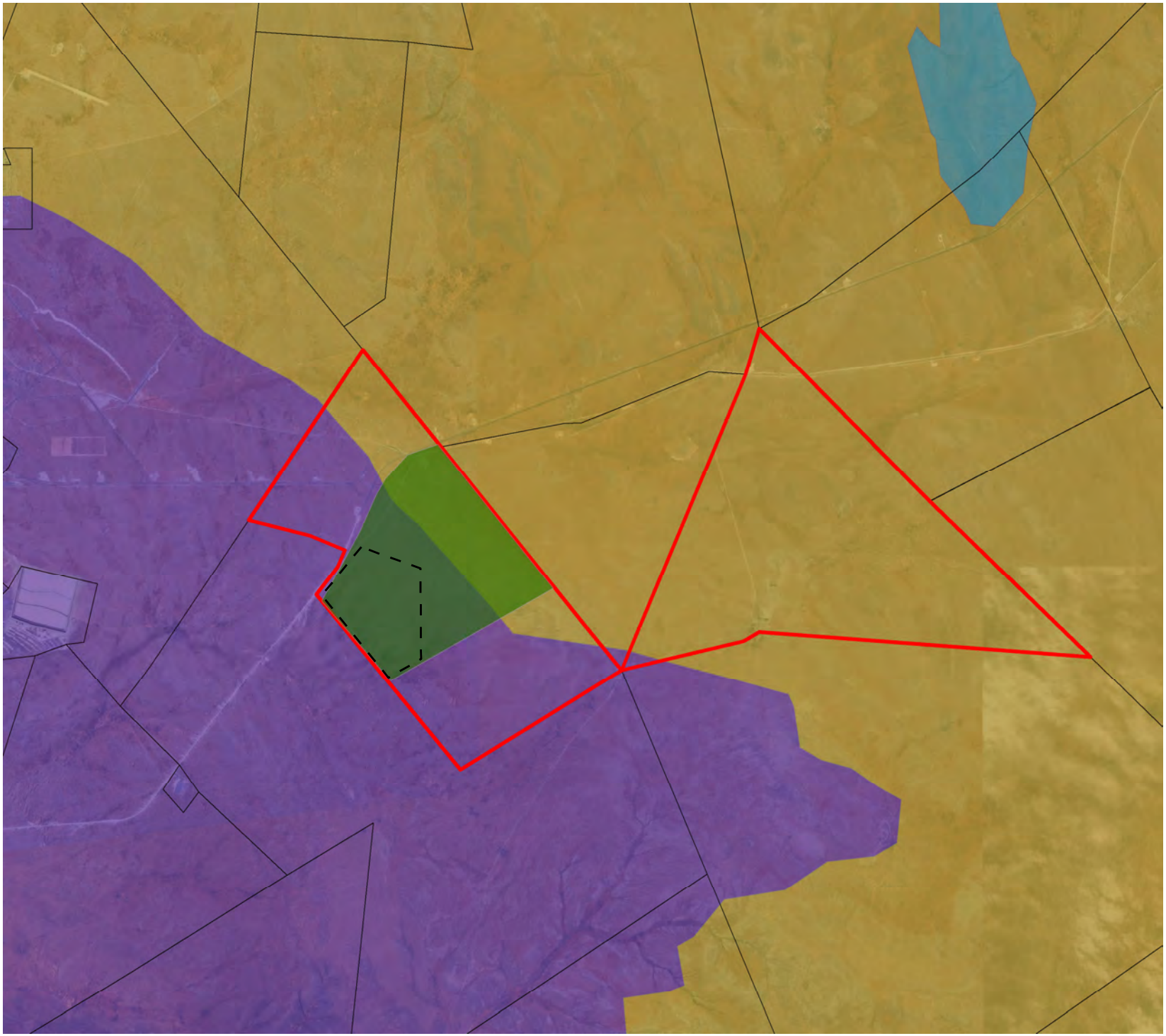


Notes

- Map Scale is 1 : 100 000 when printed on A4.
- Data Source: SANBI BGIS 2013.
- Aerial Image courtesy of Google Earth Pro 2015.
- Imagery date October 2013.

N

0 1 2 4 Kilometers

Map Index

Vegetation Type & Ecosystem Status

Humansrus Solar PV Energy Facility 2,
Remainder Farm 147

Legend

- PV Footprint
- Study Site
- Remainder of Farm 147

Vegetation Type, Ecosystem Status

- Bushmanland Arid Grassland, Least threatened
- Bushmanland Basin Shrubland, Least threatened
- Lower Gariep Broken Veld, Least threatened

Drawn	Checked	Date	Reference
Wynand Loftus	Dale Holder	February 2015	SIY317

Cape Environmental Assessment Practitioners (Pty) Ltd

Bushmanland Group are also significant. Dorbank outcrops at many places and a very dense subdendritic drainage and dissection pattern. The dominating soil forms are Hutton and Mispah—coarse, sandy and shallow (0.1–0.3 m deep). Fb land type dominates the landscape.

Climate Lowest MAP of the vegetation types of the Nama-Karoo (80–120 mm). Seasonal rainfall peaks in March, winters are dry. Incidence of frost is relatively low. See also climate diagram for NKb 2 Blouputs Karroid Thornveld (Figure 7.2).

Important Taxa Small Trees: *Acacia mellifera* subsp. *detinens* (d), *Boscia albitrunca* (d), *B. foetida* subsp. *foetida* (d), *Acacia erioloba*, *Maerua gilgii*. Tall Shrubs: *Rhigozum trichotomum* (d), *Adenolobus garipensis*, *Cadaba aphylla*, *Caesalpinia bracteata*, *Ehretia rigida* subsp. *rigida*, *Nymania capensis*, *Parkinsonia africana*. Epiphytic Semiparasitic Shrub: *Tapinanthus oleifolius*. Low Shrubs: *Phaeoptilum spinosum* (d), *Aptosimum marlothii*, *Berkheya spinosissima* subsp. *namaensis*, *Blepharis mitrata*, *Eriocephalus microphyllus* var. *pubescens*, *Galenia africana*, *Hermannia gariepina*, *H. spinosa*, *H. stricta*, *Indigofera pechuelii*, *Limeum aethiopicum*, *Lophiocarpus polystachyus*, *Microloma incanum*, *Solanum capense*, *Tephrosia dregeana*, *Zygophyllum rigidum*. Succulent Shrubs: *Hoodia gordonii*, *Kleinia longiflora*, *Lycium bosciifolium*, *Salsola rabieana*. Semiparasitic Shrub: *Thesium lineatum*. Herbaceous Climbers: *Coccinia rehmannii*, *Pergularia daemia* var. *leiocarpa*. Herbs: *Amaranthus praetermissus*, *Chascanum garipense*, *Dicoma capensis*, *Forsskaolea candida*, *Limeum myosotis* var. *confusum*, *Mollugo cerviana*, *Sesamum capense*, *Tribulus cristatus*, *T. pterophorus*. Succulent Herbs: *Gisekia pharnacioides*, *Psilocaulon coriarium*, *Trianthema parvifolia*. Graminoids: *Schmidtia kalahariensis* (d), *Stipagrostis ciliata* (d), *S. hochstetteriana* (d), *S. obtusa* (d), *S. uniplumis* (d), *Aristida adscensionis*, *A. congesta*, *Cenchrus ciliaris*, *Enneapogon cenchroides*, *E. desvauxii*, *E. scaber*, *Eragrostis annulata*, *Leucophrys mesocoma*, *Setaria verticillata*, *Tragus racemosus*.

