HANTAM MUNICIPALITY

CALVINIA BULK WATER SUPPLY

WATER USE LICENSE APPLICATION
FOR THE CONSTRUCTION OF NEW PIPELINES

FRESH WATER REPORT Version 2.1

A REQUIREMENT IN TERMS OF SECTION 21 OF THE NATIONAL WATER ACT
September 2021

bvi 50 YEAR CELEBRATION EST 1967-2017
• ENGINEERING • PROCUREMENT • MANAGEMENT

EnviroAfrica
Environmental Management and Impact Assessment
Omgewingsbestuur en Impakbeoordeling

REPORT

watsan AFRICA

Index

Abbreviations

Critical Biodiversity Area	CBA
Department of Environmental Affairs and Nature Conservation	DENC
Department of Environment, Fisheries and Forestry	DEFF
Department of Water and Sanitation	DWA
Ecological Importance	EI
Ecological Sensitivity	ES
Ecological Support Area	ESA
Environmental Impact Assessment	EIA
Ecological Importance and Sensitivity Category	EISC
Electronic Water Use License Application (on-line)	eWULAA
Government Notice	GN
Metres Above Sea Level	masl
National Environmental Management Act (107 of 1998)	NEMA
National Freshwater Environment Priority Area	NFEPA
National Water Act (36 of 1998)	NWA
Present Ecological State	PES
South Africa National Biodiversity Institute	SANBI
Water Use License Application	WULA

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1 Introduction

The town of Calvinia in the Hantam Karoo needs an upgrade of the current urban water provisioning system, with more boreholes and pipelines added to the system. The Hantam Municipality appointed the consulting civil engineering firm BVi of Upington to undertake the project. Projects of such a dimension requires an Environmental Impact Assessment (EIA).

Enviro Africa of Somerset West was subsequently appointed to carry out the EIA, in terms of NEMA, together with the public participation process (Figure 1).

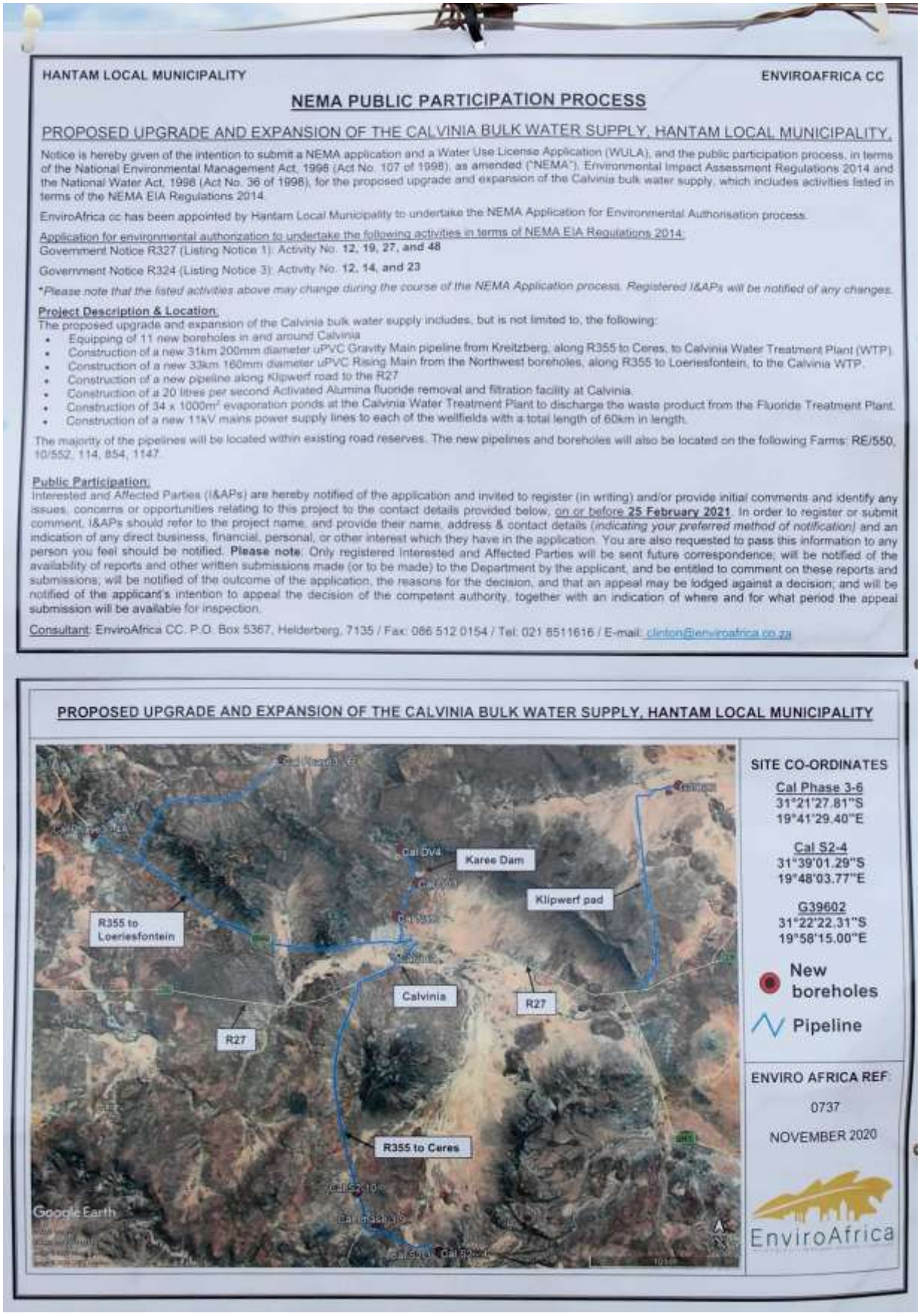
The envisaged pipelines cross many mostly dry drainage lines. These drainage lines only have water during and shortly after the occasional heavy rainfall event. These drainage lines are nevertheless recognized as legitimate water resources in terms of the NWA. Because of this, a WULA is required to legitimize the envisages construction if the pipelines, for which a Fresh Water Report is to be submitted, along with a WULA.

WATSAN Africa was appointed to produce the Fresh Water Report and to carry out the WULA in terms of the NWA. The required site visits were conducted on 17 and 18 November 2020, along with other specialist scientists that were appointed for this project.

The Fresh Water Report must contain adequate information to allow for informed decision-making. The decision to approve the proposed urban development rests with DWS officials, in terms of S21 of the NWA. The Fresh Water Report must contain specified information according to a set profile, which has been developed over a number of years over many such reports and in accordance with GN509. A Risk Matrix is to be completed, as published on the DWA webpage.

WATSAN Africa has produced similar reports for projects in the Northern Cape, such as the Komaggas and Brandvlei pipelines, as well as for pipelines for the irrigation with treated wastewater in Calvinia. With these reports, an approach and methodology has been developed. This methodology has been further developed for the Calvinia bulk water pipelines.

The pipeline's position was changed, with the result that the freshwater report was updated. An additional site visit was conducted on 25 August 2021. This then is the updated report to include the relocation of the pipeline.



HANTAM LOCAL MUNICIPALITY

ENVIROAFRICA CC

NEMA PUBLIC PARTICIPATION PROCESS

PROPOSED UPGRADE AND EXPANSION OF THE CALVINIA BULK WATER SUPPLY, HANTAM LOCAL MUNICIPALITY

Notice is hereby given of the intention to submit a NEMA application and a Water Use License Application (WULA), and the public participation process, in terms of the National Environmental Management Act, 1998 (Act No. 107 of 1998), as amended ("NEMA"), Environmental Impact Assessment Regulations 2014 and the National Water Act, 1998 (Act No. 36 of 1998), for the proposed upgrade and expansion of the Calvinia bulk water supply, which includes activities listed in terms of the NEMA EIA Regulations 2014.

EnviroAfrica cc has been appointed by Hantam Local Municipality to undertake the NEMA Application for Environmental Authorisation process.

