Karoo Transition in the Kalahari-Highveld phytochorion but the study site lies close to the border between this phytochorion and the Karoo-Namib phytochorion. The vegetation abuts on and provides transitions between four surrounding phytochoria, making the vegetation complex (White 1983). The species composition is an admixture of the four surrounding units: Zambezian; Karoo-Namib; Tongaland-Pondoland and Afromontane.

5.4 Veld Type

The Acocks (1988) Veld Type is listed as Central Upper Karoo (Acocks Veld Type 27). It is a grassy Karoo with *Eragrostis lehmanniana* Nees and *Aristida congesta* Roem. & Schult. dominating. Dominant shrubs are asteraceous in the genera *Eriocephalus*, *Pentzia* and *Pteronia*. Grasses are more common on ridges and hills. The flood plains have a short, dense veld. Water courses tend to have *Acacia karroo* Hayne and *Phragmites australis* (Cav.) Steud. (Acocks, 1988).

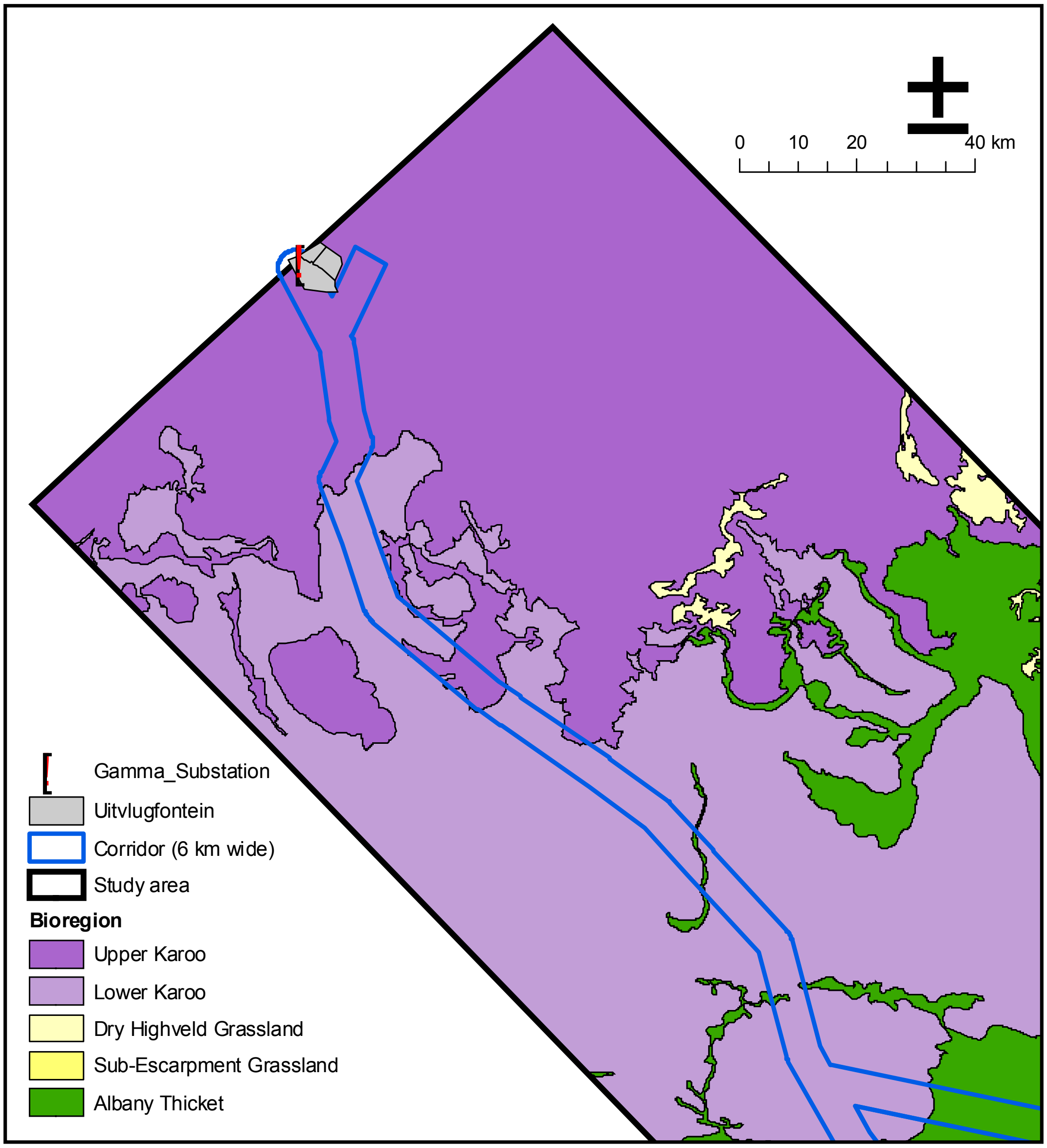

Figure 3. The Bioregions (Mucina *et al.*, 2005) of the area surrounding the Gamma Sub-station study site.