Conservation Least threatened. Target 21%. About 27% of the mapped area under statutory conservation (Augrabies Falls National Park), which is the highest value of any vegetation type in the Nama-Karoo. Only very small area has been transformed. Erosion is low (79%) and very low (21%).

Remarks This vegetation type has the smallest mapped area of all Nama-Karoo vegetation units. It also occurs in some areas in the Riemvasmaak region to the north of the Orange River where it was not mapped because of lack of GIS coverage.

References Werger & Coetzee (1977), Bezuidenhout (1996), Bezuidenhout & Jardine (2001).

L. Mucina

Figure 7.5 NKb 3 Bushmanland Arid Grassland: Arid grassland dominated by species of *Aristida* and *Stipagrostis*, with a solitary koppie supporting vegetation of SKr 19 Bushmanland Inselberg Shrubland (Northern Cape, Aggeneys).

NKb 3 Bushmanland Arid Grassland

VT 29 Arid Karoo and Desert False Grassveld (36%), VT 32 Orange River Broken Veld (36%) (Acocks 1953). LR 51 Orange River Nama Karoo (51%) (Low & Rebelo 1996).

Distribution Northern Cape Province: Spanning about one degree of latitude from around Aggeneys in the west to Prieska in the east. The southern border of the unit is formed by edges of the Bushmanland Basin while in the northwest this vegetation unit borders on desert vegetation (northwest of Aggeneys and Pofadder). The northern border (in the vicinity of Upington) and the eastern border (between Upington and Prieska) are formed with often intermingling units of Lower Gariep Broken Veld, Kalahari Karroid Shrubland and Gordonia Duneveld. Most of the western border is formed by the edge of the Namaqualand hills. Altitude varies mostly from 600–1 200 m.

Vegetation & Landscape Features Extensive to irregular plains on a slightly sloping plateau sparsely vegetated by grassland dominated by white grasses (*Stipagrostis* species) giving this vegetation type the character of semidesert 'steppe'. In places low shrubs of *Salsola* change the vegetation structure. In years of abundant rainfall rich displays of annual herbs can be expected.

Geology & Soils A third of the area is covered by recent (Quaternary) alluvium and calcrete. Superficial deposits of the Kalahari Group are also present in the east. The extensive Palaeozoic diamictites of the Dwyka Group also outcrop in the area as do gneisses and metasediments of Mokolian age. The soils of most of the area are red-yellow apedal soils, freely drained, with a high base status and <300 mm deep, with about one fifth of the area deeper than 300 mm, typical of Ag and Ae land types.

Climate Rainfall largely in late summer/early autumn (major peak) and very variable from year to year. MAP ranges from about 70 mm in the west to 200 mm in the east. Mean maximum and minimum monthly temperatures for Kenhardt are 40.6°C and –3.7°C for January and July respectively. Corresponding values for Pofadder are 38.3°C and –0.6°C. Frost incidence ranges from around 10 frost days per year in the northwest to about 35 days in the east. Whirl winds (dust devils) are common on hot summer days. See also climate diagram for NKb 3 Bushmanland Arid Grassland (Figure 7.2).

Important Taxa ([W]Western and [E]Eastern regions of the unit only) Graminoids: *Aristida adscensionis* (d), *A. congesta* (d), *Enneapogon desvauxii* (d), *Eragrostis nindensis* (d), *Schmidtia kalahariensis* (d), *Stipagrostis ciliata* (d), *S. obtusa* (d), *Cenchrus ciliaris*, *Enneapogon scaber*, *Eragrostis annulata*[E], *E. porosa*[E], *E. procumbens*, *Panicum lanipes*[E], *Setaria verticillata*[E], *Sporobolus nervosus*, *Stipagrostis brevifolia*[W], *S. uniplumis*, *Tragus berte-*

ronianus, *T. racemosus*[E]. Small Trees: *Acacia mellifera* subsp. *detinens*[E], *Boscia foetida* subsp. *foetida*. Tall Shrubs: *Lycium cinereum* (d), *Rhigozum trichotomum* (d), *Cadaba aphylla*, *Parkinsonia africana*. Low Shrubs: *Aptosimum spinescens* (d), *Hermannia spinosa* (d), *Pentzia spinescens* (d), *Aizoon asbestinum*[E], *A. schellenbergii*[E], *Aptosimum elongatum*, *A. lineare*[E], *A. marlothii*[E], *Barleria rigida*, *Berkheya annectens*, *Blepharis mitrata*, *Eriocephalus ambiguus*, *E. spinescens*, *Limeum aethiopicum*, *Lophiocarpus polystachyus*, *Monechma incanum*, *M. spartioides*, *Pentzia pinnatisecta*, *Phaeoptilum spinosum*[E], *Polygala seminuda*, *Pteronia leucoclada*, *P. mucronata*, *P. sordida*, *Rosenia humilis*, *Senecio niveus*, *Sericocoma avolans*, *Solanum capense*, *Talinum arnotii*[E], *Tetragonia arbuscula*, *Zygophyllum microphyllum*. Succulent Shrubs: *Kleinia longiflora*, *Lycium bosciifolium*, *Salsola tuberculata*, *S. glabrescens*. Herbs: *Acanthopsis hoffmannseggiana*, *Aizoon canariense*, *Amaranthus praetermissus*, *Barleria lichtensteiniana*[E], *Chamaesyce inaequilatera*, *Dicoma capensis*, *Indigastrum argyraeum*, *Lotononis platycarpa*, *Sesamum capense*, *Tribulus pterophorus*, *T. terrestris*, *Vahlia capensis*. Succulent Herbs: *Gisekia pharnacioides*[E], *Psilocaulon coriarium*, *Trianthema parvifolia*. Geophytic Herb: *Moraea venenata*.

Biogeographically Important Taxon (Bushmanland endemic) Succulent Herb: *Tridentea dwequensis*.

Endemic Taxa Succulent Shrubs: *Dinteranthus pole-evansii*, *Larryleachia dinteri*, *L. marlothii*, *Ruschia kenhardtensis*. Herbs: *Lotononis oligocephala*, *Nemesia maxii*.

Conservation Least threatened. Target 21%. Only small patches statutorily conserved in Augrabies Falls National Park and Goegab Nature Reserve. Very little of the area has been transformed. Erosion is very low (60%) and low (33%).

Remarks This unit has a large longitudinal extent, with some species common in only part of the unit. Further research may lead to the split of this unit at a later stage.

References Acocks (1953, 1988), Du Toit (1996), L. Mucina (unpubl. data).