Application for environmental authorization to undertake the following activities in terms of NEMA EIA Regulations 2014:
Government Notice R327 (Listing Notice 1): Activity No. **12, 19, 27, and 48**

Government Notice R324 (Listing Notice 3): Activity No. **12, 14, and 23**

**Please note that the listed activities above may change during the course of the NEMA Application process. Registered I&APs will be notified of any changes.*

Project Description & Location:
The proposed upgrade and expansion of the Calvinia bulk water supply includes, but is not limited to, the following:

- Equipping of 11 new boreholes in and around Calvinia
- Construction of a new 31km 200mm diameter uPVC Gravity Main pipeline from Kreitzberg, along R355 to Ceres, to Calvinia Water Treatment Plant (WTP).
- Construction of a new 33km 160mm diameter uPVC Rising Main from the Northwest boreholes, along R355 to Loeriesfontein, to the Calvinia WTP.
- Construction of a new pipeline along Klipwerf road to the R27
- Construction of a 20 litres per second Activated Alumina fluoride removal and filtration facility at Calvinia.
- Construction of 34 x 1000m³ evaporation ponds at the Calvinia Water Treatment Plant to discharge the waste product from the Fluoride Treatment Plant.
- Construction of a new 11kV mains power supply lines to each of the wellfields with a total length of 60km in length.

The majority of the pipelines will be located within existing road reserves. The new pipelines and boreholes will also be located on the following Farms: RE/550, 10/552, 114, 854, 1147.

Public Participation:
Interested and Affected Parties (I&APs) are hereby notified of the application and invited to register (in writing) and/or provide initial comments and identify any issues, concerns or opportunities relating to this project to the contact details provided below, on or before **25 February 2021**. In order to register or submit comment, I&APs should refer to the project name, and provide their name, address & contact details (*indicating your preferred method of notification*) and an indication of any direct business, financial, personal, or other interest which they have in the application. You are also requested to pass this information to any person you feel should be notified. **Please note**: Only registered Interested and Affected Parties will be sent future correspondence; will be notified of the availability of reports and other written submissions made (or to be made) to the Department by the applicant, and be entitled to comment on these reports and submissions; will be notified of the outcome of the application, the reasons for the decision, and that an appeal may be lodged against a decision; and will be notified of the applicant's intention to appeal the decision of the competent authority, together with an indication of where and for what period the appeal submission will be available for inspection.

Consultant: EnviroAfrica CC. P.O. Box 5367, Helderberg, 7135 / Fax: 086 512 0154 / Tel: 021 8511616 / E-mail: clinton@enviroafrica.co.za

PROPOSED UPGRADE AND EXPANSION OF THE CALVINIA BULK WATER SUPPLY, HANTAM LOCAL MUNICIPALITY

SITE CO-ORDINATES

Cal Phase 3-6
31°21'27.81"S
19°41'29.40"E

Cal S2-4
31°39'01.29"S
19°48'03.77"E

G39602
31°22'22.31"S
19°58'15.00"E

New boreholes

Pipeline

ENVIRO AFRICA REF:
0737
NOVEMBER 2020

EnviroAfrica

Figure 1 Public participation

2 Legal Framework

The proposed development "triggers" sections of the National Water Act. These are the following:

S21 (c) *Impeding or diverting the flow of a water course*

The proposed pipeline is spanning the banks of drainage lines. The drainage lines would be altered, should the development go ahead.

S21 (i) *Altering the bed, bank, course of characteristics of a water course.*

Some part of the proposed pipeline will alter the characteristics of the banks of the drainage lines.

Government Notice 267 of 24 March 2017

Government Notice 1180 of 2002. *Risk Matrix.*

The Risk Matrix as published on the DWS official webpage must be completed and submitted along with the Water Use Licence Application (WULA). The outcome of this risk assessment determines if a letter of consent, a General Authorization or a License is required.

Government Notice 509 of 26 August 2016

An extensive set of regulations that apply to any development in a water course is listed in this government notice in terms of Section 24 of the NWA. No development take place within the 1:100 year-flood line without the consent of the DWS. If the 1:100-year flood line flood line is not known, no development may take place within a 100m from a water course without the consent of the DWS.

S27 of the NWA

The WULA should include the following aspects:

- Redressing past discrimination
- Efficient use of the water in public interest
- The socio-economic impact of the water use
- Catchment management strategies
- Effect on the water resource
- Effect on other water users

- Investments already made with regard to this WULA
- Meeting the requirements of the Ecological Reserve
- Duration of the undertaking

Likewise, the development triggers a part of the National Environmental Management Act, NEMA, 107 of 1998).

The EIA Regulations of 2014 No.1 Activity 12 states that no development may take place within 32m of a water course without the consent of the Department of Environmental Affairs and its provincial representatives. A part of the development is in drainage lines. Consequently, this regulation is relevant to this application.

This Fresh Water Report is focussed in S21 (c) and (i) of the NWA. Should it ever become necessary to extend a WULA to the taking of water from a resource in terms of S21 (a) or the storing of water in the additional reservoirs in terms of S21(b), a separate report is required, focussed on the specific requirements of these two sub-sections of the NWA.

3 Calvinia Climate

http://www.saexplorer.co.za/south-africa/climate/calvinia_climate.asp

Calvinia normally receives about 146mm of rain per year and because it receives most of its rainfall during winter it has a Mediterranean climate. The chart below (Figure 2, lower left) shows the average rainfall values for Calvinia per month. It receives the lowest rainfall (1mm) in January and the highest (23mm) in June. The monthly distribution of average daily maximum temperatures (centre chart below) shows that the average midday temperatures for Calvinia range from 15.3°C in July to 30.6°C in January. The region is the coldest during July when the mercury drops to 1.4°C on average during the night.

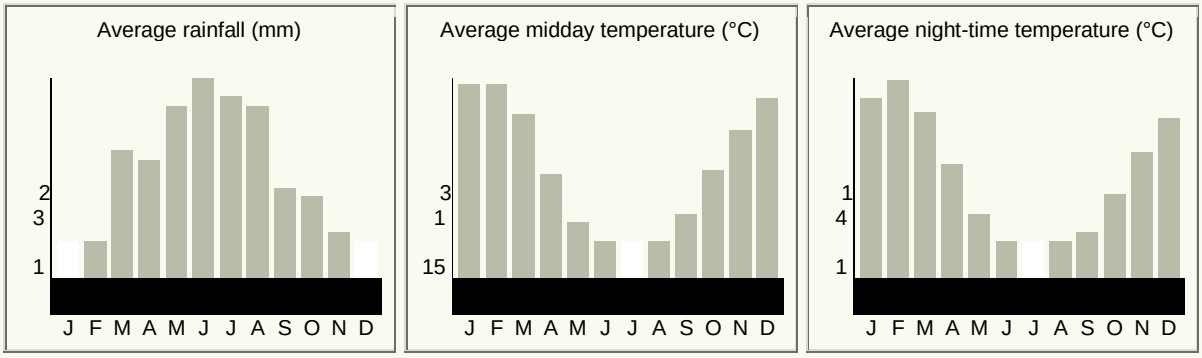


Figure 2 Calvinia Climate

With such a low rainfall the area can be described as arid. For at least two months of the year there is no rainfall at all.

The rainfall is highly variably. The drought of 2019 and the preceding years was one of the worst in recorded history. It was hard to conceive that the district's vegetation would ever recover from dry stubble to edible life stock fodder. The good rains of 2020 performed this very miracle. During the site visit on 16 November, the landscape was transformed. However, at the time sheep farming already had its impact, with the vegetation trimmed on much of the farm land.

4 Quaternary Catchments

https://gis.elsenburg.com/arcgis/rest/directories/arcgisoutput/GP_Services/ExportWebMapPro_GPServer/_ags_bfd1f77a-39e9-11eb-8e48-005056b43772.jpg

The quaternary catchments are shown in Figure 3.

Calvinia is located in the E40B quaternary catchment.

The Ceres Road pipeline from the south is located in the E40A quaternary catchment.

The Loeriesfontein Road pipeline to the west is located in the E40B quaternary catchment. A section of this pipeline will be constructed in the E32A quaternary catchment.

The E group of quaternary catchments are all part of the Olifants River catchment.

