

**Botanical Assessment for the proposed  
strengthening (partial reconstruction)  
of National Route 27 Sections 7 & 8 between  
the Western Cape Province/ Northern Cape Province  
Border and Calvinia**



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**Prepared for CCA Environmental (Pty) Ltd)**

**Client: SANRAL**



## environmental affairs

Department:  
Environmental Affairs  
REPUBLIC OF SOUTH AFRICA

### DETAILS OF SPECIALIST AND DECLARATION OF INTEREST

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Application for authorisation in terms of the National Environmental Management Act, 1998 (Act No. 107 of 1998), as amended and the Environmental Impact Assessment Regulations, 2010

### PROJECT TITLE

PROPOSED STRENGTHENING (PARTIAL RECONSTRUCTION) OF NATIONAL ROUTE 27 SECTION 7 & 8 BETWEEN WESTERN/ NORTHERN CAPE BORDER (KM 40.0) AND CALVINIA (KM 70.0) - CONTRACT R.027-080-2011/1D

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#### 4.2 The specialist appointed in terms of the Regulations

I, David Jury McDonald , declare that --

##### General declaration:

- I act as the independent specialist in this application
- I will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant
- I declare that there are no circumstances that may compromise my objectivity in performing such work;
- I have expertise in conducting the specialist report relevant to this application, including knowledge of the Act, regulations and any guidelines that have relevance to the proposed activity;
- I will comply with the Act, regulations and all other applicable legislation;
- I have no, and will not engage in, conflicting interests in the undertaking of the activity;
- I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing - any decision to be taken with respect to the application by the competent authority; and - the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority;
- All the particulars furnished by me in this form are true and correct; and
- I realise that a false declaration is an offence in terms of Regulation 71 and is punishable in terms of section 24F of the Act.



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Signature of the specialist:

Bergwind Botanical Surveys & Tours CC

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Name of company (if applicable):

19 May 2011

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Date:

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# 1. Introduction

## 1.1 Scope

The R27 national road from the border between the Western and Northern Cape Provinces at Vanrhyn's Pass to Calvinia requires strengthening of the existing layers and limited widening. The road route includes approximately 10 km of R27 Section 7 and 70 km of R27 Section 8. A number of culverts and some of the bridges over the Oorlogskloof River that date to the 1950's will require widening and reconstruction. The proposed road works are likely to affect the vegetation in the road-reserve corridor. Road reserves can be important corridors for wildlife and also important repositories for biodiversity (Esler & Milton, 2006). It is therefore necessary to assess the impact of the proposed road-works on the plant communities found in the road reserves along the designated sections of the R 27 and to include a botanical assessment as part of the Environmental Impact Assessment.

The proposed road-works will entail the following activities:

- Re-layering, re-shaping and compaction and re-surfacing of the existing road.
- Re-construction of certain culverts to strengthen them.
- Re-construction of the existing bridges where necessary at the crossings over the Oorlogskloof River, to provide greater road width and increased strength.
- Sourcing of road metal from borrow pits and quarries that will entail further excavation of existing borrow pits.

Bergwind Botanical Surveys & Tours CC (Dr D.J. McDonald) was commissioned to survey and assess the vegetation and habitat found in the road reserves of the above road sections and at seven (7) borrow pits, to inform the process for authorisation to carry out the proposed activities. The assessment takes careful note of the requirements and recommendations of CapeNature (Western Cape Province), Department of Environment Affairs and Nature Conservation, Northern Cape and the Botanical Society of South Africa for proactive assessment of biodiversity of sites where there is a proposed change of land use or potential impact (positive or negative) on natural vegetation. The study follows published guidelines for evaluating potential impacts on the natural vegetation in an area earmarked for some form of development (Brownlie 2005, De Villiers *et al.* 2005) as well as the guidelines for specialists in the Western Cape Province.

## **1.2 Terms of Reference**

- Provide a brief outline of the approach used in the study. Assumptions, sources of information and the difficulties with predictive models must also be clearly stated.
- If applicable, provide a brief description of any consultation process that was undertaken, as well as a brief description and copies of any comments that were received during any consultation process.

### **1.2.1 General Terms of Reference:**

- Review previous work done in the area and describe the baseline conditions that exist in the study area.
- Provide a full assessment report on any sensitive areas identified in the road reserve as well as the seven borrow pit sites and four bridge sites.
- Identify and assess potential impacts of the construction, operational and closure/decommissioning phases, as relevant in the case of each site. To ensure that specialists use a common standard, the determination of the significance of the assessed impacts will be undertaken in accordance with CCA Environmental's Convention for Assigning Significance Ratings to Impacts (Appendix1). A table template for reporting on impact assessment is provided in Attachment C for use in assessment reports.
- Identify feasible ways in which impacts could be mitigated and benefits enhanced giving an indication of the likely effectiveness of such mitigation and how these could be implemented in the construction and management of the proposed development.
- Identify and assess any cumulative impacts arising from the proposed project.
- Identify and list all legislation and permit requirements that are relevant to the development proposal in the specific field of expertise, and provide guidance for compliance with any relevant legislation.

- Indicate the reliability of information utilised in the assessment of impacts, as well as any constraints to which the assessment was subjected (e.g. any areas of insufficient information or uncertainty).
- Indicate whether any of these areas of insufficient information or uncertainty associated with the specialist study would impact on the decision whether or not to authorise the proposed project.
- Comply with guidelines on specialist study requirements for EIA provided by the Department of Environmental Affairs (DEA) and the Department of Environmental Affairs and Development Planning (DEA&DP) of the Western Cape Province, as well as the requirements listed in Sections 17 and 32(2) of the EIA Regulations 2010 dated 18 June 2010 promulgated in terms of Chapter 5 of NEMA.

### **1.2.2 Specific Terms of Reference for Botanical Assessment**

- Provide a broad, baseline description of the vegetation of the study area, placing it in a regional context. Reference should also be made to any bioregional maps of the area.
- Map the vegetation communities and associated conservation value/sensitivity of the study area and identify any areas of specific concern (e.g. high sensitivity and/or conservation status).
- Provide guidance on any permits that would be required from any organ of state in respect of the conservation or removal of vegetation in the study area.
- Provide specific information relating to the vegetation of each borrow pit and bridge site, with reference to any species of special concern and their conservation status, which can be used as baseline information for the assessment of potential impacts of the proposed project.
- Investigate ecological/biodiversity processes that could be affected by the proposed project.
- Identify, describe and assess the impacts of the proposed activities and any activity alternatives on the vegetation.



- Recommend appropriate, practicable mitigation measures that will reduce all major (significant) impacts or enhance potential benefits, if any.



Figure 1. Location of the R27 route between Vanrhyn's Pass (at the boundary between Western and Northern Cape Provinces) and Calvinia.

### 1.3 Assumptions and Limitations

The Hantam region where the study area is situated is subject mainly to winter rainfall but also benefits from occasional rain showers and thunderstorms in the summer. Most of the flora therefore is winter-growing with a flush of flowering in the spring. The principal limitation of the present survey was the season in which the survey was conducted. Early winter rain had been experienced at Nieuwoudtville and Calvinia shortly before and during the survey period but this had not yet influenced the winter growth of the plants. Consequently most plant species appeared drought-stressed and in poor condition, with very few flowers, at the time of the field

sampling. Despite this, it was possible to successfully identify most of the shrub species and some of the herbaceous species. Geophytes, if present, were generally not yet evident apart from *Brunsvigia bosmaniae*. The presence of this species was made obvious by the mature inflorescences (tumble-weed seed capsules) and in some places early 'new' leaves.

### 3. Project Area

#### 3.1 Locality

Approximately 30 km east of Vanrhynsdorp the land rises sharply from the lowlands at more-or-less 200 m above mean sea level (a.m.s.l.) to 800 m on the Bokkeveld Escarpment. The boundary between the Western Cape Province and the Northern Cape Province is on the escarpment. The R27 National Route runs due east from Vanrhynsdorp, climbs the escarpment at Vanrhyn's Pass and then continues eastwards past Nieuwoudtville, which lies approximately 10 km from the edge of the escarpment, inland across the Bokkeveld Plateau to Calvinia which is at the foot of the Hantamsberge, 70 km from Nieuwoudtville (Figures 1 – 3). The last ± 10 km of the R27 Section 7 and R 27 Section 8 fall within the Northern Cape Province but the road is administered by South African National Roads Agency Limited (SANRAL) as a national route.

As noted above the project has two aspects (1) the survey of the road reserve from Vanrhyn's Pass to Calvinia and (2) the investigation of seven borrow pits for road-making materials. The road is by nature a linear feature and is well defined. The borrow pits investigated for possible extension are located at intervals along the road route as described above and are found at the localities given in Table 1. One of the borrow pits (R27-8 km 32.6 RHS 6.2) is at an abandoned mine.

**Table 1. Location of borrow pits**

Borrow Pit No.	Latitude	Longitude
R27-7 km 51 LHS 6.9 (BP1)	S 31° 20' 01.3"	E 19° 07' 06.1"
R27-8 km 9.5 LHS 0.2 (BP2)	S 31° 23' 57.7"	E 19° 12' 40.3"
R27-8 km 32.6 RHS 6.2 (BP3)	S 31° 32' 15.4"	E 19° 24' 11.9"
R27-8 km 39.8 LHS 0.1 (BP4)	S 31° 29' 26.4"	E 19° 29' 28.3"
R27-8 km 45.0 RHS 0.2 (BP5)	S 31° 29' 43.7"	E 19° 32' 44.7"

R27-8 km 50.4 LHS 0.1 (BP6)	S 31° 29' 43.0"	E 19° 36' 08.2"
R27-8 km 61.6 RHS 1.0 (BP7)	S 31° 30' 35.3"	E 19° 43' 00.0"