NKb 4 Bushmanland Sandy Grassland

VT 29 Arid Karoo and Desert False Grassveld (80%) (Acocks 1953). LR 49 Bushmanland Nama Karoo (71%) (Low & Rebelo 1996).

Distribution Northern Cape Province: Surrounds of Aggeneys (northern Bushmanland) and a few isolated patches south of Copperton on the eastern edge of the Bushmanland Basin suggesting the course of the paleoriverine system of the Orange River and its tributaries. The largest continuous patch of this vegetation type fills the shallow valley of the intermittent Koa River southeast and west of Aggeneys. Altitude varies mostly from 500–1 200 m.

Vegetation & Landscape Features Dense, sandy grassland plains with dominating white grasses (*Stipagrostis, Schmidtia*) and abundant drought-resistant shrubs. After rainy winters rich displays of ephemeral spring flora (*Grielum humifusum, Gazania lichtensteinii*) can occur.

Geology & Soils Mostly Quaternary sediments (sand, calcrete) with some contribution of the pre-Pleistocene Kalahari Group sediments in the east. Typically the surface is covered by red sands >300 mm deep, forming dunes in places. Af land type dominates.

Climate Major rainfall peak between February and April and a minor peak in November. MAP ranges from about 70–110 mm. See also climate diagram for NKb 4 Bushmanland Sandy Grassland (Figure 7.2).

Important Taxa Graminoids: *Schmidtia kalahariensis* (d), *Stipagrostis brevifolia* (d), *S. ciliata* (d), *S. obtusa* (d), *Aristida adscensionis*, *A. congesta*, *Centropodia glauca*, *Enneapogon desvauxii*, *Stipagrostis anomala*. Herbs: *Gazania lichtensteinii* (d), *Grielum humifusum* (d), *Tribulus zeyheri* (d), *Dicoma capensis*, *Hirpicium echinus*, *Manulea nervosa*, *Requienia sphaerosperma*, *Sesamum capense*. Succulent Herb: *Crassula muscosa*. Tall Shrubs: *Rhigozum trichotomum*, *Sisyndite spartea*. Low Shrubs: *Zygophyllum microphyllum* (d), *Barleria rigida*, *Berkheya spinosissima* subsp. *namaensis*, *Eriocephalus microphyllus* var. *pubescens*, *E. pauperrimus*, *Galenia fruticosa*, *Hermannia spinosa*, *Monechma incanum*, *Peliostomum leucorrhizum*, *Pentzia spinescens*, *Plinthus karooicus*, *Pteronia mucronata*, *P. sordida*, *Rosenia humilis*, *Tetragonia arbuscula*. Succulent Shrubs: *Aridaria noctiflora* subsp. *straminea*, *Lycium bosciifolium*, *Ruschia robusta*, *Salsola tuberculata*, *Senecio cotyledonis*, *Zygophyllum flexuosum*, *Z. foetidum*. Woody Succulent Climber: *Sarcostemma viminale*.

Conservation Least threatened. Target 21%. None conserved in statutory conservation areas. Very little of the area has been transformed. The alien shrub *Prosopis* sp. can be seen as a threat. Erosion is very low (82%) or moderate (17%).

Remarks This is a poorly known vegetation unit, separable from the surrounding units by its deep sands, often with red sand dunes. The occurrence of elements such as *Acacia erioloba*, *Schmidtia kalahariensis* and *Tribulus zeyheri* suggests similarity to southern Kalahari duneveld flora.

References Anderson & Van Heerden (2000), L. Mucina (unpubl. data).

L. Mucina

Figure 7.6 NKb 4 Bushmanland Sandy Grassland: Dry shrubby grassland dominated by *Stipagrostis obtusa* and *S. brevifolia* on deep sands of the ancient Koa River wash near Aggeneys (Northern Cape).

NKb 5 Kalahari Karroid Shrubland

VT 16 Kalahari Thornveld and Shrub Bushveld (60%) (Acocks 1953). LR 29 Karroid Kalahari Bushveld (61%) (Low & Rebelo 1996).

Distribution Northern Cape Province: Typically forming belts alternating with belts of Gordonia Duneveld on plains northwest of Upington through Lutzputs and Noenieput to the Rietfontein/Mier area in the north. Other patches occur around Kakamas and north of Groblershoop. The unit is also found in the neighbouring Namibia. Altitude varies mostly from 700–1 100 m.

Vegetation & Landscape Features Low karroid shrubland on flat, gravel plains. Karoo-related elements (shrubs) meet here with northern floristic elements, indicating a transition to the Kalahari region and sandy soils.

Geology & Soils Cenozoic Kalahari Group sands and small patches also on calcrete outcrops and screes on scarps of intermittent rivers (mekgacha). In places Dwyka Group tillites outcrop. The soils are deep (>300 mm), red-yellow, apedal, freely drained, with a high base status, typical of Ae land type.

Climate MAP ranges from about 100–200 mm and most rain falls in late summer and early autumn. Winters are particularly dry, with lowest winter relative humidity compared to other Nama-Karoo types. Mean maximum and minimum monthly temperatures in Upington are 39.5°C and –4.2°C for January and July, respectively. Solar radiation is high and in winter is higher than in any other vegetation type of the Nama-Karoo. See also climate diagram for NKb 5 Kalahari Karroid Shrubland (Figure 7.2).

Important Taxa Small Trees: *Acacia mellifera* subsp. *detinens* (d), *Parkinsonia africana* (d), *Boscia foetida* subsp. *foetida*. Tall Shrub: *Rhigozum trichotomum* (d). Epiphytic Semiparasitic Shrub: *Tapinanthus oleifolius*. Low Shrubs: *Hermannia spinosa* (d), *Limeum aethiopicum* (d), *Phaeoptilum spinosum* (d), *Aizoon schellenbergii*, *Aptosimum albomarginatum*, *A. lineare*, *A. marlothii*, *A. spinescens*, *Barleria rigida*, *Hermannia modesta*, *Indigofera heterotricha*, *Leucosphaera bainesii*, *Monechma genistifolium* subsp. *genistifolium*, *Phyllanthus maderaspatensis*, *Polygala seminuda*, *Ptycholobium biflorum* subsp. *biflorum*, *Sericocoma avolans*, *Solanum capense*, *Tephrosia dregeana*. Herbs: *Dicoma capensis* (d), *Chamaesyce inaequilatera* (d), *Amaranthus praetermissus*, *Barleria lichtensteiniana*, *Chamaesyce glanduligera*. *Chascanum garipense*, *Cleome angustifolia* subsp. *diandra*, *Cucumis africanus*, *Geigeria ornativa*, *Hermannia abrotanoides*, *Indigastrum argyraeum*, *Indigofera alternans*, *I. auricoma*, *Kohautia cynanchica*, *Limeum argute-carinatum*, *Mollugo cerviana*, *Monsonia umbellata*, *Sesamum capense*, *Tribulus cristatus*, *T. pterophorus*, *T. terrestris*. Succulent Herbs: *Gisekia africana*, *G. pharnacioides*, *Trianthema parvifolia*. Graminoids: *Aristida adscensionis* (d), *Enneapogon desvauxii* (d), *E. scaber* (d), *Stipagrostis obtusa* (d), *Aristida congesta*, *Enneapogon cenchroides*, *Eragrostis annulata*, *E. homomalla*, *E. porosa*, *Schmidtia kalahariensis*, *Stipagrostis anomala*, *S. ciliata*, *S. hochstetteriana*, *S. uniplumis*, *Tragus berteronianus*, *T. racemosus*.