The Klipwerf Road pipeline will be constructed in the D58B quaternary catchment.

The D group of quaternary catchments are ultimately all part of the Orange River catchment.

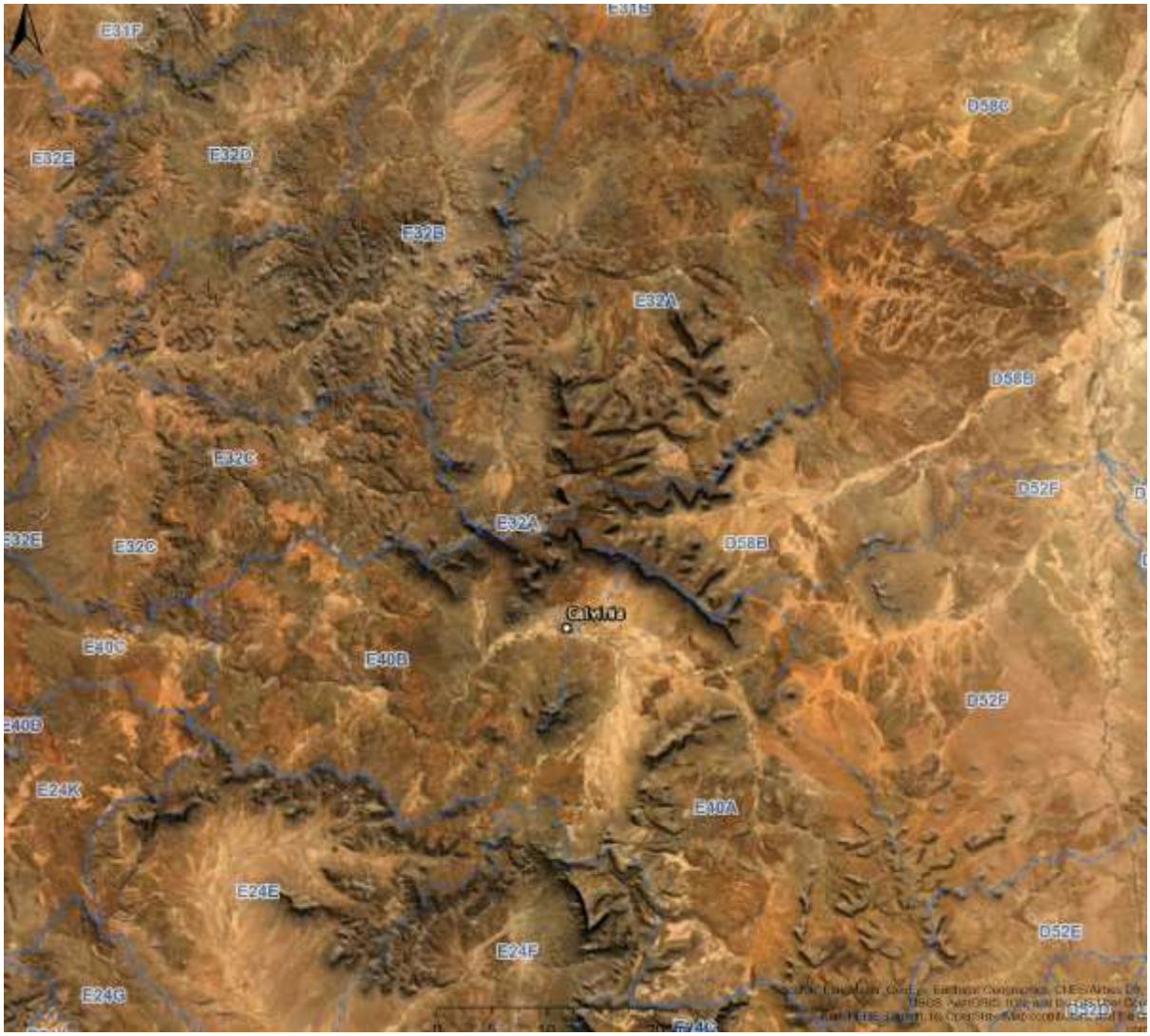


Figure 3 Quaternary Catchments (Cape Farm Mapper)

5 Vegetation

http://bgisviewer.sanbi.org/Html5Viewer/Index.html?configBase=http://bgisviewer.sanbi.org/Geocortex/Essentials/REST/sites/Vegmap/viewers/National_Vegetation_Map_2009/virtualdirectory/Resources/Config/Default&user=&extent=&layerTheme=

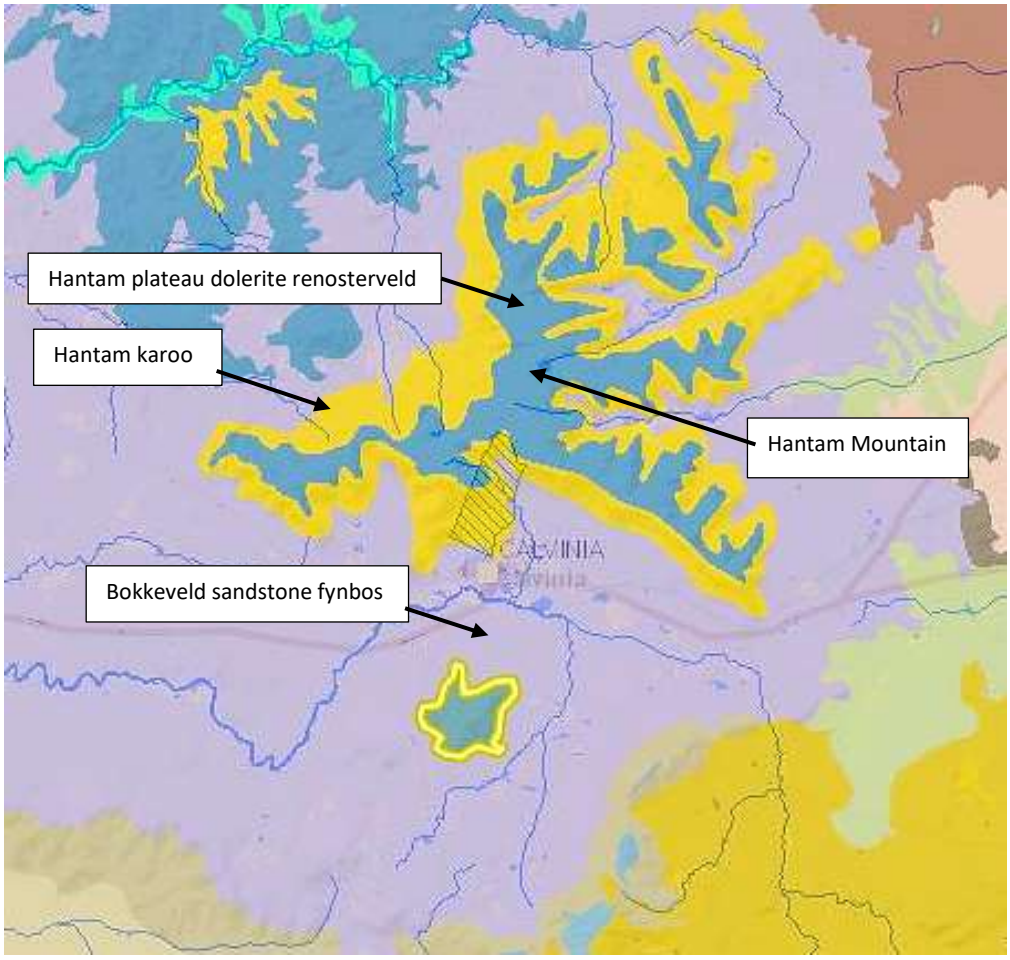


Figure 4 Vegetation

According to the SANBI webpage, just about all of the pipelines will stretch across Bokkeveld Sandstone Fynbos (Mucina & Rutherford, 2006). Only a section of the Loeriesfontein Road pipeline, the minor road AP2886, skirts the north western face of the Hantam Mountain, over some Hantam Karoo.

The rivers are all marked as NFEPA's.