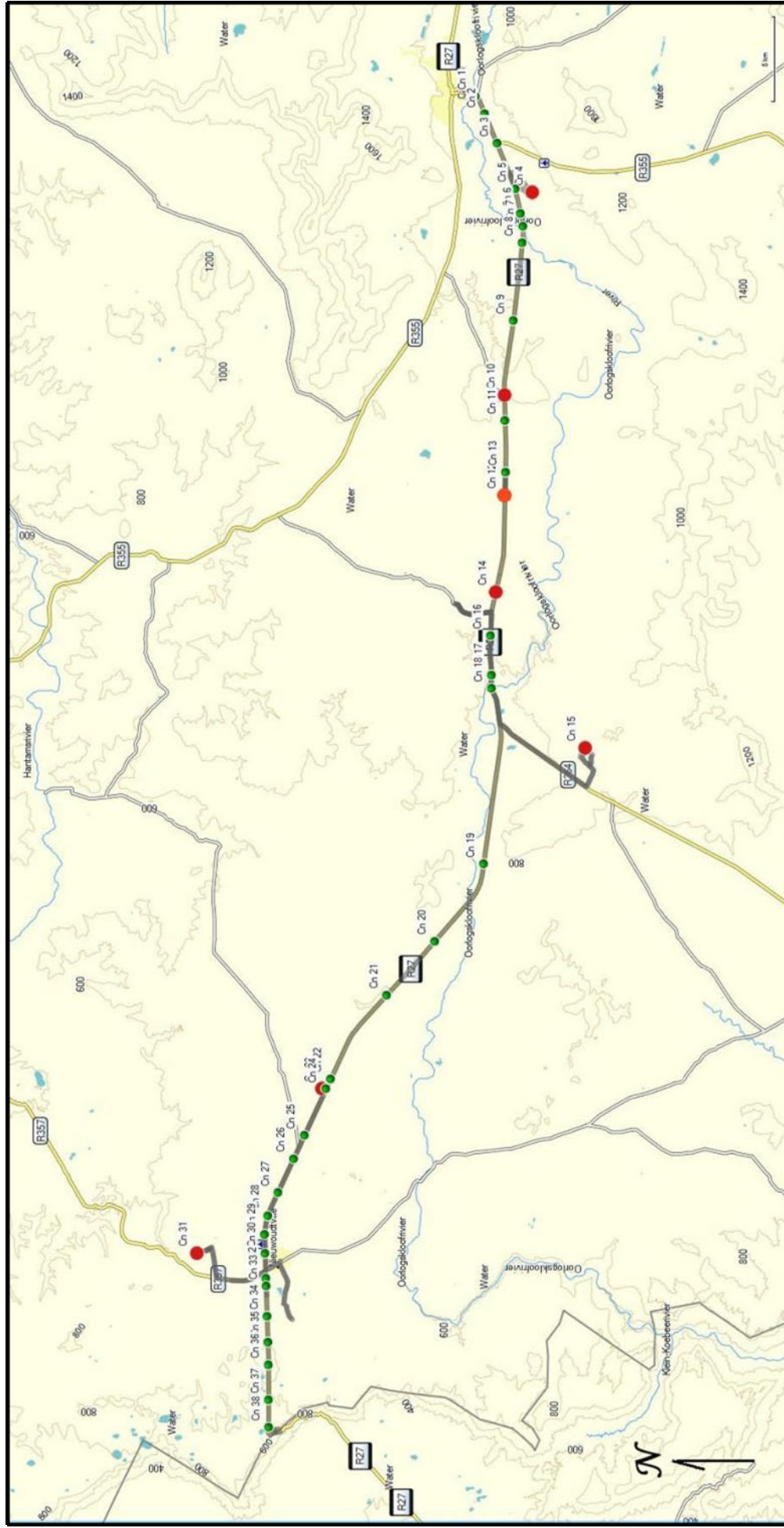


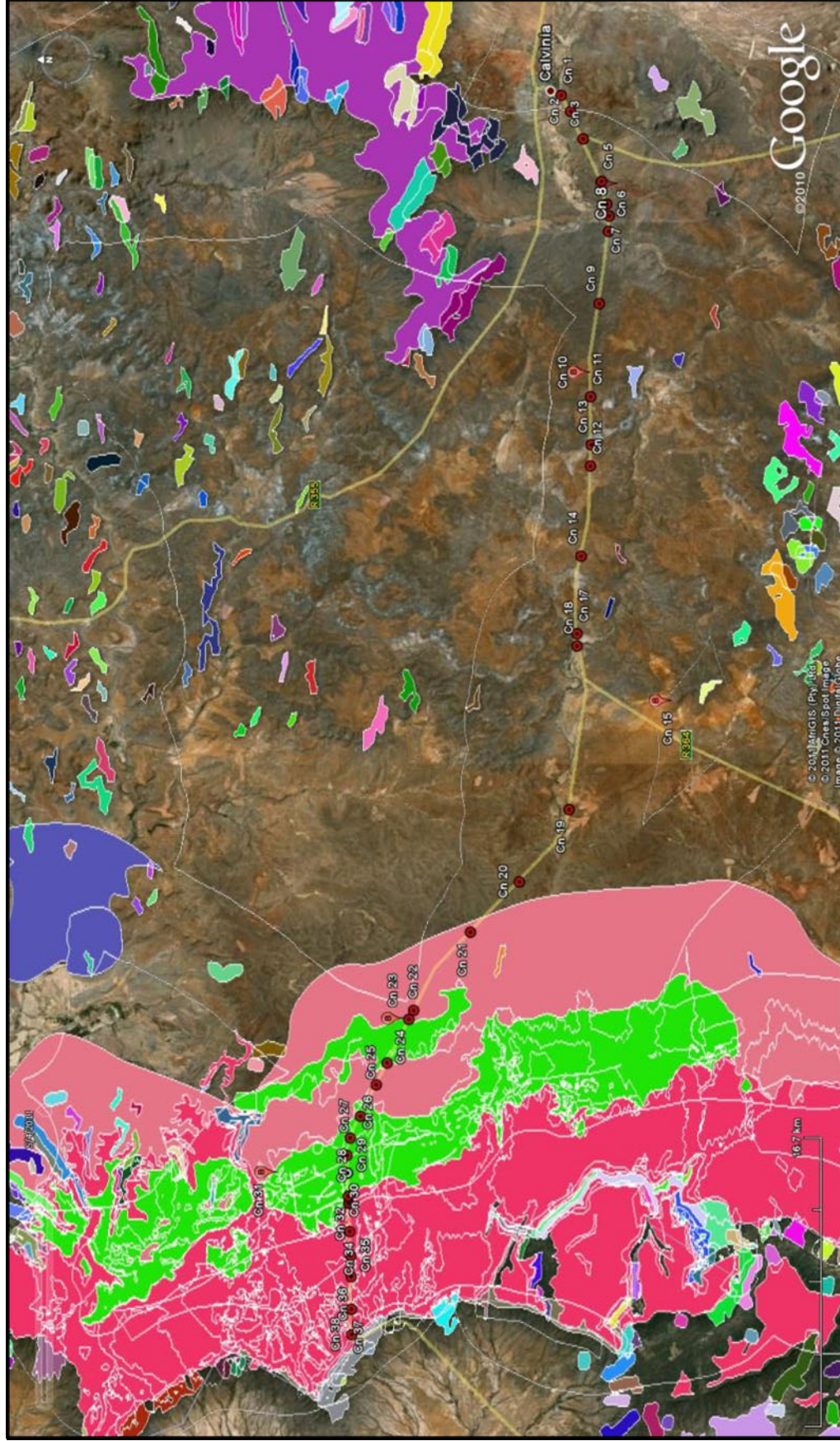
Figure 2. Topographical map of the area through which the R27 Sections 7 & 8 route passes. Waypoints with green icons were those along the road route and those with red icons are the proposed borrow pits.



Figure 3. The R27 Sections 7 & 8 route between Vanrhyn's Pass in the west and Calvinia in the east showing the sample waypoints Cn# with red dots, the proposed borrow pits (pink tear-drop icons) and the four bridges B1 – B4 (yellow), superimposed on a Google Earth © aerial image of the study area.



**Figure 4.** Portion of the mapped Critical Biodiversity Areas (CBA's) and Ecological Support Areas (ESA's) for Namaqualand District Municipality – shown together as green shading. The sample waypoints (Cn#) are superimposed and those from Cn1 – Cn20 fall within an ESA corridor. Those from Cn21 – Cn38 fall within a Critical Biodiversity Area (refer to Figure 5).



**Figure 5.** Aerial view (Google Earth ©) of the study area with Critical Biodiversity Areas (CBA's) superimposed. All waypoint samples CN21—CN38 i.e. from the occurrence of Nieuwoudtville—Roggeveld Dolerite Renosterveld (dark pink) westwards through Nieuwoudtville Shale Renosterveld (lime green) and Bokkeveld Sandstone Fynbos (Red) fall within CBA's.

### 3.2 Landscape, Geology, Topography and Soils

The ascent of the Bokkeveld Escarpment at Vanrhyn's Pass takes one through a series of strata; the Malmesbury, Table Mountain and Bokkeveld Groups of the Cape Supergroup. The sandstone sediments of the Nardouw Sub-group (Table Mountain Group) give rise to acid, sandy soils found on the edge of the Bokkeveld Escarpment. These give way further inland to the Dwyka Group (tillites) (Karoo Supergroup) that have a fine-grained matrix and weather to clay-rich soils. In the study area the Dwyka Group is sandwiched in a north-south band between the sandstone sediments of the Cape Supergroup and the dolerites found around Nieuwoudtville. Eccca Group (shales) and to a lesser extent Dwyka tillites of the Karoo Supergroup give rise to clay-rich soils typical of the large undulating open areas of the Hantam between Nieuwoudtville and Calvinia. These sedimentary strata were intruded by igneous lavas of the Karoo Dolerite Suite (Manning & Goldblatt, 2007; Rebelo *et al.* 2006 in Mucina & Rutherford, 2006).

Dolerite koppies and open areas of doleritic soils are characteristic of the area around Nieuwoudtville and on the Hantam Plateau. During the Jurassic Period (180 – 135 mya) when there was major volcanic activity prior to the break-up of the Gondwana super-continent, igneous dolerite was deposited over or intruded into vast areas of sedimentary strata in the Karoo. Over time the dolerite dykes and sills have been exposed by weathering of the softer shales and sandstones. On level land surfaces the dolerite has weathered to form clay-rich (swelling clays) red soils of the Arcadia Form. On steeper slopes where weathering is more limited, shallow Glenrosa and Hutton Form soils develop. Owing to the low rainfall in the Hantam the dolerite-derived soils are base-saturated with a neutral pH.

Dolerite is notably found at the abandoned mine mentioned above (page 7) as well as at some of the identified borrow pits east of Nieuwoudtville.

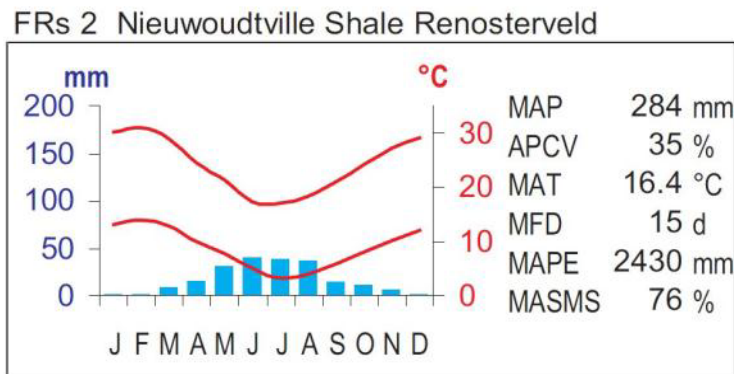


**Figure 6.** A typical dolerite 'koppie' outcrop near Nieuwoudtville with characteristic red soil.

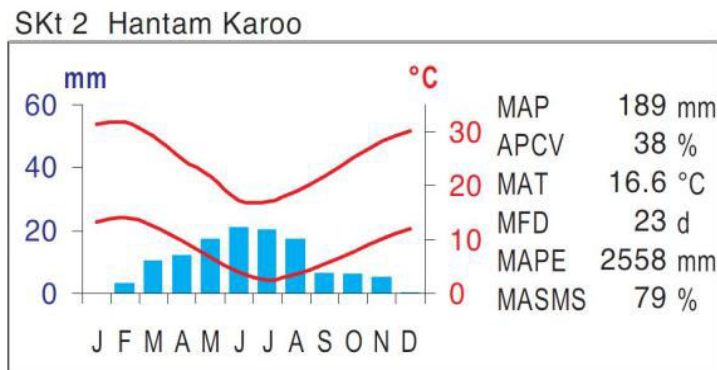


### 3.3 Climate

The climate of the Hantam Karoo and that of the Nieuwoudtville area in the west is a winter-rainfall area with most rain occurring in the months of May to August, peaking in June (Figures 7&8). Very little rain occurs in December, January and February but late summer showers and thunderstorms can provide relief to the high daytime temperatures. The area around Nieuwoudtville experiences a mean annual precipitation (MAP) of 284 mm which is almost 100 mm more than the more arid central Hantam which has a MAP of 189 mm. Evaporation demand both in the air and soil is also somewhat higher in the central Hantam than at Nieuwoudtville which further accounts for its more arid character. The annual cycle of temperatures is similar from Nieuwoudtville eastwards to Calvinia with mean annual temperature (MAT) around 16°C. Frost is also more prevalent in the central Hantam (23 days *per annum*) than at Nieuwoudtville (15 days *per annum*) (Rebelo *et al.*, 2006)



**Figure 7.** Climate diagram for Nieuwoudtville Shale Renosterveld which represents the climate for the Nieuwoudtville area. MAP = Mean Annual Precipitation; APCV = Annual Precipitation Coefficient of Variation; MAT = Mean Annual Temperature; MFD = Mean Frost Days per annum; MAPE = Mean Annual Potential Evaporation; MASMS = Mean Annual Soil Moisture Stress (from Mucina & Rutherford, 2006).



**Figure 8.** Climate diagram for the Hantam Karoo (see Figure 7 for legend) (from Mucina & Rutherford, 2006).

## 4. Evaluation Method

The R27 National Road Route, Sections 7 & 8 were visited on 2, 3 & 4 May 2011 at the beginning of winter after the first winter rains. The preceding summer had been dry as stated above and a limitation was that the vegetation had not yet had time to recover and benefit from the rain after the long period of, hot dry conditions. However, adequate plant material, sometimes in a dry state, was available over most of the survey route to be able to make meaningful observations.

The route from Vanrhyn's Pass to Calvinia was initially travelled by vehicle on 2 May 2011 to obtain an 'overview impression' of the vegetation in the road reserves. Over the following two days the route was travelled in reverse during which time the borrow pits were also visited and evaluated. Regular stops were made along the R27 route at which waypoints were recorded with observations and photographs of the vegetation.

## 5. Results

### 5.1 The Vegetation

Biogeographically the study area falls partly within the Fynbos Biome (Mucina & Rutherford, 2006) in the west and mostly within the Succulent Karoo Biome (Van Wyk & Smith, 2005; Mucina & Rutherford, 2006). A sequence of vegetation types occurs from west to east from the Bokkeveld Escarpment inland to Calvinia. This is described in broad terms in the national classification of the vegetation of South Africa (Rebello *et al.* 2006). The vegetation of the Bokkeveld Escarpment on sandstone-derived soils has higher rainfall than that found further inland to the east. It is 'true fynbos' and is classified as Bokkeveld Sandstone Fynbos (FFs1). On the clay-rich soils derived from Dwyka sediments the vegetation is Nieuwoudtville Shale Renosterveld (FRs2). Next in the sequence is Nieuwoudtville-Roggeveld Dolerite Renosterveld (FRd1), in a narrow north-south band which is widest in the north and tapers southwards to terminate south of the Oorlogskloof River. East of the exposures of dolerite and dolerite-derived soils the vegetation is classified as Hantam Karoo (SK2) on the clay-rich soils to Calvinia and beyond (Figure 9).

In a study of the vegetation of the Hantam-Tanqua-Roggeveld subregion (Van der Merwe *et al.* (2008a & b) described the vegetation associations or communities found in more detail and mapped these associations as in Figure 10. They did not include the Bokkeveld Sandstone Fynbos in their study, only the Succulent Karoo vegetation. Along

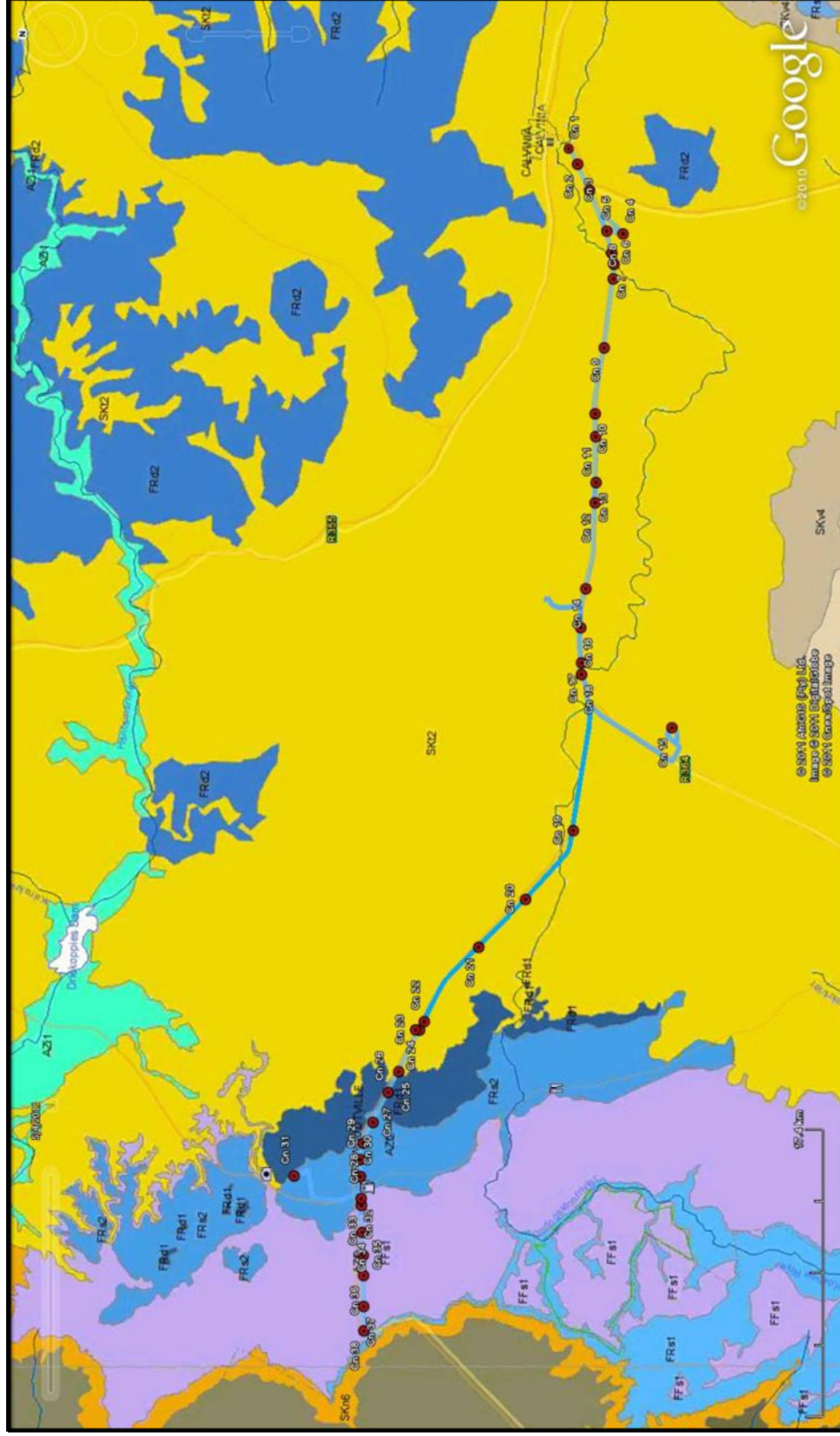
the west to east gradient from Nieuwoudtville to Calvinia, six mapped vegetation are encountered following the classification of Van der Merwe *et al.* (2008a & b). Two of these units, the Nieuwoudtville Mosaic, Grootfontein Mosaic and Calvinia Mosaic each comprise more than one vegetation association. This level of detail is beyond the scope of this study and the reader is referred to the original papers of Van der Merwe *et al.* (2008a & b) should more detail be required. In west to east order these vegetation units are:

1. Nieuwoudtville Mosaic
2. Grootfontein Mosaic
3. *Leipoldtia schulzei* – *Eriocephalus purpureus* Hantam Karoo
4. *Erodium cicutarium* – *Eriocephalus purpureus* Hantam Karoo
5. *Eriocephalus ericoides* – *Pteronia glomerata* Roggeveld Karoo
6. Calvinia Mosaic

## 5.2 Vegetation units and disturbance regime of the road reserve of the R27, Sections 7 & 8.

The vegetation encountered at the sample waypoints has been assigned to the above six units based on geographical position and the species composition of the vegetation at the respective waypoints and borrow pits. The condition of the vegetation was evaluated as well, as given in the brief notes in Table 2.

Historically the vegetation of the road reserve between Vanrhyn's Pass and Calvinia has been heavily impacted by various negative activities but most of all by removal of natural vegetation under the banner of '*maintenance*'. This has been documented by Prof Sue Milton (Esler & Milton, 2006) in observations along the R27 in March 2005 (see Appendix 2) where work teams were removing natural shrub vegetation to ostensibly (1) improve road safety, (2) improve visibility, (3) simplify maintenance, and (4) create jobs. Clearly this activity has had a long-term negative effect since six years later the vegetation has not recovered to its former state. The road-verge along virtually the whole length of the surveyed sections is regularly mowed and the vegetation between the 1—2 m verge and the fence, within the road reserve, is in poor condition over considerable distances. The negative impact of the historical clearing of vegetation has undoubtedly compromised the value of the R27 road-reserve as a biodiversity corridor and efforts must be made to curtail the negative activities and promote a better understanding of the value of the roadside habitat.



**Figure 9.** Portion of the Vegetation Map of South Africa, Lesotho & Swaziland (Mucina *et al.* 2005), showing the various vegetation types found along the R27 Sections 7 & 8, Northern Cape Province: FFs1 (mauve)—Bokkeveld SandstoneFynbos; FRs2 (light blue) – Nieuwoudtville Shale Renosterveld; FRd1 (dark blue) – Roggeveld Dolerite Renosterveld; SKt2 (yellow) – Hantam Karoo. The blue line is the survey route with waypoints CN#.

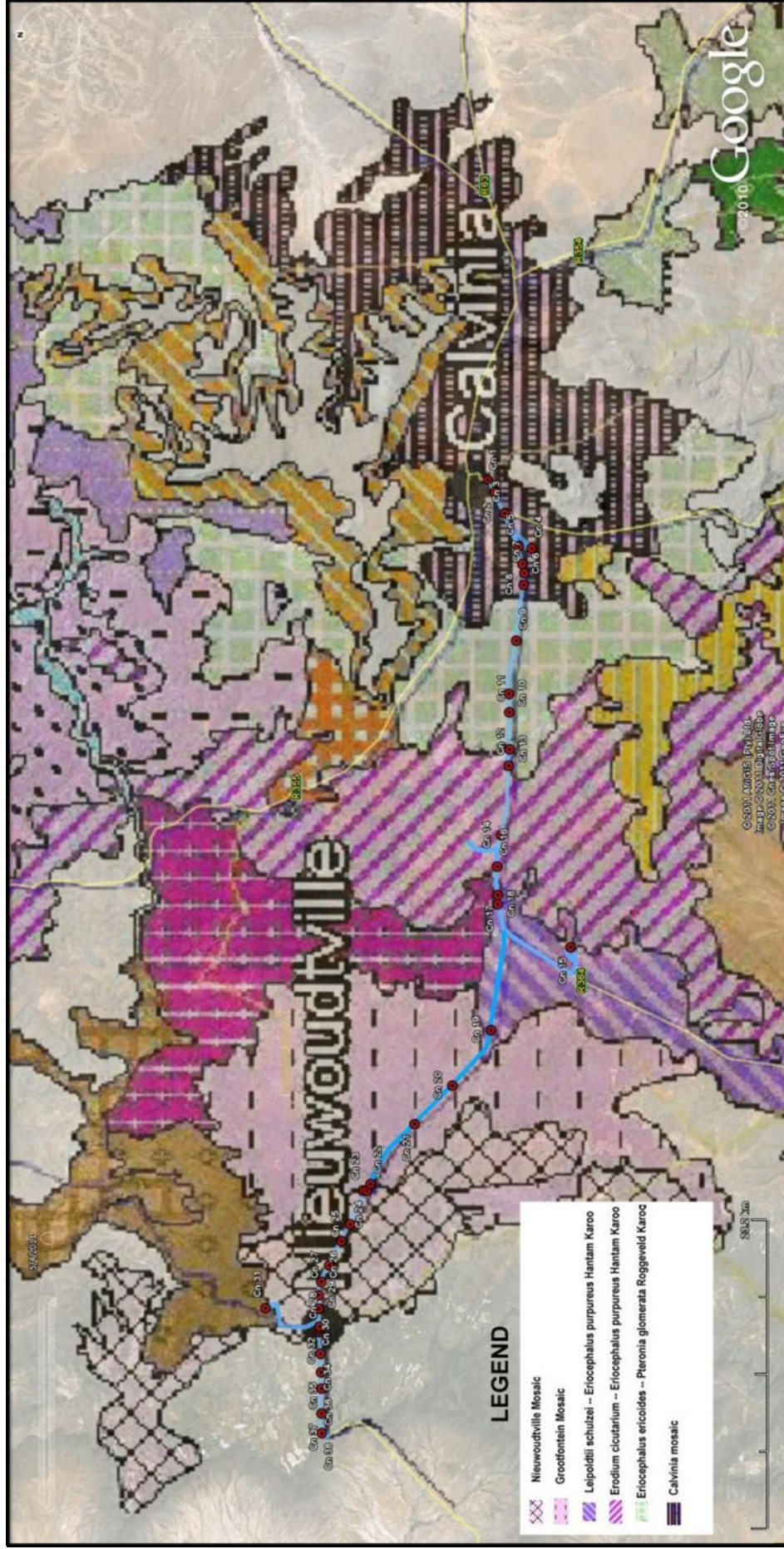


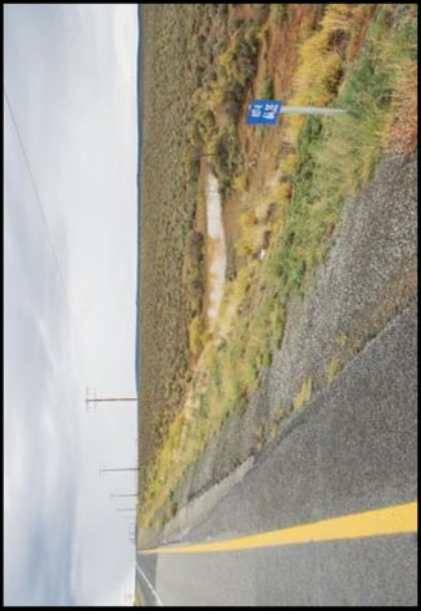

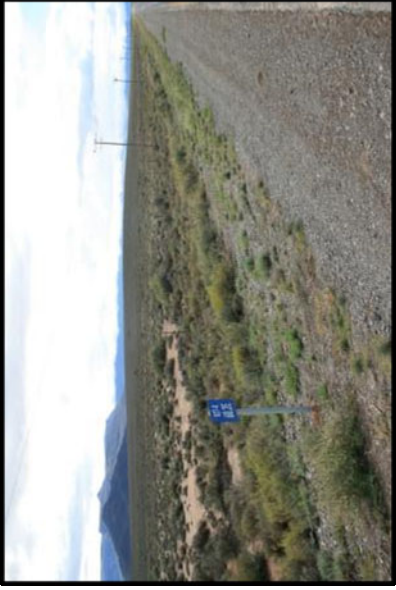



Figure 10. Portion of vegetation map of Nieuwoudtville – Calvinia from Van der Merwe *et al.* (2008b). The blue line is the survey route with waypoints CN#.

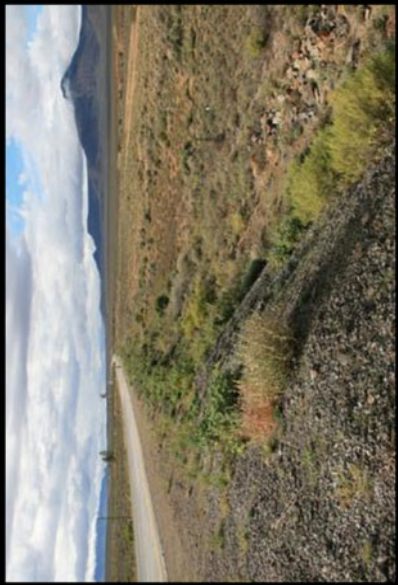

**Table 2. Waypoints with descriptions of vegetation and illustrative photographs for Sections 7 and 8 of the R 27 National Route, Northern Cape Province. Vegetation Unit in green type follows Vander Merwe et al. classification and unit in red type the national classification.**

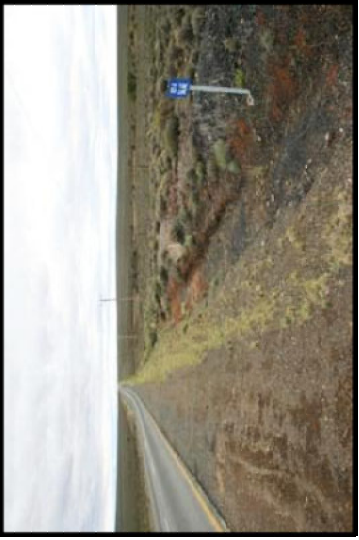
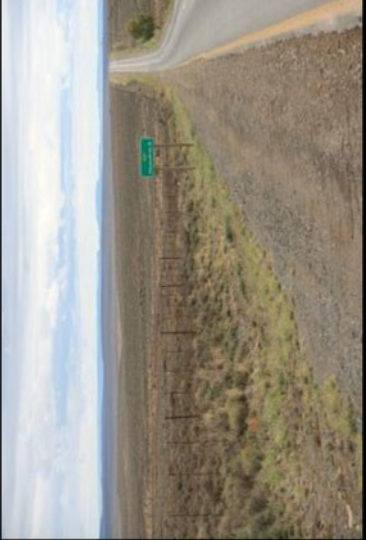
Waypoint	Vegetation Unit *	Brief descriptive notes	
<p><b>CN1</b> S 31° 28' 48.3" E 19° 46' 14.0"</p>	<p><b>Calvinia Mosaic</b> <b>Hantam Karoo</b></p>	<p>At the Keiskie turnoff outside Calvinia. The road reserve is highly disturbed on both sides of the road. The vegetation consists mainly of weeds such as <i>Salsola kali</i> (rolbos), <i>Atriplex semibaccata</i>, <i>Atriplex lindleyi</i> subsp. <i>inflata</i>, <i>Malephora crassa</i>, <i>Salsola</i> sp., <i>Ruschia</i> sp., <i>Chrysocoma ciliata</i>, <i>Galenia africana</i> and <i>Gazania krebsiana</i>.</p>	
<p><b>CN2</b> S 31° 29' 05.8" E 19° 45' 38.9"</p>	<p><b>Calvinia Mosaic</b> <b>Hantam Karoo</b></p>	<p>Near road marker R27-8 66.0 E. A culvert is found here and both side of the road are disturbed and vegetated mainly with weedy species. <i>Galenia africana</i> is prominent. Other species include <i>Salsola kali</i>, <i>Eragrostis</i> sp., <i>Sonchus oleraceus</i>, <i>Fingerhuthia africana</i>, <i>Felicia muricata</i>, <i>Erodium cicutarium</i>, and <i>Cucumis myriocarpus</i> subsp. <i>leptodermis</i>.</p>	