Biogeographically Important Taxon (Southwestern distribution limit) Graminoid: *Dinebra retroflexa*.

Conservation Least threatened. Target 21%. Very little statutorily conserved in Augrabies Falls National Park. Although only a small area has been transformed many of the belts of this type were preferred routes for early roads, thus promoting the introduction of alien plants (about a quarter of the unit has scattered *Prosopis* species). Erosion is very low (94%).

Remarks Vegetation of this mapping unit shows transitional features between the Kalahari proper (Savanna Biome) and the northern Nama-Karoo.

References Leistner (1967), Leistner & Werger (1973), Werger & Leistner (1975), Werger (1978b, 1986), Werger et al. (1979), Bezuidenhout (1996), Werger & Coetzee (1977).

NKb 6 Bushmanland Basin Shrubland

VT 29 Arid Karoo and Desert False Grassveld (88%) (Acocks 1953). LR 49 Bushmanland Nama Karoo (92%) (Low & Rebelo 1996).

Distribution Northern Cape Province: Large Bushmanland Basin centred on Brandvlei and Van Wyksvlei area, spanning Granaatboskolk in the west to Copperton in the east, and Kenhardt vicinity in the north to Williston vicinity in the south. Altitude ranges mostly from 800–1 200 m.

Vegetation & Landscape Features Slightly irregular plains with dwarf shrubland dominated by a mixture of low sturdy and spiny (and sometimes also succulent) shrubs (*Rhigozum*, *Salsola*, *Pentzia*, *Eriocephalus*), 'white' grasses (*Stipagrostis*) and in years of high rainfall also by abundant annuals such as species of *Gazania* and *Leysera*.

Geology & Soils Mudstones and shales of Ecca Group (Prince Albert and Volksrust Formations) and Dwyka tillites, both of early Karoo age, dominate. About 20% of rock outcrop is formed by Jurassic intrusive dolerite sheets and dykes. Soils are shallow Glenrosa and Mispah forms, with lime generally present in the entire landscape (Fc land type) and, to a lesser extent, red-yellow apedal, freely drained soils with a high base status and usually <15% clay (Ah and Ai land types) are also found. The salt content in these soils is very high.

Climate Rainfall occurs in late summer and early autumn. MAP ranges from about 100–200 mm. Mean maximum and minimum monthly temperatures in Brandvlei are 39.6°C and –2.2°C for January and July, respectively. Corresponding values for Van Wyksvlei are 39.5°C and –4.6°C. See also climate diagram for NKb 6 Bushmanland Basin Shrubland (Figure 7.2).

Important Taxa Tall Shrubs: *Lycium cinereum* (d), *Rhigozum trichotomum* (d). Low Shrubs: *Aptosimum spinescens* (d), *Hermannia spinosa* (d), *Pentzia spinescens* (d), *Zygophyllum microphyllum* (d), *Aptosimum elongatum*, *A. marlothii*, *Berkheya annectens*, *Eriocephalus microphyllus* var. *pubescens*, *E. pauperrimus*, *E. spinescens*, *Felicia clavipilosa* subsp. *clavipilosa*, *Limeum aethiopicum*, *Osteospermum armatum*, *O. spinescens*, *Pegolettia retrofracta*, *Phaeoptilum spinosum*, *Plinthus karooicus*, *Polygala seminuda*, *Pteronia glauca*, *P. inflexa*, *P. leucoclada*, *P. mucronata*, *P. sordida*, *Rosenia humilis*, *Selago albida*, *Senecio niveus*, *Tetragonia arbuscula*, *Zygophyllum lichtensteinianum*. Succulent Shrubs: *Salsola tuberculata* (d), *Aridaria noctiflora* subsp. *straminea*, *Brownanthus ciliatus* subsp. *ciliatus*, *Galenia sarcophylla*, *Lycium bosciifolium*, *Ruschia intricata*, *Salsola namibica*, *Sarcocaulon patersonii*, *S. salmoniflorum*, *Tripteris sinuata* var. *linearis*, *Zygophyllum flexuosum*. Semiparasitic Shrub: *Thesium hystrix*. Herbs: *Gazania lichtensteinii* (d), *Leysera tenella* (d), *Amaranthus praetermissus*, *Chamaesyce inaequilatera*, *Dicoma capensis*, *Indigastrum argyraeum*, *Lepidium desertorum*, *Monsonia umbellata*, *Radyera urens*, *Sesamum capense*, *Tribulus terrestris*, *T. zeyheri*. Succulent Herbs: *Mesembryanthemum crystallinum*, *M. stenandrum*, *Trianthema parvifolia*, *Zygophyllum simplex*. Graminoids: *Aristida adscensionis* (d), *Enneapogon desvauxii* (d), *Stipagrostis ciliata* (d), *S. obtusa* (d), *Aristida congesta*, *Enneapogon scaber*, *Stipagrostis anomala*, *Tragus berteronianus*, *T. racemosus*.

L. Mucina

Figure 7.7 NKb 6 Bushmanland Basin Shrubland: Dwarf shrublands of the central Bushmanland with *Rhigozum trichotomum* and *Stipagrostis* species (Northern Cape, Brandvlei).

Biogeographically Important Taxon (Bushmanland endemic) Succulent Herb: *Tridentea dwequensis*.

Endemic Taxa Herb: *Cromidon minutum*. Geophytic Herbs: *Ornithogalum bicornutum*, *O. ovatum* subsp. *oliverorum*.

Conservation Least threatened. Target 21%. None of the unit is conserved in statutory conservation areas. No signs of serious transformation, but scattered individuals of *Prosopis* sp. occur in some areas (e.g. in the vicinity of the Sak River drainage system), and some localised dense infestations form closed 'woodlands' along the eastern border of the unit with Northern Upper Karoo (east of Van Wyksvlei). Erosion is moderate (56%) and low (34%).

Remarks The Bushmanland Basin forms an environment for a number of endorheic pans (vloere) and extensive systems of intermittent river channels (including that of the Sak River). In comparison to the bordering Bushmanland Arid Grassland in the north, the vegetation of the Bushmanland Basin shows increased presence of shrubs (especially succulents) and plant indicators of high salt status of soil.

References Acocks (1953, 1988).

Upper Karoo

NKu 1 Western Upper Karoo

VT 29 Arid Karoo and Desert False Grassveld (82%) (Acocks 1953). LR 49 Bushmanland Nama Karoo (84%) (Low & Rebelo 1996).

Distribution Northern Cape Province and a small part in the Western Cape Province: Plains from the Fish River and upper reaches of the Renoster River in the west as far as Fraserburg and Carnarvon in the east, sandwiched between the Bushmanland Basin in the north and the Roggeveld Karoo and edges of the Great Escarpment in the south. Altitude varies mostly from 1 000–1 500 m.