6 The Project

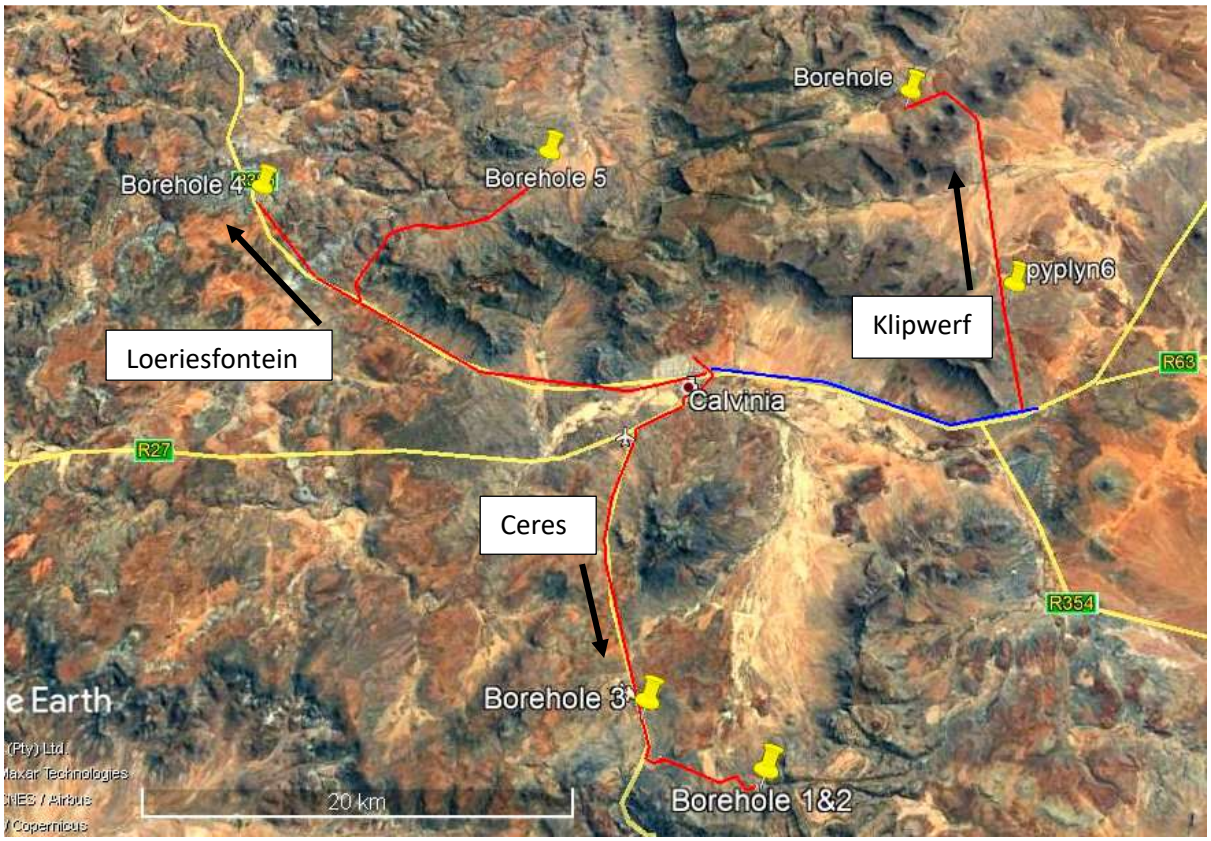


Figure 5 Project (BVi)

A total of 6 boreholes have been sunk to augment the water demand of the town of Calvinia (Figure 5). These boreholes will be connected to the Calvinia water purification works with pipelines. There will be 3 new pipelines.

- Ceres Route. This pipeline will be constructed along the road to Ceres to connect to two of the new boreholes south of Calvinia. This pipeline will be 26.5km long. Originally, it was planned that this pipeline will swing to the east at the R27 trunk road, follow the verge of the road and then cross the Oorlogskloof River. It was planned that the pipeline will be suspended on the bridge over the river, to connect to the existing pipeline in Calvinia, but this was not to happen. Instead, the pipeline had to be moved on a route directly to the river. It will now be trenched through the river to connect to the existing pipeline to the west of Calvinia on the northern verge of the R355 to Loeriesfontein (Figure 1).
- Loeriesfontein Route. There is one borehole on the side of the road to Loeriesfontein on the north west of Calvinia and another on a minor road that

turns out to the north east out of the Loeriesfontein road. The combined length of these pipelines is 44km.

- Klipwerf Route. This pipeline will be to the east of Calvinia, stretching to the north along the Klipwerf Road. The pipeline will be 22 km long. It will connect to an existing pipeline along the trunk road to the east of Calvinia.

It is therefore a substantial project with a total of length of 92,5km of pipeline. This must all be trenched, underground, crossing many drainage lines.

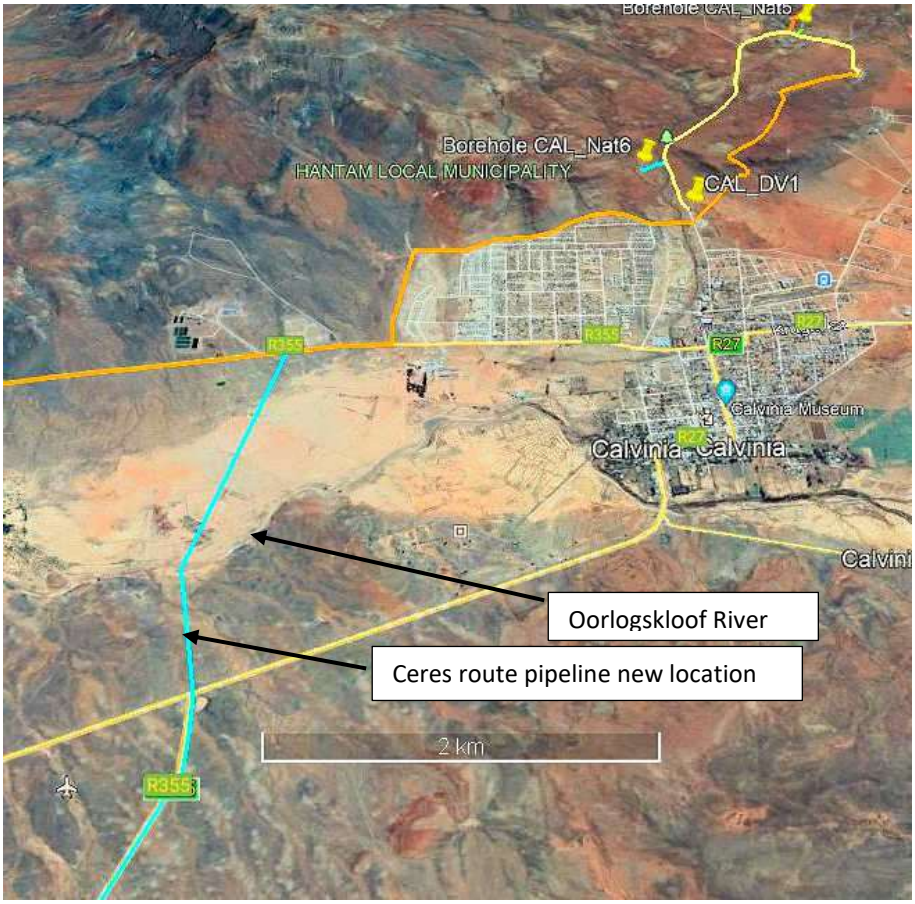


Figure 6 Ceres Road pipeline new location

7 River reaches in and around Calvinia

The envisaged Ceres Road pipeline from Borehole 1, 2 and 3 is located in the Oorlogskloof River sub-catchment (Figure 6). The upper reaches are some 20 km south of Calvinia, from where the river stretches to the north towards Calvinia, where it angles to the west. To the west of the escarpment it becomes the Kobee River, which joins up with the Doring River, the main tributary of the Olifants River.

The south western face of the Hantam Mountain gives rise to the upper tributaries of the Tierpoort River, which runs to the south and into the Oorlogskloof River. The envisaged pipeline from Borehole 4 and 5 will cross the Tierpoort River.