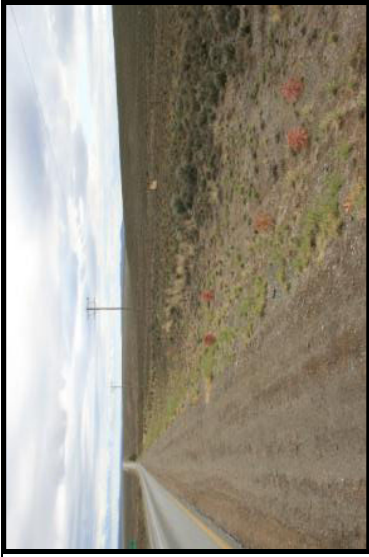

<p><b>CN3</b> S 31° 29' 29.5" E 19° 44' 39.1"</p>	<p><b>Calvinia Mosaic</b> <b>Hantam Karoo</b></p>	<p>This waypoint is at the R 355 / R 27 intersection at R27-8 64.2 E. The road reserve close to the road on both sides is highly disturbed with abundant weeds. <i>Galenia africana</i> is prevalent with <i>Cucumis myriocarpus</i> subsp. <i>leptodermis</i> present. On the south-west side of the intersection is a stand of <i>Eriocephalus</i> sp. together with <i>Ruschia</i> cf. <i>intricata</i>, <i>Psilocaulon junceum</i> and <i>Osteospermum</i> sp.</p>	
<p><b>CN5</b> S 31° 30' 03.7" E 19° 43' 06.3"</p>	<p><b>Calvinia Mosaic</b> <b>Hantam Karoo</b></p>	<p>This waypoint is at the entrance to the track to Borrow Pit 7 near road marker R27-8 61.2E. The vegetation on both sides of the road is in poor condition when compared with the vegetation on the adjacent private property.</p>	


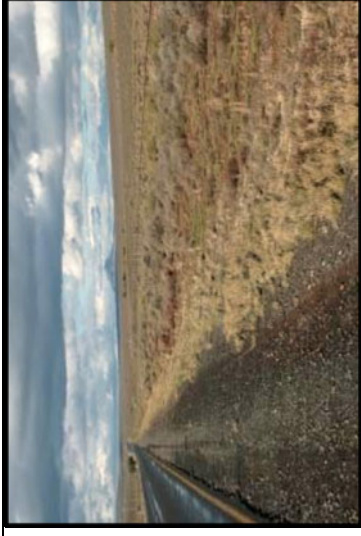
<p><b>CN6</b> S 31° 30' 13.6" E 19° 42' 16.3"</p>	<p><b>Calvinia Mosaic</b> <b>Hantam Karoo</b></p>	<p>At the R27-8 60.2E marker. As at most places the vegetation near the edge of the road is most disturbed (mowed) whereas closer to the fence it is shrubby with numerous weedy species. Species recorded include, <i>Chrysocoma ciliata</i>, <i>Pentzia incana</i>, <i>Drosanthemum</i> sp., <i>Osteospermum</i> sp., <i>Eriocephalus ericoides</i>, <i>Felicia</i> sp. <i>Salvia</i> sp. <i>Stipagrostis namaquense</i>, <i>Lycium</i> sp. <i>Hermannia</i> sp., <i>Atriplex semibaccata</i>, <i>Galenia sarcophylla</i>, <i>Tetragonia</i> sp., <i>Oxalis pes-caprae</i>, <i>Galenia africana</i>, <i>Mesembryanthemum guerichianum</i>, <i>Salsola kali</i>, <i>Fingerhuthia africana</i>, <i>Ceratotheca triloba</i>.</p>	
<p><b>CN7</b> S 31° 30' 18.2" E 19° 41' 50.4"</p>	<p><b>Calvinia Mosaic</b> <b>Hantam Karoo</b></p>	<p>Lay-by area on north side of road at R 27-8 59.4E which is highly disturbed. Piles of gravel are present and the area is used for road-works. The south side of the road has short shrubby vegetation with a mowed grassy verge.</p>	





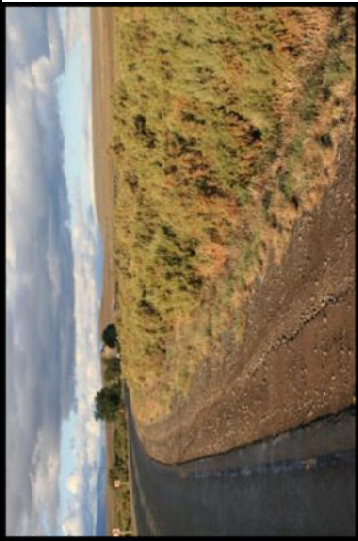

<p><b>CN8</b> S 31° 30' 16.9" E 19° 41' 16.9"</p>	<p><b>Calvinia Mosaic</b> <b>Hantam Karoo</b></p>	<p>A steep slope is found on the south side of the road here, near marker R27-8 58.6E. Owing to the road fill the vegetation is weedy.</p>	
	<p><b>Calvinia Mosaic</b> <b>Hantam Karoo</b></p>	<p>On the north side at waypoint CN8 the road cuts through shale sediments. The vegetation on the road verge is weedy but closer to the fence is less disturbed and is continuous with the natural community on the adjacent private property.</p>	



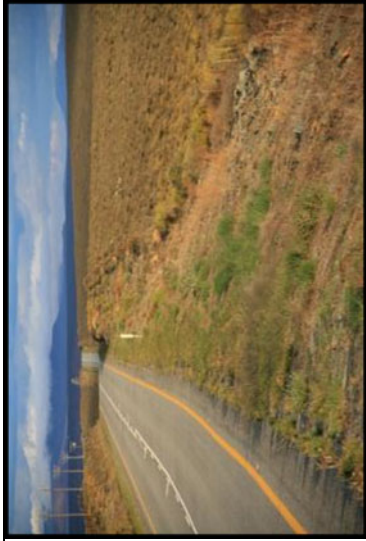
<p><b>CN9</b> S 31° 29' 59.9" E 19° 38' 39.0"</p>	<p><i>Eriocephalus ericoides</i> – <i>Pteronia glomerata</i> Roggeveld Karoo <b>Hantam Karoo</b></p>	<p>This location is at road marker R27-8 54.4E. The road is straight for a long distance with the road verge cleared of most vegetation except low grasses. Beyond the road verge within the road reserve is low shrubland that extends over a wide area both north and south of the road.</p>	
<p><b>CN11</b> S 31° 29' 44.1" E 19° 35' 16.1"</p>	<p><i>Eriocephalus ericoides</i> – <i>Pteronia glomerata</i> Roggeveld Karoo <b>Hantam Karoo</b></p>	<p>This waypoint is at R 27-8 49.0E. The road reserve on the south side is narrower than the north side and is highly disturbed.</p>	

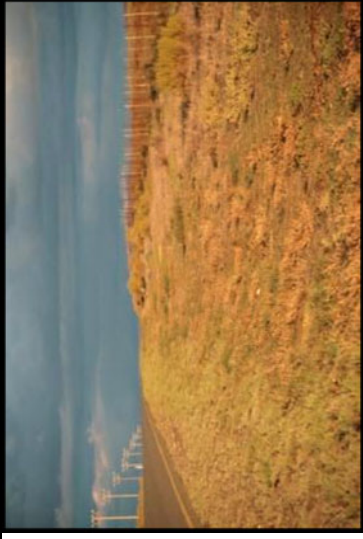

	<p><i>Ericephalus ericoides</i> –  <i>Pteronia glomerata</i>                  Roggeveld Karoo</p> <p><b>Hantam Karoo</b></p>	<p>On the north side at waypoint CN11 the vegetation beyond the verge is mowed but less disturbed close to the fence where there is typical low shrubland or “bossieveld”. <i>Brunsvigia bosmaniae</i> was found at this location</p>	
<p><b>CN13</b>                  S 31° 29' 45.4"                  E 19° 33' 31.2"</p>	<p><i>Ericephalus ericoides</i> –  <i>Pteronia glomerata</i>                  Roggeveld Karoo</p> <p><b>Hantam Karoo</b></p>	<p>Typical view of private property with low Karoo “bossieveld” – fairly heavily grazed -- to the south of entrance gate off the R27 to the proposed dolerite quarry.</p>	

<p><b>CN16</b> S 31° 29' 17.0" E 19° 27' 59.3"</p>	<p><i>Erodium cicutarium</i> – <i>Eriocephalus purpureus</i> Hantam Karoo <b>Hantam Karoo</b></p>	<p>At road marker R27-8 37.4E. The road reserve on the north side (opposite) is narrower than that on the south side (below right). As is mostly the case, the vegetation on the road verge (both sides) is highly disturbed and grassy. Closer to the fence the vegetation is low "bossieveld" dominated by succulent shrubs (Aizoaceae) and composite shrubs (Asteraceae).</p>	
	<p><i>Erodium cicutarium</i> – <i>Eriocephalus purpureus</i> Hantam Karoo <b>Hantam Karoo</b></p>	<p>View of the south side of the R27 at waypoint CN16.</p>	


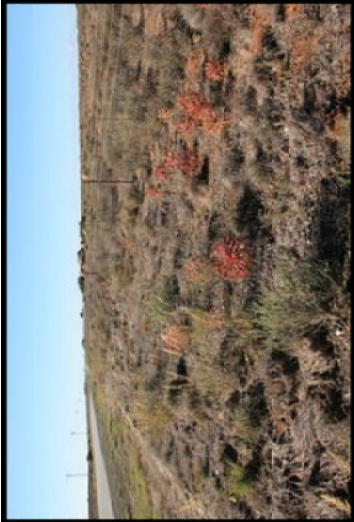
	<p><i>Erodium cicutarium</i> –  <i>Ericephalus purpureus</i>                  Hantam Karoo                  Hantam Karoo</p>	<p>Near waypoint CN16 the road cuts through shale sediments of the Ecca Group.</p>	
<p>CN17                  S 31° 29' 18.8"                  E 19° 26' 39.1"</p>	<p><i>Leipoldtia schulzei</i> –  <i>Ericephalus purpureus</i>                  Hantam Karoo                  Hantam Karoo</p>	<p>At the entrance to the farm Toekoms which is near the bridge built in 1959 over the Oorlogskloof River. The vegetation in the road reserve on the south side is highly disturbed with a suite of weedy species. On the north side of the road the vegetation is less disturbed, consisting of typical low 'bossieveld' where it has not been mowed.</p>	


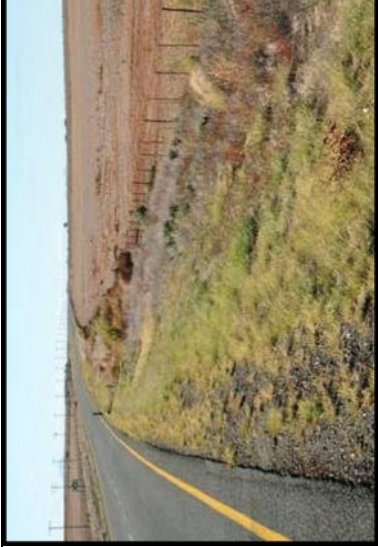
<p><b>CN18</b> S 31° 29' 18.9" E 19° 26' 12.5"</p>	<p><b>Leipoldtia schulzei</b> – <b>Ericephalus purpureus</b> Hantam Karoo <b>Hantam Karoo</b></p>	<p>This waypoint is a short distance to the west of the 1959 Oorlogskloof River bridge. On both the south (see photo) and north sides of the road there are dense stands of <i>Salsola aphylla</i> (gannabos), extending to the river banks at the bridge. On the north side there are also numerous mesquite trees (<i>Prosopis glandulosa</i>).</p>	
<p><b>CN19</b> S 31° 29' 03.9" E 19° 20' 16.1"</p>	<p><b>Leipoldtia schulzei</b> – <b>Ericephalus purpureus</b> Hantam Karoo <b>Hantam Karoo</b></p>	<p>At road marker R27-8 25 E. A change in the vegetation was noted at this waypoint. It is noticeably taller and dominated by <i>Pteronia pallens</i>. Other species include <i>Psilocaulon junceum</i>, <i>Zygophyllum</i> sp., <i>Ruschia intricata</i>, <i>Atriplex lindleyi</i> subsp. <i>inflata</i>, <i>Salsola tuberculata</i>.</p>	



	<p><i>Leipoldtia schulzei</i> –  <i>Eriocephalus purpureus</i>  Hantam Karoo  Hantam Karoo</p>	<p>Calcrete is found in the soil here on the south side of the road at waypoint CN19. This correlates well with the presence of <i>Pteronia pallens</i>.</p>	
<p><b>CN20</b>  S 31° 27' 31.4"  E 19° 17' 38.6"</p>	<p>Grootfontein Mosaic  Hantam Karoo</p>	<p>At the R27-8 19.8E road marker the vegetation in the road reserve is highly disturbed with <i>Galenia africana</i>, <i>Augea capensis</i> and <i>Pentzia incana</i> prominent. Other species include <i>Ruschia</i> sp., <i>Eriocephalus ericoides</i>, <i>Asparagus</i> sp., <i>Salsola kali</i> and <i>Erodium cicutarium</i>.</p>	
<p><b>CN21</b>  S 31° 26' 00.3"  E 19° 15' 49.3"</p>	<p>Grootfontein Mosaic  Hantam Karoo</p>	<p>Approximately 20km east of Nieuwoudtville westwards the road has been resurfaced. At the R27-8 19.8E road marker the vegetation in the road reserve is highly disturbed from the edge of the road up to the fence. There appears to be a correlation between the newer road surface and the roadside disturbance. The vegetation is dominated by grasses, <i>Galenia africana</i> and <i>Salsola kali</i>, all indicating the high level of disturbance.</p>	