Vegetation & Landscape Features Much dissected landscape in the south-west associated with the tributaries of the upper catchment of the Sak River (e.g. Renoster River, Riet River, Klein Sak River), often rocky. Mixture of small-leaved shrubs and shrubby succulents (*Brownanthus*, *Drosanthemum*, *Ruschia* etc.) with drought-resistant (mostly 'white') grasses is the determinant feature of the vegetation structure.

Geology & Soils Karoo sediments (shales, mudstones and arenites) of the Beaufort Group (Adelaide Subgroup) and to a lesser extent also of the Waterford Formation (Ecca Group). Intrusive dolerites of the Jurassic Karoo Dolerite Suite also feature. Glenrosa and Mispah soils (with lime generally present in the entire landscape) are overwhelmingly dominant. Fc land type dominates.

Climate Most of the precipitation occurs in autumn, peaking in March. MAP ranges from about 120–220 mm. Mean maximum and minimum monthly temperatures in Fraserburg are 36.2°C and –5.7°C for January and July, respectively. Corresponding values for Williston are 38.1°C and –4.5°C. Incidence of frost ranges from around 30 frost days per year in the north to about 60 days in the south. See also climate diagram for NKu 1 Western Upper Karoo (Figure 7.2).

Important Taxa Tall Shrubs: *Lycium cinereum* (d), *L. pilifolium*, *Rhigozum trichotomum*, *Tripteris sinuata* var. *linearis*. Low Shrubs: *Chrysocoma ciliata* (d), *Eriocephalus ericoides* subsp. *ericoides* (d), *E. spinescens* (d), *Helichrysum lucilioides* (d), *Osteospermum spinescens* (d), *Pentzia globosa* (d), *P. spinescens* (d), *Tetragonia arbuscula* (d), *Amphiglossa triflora*, *Aptosimum elongatum*, *A. indivisum*, *A. spinescens*, *Asparagus capensis* var. *capensis*, *Berkheya annectens*, *Eriocephalus decussatus*, *E. pauperrimus*, *Euryops imbricatus*, *E. multifidus*, *Felicia macrorrhiza*, *F. muricata*, *Hermannia cuneifolia*, *H. grandiflora*, *H. multiflora*, *H. spinosa*, *Limeum aethiopicum*, *Melolobium candicans*,

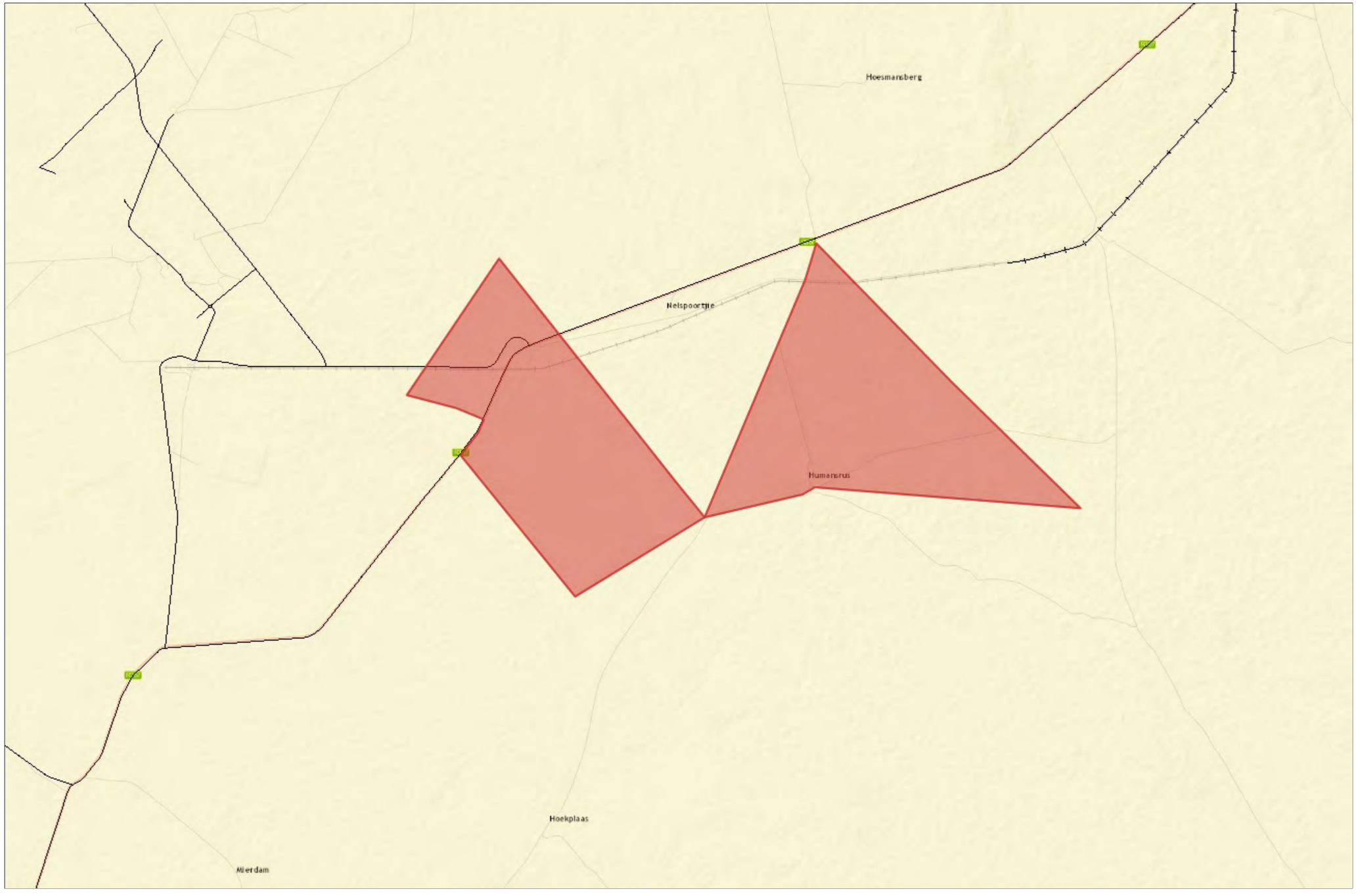
L. Mucina

Figure 7.8 NKu 1 Western Upper Karoo: Shrub-rich karoo grasslands dominated by *Aristida* and *Stipagrostis* northeast of Williston (Northern Cape).

SANBI Biodiversity for Life

BGIS Land Use Decision Support (LUDS) Tool

RE Capital 14 Solar Development - Remainder of Farm 147 Humansrus



Description

Critical Biodiversity Areas
According to SANBI BGIS there is no Biodiversity Conservation Plans available this Municipal area.