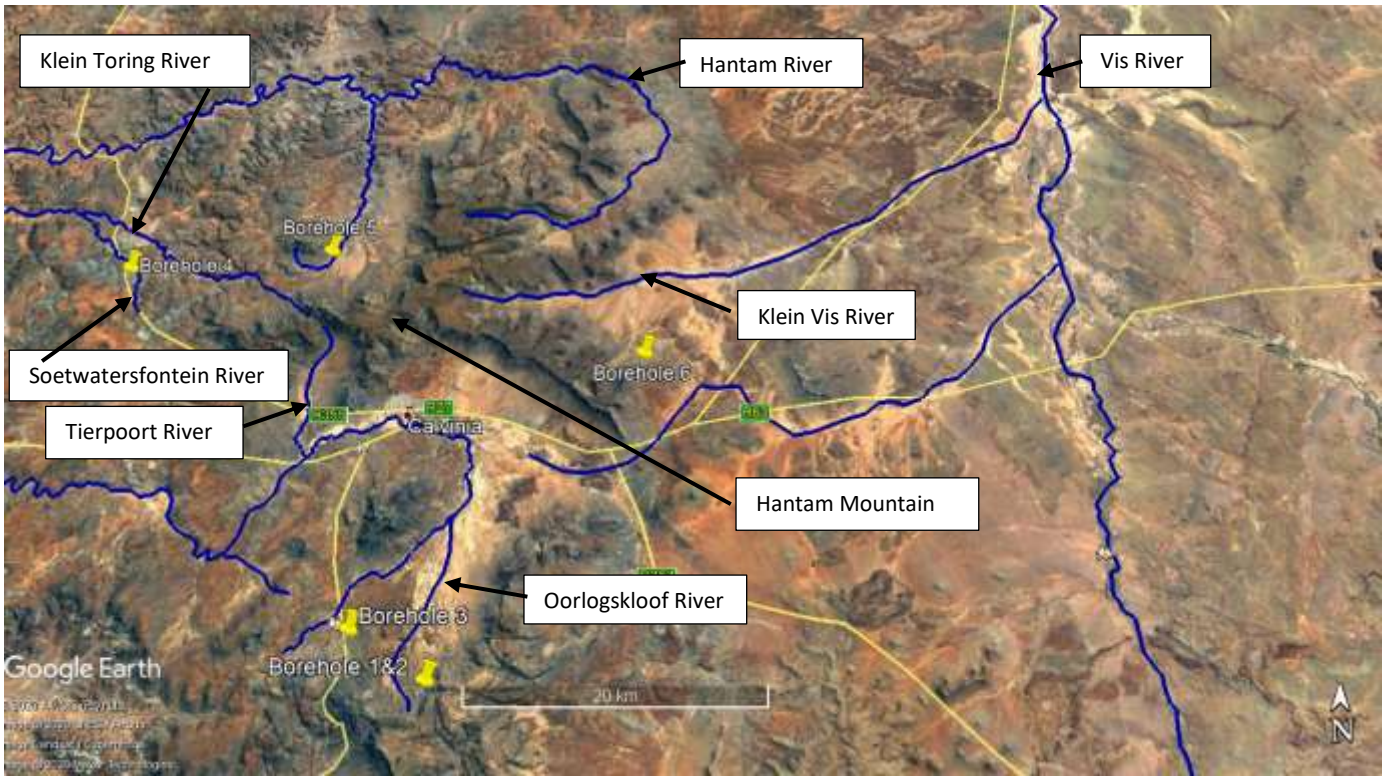


Figure 7 River Reaches in and around Calvinia

The pipeline from Borehole 5 will cross the upper reaches of the Soetwatersfontein River, which together with the Klein Toring River flows into the Hantam River. Far away to the west, the Hantam River becomes the Sout River, which together with the Vars River forms the relatively short reach of the Hol River, which in turn flow into the Olifants River near Lutzville close to the Atlantic Ocean.

Borehole Nr 6 is located in the sub-catchment of the Klein Vis River, which connects to the Vis River to the west. The Vis River heads in a northerly direction into a series of large pans in the central Bushmanland, where it becomes the Sak River. The overflow from the Sak River was named the Hartbees River to the north of the pans, to connect to the Orange River near Kakamas some 450km to the north of Calvinia.

Figure 1 is really a very much simplified explanation of the river reaches in and around Calvinia, to indicate the direction of the runoff from the ground on which the pipelines are to travel. In reality the district is covered with a dense network of drainage lines, like a bird's feather, with literally hundreds of secondary and tertiary sub-catchments and further sub-divisions thereof.

8 Mitigation measures

The envisaged pipelines are to follow the roads, according to planning, in the road reserves, from the various boreholes all the way to the water purification works in the town of Calvinia.

There were numerous crossings of the pipes over or through the drainage lines. There is now a crossing through the Oorlogskloof River as well. Where these crossings occur, the water supply pipeline must:

- Not wash open during the occasional storm event, when drainage lines may come down in flood;
- Allow the free flow of storm water as it was before the installation of the pipeline. Storm water must not dam up behind the pipeline. The installed pipeline and its associated infrastructure must not deviate the flow of storm water in any way.
- The pipeline, its construction and operation, must not be conducive to more sediment transportation along with occasional moving flood water.

These are the main aims of the environmental program during the life cycle of the envisaged pipeline.

A method must therefore be established to indicate where these crossing are, on a map, in such a way that the contractor who is about to entrench the pipelines, can easily and accurately find the crossings of concern, along with a clear indication of what sort of protection measures are required.

Protection measures include the following:

- The pipeline must be entrenched deeper, with more backfill cover. It is assumed that 700mm is adequate for most of the distance, but where it crosses more prominent drainage lines, it can vary between 900mm and 1200mm, depending on the size of the drainage line.
- Where large drainage lines or rivers are crossed, the pipeline must be protected with gabions, reno matrasses or even concrete structures. It should be buried deep enough so that the chances of washing open is minimized, at 1200mm or more. The riverbanks may need stabilization as well.

In addition to the above, more mitigation measures apply:

The best time to construct the pipelines will be during the dry season, when the likelihood of flash floods are at its lowest.

The pipleines should, wherever possible, be constructed on the uphill side of the roads and the culverts, where the erosion is consistently at its least and where the environmental impact is going to be at its least. It is going to be much more difficult and costly to construct the pipelines downstream in the eroded parts along the culverts.

The trenches must be compacted and landscaped to blend in with the surroundings, following the entrenchment of the new piplines.

Flood water flows faster through culverts, as has been previously explained, with a higher erosion potential when it exits on the downhill side. This can be exaserbated when the uphill side of culvers are covered with Reno matrasses and other smooth structures with a low flow resistance. For this reason it may be necessary to upgrade the downhill side of culverts as well with Reno matrasses or similar structures. At some crossings, where erosion is obvious, especially down steep inclines, conrete structures may be required.

An experienced ECO must be appointed to oversee the construction of the pipelines.

The pipeline, once in operation, must be regularly inspected to look for leaks. Should leaks occur, it should be fixed immediately.

9 Methodology

There were numerous drainage lines along the paths of the envisaged pipelines, too many to find the coordinates for each of these crossings.

To get to grips with the volume of the work that had to completed within the available time and budget of this WULA, as is the case with most if not all WULA's, the drainage lines, depending on their size, were divided into 5 classes (Table 1)

Classes 1, 2 and 3 were only counted. Class 4 and 5 were marked, the coordinates were noted, using a hand-held GPS. These drainage lines were photographed, upstream and downstream of the road, as well as the culvert or bridge.

A complete record of these photographs is available. This photographic record is substantial and cannot be all included in this Fresh Water Report, but is available upon request, should the contractor require more information.

The classification for some of the drainage lines posed difficulty, because erosion downstream of a culvert can be substantial, with dongas, vertical sides and wide beds, while upstream there can be scarcely a sign of any drainage line. It was surmised that the smooth foundation of a box culvert or a large pipe culvert can cause the flow of storm water to be accelerated. Where it gushes out from underneath the road, it possesses adequate velocity and as a result an enhanced erosion potential to scour out a substantial drainage line. Upstream of the culvert, the drainage line can be a class 1 of 2, while downstream it can be a class 4 or 5. In this event, an average score for the class was arrived at.