5.5 Vegetation Type

Low and Rebelo (1996) list the Vegetation Type to be Upper Nama-Karoo (Vegetation Type 50). The most recent vegetation map (Mucina and Rutherford, 2006) refers to it as Eastern Upper Karoo. The latter terminology is adopted (Figure 4).

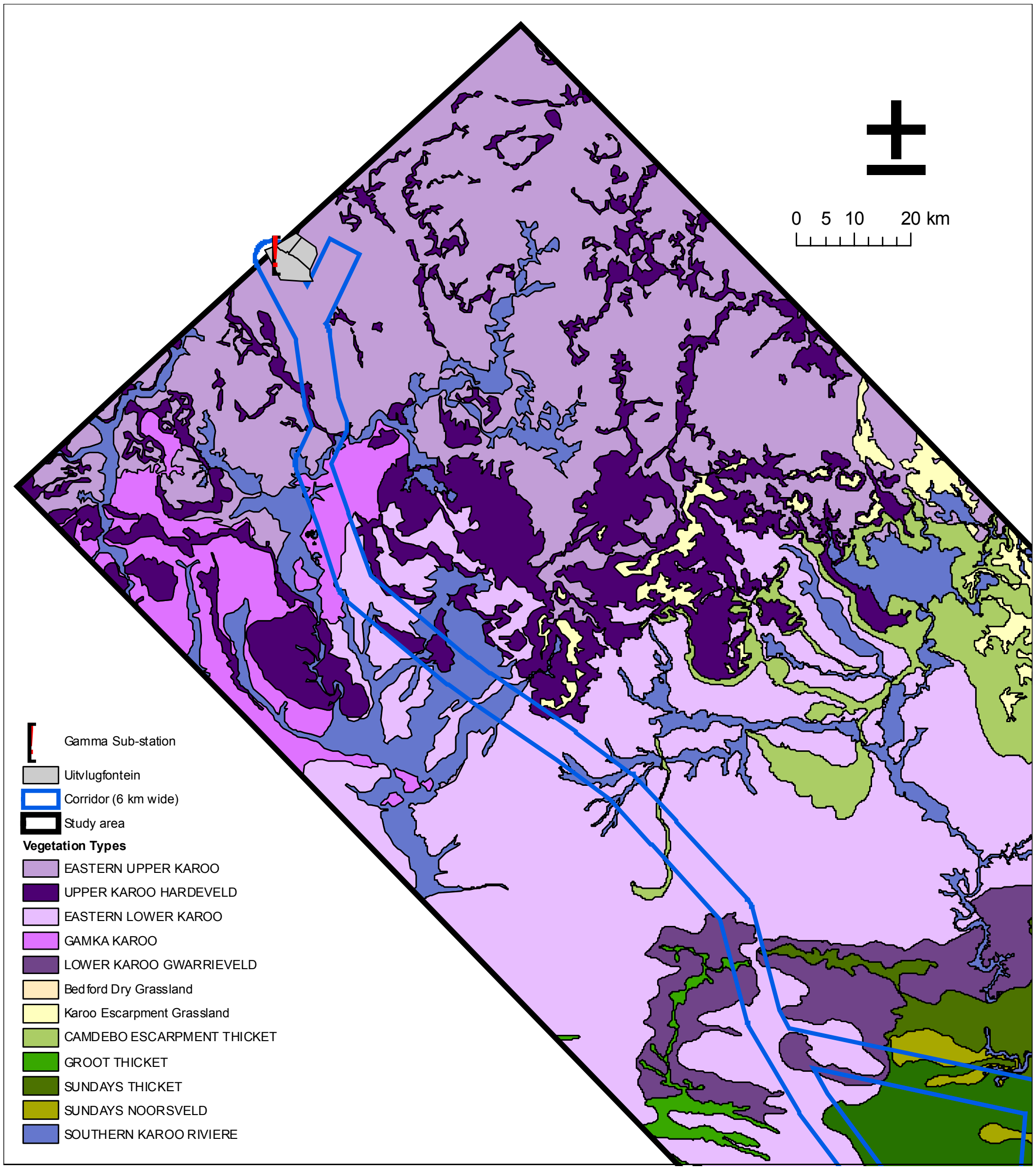

Figure 4. The Vegetation Types (Mucina *et al.*, 2005) of the area surrounding the Gamma Sub-station study site.

Eastern Upper Karoo vegetation occurs on flat to gently sloping portions of the Upper Karoo. The nearby hills and shale beds have Upper Karoo Hardeveld. It is dominated by dwarf microphyllous shrubs, with grasses becoming prominent after good summer rainfall (Mucina and Rutherford, 2006). The grass component is dominated by *Aristida* and *Eragrostis*.