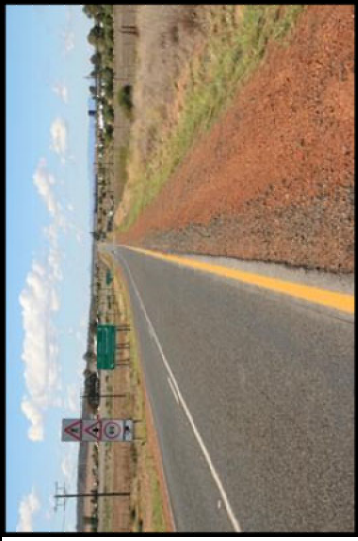
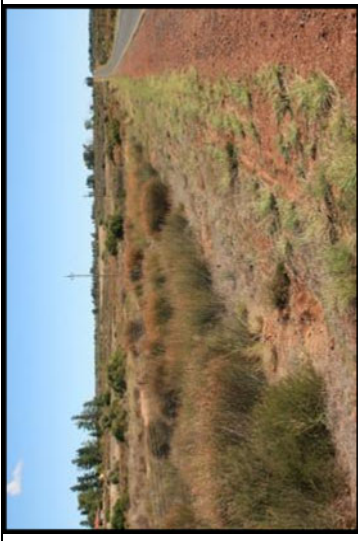
<p><b>CN22</b> S 31° 24' 14.6" E 19° 12' 59.3"</p>	<p><b>Grooffontein Mosaic</b> <b>Hantam Karoo</b></p>	<p>At the R27-8 10.2E road marker the road reserve is mowed almost to the fence. A 'row' of <i>Ruschia</i> sp. shrubs about 1m wide is found along the fence. <i>Brunsvigia bosmaniae</i> is present, being a geophyte it survives the mowing. Even <i>Galenia africana</i> is sparse at this location.</p>	
<p><b>CN24</b> S 31° 24' 05.5" E 19° 12' 39.6"</p>	<p><b>Nieuwoudtville Mosaic</b> <b>Hantam Karoo</b></p>	<p>At road marker R27-8 9.6E (near Borrow Pit 2). The road reserve on both sides is highly disturbed. On the north side the road verge is mowed for width of 5 m. The natural shrubby vegetation is dominated by <i>Pentzia incana</i>. Other species include <i>Augea capensis</i>, <i>Chrysocoma ciliata</i>, <i>Stipagrostis namaquense</i>, <i>Eragrostis curvula</i>, <i>Oxalis pes-caprae</i>, <i>Mesembryanthemum guerichianum</i>, <i>Galenia africana</i>, <i>Atriplex semibaccata</i>.</p>	

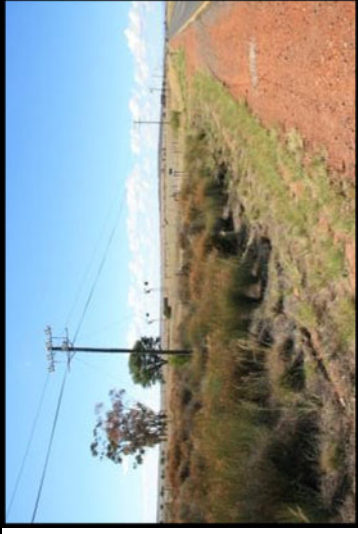




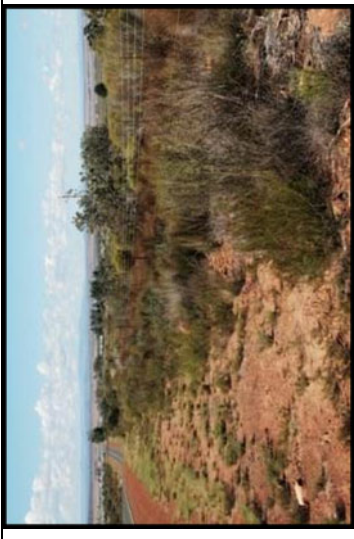
<p><b>CN25</b> S 31° 23' 25.1" E 19° 11' 04.8"</p>	<p><b>Nieuwoudtville Mosaic</b> <b>Hantam Karoo</b></p>	<p>This location is at the R27-8 6.8E road marker where the road reserve is highly disturbed. The vegetation is principally dry annual grasses with <i>Psilocaulon junceum</i>, <i>Lycium</i> sp., <i>Asparagus capensis</i>, <i>Atriplex nummularia</i>, <i>Atriplex semibaccata</i>, <i>Salsola kali</i>, <i>Mesembryanthemum guerichianum</i> and <i>Brunsvigia bosmaniae</i>.</p>	
<p><b>CN26</b> S 31° 23' 04.7" E 19° 10' 17.2"</p>	<p><b>Nieuwoudtville Mosaic</b> <b>Nieuwoudtville—</b> <b>Roggeveld Dolerite</b> <b>Renosterveld</b></p>	<p>At this road marker (R27-8 5.4E) the soil is derived from dolerite. The vegetation has numerous species but shows signs of intense disturbance. Species recorded include <i>Brunsvigia bosmaniae</i>, <i>Boo phone haemanthoides</i>, <i>Chrysocoma ciliata</i>, <i>Oxalis</i> sp. (pink flowers), <i>Trachyantra</i> cf. <i>falcata</i>, <i>Asparagus capensis</i>, <i>Berkheya</i> sp., <i>Oxalis</i> sp. (yellow flowers), <i>Salsola kali</i>, <i>Psilocaulon junceum</i>, <i>Malephora crassa</i>, <i>Atriplex semibaccata</i>, <i>Eragrostis curvula</i>, <i>Hermannia</i> sp.</p>	

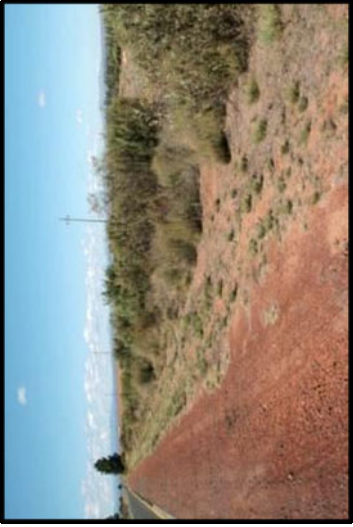

<p><b>CN27</b> S 31° 22' 35.1" E 19° 09' 08.8"</p>	<p><b>Nieuwoudtville Mosaic</b> <b>Nieuwoudtville Shale</b> <b>Renosterfeld</b></p>	<p>This location is at the R 27-8 3.4E marker. The road reserve is in poor condition. The vegetation consists mainly of dry grass and weedy species. No Nieuwoudtville Shale Renosterfeld is present and the adjacent private land has also been cleared of natural vegetation.</p>	
<p><b>CN28</b> S 31° 22' 16.0" E 19° 08' 21.4"</p>	<p><b>Nieuwoudtville Mosaic</b> <b>Nieuwoudtville Shale</b> <b>Renosterfeld</b></p>	<p>Near road marker R27-8 2.0 E. The road reserve is in poor condition. The verge is mowed and is populated by <i>Eragrostis curvula</i>. Other species recorded are <i>Galenia africana</i>, <i>Gomphocarpus fruticosus</i> and <i>Erodium moschatum</i>.</p>	

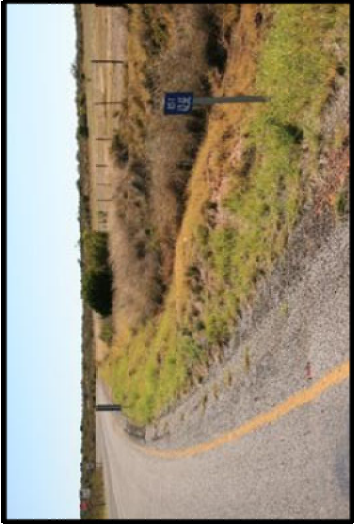
<p><b>CN29</b> S 31° 22' 09.8" E 19° 07' 43.7"</p>	<p><b>Nieuwoudtville Mosaic</b> <b>Nieuwoudtville Shale</b> <b>Renosterveld</b></p>	<p>This location is close to the R 27-8 1.0E marker at the entrance to the Nieuwoudtville Landfill. The road reserve is highly transformed and disturbed. The vegetation is dominated by grass and exotic statics or sea lavender (<i>Limonium sinuatum</i>) that has no doubt escaped from the nearby town. Other species recorded here include <i>Gomphocarpus fruticosus</i>, <i>Eragrostis curvula</i>, <i>Avena fatua</i> and <i>Salsola kali</i>.</p>	
<p><b>CN30</b> S 31° 22' 10.6" E 19° 07' 05.1"</p>	<p><b>Nieuwoudtville Mosaic</b> <b>Nieuwoudtville Shale</b> <b>Renosterveld</b></p>	<p>This location is on the outskirts of Nieuwoudtville. Stands of <i>Albucca canadensis</i> are found on both sides of the road. According to Vlok &amp; Schutte-Vlok (2010) presence of this species in abundance indicates intense disturbance and this is clearly the case here. The road reserve is dominated by grass and other weedy species contribute to the vegetation matrix.</p>	

<p><b>CN32</b> S 31° 22' 12.2" E 19° 06' 14.6"</p>	<p><b>Nieuwoudtville Mosaic</b> <b>Nieuwoudtville Shale</b> <b>Renosterveld</b></p>	<p>A short distance west of the R357 / R27 intersection near road marker R27-7 50.6E. Embankments are found on both sides of the road. The verge of the road is mowed but the road reserve is generally very disturbed and not sensitive. Apart from the dry grass which dominates, species recorded include <i>Pentzia incana</i>, <i>Atriplex semibaccata</i>, <i>Eragrostis curvula</i> and <i>Elytropappus rhinocerotis</i>.</p>	
<p><b>CN33</b> S 31° 22' 12.7" E 19° 05' 59.0"</p>	<p><b>Bokkeveld Sandstone</b> <b>Fynbos</b></p>	<p>This location near the R27-7 50.2 E road marker indicates the 'boundary' of the fynbos vegetation. <i>Willdenowia incurvata</i> (Sonnkwasriet) is the dominant species. The road reserve has variable condition westwards up the hill on both sides of the road. The road verge is mowed and not sensitive but between the road verge and the fence the fynbos vegetation is sensitive. The road reserve on the south side of the road is illustrated opposite.</p>	

	<p><b>Bokkeveld Sandstone</b> <b>Fynbos</b></p>	<p>The north side of the R27 near marker R 27-7 50.2E, dominated by <i>Willdenowia incurvata</i>. Other fynbos species of lower stature are also found here but some of the larger shrubs have been actively removed.</p>	
<p><b>CN34</b> S 31° 22' 14.6" E 19° 04' 57.5"</p>	<p><b>Bokkeveld Sandstone</b> <b>Fynbos</b></p>	<p>At road marker R27-7 48.6E there is fynbos on both sides of the road with the south side more heavily disturbed with mowed <i>Eragrostis curvula</i> on the road verge. Species found in the fynbos include <i>Anthospermum aethiopicum</i>, <i>Cliffortia ruscifolia</i>, <i>Searsia angustifolia</i>, <i>Oxalis</i> spp., <i>Diospyros glabra</i>, <i>Willdenowia incurvata</i>, <i>Lobelia</i> cf. <i>pinifolia</i>, <i>Pelargonium triste</i>.</p>	

	<p><b>Bokkeveld Sandstone</b> <b>Fynbos</b></p>	<p>The Restionaceae (<i>Willdenowia incurvata</i>) has been actively cut and piled into heaps near waypoint CN34. This was done as part of the 'job creation' programme. It is a highly undesirable practice that should be terminated since it negatively impacts the fynbos in the road reserve.</p>	
<p><b>CN35</b> S 31° 22' 16.2" S 19° 04' 04.9"</p>	<p><b>Bokkeveld Sandstone</b> <b>Fynbos</b></p>	<p><i>Willdenowia incurvata</i> has also be selectively cut and removed at this location near road marker R27-7 47.2E. Shrubs have also been actively cleared at this site. Despite this high degree of disturbance the fynbos vegetation has persisted and species recorded include, <i>Montinia caryophyllacea</i>, <i>Thesium sp.</i>, <i>Phylla sp.</i> (low, fluffy shrublet), <i>Ischyrolepis gaudichaudiana</i>, <i>Ruschia sp.</i>, <i>Lobostemon glaucophyllus</i>, <i>Anthospermum aethiopicum</i>, <i>Protea laurifolia</i>, <i>Senecio sp.</i></p>	

<p><b>CN36</b> S 31° 22' 17.0" E 19° 03' 18.8"</p>	<p><b>Bokkeveld Sandstone</b> <b>Fynbos</b></p>	<p>This waypoint is at the R27-7 46.0 road marker. The fynbos is intact in a narrow band on both sides of the road within the road reserve. (Over the fence the land has been cultivated). However, the fynbos is rather disturbed. Species recorded at this site include <i>Paranomus bracteolaris</i>, <i>Chironia baccifera</i>, <i>Anthospermum aethiopicum</i>, <i>Searsia angustifolia</i>, <i>Athanasia trifurcata</i>, <i>Eriocephalus africanus</i>, <i>Ruschia carolii</i>, <i>Cliffortia ruscifolia</i>, <i>Ischyrolepis gaudichaudiana</i>, <i>Lobostemon</i> sp., <i>Pelargonium scabrum</i>, <i>Chrysocoma ciliata</i>, <i>Leucadendron pubescens</i>, and <i>Passerina truncata</i> subsp. <i>truncata</i>. Further disturbance of this fynbos would be undesirable.</p>	
<p><b>CN37</b> S 31° 22' 17.1" E 19° 02' 07.9"</p>	<p><b>Bokkeveld Sandstone</b> <b>Fynbos</b></p>	<p>Between R27-7 44E and R 27-7 45E are two rows of pine trees (north and south side of the road) inside private property but close to the fence. There is fynbos in the road reserve but due to the proximity of the pine trees the fynbos has been suppressed and is not in good condition.</p>	

<p><b>CN38</b>  S 31° 22' 17.4"  E 19° 01' 12.3"</p>	<p><b>Bokkeveld Sandstone</b>  <b>Fynbos</b></p>	<p>This waypoint is near the edge of the Bokkeveld Escarpment at the top of Vanrhyn's Pass at road marker R27-7 42.6E. The vegetation in the road reserve on the south side is highly disturbed and very grassy. Species recorded include <i>Merxmuellera stricta</i>, <i>Eragrostis curvula</i>, <i>Diospyros glabra</i>, <i>Athanasia trifurcata</i>, <i>Anthospermum aethiopicum</i>, <i>Felicia filifolia</i> and <i>Seriphium plumosum</i>. On the north side (illustrated) the fynbos has been transformed to a grassy matrix. Species recorded include <i>Carpobrotus edulis</i>, <i>Pennisetum setaceum</i> (exotic invasive), <i>Eragrostis curvula</i>, <i>Cynodon dactylon</i>, <i>Anthospermum aethiopicum</i>, <i>Passerina truncata</i> subsp. <i>truncata</i> and <i>Gomphocarpus fruticosus</i>.</p>	
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### 5.3 Vegetation units and disturbance regime of the proposed borrow pits

The seven borrow pits are located at intervals along the R27 which would make for relatively easy accessibility and limited haulage distance. The borrow pits are listed following the convention of the road engineers to enable cross-referencing to other documentation. The order follows a geographical sequence from west to east.