Legend

- Municipal Summaries Northern Cape
- National roads
- Secondary roads
  - ARTERIAL ROUTE
  - MAIN ROAD
  - SECONDARY ROAD
- Railway lines
- World Street Map
- World Physical Map

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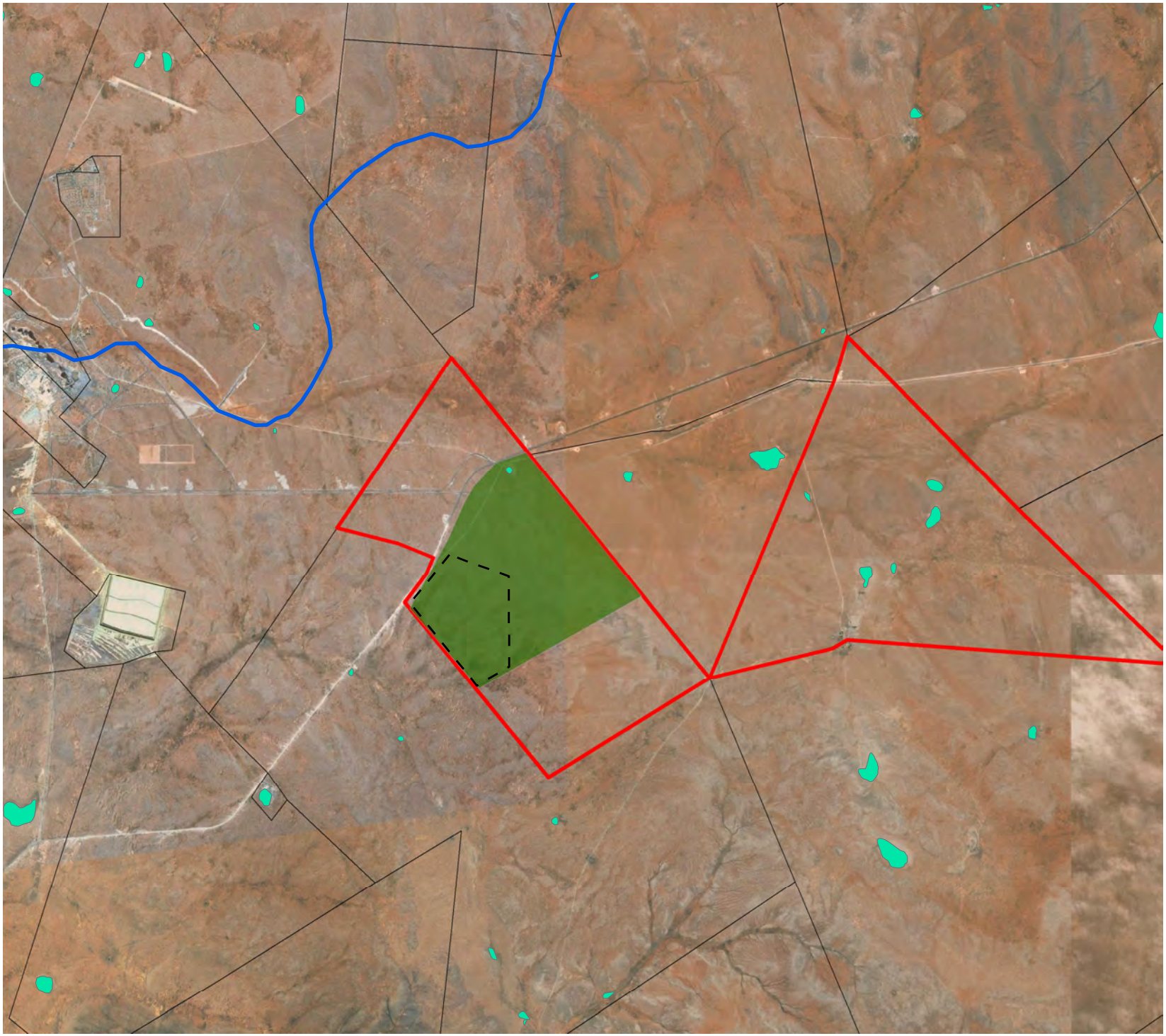

Notes

- Map Scale is 1 : 100 000 when printed on A4.
- Data Source: SANBI BGIS 2013.
- Aerial Image courtesy of Google Earth Pro 2015.
- Imagery date October 2013.

N

0 0.375 0.75 1.5 2.25 3
Kilometers

Map Index

National Freshwater Ecosystem Priority Areas

Humansrus Solar PV Energy Facility 2,
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Legend

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- Study Site
- Remainder of Farm 147

Drawn	Checked	Date	Reference
Wynand Loftus	Dale Holder	February 2015	SIY317

Cape Environmental Assessment Practitioners (Pty) Ltd

Notes

- Map Scale is 1 : 100 000 when printed on A4.
- Data Source: SANBI BGIS 2013.
- Aerial Image courtesy of Google Earth Pro 2015.
- Imagery date October 2013.

N

0 0.375 0.75 1.5 2.25 3
Kilometers

Map Index

National Protected Areas Expansion Strategy

Humansrus Solar PV Energy Facility 2,
Remainder Farm 147

Legend

- Formal Protected Areas
- Informal Protected Areas
- NPAES Focus Areas
- PV Footprint
- Study Site
- Remainder of Farm 147

Drawn	Checked	Date	Reference
Wynand Loftus	Dale Holder	February 2015	SIY317

Cape Environmental Assessment Practitioners (Pty) Ltd

MUNICIPAL BIODIVERSITY SUMMARY PROJECT

SOUTH AFRICAN national biodiversity institute SANBI

environmental affairs
Department
Environmental Affairs
REPUBLIC OF SOUTH AFRICA

Siyathemba Municipality

Size of municipality	820869ha
Areas remaining natural	798626.7ha (97.3% of municipality)
Areas where no natural habitat remains	22244.6ha (2.7% of municipality

PROTECTED AREAS

Land-based protected areas (formal)

There are no protected areas in Siyathemba Municipality

Ramsar sites

There are no Ramsar sites in Siyathemba Municipality

TERRESTRIAL ECOSYSTEMS

Biomes

Name	Size
Nama-Karoo	748993.6ha (91.24% of municipality)
Savanna	71874.7ha (8.76% of municipality)

2 biomes in Siyathemba Municipality covering 820868.4ha

Vegetation Types

Name	Size
Bushmanland Arid Grassland	280146.3ha (34.13% of municipality)
Bushmanland Vloere	568ha (0.07% of municipality)
Gordonia Duneveld	59217.9ha (7.21% of municipality)
Highveld Salt Pans	1187.7ha (0.14% of municipality)
Koranna-Langeberg Mountain Bushveld	182.7ha (0.02% of municipality)
Kuruman Mountain Bushveld	7245ha (0.88% of municipality)
Lower Gariep Alluvial Vegetation	443.8ha (0.05% of municipality)
Lower Gariep Broken Veld	131327.1ha (16% of municipality)
Northern Upper Karoo	294326.1ha (35.86% of municipality)
Olifantshoek Plains Thornveld	4163.4ha (0.51% of municipality)
Upper Gariep Alluvial Vegetation	42060.3ha (5.12% of municipality)