The Eastern Upper Karoo receives mainly autumn and late summer rain (slightly bimodal due to it being in the south-eastern sector of South Africa). Precipitation ranges from 180 mm a^{-1} in the west to 430 mm a^{-1} in the east – the study site falls in the 250 mm a^{-1} area. The immediate area has approximately 80 frost days per year and mean maximum and minimum monthly temperatures for Victoria West are 37°C and -8°C (Mucina and Rutherford, 2006).

Dominant and important taxa of the Eastern Upper Karoo are listed in Table 1.

Table 1. Endemic, dominant and important plant taxa of Eastern Upper Karoo (Mucina and Rutherford, 2006).

Eastern Upper Karoo		
Endemic plant taxa	**Dominant plant taxa**	**Important plant taxa**
Tall Shrubs		
Phymaspermum scoparium (DC.) Källersjö	*Lycium cinereum* Thunb.	*Lycium horridum* Thunb. *Lycium oxycarpum* Dunal
Low Shrubs		
Aspalathus acicularis E.Mey. subsp. *planifolia* *Selago persimilis* Hilliard *Selago walpersii* Choisy	*Chrysocoma ciliata* L. *Eriocephalus ericoides* (L.f.) Druce subsp. *ericoides* *Eriocephalus spinescens* Burch. *Pentzia globosa* Less. *Pentzia incana* (Thunb.) Kuntze *Phymaspermum parvifolium* (DC.) Benth. & Hook. *Salsola calluna* Fenzl ex C.H.Wright	*Aptosium procumbens* (Lehm.) Steud. *Felicia muricata* (Thunb.) Nees *Gnidia polycephala* (C.A.Mey.) Gilg *Helichrysum dregeanum* Sond. & Harv. *Helichrysum lucilioides* Less. *Limeum aethiopicum* Burm. *Nenax microphylla* (Sond.) Salter *Osteospermum leptolobum* (Harv.) Norl. *Plinthus karooicus* I.Verd. *Pteronia glauca* Thunb. *Rosenia humilis* (Less.) K.Bremer *Selago geniculata* L.f. *Selago saxatilis* E.Mey.
Succulent Shrubs		
Chasmatophyllum rouxii L.Bolus *Hertia cluytiifolia* (DC.) Kuntze *Rabiea albinota* (Haw.) N.E.Br. *Salsola tetramera* Botsch.		*Euphorbia hypogaea* Marloth *Ruschia intricata* (N.E.Br.) H.E.K.Hartmann
Herbs		
		Indigofera alternans DC. *Pelargonium minimum* (Cav.) Willd. *Tribulus terrestris* L.
Geophytes		
	Moraea pallida (Baker) Goldblatt	*Moraea polystachya* (Thunb.) Ker Gawl. *Syringodea bifucata* M.P.de Vos *Syringodea concolor* (Baker) M.P.de Vos
Graminoids		
	Aristida congesta Roem. & Schult. *Aristida diffusa* Trin. *Cynodon incompletus* Nees *Eragrostis bergiana* (Kunth) Trin. *Eragrostis bicolor* Nees *Eragrostis lehmanniana* Nees *Eragrostis obtusa* Munro ex Ficalho & Hiern *Sporobolus fimbriatus* (Trin.) Nees *Stipagrostis ciliata* (Desf.) De Winter *Tragus koelerioides Asch.*	*Aristida adscensionis* L. *Chloris virgata* Sw. *Cyperus usitatus* Burch. *Digitaria eriantha* Steud. *Enneapogon desvauxii* P.Beauv. *Enneapogon scoparius*Stapf *Eragrostis curvula* (Schrad.) Nees *Fingerhuthia africana* Lehm. *Heteropogon contortus* (L.) Roem. & Schult. *Sporobolus ludwigii* Hochst. *Sporobolus tenellus* (Spreng.) Kunth *Stipagrostis obtusa* (Delile) Nees *Themeda triandra* Forssk. *Tragus berteronianus* Schult.

6. Conservation Value

The National Spatial Biodiversity Assessment (Rouget *et al.*, 2004) classified the area proposed for the Sub-station as being **low in South African endemics**. Endemic species are those that are unique to a defined geographical area (in this case South Africa). These species are found in South Africa and nowhere else in the wild.

The Gamma Sub-station site falls in an area with **very low numbers of threatened plant species** (Rouget *et al.*, 2004). The World Conservation Union (IUCN) has developed Red Data Book categories based on the need for conservation of species of special concern. The categories are described as follows (taken from version 3.1 of 2001):

- <u>Threatened</u> species are critically endangered, endangered or vulnerable.
- <u>Critically endangered</u> species are when the best available evidence is that it is considered to be facing an extremely high risk of extinction in the wild.
- <u>Endangered</u> species are when the best available evidence is that it is considered to be facing a very high risk of extinction in the wild.
- <u>Vulnerable</u> species are when the best available evidence is that it is considered to be facing a high risk of extinction in the wild.
- <u>Near threatened</u> species are when it is close to qualifying for or is likely to qualify for a threatened category in the near future.
- <u>Data deficient</u> (uncertain) species possibly fall in one of the above categories, but this is uncertain because of lack of information. Data Deficient is therefore not a category of threat but threatened status may well be justified.