#### 5.3.1 Borrow Pit 1: BP R27-7 km 51 LHS 7.1 (Waypoint CN31: S 31° 20' 01.3" E 19° 07' 06.1")

The mapped position of Borrow Pit 1 indicates that it occurs on the boundary between Nieuwoudtville Shale Renosterveld and Nieuwoudtville—Roggeveld Dolerite Renosterveld. Field investigation revealed that it is firmly within the latter type. Despite the fact that this vegetation type has been listed as Least Threatened in the National Spatial Biodiversity Assessment (Rouget *et al.* 2004), together with Nieuwoudtville Shale Renosterveld it harbours a very high concentration of geophytic (bulb) species many of which are endemic. This ecosystem is therefore considered as extremely important as a repository for plant biodiversity (D. Snijman pers. comm. – taxonomist at Compton Herbarium, Kirstenbosch) and therefore highly sensitive. This area also falls within the mapped Critical Biodiversity Areas for Namaqualand District Municipality (Figures 4 & 5) (Desmet & Marsh, 2008). Consequently it has high conservation value and should be impacted as little as possible. For this reason further exploitation of the existing borrow pit at the Borrow Pit 1 site is not advocated and discouraged in the strongest terms. Any further excavation of dolerite material at this site would result in a HIGH NEGATIVE impact with no effective mitigation possible.



**Figure 11.** Dolerite outcrop with existing borrow pit (quarry) at the Borrow Pit 1 site, as seen from the west. This area falls within a Critical Biodiversity area and is botanically highly sensitive.

### 5.3.2 Borrow Pit 2: BP R27-8 km 9.5 LHS 0.2 (Waypoint CN23: S 31° 23' 57.7" E 19° 12' 40.3")

Borrow Pit 2 is situated in an undulating landscape approximately 10 km east of Nieuwoudtville. The soils are dolerite-derived and this area is included in the Critical Biodiversity Map (Figure 4) for the Nieuwoudtville District within the Namaqualand District Municipality (Desmet & Marsh, 2008). The existing borrow pit depression has been invaded by weedy *Dittrichia graveolens* and has otherwise restored with sparse shrubs. The intention is to extend the existing borrow pit in a north-easterly direction. Ideally this area should not be exploited if the principle of avoiding Critical Biodiversity Areas is to be applied. Future excavation would impact undisturbed natural succulent-dominated shrubland but it is felt that since the vegetation surrounding the borrow pit is relatively wide-spread and no dolerite koppies or outcrops would be affected and that the field investigation did not reveal any 'red flag' plant species, the proposed extension of the borrow pit is deemed acceptable. Impact on the vegetation will, however, be of HIGH NEGATIVE significance on a local scale. Mitigation by appropriate rehabilitation would lower the impact to MEDIUM NEGATIVE.



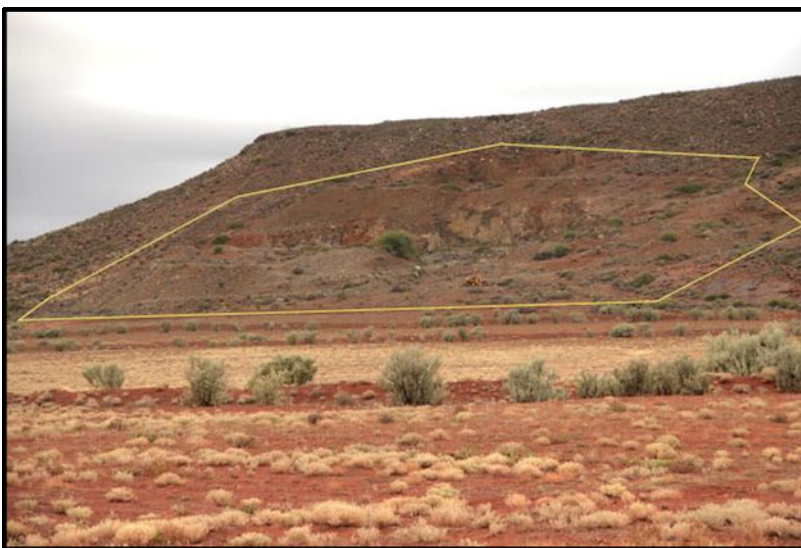
**Figure 12.** Borrow Pit 2 showing the existing excavation invaded by weedy pioneer species, notably *Dittrichia graveolens* and *Galenia africana*.

### 5.3.3 Borrow Pit 3: BP R27-8 km 32.6 RHS 6.2 (Waypoint CN15: S 31° 32' 15.4" E 19° 24' 11.9")

Borrow Pit 3 is at the site of an abandoned mine. A considerable amount of material was excavated in the process of mining for Iceland Spar (a variety of calcite). This material is now in abandoned tailings-heaps and is suitable for use as road metal. The area of the mine itself is highly

disturbed and the surrounding lands have been cleared of Hantam Karoo vegetation. These areas have been invaded *en masse* by the exotic invasive *Atriplex lindleyi* subsp. *inflata*. *Atriplex nummularia* (Old Man Saltbush), an exotic fodder plant, has also been planted on the cleared land.

The abandoned mine site is already highly disturbed and therefore any further activity in this area, if confined to the mine and disturbed fields, will have very little if any further negative impact. Removal of the tailings would be acceptable but any further active quarrying of the abandoned mine would be discouraged since it could then affect the undisturbed vegetation on the surrounding dolerite-capped hills.



**Figure 13.** The abandoned Iceland Spar mine outlined in yellow. The tailings dump that can be used for road building is seen in the lower left-hand corner.

#### 5.3.4 Borrow Pit 4: BP R27-8 km 39.8 LHS 0.1 (Waypoint CN14: S 31° 29' 26.4" E 19° 29' 28.3")

Borrow Pit 4 is on the farm Matjiesfontein and is close to the road on the north side. The existing pit is extensive and the proposal is to extend it northwards. The soil is dolerite-derived resulting from a dolerite intrusion into the Ecca shales. At this site there is no major discernable difference between the low shrubby succulent vegetation on the north-east side of the existing pit and the vegetation found on the shale-derived soils. The vegetation that would be impacted by extension of the borrow pit is extensive over the landscape to the north and east and the extension of the borrow pit is considered acceptable. A small dolerite koppie (Figure 14) will be lost due to the proposed excavation. This is unfortunate but the small size of the koppie and its relative isolation in the landscape indicate that this loss will be acceptable. As for Borrow Pit 2 impact on the vegetation will, however, be of HIGH NEGATIVE significance on a local scale. Mitigation by appropriate rehabilitation would lower the impact to MEDIUM NEGATIVE.



**Figure 14.** The existing Borrow Pit 4 on Matjiesfontein Farm which would be extended northwards into undisturbed Hantam Karoo veld. The small dolerite outcrop would be lost.



**Figure 15.** The Hantam Karoo vegetation on dolerite-derived soil at the boundary between Matjiesfontein Farm and the R27 road reserve.

#### 5.3.5 Borrow Pit 5: BP R27-8 km 45.0 RHS 0.2 (Waypoint CN12: S 31° 29' 43.7" E 19° 32' 44.7")

Borrow Pit 5 is extensively disturbed and has rehabilitated to a limited extent in certain parts. The disturbance has encouraged the invasion of exotic invasive species such as *Prosopis glandulosa*. The site is located in an area of Hantam Karoo 'bossieveld' (*Eriocephalus ericoides* – *Pteronia glomerata* Roggeveld Karoo according to Van der Merwe *et al.* 2008b) dominated by low succulent shrubs and composites such as *Pentzia incana*, *Eriocephalusericoides* and *Chrysocoma ciliata*. It has 'Least Threatened' conservation status (Rouget *et al.* 2004). There is little concern about the extension of this borrow pit and the potential impact is rated as MEDIUM NEGATIVE and with

mitigation i.e. smoothing of the disturbed surfaces to provide a graded landscape for re-colonisation of the shrubland, the impact can be mitigated to LOW NEGATIVE.



**Figure 16.** Borrow pit 5 which presently covers an extensive area would be extended southwards and also made deeper in places.

#### 5.3.6 Borrow Pit 6: BP R27-8 km 50.4 LHS 0.1 (Waypoint CN10: S 31° 29' 43.0" E 19° 36' 08.2")

Borrow Pit 6 is located close to the R27 road on the north side approximately 20 km west of Calvinia in Hantam Karoo vegetation (*Eriocephalus ericoides* – *Pteronia glomerata* Roggeveld Karoo according to Van der Merwe *et al.* 2008b). The disturbed area of the existing borrow pit has restored to a limited extent. The proposal is to extend the excavation northwards and as for Borrow Pit 5 there is little concern about the extension of this borrow pit. The anticipated impact is rated as MEDIUM NEGATIVE and with mitigation i.e. smoothing of the disturbed surfaces to provide a graded landscape for re-colonisation of the shrubland, the impact can be mitigated to LOW NEGATIVE.



**Figure 17.** The existing borrow pit (BP6) would be extended northwards into undisturbed Hantam Karoo veld.

**5.3.7 Borrow Pit 7: BP R27-8 km 61.6 RHS 1.0 (Waypoint CN 4: S 31° 30' 35.3" E 19° 43' 00.0")**

Borrow Pit 7 is near and to the south-west of the Calvinia Airfield. It is on an undulating plain but more specifically the existing pit has been excavated into a small rise. The geology is weathered dolerite and calcrete. The proposed extension would be southwards and south-eastwards and would impact low succulent Hantam Karoo shrubland of the Calvinia Mosaic but more specifically the *Eriocephalus ericoides* – *Pteronia glomerata* Roggeveld Karoo since the substrate is doleritic (see Van der Merwe *et al.* 2008b). Species include *Asparagus capensis*, *Aptosimum indivisum*, *Atriplex lindleyi* subsp. *inflata*, *Crassula* sp., *Eriocephalus ericoides*, *Felicia cf. muricata*, *Gethyllis* sp., *Mesembryanthemum guerichianum*, *Pentzia incana*, *Psilocalon junceum*, *Ruschia* sp. (spine-tipped leaves) and *Ruschia* sp. 2.

The area around the existing borrow pit is already disturbed and since the vegetation is very extensive in this region and has a Least Threatened conservation status, extension of the borrow pit would result in an impact with MEDIUM NEGATIVE significance.



**Figure 18.** View of Borrow Pit 7 looking south-east. It would be extended further south-eastwards and southwards



**Figure 19.** The edge of the existing Borrow Pit 7 on the east side. The vegetation has a high concentration of low succulents.



**Figure 20.** Dolerite boulders of various sizes, some covered with red and green lichen, litter the surface of the area where BP7 would be extended.

#### 5.4 Implications of bridge-widening on the vegetation

Four bridges are found along the R27 Section 7 & 8 route (Figure 3). They cross the Oorlogskloof River as it meanders eastwards.

At Bridge 1 (S 31° 28' 34.68" E 19° 18' 57.23") and Bridge 3 (S 31° 30' 18.87" E 19° 41' 38.8"), the bridges have very little influence on the vegetation in the road reserve, with the vegetation being as disturbed as elsewhere in the road reserve in the vicinity of the bridges (Figure 21). At Bridge 2 (S 31° 29' 17.53" E 19° 26' 25.53") *Salsola aphylla* forms dense stands in the road reserve up to the bridge on the west side (Figure 22) whereas on the east side the roadside vegetation is a disturbed collection of weedy species on the south side and a cleared lay-by on the north side (Figure 23). Bridge 4 (S 31° 28' 46.06" E 19° 46' 13.85") is at the entrance to Calvinia and the vegetation around the bridge structure consists mainly of weedy species due to intense disturbance (Figure 24).

The proposed widening of the bridges poses only a low negative impact on any natural vegetation in the vicinity of the bridges and no constraints on the construction activities should be imposed from a terrestrial flora viewpoint.



**Figure 21.** Approach to Bridge 3 on the east side. The vegetation near the bridge is as highly disturbed as the road reserve vegetation in the vicinity.



**Figure 22.** West side of bridge near Soetwater and Toekoms (Bridge 2) with dense *Salsola aphylla* in the road reserve.



**Figure 23.** East side of Bridge 2 with disturbed road reserve colonised by weedy species. On the right hand side is a lay-by under the large thorn-tree.



**Figure 24.** The entrance to Calvinia at the Oorlogskloof River crossing (Bridge 1). The area around the bridge at both ends is highly disturbed.

## 6. Assessment of Impacts

Impacts on the vegetation of the R27 Sections 7 & 8 and the seven borrow pits are assessed following the assessment methodology given in Appendix 1.



Two types of impacts are assessed:

- **Direct impacts:** Impacts occurring directly on the vegetation of the site as a result of the proposed effluent disposal / agricultural development.
- **Cumulative impacts:** impacts caused by several projects, strategic actions and existing trends (e.g. loss of habitat of a specific type).

## 7. Direct Impacts

The impacts on the vegetation and habitat in the road reserves and at the earmarked borrow pits are considered for two identified potential impacts which are:

- Loss of vegetation type and habitat including plant species due to road-building activities
- Loss of ecological processes e.g. fire, pollination.

These impacts are applied to the different vegetation types according to the national vegetation classification (broader units) as they occur in Sections 7 and 8 of the R27 National Route.

### 7.1 Loss of Hantam Karoo vegetation in Section 8 of the R27 National Route

The Hantam Karoo vegetation is very extensive and covers large areas of natural rangeland beyond the road reserve of the R27 Section 8. These rangelands are in variable condition since they are grazed mostly by sheep. Within the road reserve there are patches of vegetation that area in fair to good condition but mostly the vegetation is in poor condition. I consider this poor condition to be attributable to the historically inappropriate management of the vegetation within the road reserve. However, this would not condone further disturbance during future road-building activities or future road-reserve management. There could be further loss of Hantam Karoo vegetation due to impacts from road-building although with the present condition that loss would be limited. The impact is thus rated as of HIGH NEGATIVE significance without mitigation and LOW NEGATIVE with mitigation.