This has consequences for the lying of the pipeline. It seems to be much more cost effective to excavate the trench and bury the pipeline upstream of the culverts and the roads. Downstream of the culverts, adjacent to the roads, there are many more class

4 and 5 drainage lines that require much more earth works and other civil infrastructure.

Table 1 Drainage Line Classes

Class	Characteristics	Actions
Class 1	There is no discernible or visible drainage line. There is only a culvert.	No action is required
Class 2	There is a drainage line. The drainage line is faint.	No action is required
Class 3	There is a discernible drainage line. The drainage line is distinct.	No action is required, apart from that the trench must be 900mm deep
Class 4	There is an obvious, discernible drainage line, with clear signs of sediment transportation.	Pipeline protection measures and erosion control measures must be implemented. The pipeline must be covered with 900 to 1200mm of backfill.
Class 5	Drainage lines resemble a river, more often than not incised, often with a wide river bed.	Pipelines protection measures must be implemented, such as gabions, reno matrasses and anchors

10 Number of drainage lines

The number of drainage lines in each class and for each of the 3 routes are given in Table 2.

According to Table 2, there are 67 crossings (Class 3, 4 and 5) that will require protection measures, some of which can be substantial (Class 4 and 5).

Table 2 Number of drainage lines

Route	Class 1	Class 2	Class 3	Class 4	Class 5
Ceres Road	0	5	10	4	6
Loeriesfontein AP 2886 Road	37	33	24	13	4
Klipwerf Road	6	3	3	2	1
Total	43	41	37	19	11
Grand Total	151				

10.1 Ceres Road

Only the Class 4 and Class 5 crossings have been marked on Figure 7 and listed in Table 3.

The GPS coordinates were taken from the vehicle parked on the road next to the crossings, rather than right on the crossing, so the coordinates may be approximately 5 paces from the mark, but close enough to find the crossings from the given coordinates.

The blue lines on Figure 7 indicate the stretch of the envisaged pipeline where Class 1, 2 and 3 crossings were encountered and where apart from some deeper digging in of the pipeline at the Class 3 crossings is required, no further mitigation measures are asked for.

The resolution on Figure 7 is rather low, with the drainage lines not discernible. Hence the part of the Figure 7 from Crossing No. 7 to No. 11 was enlarged (Figure 8). This is still not ideal, as an even bigger enlargement is required, but the figure nevertheless gives more detail.

There are a number of drainage lines down the hill on the eastern side of the road, passing under the road with either box or pipe culverts. The mean slope from the highest point on the hill to the road is 7 vertical meters in every 100 horizontal meters. This is a steep slope that gives rise to a high velocity of running storm water during the occasional high rainfall event. The result of this is evident on the ground, with deep dongas scoured out.

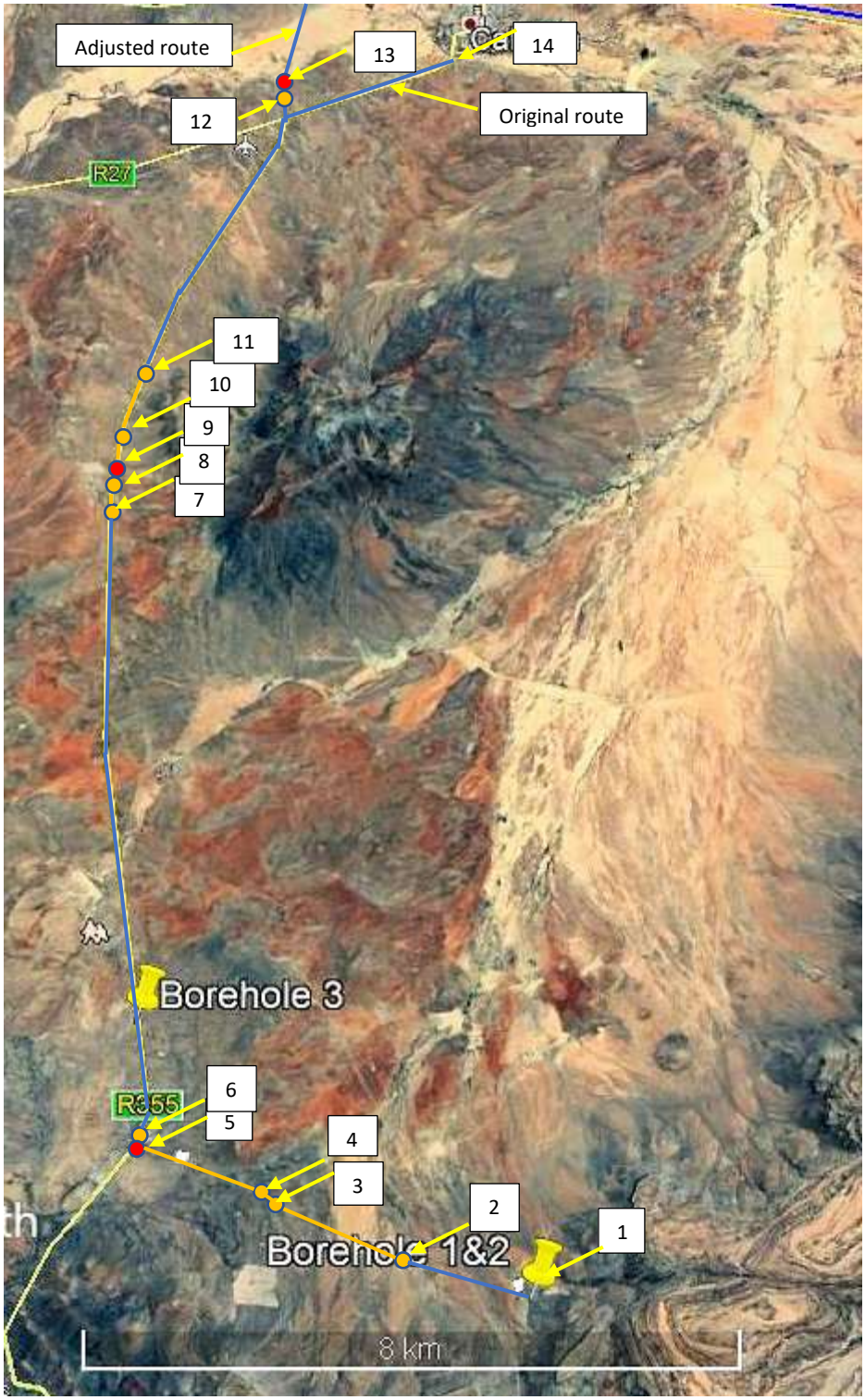


Figure 8 Ceres Road

Crossing No 11 (Figure 10) is serves as an example. Upstream, to the east of the road, apart from the storm water trench next to the shoulder of the road, the drainage line is hardly visible. It passes underneath the road with a pipe culvert. These are 3 pipes of 600mm diameter. Downstream of the culvert, the drainage line is deeply scoured out.

Pipe culverts can have from only one up to 6 pipes. These pipes can be 300, 600 or 900mm in diameter.

Crossing No. 9 is much larger, with the drainage line stretching to the south around the hill. This drainage line has a much larger catchment area. Upstream of the crossing, the drainage line is well defined, not deeply incised, some 2m wide and looks rather benign (Figure 11). It passes underneath the road through a constructed box culvert. Downstream, the foundation of the culvert is heavily eroded. The drainage line curves to the north, where it is eroded and deeply incised.