The study site falls in an area of low carbon sequestration value (Rouget *et al.*, 2004) because of low biomass. The site lies far from Biogeographic nodes (Rouget *et al.*, 2004). Biogeographic nodes are where there are several Vegetation Types occurring in a small area. Biogeographic units in most of the Nama-Karoo are large.

Strategic priorities for conservation intervention are identified in the National Spatial Biodiversity Assessment (Driver *et al*., 2004) on the basis of irreplaceability and vulnerability. Simply stated, those areas that are essential for achieving representation targets have high irreplaceability while those that are highly vulnerable to threatening processes are likely to be lost if threats continue or develop. Those vegetation units with high irreplaceability and vulnerability are the priorities for conservation action (Cowling *et al*., 1999).

Essentially, irreplaceability is a measure assigned to a planning unit that reflects the importance of that area, in the context of the planning domain, for the achievement of the regional conservation targets. Irreplaceability can be defined in two ways (Pressey *et al*., 1994): The potential contribution of any site to a conservation goal or the likelihood of that site being required to achieve the goal; and The extent to which the options for achieving a system of conservation areas that is representative (achieves all the conservation targets) are reduced if that site is lost or made unavailable. A map of irreplaceability values is, therefore, a map of options: in areas of high irreplaceability, all (most) extant habitat is required to achieve targets; in areas of low irreplaceability, there is greater flexibility in the array of available sites required to meet a regional conservation goal (Pressey, 1999).

The Gamma Sub-station site is ranked as being at the **lowest level of irreplaceability** for vegetation (0.2 = lowest level of conservation importance). Furthermore, it ranks lowest for process (including features of high water yield areas, biogeographic nodes, carbon sequestration areas, escarpment and associated mountain ranges, and areas of biome resilience to climate change), habitat value and land capability (Rouget, 2004). There is no afforestation potential and the Upper Nama-Karoo is in the least-fragmented category for vegetation. The potential for alien invasion is low to very low. These factors place it at very low vulnerability, i.e. it has the **lowest level of vulnerability**.

Overall the Vegetation Type ranks at **very low for conservation value** (Rouget, 2004) and the transformation of 172 ha of Eastern Upper Karoo for a Sub-station will not jeopardize future conservation plans for the Vegetation Type.

The Eastern Upper Karoo Vegetation Type is "**hardly protected**" (Figure 5; Mucina and Rutherford, 2006) with only 1% formally protected. The target level of protection for the Vegetation Type is 21%, but large areas are still available for achieving this target (Rouget *et al.*, 2004). The ecosystem status for Eastern Upper Karoo is considered to be **Least Threatened** (Figure 6; Mucina *et al.*, 2005). The Eastern Upper Karoo has a total area of 4 982 132 ha of which 4 882 819 ha (or 98%) remains natural (if degraded in places).

7. Species of Special Concern

No Red Data Book species were recorded on the site.

Only one non-abundant species of special concern (SSC) was recorded on the Gamma Sub-station site: *Boophone* disticha (L.f.) Herb. or gifbol. *Boophone disticha* is protected by virtue of belonging to the Amaryllidaceae (Nature Conservation Ordinance 19 of 1974) and is not common in the area.

There are also members of several protected plant families that were recorded on the site (Appendix 1) but these are all abundant in the surrounding vegetation and occur over a large area. The plant families that are protected according to the Cape Nature and Environmental Conservation Ordinance 19 of 1974 are:

- Amaryllidaceae
- Apocynaceae (including previous Asclepiadaceae)
- Euphorbiaceae
- Iridaceae
- Mesembryanthemaceae

8. Exotic Species

The Nama-Karoo vegetation is not particularly susceptible to alien plant invasion. No exotics were recorded at the Gamma Sub-station site.

9. Transformation

The extent to which grasses should occur in Nama-Karoo vegetation is a topic of debate (summarized in Milton and Hoffman, 1994). There are no completely pristine areas remaining in the Karoo and the "natural" or pristine state is unknown. Because the grass cover cannot be used as an estimate of vegetation condition, four criteria were used to assess extent of transformation: firstly grass cover was used and in addition, the degree of trampling, extent of visible browse/graze scars on the plants and lastly, the extent of faecal deposition.