11 vegetation types in Siyathemba Municipality covering 820868.4ha

Threatened Terrestrial Ecosystems

Critically Endangered (CR)

There are no critically endangered in Siyathemba Municipality

Endangered (EN)

Name	Size
Lower Gariep Alluvial Vegetation - AZa 3	345.3ha (0.04% of municipality)

1 endangered ecosystems in the Siyathemba Municipality covering 345.3ha (0% of municipality)

Vulnerable (VU)

There are no vulnerable ecosystems in this municipality

FRESHWATER ECOSYSTEMS

Water Management Areas

Name	Area
LOWER ORANGE	820870.6ha (100% of municipality)

1 water management areas in Siyathemba Municipality covering 820870.6ha

Rivers

Name
Brak
Orange

2 rivers in Siyathemba Municipality

Wetlands

530 covering 10791.5ha (1.3%) of Siyathemba Municipality

BGIS Land Use Decision Support (LUDS) Report

Generated on the BGIS website: 5/12/2014

Disclaimer:

The Land-Use Decision Support (LUDS) Tool has been developed to facilitate and support biodiversity planning and land-use decision-making at a national and provincial level. Its primary objective is to serve as a guide for biodiversity planning and should not replace specialist ecological assessments.

While SANBI endeavours to keep the information on BGIS up-to-date and makes reasonable efforts to ensure that the data it publishes are accurate, SANBI makes no representations or warranties of any kind, express or implied, about the completeness, accuracy, reliability, suitability or availability with respect to the information contained on the website for any purpose. SANBI will not be liable for any loss or damage; including without limitation, indirect or consequential loss or damage, or any loss or damage whatsoever arising from loss of data or profits arising out of, or in connection with, the use of this tool.

Please note: that the spatial information incorporated into the LUDS Tool was mapped at various scales, with much of the spatial information mapped at a scale of 1:250 000 (i.e. 1 cm on the map = 2,5 km on the ground) or greater. To ensure maximum accuracy, always check the map against actual conditions on the ground when undertaking planning and decision-making, or contact the relevant conservation authority for additional assistance.

Please forward any queries or concerns to BGIShelp@SANBI.org.za.

1. Information extracted from national datasets

The information below is extracted for the analysed area from national datasets available on BGIS. There is a short description of the dataset under each heading and the URLs to the webpage on BGIS with further information.

1.1. National terrestrial information

1.1.1. National list of threatened terrestrial ecosystems

BGIS source: National list of threatened terrestrial ecosystems for South Africa (2011) – original extents

A list of all threatened ecosystem patches which original extent intersects the analysed area. Note: the data represents the **original extents** of the threatened ecosystems; in other words, natural areas which have been converted to agriculture, mining and urban areas have been **included**. Please view the area using the BGIS online map viewer Bing maps or Google maps tool in order to see whether any natural vegetation may still exist.

BGIS project overview and report: http://bgis.sanbi.org/ecosystems/project.asp
BGIS download metadata and layer: http://bgis.sanbi.org/ecosystems/map.asp

Ecosystem Name	Code	Status
# threatened ecosystems: 0		

1.1.2. National vegetation types

BGIS source: Vegetation Map of South Africa, Lesotho and Swaziland (Mucina & Rutherford 2006)

A list of all the national vegetation types the corresponding number of patches of each which original extents covered the analysed area. Note that this list is based on the estimated original extents of the vegetation types prior to any transformation. Please view the area using the BGIS online map viewer Bing maps or Google maps tool in order to see whether any natural vegetation may still exist.

BGIS project overview and report: http://bgis.sanbi.org/vegmap/project.asp
BGIS download metadata and layer: http://bgis.sanbi.org/vegmap/map.asp

Instructions on how to find Mucina & Rutherford (2006) vegetation type descriptions using BGIS online maps: http://bgis.sanbi.org/vegmap/Veg_Map_Instructions.pdf

The **map code** below refers to the short code used on the wall map and BGIS interactive maps which helps to accurately identify a vegetation type given the complexity of the map's legend colours.

Vegetation type name	Map code	Biome
Bushmanland Arid Grassland	NKb 3	Nama-Karoo Biome
Bushmanland Basin Shrubland	NKb 6	Nama-Karoo Biome

1.1.3. Indigenous forest patches (DWAF)

BGIS source: DWAF Indigenous Forest Patches (2005)

A list of all the indigenous forest patches found within the analysed area

BGIS project overview and report: http://bgis.sanbi.org/indigenousforest/project.asp
BGIS download metadata and layer: http://bgis.sanbi.org/indigenousforest/map.asp

Forest name	Forest group	Patch Size
# forest patches: 0		

1.1.4. National soil classes

BGIS source: General soils and soil classes

A list of all the dominant soil classes the extents of which cover the analysed area. Please note that these soil classes were developed for agricultural use.

BGIS project overview and report: http://bgis.sanbi.org/Soils/project.asp
BGIS download metadata: http://bgis.sanbi.org/Soils/project.asp (Please contact the data owner, the Agricultural Research Council, to obtain the GIS data)

Soil Class	Soil Class ID
Freely drained, structureless soils	S2

1.2. National aquatic information

1.2.1. Wetlands (NFEPA Wetlands/National Wetlands Map 4)

BGIS source: National Freshwater Ecosystem Priority Areas (NFEPA) Wetland Map/National Wetlands Map 4 and NFEPA wetland clusters

A list of all Wetland units found within the analysed area, should these belong to a wetlands cluster its information is also included. Wetlands and wetland clusters which were selected as freshwater ecosystem priority areas (FEPAs) are indicated. A key to the information codes used is given below.

BGIS project overview and report (National Wetlands 4/Wetland clusters):
http://bgis.sanbi.org/nfepa/project.asp
BGIS download metadata and layer (National Wetlands 4/Wetland clusters):
http://bgis.sanbi.org/nfepa/NFEPAmap.asp

Wetlands

Wetland type	Description	Condition	NFEPA rank	FEPA status
Nama Karoo	*Natural*	AB	5	No status
Nama Karoo	*Natural*	AB	4	No status
Nama Karoo	*Natural*	AB	5	No status
Nama Karoo	*Natural*	AB	4	No status
Nama Karoo	*Natural*	AB	4	No status
Nama Karoo	*Natural*	AB	4	No status
# wetland units: 6				

Wetland clusters

Wetland cluster ID	Vegetation type	Wetland units	FEPA status
# wetland clusters: 0			

Key for NFEPA wetlands condition information codes

NFEPA condition	Description	% of total wetland area
AB	Percentage natural land cover ≥ 75%	47
D	Percentage natural land cover 25-75%	18
DEF	Riverine wetland associated with a D, E, F or Z ecological category river	2
Z1	Wetland overlaps with a 1:50 000 'artificial' inland water body from the Department of Land Affairs: Chief Directorate of Surveys and Mapping (2005-2007)	7

Z2	Majority of the wetland unit is classified as 'artificial' in the wetland locality GIS layer	4
Z3	Percentage natural land cover < 25%	20

* This percentage excludes unmapped wetlands, which includes those that have been irreversibly lost due to draining, ploughing and concreting