Table 3 Ceres Road

No.	Coordinates	
1	31°39.165'S 19°48.207'E	
2	31°38.863'S 19°47.282'E	
3	31°38.602'S 19°46.159'E	
4	31°38.543'S 19°45.984'E	
5	31°38.192'S 19°44.929'E	
6	31°38.070'S 19°44.982'E	
7	31°33.265'S 19°43.730'E	
8	31°32.948'S 19°43.703'E	
9	31°33.868'S 19°43.700'E	
10	31°32.586'S 19°43.692'E	
11	31°32.794'S 19°43.744'E	
12	31°29.171'S 19°44.583'E	
13	31°29.014'S 19°44.538'E	
14	31°28.891'S 19°46.163'E	

Figure 9 Ceres Road section enlarged

Figure 10 Ceres Road Crossing No. 11

Figure 10 Ceres Road Crossing No. 11 Continued

Figure 12 depicts the enlarged section from Borehole 1 and 2 on the very south part of the Ceres Road. The figure does not clearly show the drainage lines, but at least the road along which the pipeline is to be constructed is visible.

Upstream, Crossing No. 2 is about 3m wide, clearly defined, shallow and with a bed of coarse sand. The banks are lines with broken slate. Some of the bushes next on the banks are somewhat higher that those further away, but there is no clearly defined riparian zone (Figure 13).

There are no culverts of any sort. Storm water simply runs over the road when it rains.

Downstream, the drainage line is very much the same as upstream. It becomes deeper downstream.

The land between Crossing No. 2 and Borehole 1 and 2 is sandy, with a high clay content and is crisscrossed by numerous drainage lines. Some or small and others are bigger, incised, with clear signs of erosion. It seems as if the clay disperses easily in rainy weather, with signs of erosion and deposition everywhere.

Crossing No.5 (Figure 14) is one of the bigger ones, with a clearly defined drainage line, also shallow, but approximately 5 m wide. Judging from the debris washed up against the fence, the drainage line must, from time to time, burst its banks with

Figure 11 Ceres Road Crossing No. 9

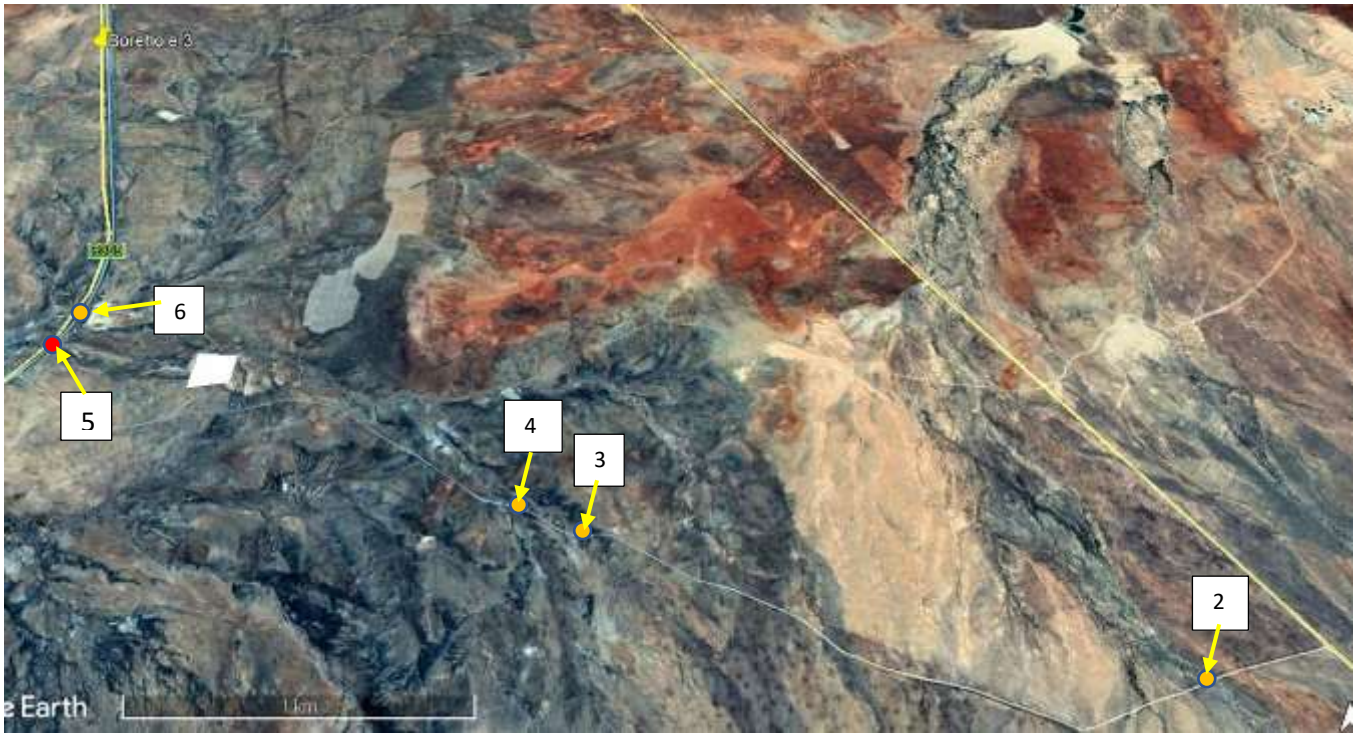


Figure 12 Ceres Road section enlarged Crossing 2 to 6

occasional flood water. It crosses the road through 900mm pipes. Downstream, the drainage line becomes more incised, with banks of approximately a meter high.

There is already a HDPE 120mm pipeline on the ground surface that passes underneath the R27 trunk road in a box culvert (Figure 14). Reportedly, this is a temporary pipeline that has been laid with funding from the DWA drought relieve fund from a borehole south of the R27 to the Calvinia water purification works. This is a different project, separate from the current one. However, the new PVC 200mm pipeline will have to follow very much the same route to the connection with the existing pipeline to the west of Calvinia on the R355 (Loeriesfontein Road).

On the section between the R27 and the Oorlogspoort River is a Class 4 crossing (Crossing No. 12, Figure 15), where the pipe must be dug in deeper.

The Class 5 crossing with the Oorlogskloof River (Crossing No.13, Figure 16) deserves more attention, as the river occasionally come down in flood with such a force that it can threaten the new pipeline. The riverbed downstream from the newly laid HDPE pipeline has been scoured out deeply (Figure 16). The pipeline at this crossing must therefore be protected, dug in deeper, with extra structures such as gabions and a reno mattress.

The flood plain here is wide and barren, with little vegetation and is disturbed because of mostly failed attempts to establish horticulture. The district here clearly is too dry, with rare availability of water in the river. The pipeline can be trenches without any ill effects to the aquatic environment.

Crossing No 14 is at the R27 road bridge (Figure 7). This crossing is not considered as a viable alternative any longer.