**Table 3. Loss of Hantam Karoo vegetation due to proposed road-work activities along Section 8 of the R27 National Route.**

CRITERIA	WITHOUT MITIGATION	WITH MITIGATION
Extent	Regional	Regional
Duration	Long-term	Long-term
Intensity	Medium	Low
Probability	Highly probable	Highly probable
Confidence	High	High
Significance	High	Low
Cumulative impact	High	Low
Nature of Cumulative impact	Loss of Hantam Karoo habitat within road reserves on both sides of the R27 Section 8 over a long distance	
Degree to which impact can be reversed	Low	
Degree to which impact may cause irreplaceable loss of resources	Medium	
Degree to which impact can be mitigated	Medium to High	

### **7.2 Loss of Hantam Karoo vegetation associated with excavation at the proposed borrow pits.**

The borrow pits in the Hantam Karoo vegetation are localised but they target doleritic areas. This has negative implications since these areas are probably more sensitive in the matrix of plant communities. However, in general the sites that have been selected are acceptable for further excavation and the anticipated impact will be MEDIUM NEGATIVE. Mitigation of the damage / impact in areas of borrow pits can be achieved by landscaping the areas (smoothing) after removal of the required road metal. This would hopefully encourage active re-colonisation of these sites by the natural flora, however, infestation by weedy species such

as *Dittrichia graveolens*, *Atriplex lindleyi* subsp. *inflata* and *Prosopis glandulosa*, can pose some post-construction problems.

**Table 4. Loss of Hantam Karoo vegetation due to proposed excavation at Borrow Pits 2 – 7.**

CRITERIA	WITHOUT MITIGATION	WITH MITIGATION
Extent	Local	Local
Duration	Long-term	Long-term
Intensity	Medium	Low
Probability	Highly probable	Highly probable
Confidence	High	High
Significance	Medium	Low
Cumulative impact	Medium	Low
Nature of Cumulative impact	A number of borrow pits are all located in similar vegetation with similar doleritic substrate	
Degree to which impact can be reversed	Low	
Degree to which impact may cause irreplaceable loss of resources	Low	
Degree to which impact can be mitigated	Medium	

### 7.3 Loss of Nieuwoudtville—Roggeveld Dolerite Renosterveld on Section 8 of the R27 National Route

Only one sample (CN26) was taken in the Nieuwoudtville—Roggeveld Dolerite Renosterveld on Section 8 of the R27 but observations along the route through the area where this vegetation occurs revealed that there is substantial disturbance of this vegetation unit alongside the road. Further future damage will therefore probably cause little additional impact on any natural vegetation. Consequently any loss of this vegetation is rated as LOW NEGATIVE.

**Table 5. Loss of Nieuwoudtville—Roggeveld Dolerite Renosterveldon Section 8 of the R27**

CRITERIA	WITHOUT MITIGATION	WITH MITIGATION
Extent	Local	Local
Duration	Long-term	Long-term
Intensity	Low	Medium
Probability	Highly probable	Highly probable
Confidence	High	High
Significance	Low	<i>Medium (Positive)</i>
Cumulative impact	Low	Low
Nature of Cumulative impact	Continued disturbance of Nieuwoudtville—Roggeveld Dolerite Renosterveldon Section 8 of the R27 which would inhibit this vegetation from re-colonising the road reserve	
Degree to which impact can be reversed	Low	
Degree to which impact may cause irreplaceable loss of resources	Medium	
Degree to which impact can be mitigated	Medium	

#### 7.4 Loss of Nieuwoudtville Shale Renosterveld on Section 8 of the R27 National Route

Nieuwoudtville Shale Renosterveld is one of the most important vegetation types on R27 Section 8. However, historically it has been treated very harshly in the road reserve (see waypoints CN27 – CN 32, Table 2). The result is that the vegetation has transformed mainly to grasses, particularly exotic annual species, and weedy shrubs such as *Gomphocarpus fruticosus*. The geophytic flora appears to have been lost, probably due to the application of weed-killer. Future road-building activities will therefore have only a LOW NEGATIVE impact on the roadside flora in the area where Nieuwoudtville Shale

Renosterveld should occur. Mitigation for impacts caused by road-building *per se* would thus not be necessary but it is recommended that post-construction attempts should be made to restore the renosterveld flora within the road-reserve in this vegetation unit.

**Table 6. Loss of Nieuwoudtville Shale Renosterveld on Section 8 of the R27**

CRITERIA	WITHOUT MITIGATION	WITH MITIGATION
Extent	Local	Local
Duration	Long-term	Long-term
Intensity	Low	Medium
Probability	Highly probable	Highly probable
Confidence	High	High
Significance	Low	<i>Medium (Positive)</i>
Cumulative impact	Low	Low
Nature of Cumulative impact	Continued disturbance of Nieuwoudtville Shale Renosterveld on Section 8 of the R27 which would inhibit this vegetation from re-colonising the road reserve	
Degree to which impact can be reversed	Medium	
Degree to which impact may cause irreplaceable loss of resources	Low	
Degree to which impact can be mitigated	Medium	

### 7.5 Loss of Nieuwoudtville—Roggeveld Dolerite Renosterveld associated with proposed excavation at Borrow Pit 1.

Nieuwoudtville—Roggeveld Dolerite Renosterveld is considered of high conservation importance (see above). **Loss of this vegetation type at Borrow Pit 1 would have an unacceptably high negative impact.** It is therefore advised that this is a 'No Go' site for the further extension of the existing borrow pit.

**Table 7. Loss of Nieuwoudtville—Roggeveld Dolerite Renosterveld at proposed Borrow Pit 1.**

CRITERIA	WITHOUT MITIGATION	WITH MITIGATION
Extent	Local	Local
Duration	Long-term	Long-term
Intensity	High	High
Probability	Highly probable	Highly probable
Confidence	High	High
Significance	High	High
Cumulative impact	High	High
Nature of Cumulative impact	Loss of Nieuwoudtville—Roggeveld Dolerite Renosterveldat proposed Borrow Pit 1 would contribute significantly to the loss of this special, high conservation value, vegetation type in its restricted range in the Nieuwoudtville District.	
Degree to which impact can be reversed	Low	
Degree to which impact may cause irreplaceable loss of resources	High	
Degree to which impact can be mitigated	Low	

### 7.6 Loss of Bokkeveld Sandstone Fynbos vegetation on Section 7 of the R27 National Route

Bokkeveld Sandstone Fynbos is under serious threat from agriculture, particularly rooibos tea cultivation, on the Bokkeveld Plateau. Therefore it must be conserved wherever possible. The road-reserve between the R357 / R27 intersection (near Nieuwoudtville) along the R27 on both sides to Vanrhyn's Pass has an important remnant of Bokkeveld Sandstone Fynbos. This must be extremely carefully observed and **no damage** due to road-building should be permitted. Any loss of this vegetation would result in a HIGH NEGATIVE impact.

**Table 8. Loss of Bokkeveld Sandstone Fynboson Section 7 of the R27 National Route.**

CRITERIA	WITHOUT MITIGATION	WITH MITIGATION
Extent	Local	Local
Duration	Long-term	Long-term
Intensity	High	High
Probability	Highly probable	High probable
Confidence	High	High
Significance	High	High
Cumulative impact	High	High
Nature of Cumulative impact	Loss of Bokkeveld Sandstone Fynbos in the road reserve will contribute to overall loss of this important vegetation type as well as loss of important road-reserve habitat.	
Degree to which impact can be reversed	Low	
Degree to which impact may cause irreplaceable loss of resources	High	
Degree to which impact can be mitigated	Medium	

### 7.7 Loss of ecological processes

Ecological processes vary from one vegetation type to the next and from one habitat to the next. Karoo vegetation therefore has different ecological processes to fynbos vegetation. However, it is prudent here to make only a general statement about potential loss of ecological processes. In the Karoo vegetation the impacts of loss of ecological processes in the area studied would be less than in the fynbos vegetation. No borrow pits are located in fynbos vegetation. Thus given the overall poor to fair condition of the

vegetation and habitat in the road reserves on Sections 7 and 8 of the R27, loss of ecological processes concomitant with loss of vegetation due to road-works can be generalised as LOW NEGATIVE.

**Table 9. Loss of ecological processes**

CRITERIA	WITHOUT MITIGATION	WITH MITIGATION
Extent	Regional	Regional
Duration	Long-term	Long-term
Intensity	Low	Low
Probability	Highly probable	Highly probable
Confidence	High	High
Significance	Low	Low
Cumulative impact	Low	Low
Nature of Cumulative impact	Loss of ecological processes in the road-reserve of R 27 Sections 7 & 8.	
Degree to which impact can be reversed	Low	
Degree to which impact may cause irreplaceable loss of resources	Low	
Degree to which impact can be mitigated	Low	

## 8. Mitigation Measures

### 8.1 Mitigation measures within the road reserve

- The most important mitigation measure would be to avoid causing any further disturbance of the vegetation within the road reserve. It is acknowledged that the verge of the road (a strip of 3 -- 5 m wide) should be mowed and kept clear of vegetation for safety and visibility purposes. However, there is no need to disturb the vegetation in the zone between the verge and the boundary fences. Although the latter zone is generally in poor condition



along Section 8 of the R27 route, this condition can be improved by minimising disturbance which would allow the shrubs to regenerate, create greater cover and enhance species diversity and the functioning of ecological processes in the roadside vegetation.

- Where disturbance is unavoidable, areas that are disturbed must be monitored by an Ecological Control Officer and once construction is completed, such areas must be treated appropriately to enhance regeneration of the roadside vegetation. This could be done by collecting seed from plants in the same community in nearby undisturbed vegetation which could be sown on disturbed areas.
- Weedy species such as *Galenia africana* (kraalbos), *Atriplex semibaccata*, *Atriplex lindleyi* subsp. *Inflata* (blasiebrak), *Prosopis glandulosa* (mesquite) and most importantly *Salsola kali* (Russian tumbleweed; rolbos) should be selectively removed prior to construction to inhibit further spread of these species along the road by construction activities. After construction these species should be actively controlled to prevent competition with more desirable species.
- Section 7 (Vanrhyn's Pass to Nieuwoudtville) which passes through Bokkeveld Sandstone Vegetation is sensitive and no vehicles or construction equipment should be allowed to damage or disturb the fynbos. This vegetation should be cordoned off with danger tape along its entire length of occurrence. In addition an educational exercise should be implemented with the contractor and workforce to impress on them the importance of this vegetation.
- Should the fynbos vegetation be inadvertently or unavoidably damaged, the Ecological Control Officer should implement measures to identify those areas for special attention for rehabilitation.
- If removal of fynbos vegetation is necessary for construction purposes e.g. for constructing culverts, post-construction restoration measures must be implemented e.g. plant material can be harvested using acceptable methods and used as a mulch to promote rehabilitation of the specific local vegetation. Hydroseeding using commercially available seed is not recommended.
- Stockpiling of road-building material must be confined to strictly demarcated areas such as at existing lay-bys to limit the distribution of this material in the road reserve.
- Extreme care must be taken to ensure that no fires are started by road crews that can spread into the roadside fynbos vegetation.

## 8.2 Mitigation measures at borrow pits

- The first and most important mitigation measure would be to completely exclude Borrow Pit 1 from consideration. An alternative borrow pit should be sought but it must be clearly understood that any alternative site within the Critical Biodiversity Areas mapped in Figure 5 would also not be considered acceptable.
- At those borrow pits deemed acceptable (apart from the abandoned mine), once excavation has been completed, the edges of the borrow pits should be smoothed to moderate gradients. There should be no steep slopes. This would limit erosion by encouraging quicker and more successful establishment of vegetation on the slopes.
- Invasion of the disturbed borrow pit areas by alien invasive species such as *Prosopis glandulosa* (mesquite) should be monitored and where necessary control measures implemented.

## 9. Indirect Impacts

Nieuwoudtville is internationally known for its spring wild-flowers and is promoted as the 'bulb capital of the world'. This is not an undeserved claim since it has been well documented that Nieuwoudtville has an extremely high diversity of geophytic plant species, many of which are endemic to the area. The R27 as the main access route is an important tourist route, particularly in the spring when wild-flowers attract visitors. Therefore greater attention to the enhancement of biodiversity with better plant cover and habitat within the road corridor will positively contribute to developing the tourist potential of the R27 route. This will also be beneficial to small mammals and birds (Rijkwaterstaat (RWS), Dienst Weg- en Waterboukunde, 1995), particularly in areas where habitat has been lost due to cultivation of private property adjacent to the R27.

## 10. Cumulative Impacts

Loss of plant diversity and habitat due to road construction and the acquisition of road-building material would contribute to negative cumulative impacts in the short to medium term. However, the total areal extent of the proposed borrow pits (excluding Borrow Pit 1) is not large in comparison with the extent of the vegetation types where they would be situated. Negative cumulative impacts, particularly if mitigation measures are strictly applied, would predictably be low. With careful and improved management of the R27 road reserve during and post

construction whereby the roadside habitat could be improved would result in positive cumulative impacts.

## 11. Management and Monitoring Requirements

- Management of the roadside vegetation along the R27 Sections 7 & 8 is key to the successful rehabilitation of habitat along the R27 route discussed in this report. An Ecological Control Officer should be appointed who regularly monitors the construction activities during upgrading of the R27. Once the construction phase is completed, rehabilitation of disturbed sites should be actively implemented where necessary.
- Crucial to the successful future conservation of biodiversity along the R27 Sections 7 & 8 will be a revision of management plans and procedures for the road reserve. The present system of indiscriminate clearing of vegetation and piling of cut material should not be permitted in future. This not only destroys the natural vegetation but encourages invasion by alien invasive species such as *Salsola kali* (rolbos) which can have safety implications (See Appendix 2).

## 12. Conclusions

At face value the present generally poor condition of the vegetation in the road reserve of R27 Section 8, mainly Succulent Karoo vegetation would suggest that there is nothing of concern and that road-building would have low negative impacts. This is not so. The road reserve, despite its poor condition, is an important zone of natural or semi-natural habitat that should be managed to encourage a diversity of plant species. Road-building activities must therefore be approached with caution to ensure that there is no further degradation of the habitat. The management plans and procedures for the R27 Section 8 must be revised post-construction to establish an improved management regime that will enhance the roadside vegetation and habitat.

On the R27 Section 7 between Vanrhyn's Pass and Nieuwoudtville, great care must be taken to not disturb or damage the Bokkeveld Sandstone Fynbos in the road reserve. This vegetation type is becoming scarce due to agriculture and the fragments left in the road reserves have great conservation value. As for R27-8 above, the management of the vegetation in the road reserve of Section 7 must be revised and improved to maintain the fynbos vegetation in good condition.