Key for NFEPA wetlands rank codes 1-6

Rank	Criterion
1	Wetlands that intersect with a Ramsar site
2	Wetlands within 500 m of a IUCN threatened frog point locality
2	Wetlands within 500 m of a threatened waterbird point locality
2	Wetlands (excluding dams) with the majority of its area within a sub-quaternary catchment that has sightings or breeding areas for threatened Wattled Cranes, Grey Crowned Cranes and Blue Cranes
2	Wetlands (excluding dams) within a sub-quaternary catchment identified by experts at the regional review workshops as containing wetlands of exceptional biodiversity importance, with valid reasons documented
2	Wetlands (excluding dams) within a sub-quaternary catchment identified by experts at the regional review workshops as containing wetlands that are good, intact examples from which to choose
3	Wetlands (excluding dams) within a sub-quaternary catchment identified by experts at the regional review workshops as containing wetlands of biodiversity importance, but with no valid reasons documented
4	Wetlands (excluding dams) in A or B condition AND associated with more than three other wetlands (both riverine or non-riverine wetlands were assessed for this criterion)
4	Wetlands in C condition AND associated with more than three other wetlands (both riverine or non-riverine wetlands were assessed for this criterion)
5	Wetlands (excluding dams) within a sub-quaternary catchment identified by experts at the regional review workshops as containing impacted Working for Wetland sites
6	Any other wetland (excluding dams)

1.2.2. Sub-quarternary catchments and rivers (NFEPA)

BGIS source: National rivers and sub-quaternary catchment FEPA status (NFEPA)

A list of all NFEPA sub-quaternary catchments and their FEPA status followed by the river units they contain with various parameters and indicators. A sub-quaternary catchment and its river indicated as FEPA are fresh water ecosystem priority areas, A blank FEPA status indicates that NFEPA did not give the sub-quaternary catchment or river

priority status. A key to the other information codes used is given below.

BGIS project overview and report (NFEPA river FEPAs and NFEPA rivers):
http://bgis.sanbi.org/nfepa/project.asp
BGIS download metadata and layer(NFEPA river FEPA and NFEPA rivers):
http://bgis.sanbi.org/nfepa/NFEPAmap.asp

Sub-quaternary catchments (river FEPAs)

NFEPA ID	FEPA status
4544	FEPA
# sub-quarternary catchments: 1	

NFEPA river units

River name	FEPA status	River type	Condition	Mainstem	Flagship
# river units: 0					

Key for NFEPA sub-quaternary catchment and river units information codes

FEPA status	River types	River condition
Summarized FEPA status using a text description, where: **FEPA**= freshwater ecosystem priority area **FISHFSA**= fish support area **FISHCORRID**= corridor critical for movement of threatened Fish between habitats **PHASE2FEPA**= phase 2 freshwater ecosystem priority area **UPSTREAM**= upstream management area In instances where several of these map categories overlapped, the status took the following order of precedence: "FEPA", “PHASE2FEPA", "FISHFSA” or “FISHCORRID”, and then “upstream management area”	Used by NFEPA which comprises: the level 1 ecoregion number hyphen (-) *followed by* the flow **N**= not,permanent/flashy **P**= permanent or seasonal hyphen (-) *followed by* the geomorphological zone **M**= mountain stream **U**= upper foothills **L**= lower foothills **F**= lowland river	Used by NFEPA, A or B is considered intact and able to contribute towards river ecosystem biodiversity targets. **A**= unmodified, natural **B**= largely natural with few modifications **AB**= A or B above **C**= moderately modified **D**= largely modified **E**= seriously modified **F**= critically extremely modified **EF**= E or F above **Z**= Tributary condition modeled as not intact, according to natural land cover

1.3. National protected area information

BGIS source: Protected areas formal and informal (NBA 2011 and NPAES 2010)

A list of all protected areas the extents of which intersect with the analysed area. The formal protected areas were updated by the National Biodiversity Assessment (NBA 2011) whereas the informal protected areas were updated by the National Protected Areas Expansion Strategy (NPAES 2010).

Also included is a list of any NPAES 2010 focus areas that were intersected by the analysed area.

BGIS NBA 2011 project overview and report:
http://bgis.sanbi.org/NBA/project.asp
BGIS formal protected areas (NBA 2011) download metadata and layer:
http://bgis.sanbi.org/NBA/terrestrial_formalprotecedareas.asp
BGIS NPAES 2010 project overview and report:
http://bgis.sanbi.org/protectedareas/NPAESinfo.asp
BGIS informal protected areas (NPAES 2010) download metadata and layer:
http://bgis.sanbi.org/protectedareas/ProtectedAreas.asp
BGIS NPAES 2010 focus areas download metadata and layer:
http://bgis.sanbi.org/protectedareas/NPAES.asp

Protected area name	Category	Management agent

Formal protected areas

 # Formal protected areas: 0

Informal protected areas

 # Informal protected areas: 0

NPAES focus area name
Gariep
NPAES focus areas 1

2. Information from the most relevant biodiversity conservation plan for the Northern Cape

BGIS source: There are no terrestrial or aquatic biodiversity conservation plan datasets available for the Northern Cape on BGIS, please refer to the national information above

3. Municipal and cadastral information

3.1. Province and municipality

The Municipal Demarcation Board's 2009 boundaries are used for the BGIS LUDS tool as these correspond with the municipal biodiversity summaries. The boundaries in the LUDS tool will be updated along with the next municipal biodiversity summaries update.

Municipal biodiversity summary information can be on BGIS by going to the following link http://196.21.45.151/devBGIS/municipalities/municipality.asp.
and following the steps i.e. choose a province and then a municipality on the map or from the dropdown box. These steps also constitute STEP 1: *Find the appropriate BGIS map (LUDS Map) for your municipality*. Please contact SANBI municipal programme for more information about the Municipal Biodiversity Summaries Project.

Note: the LUDS tool does not allow analyses to cut cross municipal and provincial boundaries i.e. any analysis must fall within a single province and municipality.

Province (code): Northern Cape(NC)

Municipality (Cat B): (NCDMA07)

3.2. Cadastral information

A list of all cadastral units (parent farm and sub-unit properties only) which intersect the analysis area.

SG 21 code	Parcel number	Size (Ha)
C05500000000072800271	**271/728**	0.746

properties: 1

4. Envisaged development information

Development type: Infrastructure - roads, power lines etc

Additional information:

Development of a photovoltaic solar farm is proposed on the Remainder of Farm 147 Humansrus

5. Analysis area information

Below are the size (Ha) and location (centroid and extents) in degrees, minutes and seconds of the analysis area, shown in red on the map.

Unfortunately a map of the analysis area cannot at this stage be included in these LUDS reports. If you wish to have a map of the analysis area please use the print map button provided on the LUDS toolbar.

Analysis area centroid (decimal degrees): 22.3752606400763,-29.9499507307082

Analysis area extents (decimal degrees): 22.3538938345744,-30.0222695469473,22.5185825969815, -29.9465327910757

Analysis area size (Ha): Cannot be calculated, please use area tool