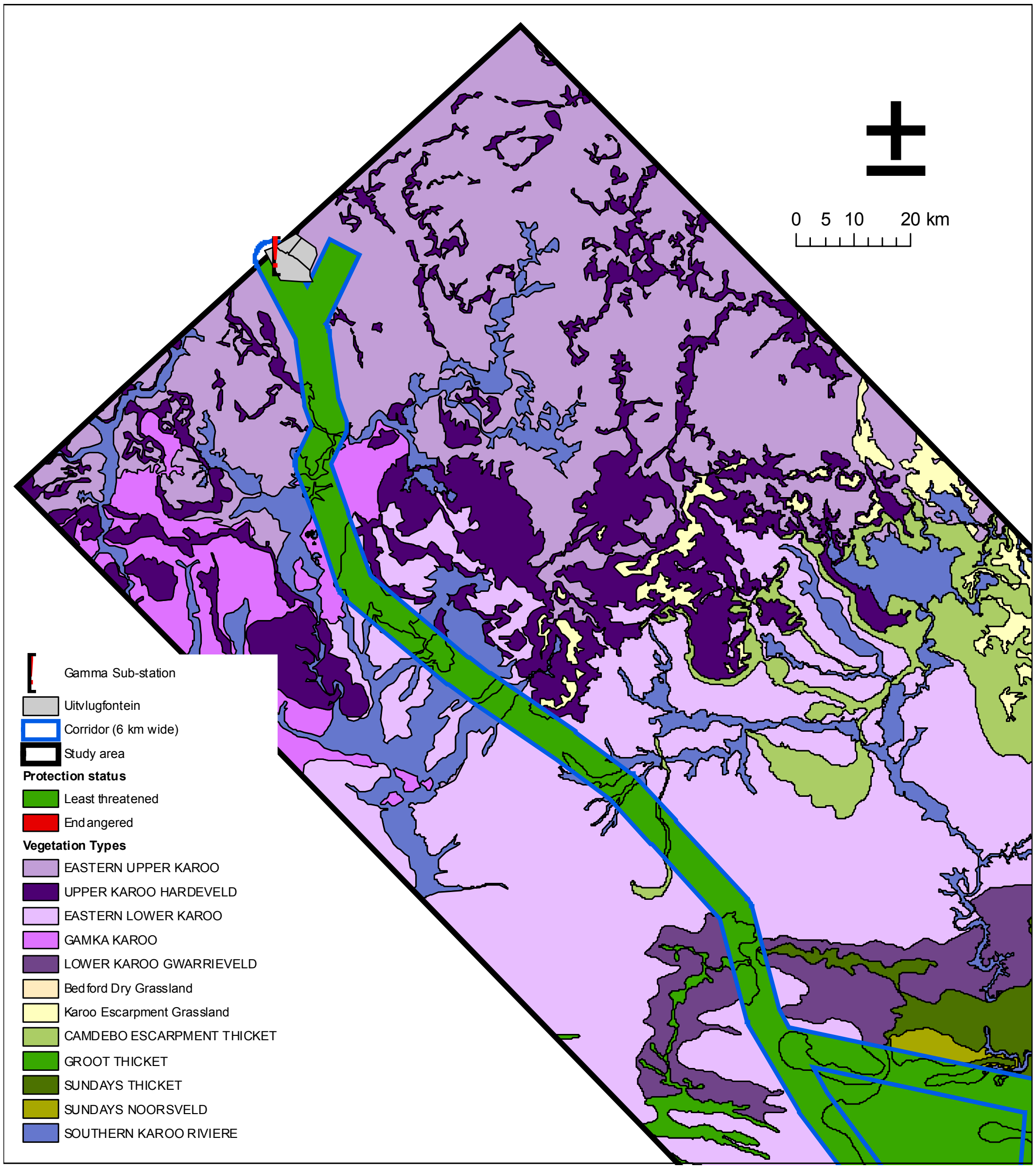

Figure 5. The protection status (Mucina *et al.*, 2005) of the Vegetation Types of the area surrounding the Gamma Sub-station study site.