Of the seven borrow pits considered, six have been deemed acceptable in terms of impacts on the vegetation. The exception is Borrow Pit 1 which must be excluded completely from consideration since it is found in a sensitive habitat within a Critical Biodiversity Area.

No 'Red Data' or endemic species were encountered during the survey. This is attributed to two factors: (1) the scope of the survey was such that it was confined to the generally highly disturbed road reserve of the R27 national route, and (2) the season of the survey was at the beginning of winter before the effects of winter rain could be expressed by the vegetation i.e. winter- and spring-flowering geophytes were not yet actively growing. The precautionary principle should therefore be applied in this respect. However, it is felt that the general emphasis on careful observance of the sensitivity of the Bokkeveld Sandstone Fynbos, Nieuwoudtville Shale Renosterveld and Nieuwoudtville—Roggeveld Dolerite Renosterveld should adequately accommodate for any threatened species that were not recorded but that are known to occur in these vegetation types and which may be influenced by the proposed road-building project.

Suggested mitigation measures must be carefully noted and applied to ensure limitation of the anticipated negative impacts that the project may have.

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## Appendix 1: CONVENTION FOR ASSIGNING SIGNIFICANCE RATINGS TO IMPACTS.

Specialists will consider seven rating scales when assessing potential impacts. These include:

- extent;
- duration;
- intensity;
- status of impact;
- probability;
- degree of confidence; and
- significance.

In assigning significance ratings to potential impacts before and after mitigation specialists are instructed to follow the approach presented below:

1. The core criteria for determining significance ratings are “extent” (Section 6.3.1), “duration” (Section 6.3.2) and “intensity” (Section 6.3.3). The preliminary significance ratings for combinations of these three criteria are given in Section 6.3.7.
2. The status of an impact is used to describe whether the impact will have a negative, positive or neutral effect on the surrounding environment. An impact may therefore be negative, positive (or referred to as a benefit) or neutral.
3. Describe the impact in terms of the probability of the impact occurring (Section 6.3.5) and the degree of confidence in the impact predictions, based on the availability of information and specialist knowledge (Section 6.3.6).
4. Additional criteria to be considered, which could “increase” the significance rating if deemed justified by the specialist, with motivation, are the following:
  - Permanent / irreversible impacts (as distinct from long-term, reversible impacts);
  - Potentially substantial cumulative effects (see Item 7 below); and
  - High level of risk or uncertainty, with potentially substantial negative consequences.
5. Additional criteria to be considered, which could “decrease” the significance rating if deemed justified by the specialist, with motivation, is the following:
  - Improbable impact, where confidence level in prediction is high.
6. When assigning significance ratings to impacts *aftermitigation*, the specialist needs to:
  - First, consider probable changes in intensity, extent and duration of the impact after mitigation, assuming effective implementation of mitigation measures, leading to a revised significance rating; and
  - Then moderate the significance rating after taking into account the likelihood of proposed mitigation measures being effectively implemented. Consider:
    - Any potentially significant risks or uncertainties associated with the effectiveness of mitigation measures;
    - The technical and financial ability of the proponent to implement the measure; and
    - The commitment of the proponent to implementing the measure, or guarantee over time that the measures would be implemented.

7. The cumulative impacts of a project should also be considered. "Cumulative impacts" refer to the impact of an activity that may become significant when added to the existing activities currently taking place within the surrounding environment.
8. Where applicable, assess the degree to which an impact may cause irreplaceable loss of a resource. A resource assists in the functioning of human or natural systems, i.e. specific vegetation, minerals, water, agricultural land, etc.
9. The significance ratings are based on largely objective criteria and inform decision-making at a project level as opposed to a local community level. In some instances, therefore, whilst the significance rating of potential impacts might be "low" or "very low", the importance of these impacts to local communities or individuals might be extremely high. The importance which I&APs attach to impacts must be taken into consideration, and recommendations should be made as to ways of avoiding or minimising these negative impacts through project design, selection of appropriate alternatives and / or management.

The relationship between the significance ratings after mitigation and decision-making can be broadly defined as follows (see overleaf): substance

Significance rating	Effect on decision-making
VERY LOW; LOW	Will not have an influence on the decision to proceed with the proposed project, provided that recommended measures to mitigate negative impacts are implemented.
MEDIUM	Should influence the decision to proceed with the proposed project, provided that recommended measures to mitigate negative impacts are implemented.
HIGH; VERY HIGH	Would strongly influence the decision to proceed with the proposed project.

## 1. Extent

"Extent" defines the physical extent or spatial scale of the impact.

Rating	Description
LOCAL	Extending only as far as the activity, limited to the site and its immediate surroundings. Specialist studies to specify extent.
REGIONAL	Western Cape. Specialist studies to specify extent.
NATIONAL	South Africa
INTERNATIONAL	

## 2. Duration

"Duration" gives an indication of how long the impact would occur.

Rating	Description
SHORT TERM	0 - 5 years
MEDIUM TERM	5 - 15 years
LONG TERM	Where the impact will cease after the operational life of the activity, either because of natural processes or by human intervention.
PERMANENT	Where mitigation either by natural processes or by human intervention will not occur in such a way or in such time span that the impact can be considered transient.



### 3. Intensity

"Intensity" establishes whether the impact would be destructive or benign.

Rating	Description
ZERO TO VERY LOW	Where the impact affects the environment in such a way that natural, cultural and social functions and processes are not affected.
LOW	Where the impact affects the environment in such a way that natural, cultural and social functions and processes continue, albeit in a slightly modified way.
MEDIUM	Where the affected environment is altered, but natural, cultural and social functions and processes continue, albeit in a modified way.
HIGH	Where natural, cultural and social functions or processes are altered to the extent that it will temporarily or permanently cease.

### 4. Loss of resources

"Loss of resource" refers to the degree to which a resource is permanently affected by the activity, i.e. the degree to which a resource is irreplaceable.

Rating	Description
LOW	Where the activity results in a loss of a particular resource but where the natural, cultural and social functions and processes are not affected.
MEDIUM	Where the loss of a resource occurs, but natural, cultural and social functions and processes continue, albeit in a modified way.
HIGH	Where the activity results in an irreplaceable loss of a resource.

### 5. Status of impact

The status of an impact is used to describe whether the impact would have a negative, positive or zero effect on the affected environment. An impact may therefore be negative, positive (or referred to as a benefit) or neutral.

### 6. Probability

"Probability" describes the likelihood of the impact occurring.

Rating	Description
IMPROBABLE	Where the possibility of the impact to materialise is very low either because of design or historic experience.
PROBABLE	Where there is a distinct possibility that the impact will occur.
HIGHLY PROBABLE	Where it is most likely that the impact will occur.
DEFINITE	Where the impact will occur regardless of any prevention measures.

### 7. Degree of confidence

This indicates the degree of confidence in the impact predictions, based on the availability of information and specialist knowledge.

Rating	Description
HIGH	Greater than 70% sure of impact prediction.
MEDIUM	Between 35% and 70% sure of impact prediction.
LOW	Less than 35% sure of impact prediction.

## 8. Significance

“Significance” attempts to evaluate the importance of a particular impact, and in doing so incorporates the above three scales (i.e. extent, duration and intensity).

Rating	Description
VERY HIGH	Impacts could be EITHER: of <b>high intensity</b> at a <b>regional level</b> and endure in the <b>long term</b> ; OR of <b>high intensity</b> at a <b>national level</b> in the <b>medium term</b> ; OR of <b>medium intensity</b> at a <b>national level</b> in the <b>long term</b> .
HIGH	Impacts could be EITHER: of <b>high intensity</b> at a <b>regional level</b> and endure in the <b>medium term</b> ; OR of <b>high intensity</b> at a <b>national level</b> in the <b>short term</b> ; OR of <b>medium intensity</b> at a <b>national level</b> in the <b>medium term</b> ; OR of <b>low intensity</b> at a <b>national level</b> in the <b>long term</b> ; OR of <b>high intensity</b> at a <b>local level</b> in the <b>long term</b> ; OR of <b>medium intensity</b> at a <b>regional level</b> in the <b>long term</b> .
MEDIUM	Impacts could be EITHER: of <b>high intensity</b> at a <b>local level</b> and endure in the <b>medium term</b> ; OR of <b>medium intensity</b> at a <b>regional level</b> in the <b>medium term</b> ; OR of <b>high intensity</b> at a <b>regional level</b> in the <b>short term</b> ; OR of <b>medium intensity</b> at a <b>national level</b> in the <b>short term</b> ; OR of <b>medium intensity</b> at a <b>local level</b> in the <b>long term</b> ; OR of <b>low intensity</b> at a <b>national level</b> in the <b>medium term</b> ; OR of <b>low intensity</b> at a <b>regional level</b> in the <b>long term</b> .
LOW	Impacts could be EITHER of <b>low intensity</b> at a <b>regional level</b> and endure in the <b>medium term</b> ; OR of <b>low intensity</b> at a <b>national level</b> in the <b>short term</b> ; OR of <b>high intensity</b> at a <b>local level</b> and endure in the <b>short term</b> ; OR of <b>medium intensity</b> at a <b>regional level</b> in the <b>short term</b> ; OR of <b>low intensity</b> at a <b>local level</b> in the <b>long term</b> ; OR of <b>medium intensity</b> at a <b>local level</b> and endure in the <b>medium term</b> .
VERY LOW	Impacts could be EITHER of <b>low intensity</b> at a <b>local level</b> and endure in the <b>medium term</b> ; OR of <b>low intensity</b> at a <b>regional level</b> and endure in the <b>short term</b> ; OR of <b>low to medium intensity</b> at a <b>local level</b> and endure in the <b>short term</b> .
INSIGNIFICANT	Impacts with: Zero to very low intensity with any combination of extent and duration.
UNKNOWN	In certain cases it may not be possible to determine the significance of an impact.

## 9. Degree to which impact can be mitigated

This indicates the degree to which an impact can be reduced / enhanced.

Rating	Description
NONE	No change in impact after mitigation.
VERY LOW	Where the significance rating stays the same, but where mitigation will reduce the intensity of the impact.
LOW	Where the significance rating drops by one level, after mitigation.
MEDIUM	Where the significance rating drops by two to three levels, after mitigation.
HIGH	Where the significance rating drops by more than three levels, after mitigation.

## 10 Reversibility of an impact

This refers to the degree to which an impact can be reversed.

Rating	Description
IRREVERSIBLE	Where the impact is permanent.
PARTIALLY REVERSIBLE	Where the impact can be partially reversed.
FULLY REVERSIBLE	Where the impact can be completely reversed.

## Appendix 2: Extract from Esler & Milton (2006)

### Box 1: Robins takes the gap: Unwanted consequences of Karoo roadside vegetation clearing for plants, wildlife and people (P. Milton)

On 11 March 2005, I drove from Lutzville via Neuwoudville, Calvinia, Williston and Panchburg to Prince Albert. There were 'unplanned' projects (5-6 people each) clearing roadside vegetation within 20 m either side of Neuwoudville, Calvinia and Williston. I stopped to see the road team as they were clearing the verges from the road (Photo 2A). The team leader told me that there were four reasons for the activity:

1. Improved road safety: it was assumed that clearing of the half-metre high shrub layer would reduce here and increase collisions with vehicles.
2. Improved visibility: it was assumed that removal of the low shrubs would improve visibility on the long straight road.
3. Simplified road maintenance.
4. Job creation.

I said that I was concerned about the removal of indigenous plants because they could be replaced with weeds. I was told that the workers were to 'spray' herbicides on the plants not just cutting the bushes back to ground level (Photo 2B), and that there were no herbicide plants in that region. They added that robins, with a preference for herbicide-treated areas, were not to be seen in the area where they were clearing. All these responses were given road willways and security, unfortunately the bees were clearly informed.

Any ecologist could have advised that clearing of indigenous vegetation would not make the roads a safer place or simplify road maintenance in the Nama Karoo. The reasons are that the clearing of long-lived shrubs leads to other, noxious and/or more flammable growing annual species and grasses. These provide a greater fuel (Photo 2C) when shrubs are dry and brown. The greater shrub structure, stems, branches and bushes to the road edges from the dry side. Secondly, although removal of shrubs slightly improves visibility in the short term, grasses and weeds, such as millets or timberwreeds (Calceola Aul) grow taller than Karoo bushes and hence obscure more of the road than did the original vegetation.

(Photo 2C) However, robins break off at ground level when dry and roll in the dust and spreading seeds, these birds are 1.5 m in diameter (I'll present an alarming spectacle for some motorists) (Photo 2D).

Whether or not there are rare plants in the roadways of the Nama Karoo is unknown. There have been few plant collections from this part of the Karoo. What is certain, however, is that the plants on road verges are a potential seed source and source of species after drought. This is because the road verges benefit from rainfall runoff from the road and are not as intensively grazed as the adjacent veld. This is a source of seeds as much as a sink for forage.

When indigenous Karoo bushes are replaced by weeds, the weeds may move into the veld through the road vegetation.

As a site where roadside vegetation is being cleared to improve road verges for health and tourism, and to improve their nature conservation value by removing obstacles with herbivore vegetation, it is strange and tragic that natural vegetation should be cleared from road sides in the very arid part of South Africa.



**Photo 2 A.** Team funded by Extended Public Works Programme clearing indigenous Karoo bushes from the roadside between east of Neuwoudville in the Nama Karoo on 11 March 2005. Note the low dense and brown colour of the vegetation. **B.** The Karoo bushes are not controlled but are cut at ground level. The roots of the plants at least reduce erosion of soil by wind and water. Piles of cut branches are stacked against the fence. **C.** Grasses and weeds (including the tall like Russian Timberrweed) obscure road verges near Williston that were cleared of indigenous shrubs about two months previously. Note that the bushes are larger and greener than the local Karoo bushes. They therefore obscure more of the road as well as attracting bees and other insects for green forage plants in this dry landscape. **D.** A dry Russian Timberrweed (Calceola Aul) that has broken the off the soil and is about to roll across the road. The bush although light in weight, measures 1 m in diameter and could easily cause a driver to swerve particularly if it bounces across a motorist's path at night. An old name for this plant is perdenbush.