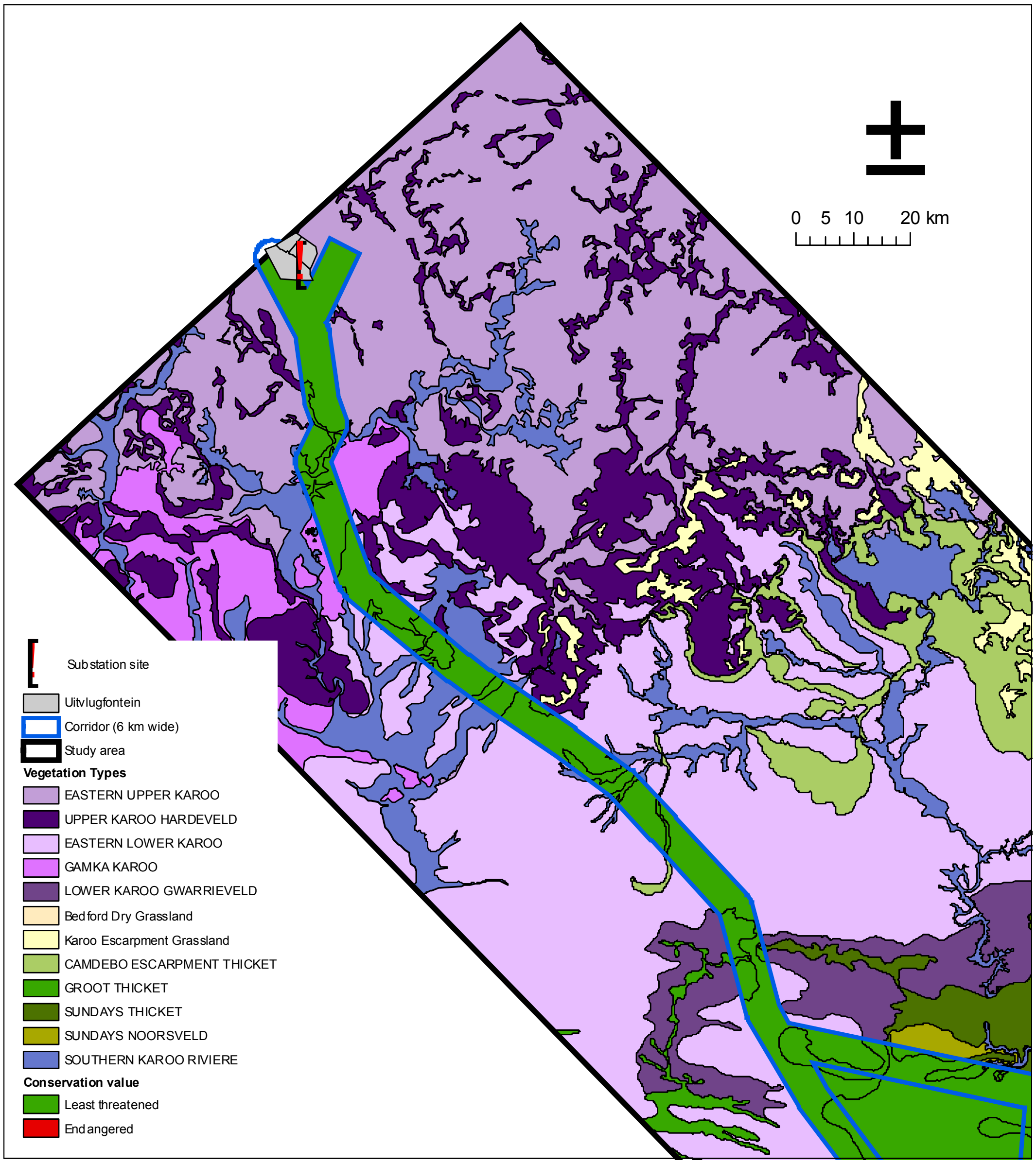

Figure 6. The conservation value (Mucina *et al.*, 2005) of the Vegetation Types of the area surrounding the Gamma Sub-station study site.

Grass cover was minimal on the Gamma Sub-station site (Plate 1). Cover abundance was estimated at just below 2% grass cover while it should range from 3 to 11% (Palmer and Hoffman, 1997).

Plate 1. The vegetation of the Gamma Sub-station site. Note the low grass cover except for the drainage line in the back of the photograph (arrow).

10. Key ecological processes

The Nama-Karoo has not attracted the same level of ecological or taxonomic interest as the other South African Biomes (Palmer and Hoffman, 1997). Despite substantial agricultural research (little published in the primary literature) and the efforts of the Foundation for Research and Development biome-scale Nama-Karoo project, the functioning of Nama-Karoo is poorly understood.

Milton and Hoffman (1994) propose six states and list nine causes of transition between them.

The states are:

1. Co-dominance of shrubs, perennial and short-lived grasses.
2. Perennial grasses in a matrix of shrubs.
3. Shrubs dominate, perennial grasses in protected sites.
4. Unpalatable shrubs dominate, perennial grasses rare.
5. Little perennial cover, soil eroded.
6. Planted pastures of saltbush (*Atriplex* spp.) or prickly pear (*Opuntia* spp.).

Changes in the states occur due to:

1. Above-average summer rainfall, light grazing.
2. Summer drought, rotational grazing at recommended stocking rates.
3. Above-average winter rainfall, summer drought, summer grazing at recommended stocking rates.

4. Winter drought, rotational grazing at recommended stocking rates.
5. Rotational grazing at recommended stocking rates, rests at seed set and after key rainfall events.
6. Continuous selective grazing at recommended stocking rates.
7. Soil reclamation and reseeding.
8. Continuous selective overgrazing, drought.
9. Cultivation and irrigation

The Gamma Sub-station site is in a moderate state of degradation (Figure 7) according to these states (State 3). For the vegetation to improve (move from State 3 to State 1) would require Continuous selective grazing at recommended stocking rates and no more severe than winter drought (transition 4). By contrast, transitions 6 (continuous selective grazing) and 8 (continuous selective overgrazing) exacerbated by drought would cause the vegetation to degrade to State 4 or 5.

11. Threats

Grazing by domestic livestock is the biggest threat to the vegetation of the Nama-Karoo (Mucina and Rutherford, 2006) in that is changes the grass:shrub ratio. In particular summer grazing reduces perennial grass cover relative to ephemerals or chamaephytes (Burke, 2002).

Overgrazing during a drought increases the severity of the grazing threat (Mucina and Rutherford, 2006).

Global climate change models indicate that global warming is a severe threat to this biome (Rutherford *et al.*, 1999).

12. Impact Assessment

Construction of the Gamma Sub-station is expected to destroy most of the vegetation of the site, and, adopting a precautionary principle, it is assumed that all of the vegetation of the site will be cleared for construction.

No positive impacts on the vegetation have been identified.

Possible negative impacts of construction of the Gamma Sub-station will be:

1. Loss of 172 ha of Eastern Upper Karoo (this represents less than 0.004% of the total natural Eastern Upper Karoo) for the Sub-station.
2. Loss of additional areas of vegetation for construction of the access roads.
3. An increased risk of alien infestation due to disturbance.
4. Destabilisation of soils due to removal of the vegetation with resultant erosion.
5. Poaching of harvested plant species due to increased access.
6. “Flash-overs” may cause unplanned fires.
7. Loss of plants of protected species.

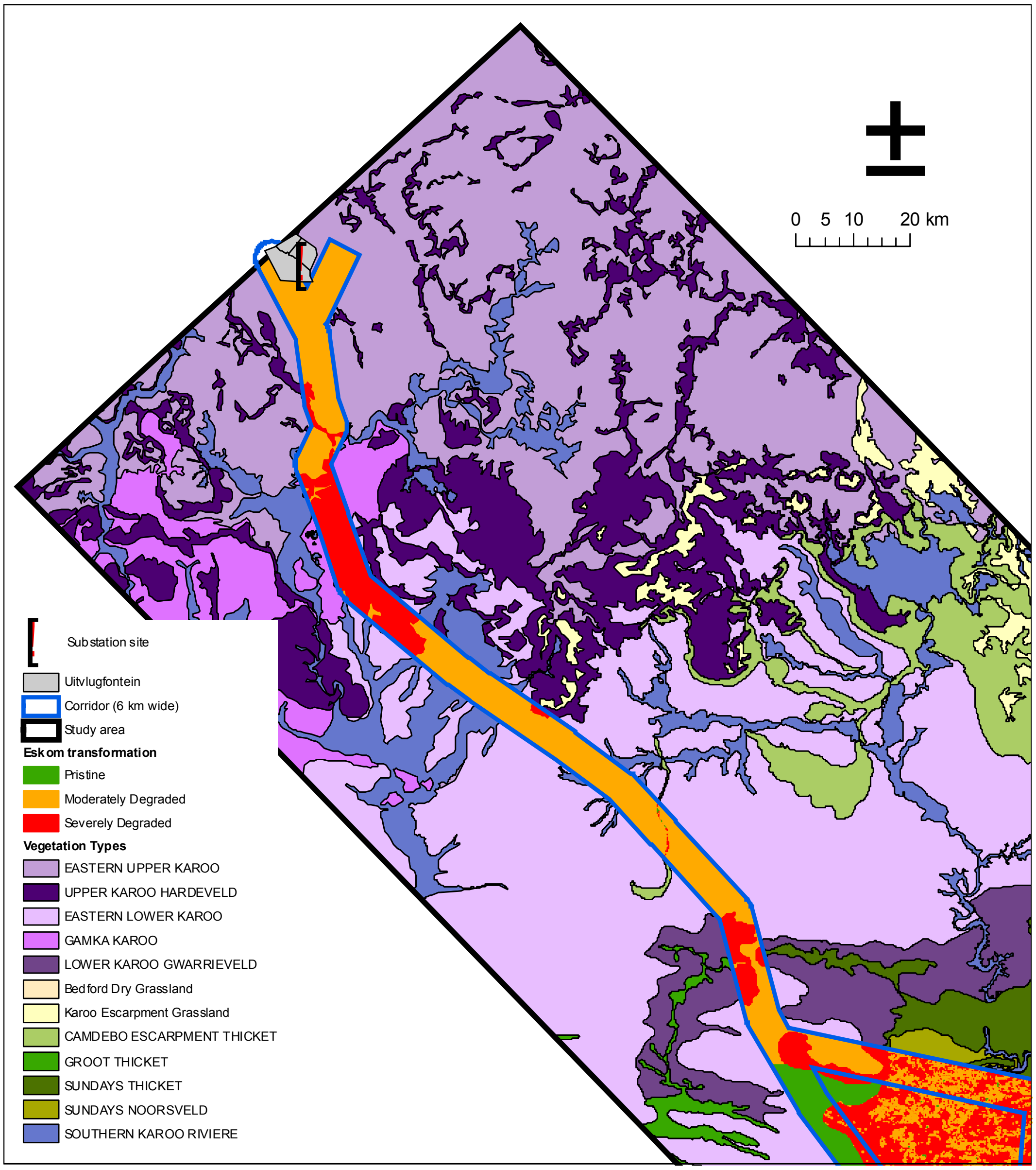

Figure 7. The degradation status (Mucina *et al.*, 2005) of the Vegetation Types of the area surrounding the Gamma Sub-station study site.

Possible <u>negative impacts</u> of operation of the Gamma Sub-station will be:

1. Roads cause high intensity runoff from the surface during rainfall events with resultant erosion.
2. Poaching of harvested plant species due to increased access.
3. “Flash-overs” may cause unplanned fires.

12. Mitigation

The identification of mitigation measures for enhancing benefits and avoiding or reducing negative impacts forms part of the process. These measures could be implemented during design, construction and operation of the proposed transmission lines.

Mitigation of negative impacts of construction of the Gamma Sub-station are:

1. Impact: Loss of 172 ha of Eastern Upper Karoo. Mitigation: Clear only the development footprint rather than the whole site. In the absence of detailed designs for the Sub-station it is not know how significant this recommendation will be.
2. Impact: Loss of additional areas of Eastern Upper Karoo for construction of the access roads. Mitigation: Clear and build areas for the permanent roads only. In the absence of detailed designs for the Sub-station it is not know how significant this recommendation will be. For temporary haul roads (to e.g. the construction camp), do not cut a road. Rather remove large rocks and drive over the veld in designated areas. This will be less damaging than construction of a road.
3. Impact: An increased risk of alien infestation due to disturbance. During construction, increased human activity will cause disturbance. Road construction also creates a disturbance along the edges. Disturbance to natural vegetation is a significant cause of infestations by exotic species. Edge disturbance due to construction will be short-term and much of this will be reversible. Fencing the site at the onset of the construction phase will reduce the extent of disturbance.
4. Impact: Destabilisation of soils due to removal of the vegetation with resultant erosion. Erosion due to clearing of the vegetation can be minimised by clearing the vegetation during the dry season and commencing construction immediately. The soils are prone to erosion and during construction remedial action should be implemented where erosion becomes evident (installation of gabions or some other revetment). Dust storms are rare and wind erosion is not predicted to be significant.
5. Impact: Poaching of harvested plant species due to increased access. No sought-after harvested plant species were recorded on the site.
6. Impact: “Flash-overs” may cause unplanned fires. The standing biomass of the Karoo grasses is too low to support a fire and the shrubs are too far apart (Plate 1) to provide sufficient fuel load for a run-away veld fire. Should fires occur, they are likely to burn out quickly.
7. Impact: Loss of plants of protected species. This impact is inevitable where vegetation is to be cleared. All the protected plants are protected because of Family status. With the exception of *Boophone disticha* all protected species on the site are common in the area. *Boophone disticha* is a geophyte that will transplant easily. All individuals could be transplanted to the edges of the site before construction commences. The protocol for translocation is given below:

Plant removal: Removal of geophytes should be done by firstly loosening the soil with a geopick or similar pointed implement. This should be done a few centimetres away from the bulb as damage to the living portion of the bulb severely reduces the translocation success.

Plant storage: Removed Bulbs will benefit by a period of drying, but this should be no more than 2 weeks after which they should be potted. The soil mixture to be used for the geophytes should be two parts topsoil with one part course sand. When potting the plants, the bulbs must be planted to the same depth as they were when removed.

Planting: Once potted plants have stabilised, they should be placed at the site for a week. Flowers and fruits must be removed to avoid pollen being introduced at the target site from the nursery. Closed buds may be retained. Soil preparation should be by removal of a plug of soil the size of the pot and the plant inserted with its soil after removal from the pot. Water each individual for improved survival. Each individual or cluster of individuals must be clearly marked and a GPS reading noted. This is done to ensure that they can be found during monitoring.

Mitigation of negative impacts of construction of the Gamma Sub-station are:

1. Impact: Roads cause high intensity runoff from the surface during rainfall events with resultant erosion. Appropriately designed storm-water drainage for constructed roads will alleviate this impact.
2. Impact: Poaching of harvested plant species due to increased access. No sought-after harvested plant species were recorded on the site.
3. Impact: "Flash-overs" may cause unplanned fires. The standing biomass of the Karoo grasses is too low to support a fire and the shrubs are too far apart (Plate 1) to provide sufficient fuel load for a run-away veld fire. Should fires occur, they are likely to burn out quickly.

13. Monitoring

Monitoring of the impacts of the Sub-station on the surrounding vegetation should be done by assessing of permanent quadrats. Five permanent quadrats should be placed outside the northern edge of the study site (AB, Figure 1), five should be placed along the east (AD, Figure 1) and five along the western border (BC, Figure 1) of the study site. Karoo vegetation is best assessed in 5 m x 5 m quadrats. Should any areas within the study site be left uncleared, five permanent quadrats should be placed in these. Ten control quadrats should be located at least 1 km away from the study site on similar topography and under similar threat conditions. These should be assessed before construction, after construction and annual thereafter for as long as is required to provide statistically defensible data (at least 5 years).

Key indicators for vegetation condition are grass:shrub ratio, species richness and cover abundance of dominant taxa.

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