Figure 13 Ceres Road Crossing No. 2

Figure 14 Ceres Road Crossing No. 5

Figure 15 R27 crossing

Figure 16 Ceres Road crossing No 12

Figure 17 Oorlogskloof River crossing

10.2 Loeriesfontein Road

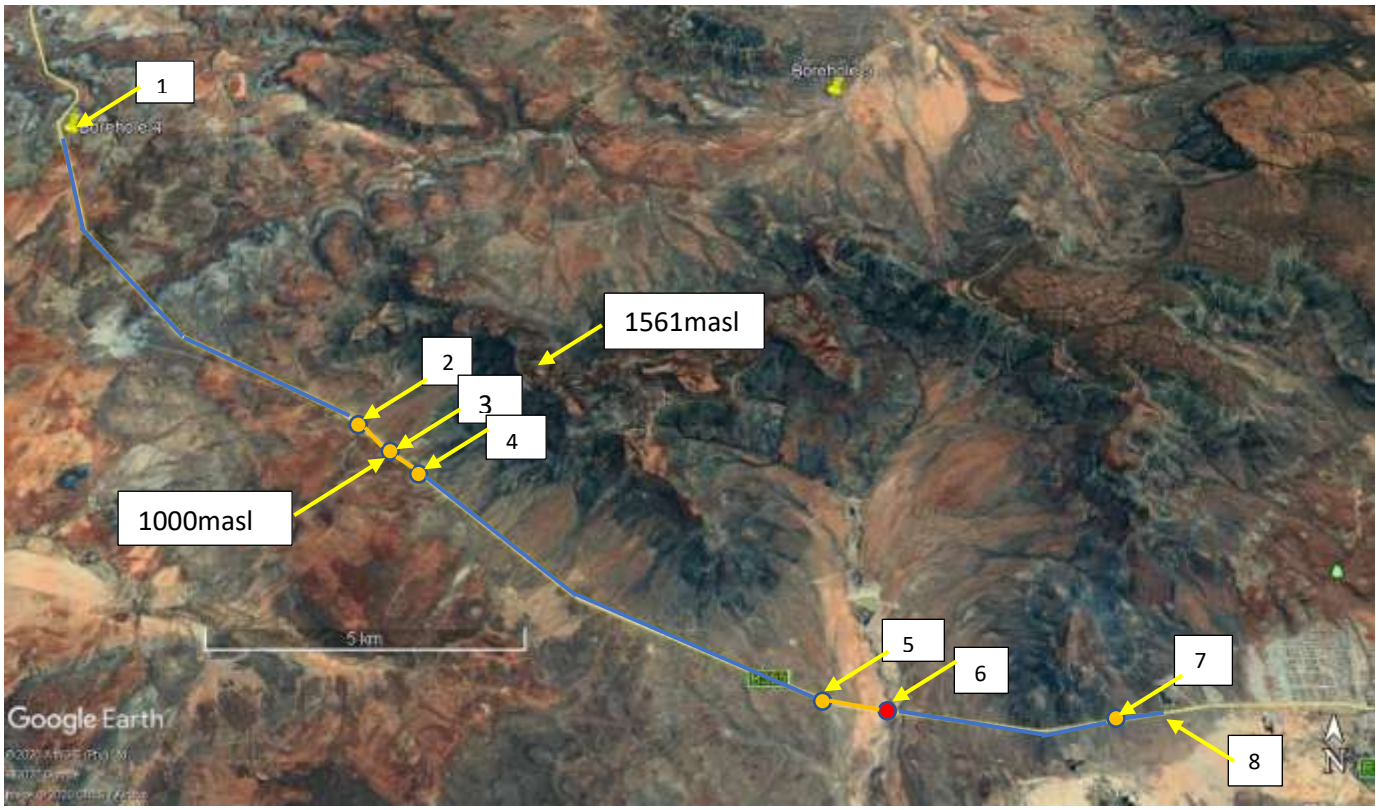


Figure 18 Loeriesfontein Road

Table 4 Loeriesfontein Road

No.	Coordinates	
1	31°21.766'S 19°31.846'E	●
2	31°25.558'S 19°36.247'E	●
3	31°25.755'S 19°36.509'E	●
4	31°26.022'S 19°36.887'E	●
5	31°28'068'S 19°41.063'E	●
6	31°28.173'S 19°41.723'E	●
7	31°28.195'S 19°43.917'E	●
8	31°28.136'S 19°44.344'E	●

The southwestern slope of the Hantam Mountain has numerous drainage lines (Figure 18). The slope here is 20 vertical meters in 100 horizontal meters, which is very steep.

This gives rise to a high velocity of runoff during stormy weather, with a very high erosion potential. Fortunately, most of these drainage lines are small, giving rise to Class 1, 2 and 3 crossings. Only 3 of the crossings in this stretch were assigned a Class 4 (Table 4).

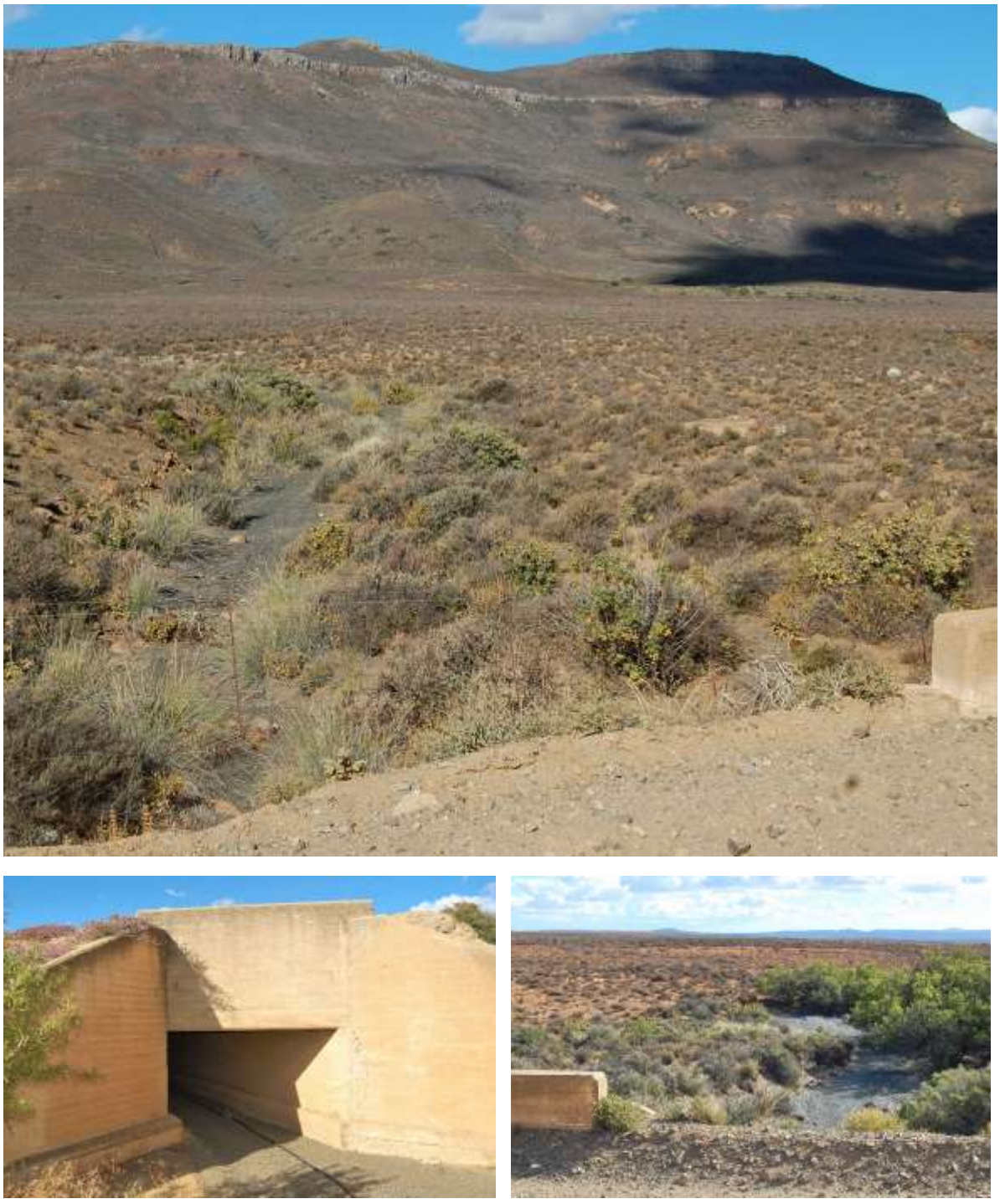


Figure 19 Loeriesfontein Crossing No.2

Upstream of the rather large constructed box culvert of Loeriesfontein Crossing No.2, the drainage line is small, with no more measures required but to dig the envisaged pipeline somewhat deeper in under the ground. Downstream, as is often the case with free-flowing culverts, the drainage line is much bigger, with a broad bed covered with coarse sand. The one bank has trees, that constitutes a scant riparian zone (Figure 19).

Adjacent to this crossing, Crossing No.3 is marked with a constructed box culvert as well.

Crossing No.4 is a box culvert as well. This culvert is seriously eroded and is need of repair. Likewise, there are a number of constructed box culverts that partly that have flood damage.

Figure 20 Crossing No. 6 Tierhoek River Bridge

Crossing No. 6 is the Tierhoek River Bridge (Figure 20). Again, the dry river bed upstream of the bridge is rather insignificant. Downstream, it is some 30m wide, with clear evidence of storm water activity. There are mature trees along the river banks, which make up the riparian vegetation.

10.3 Minor Road AP2886

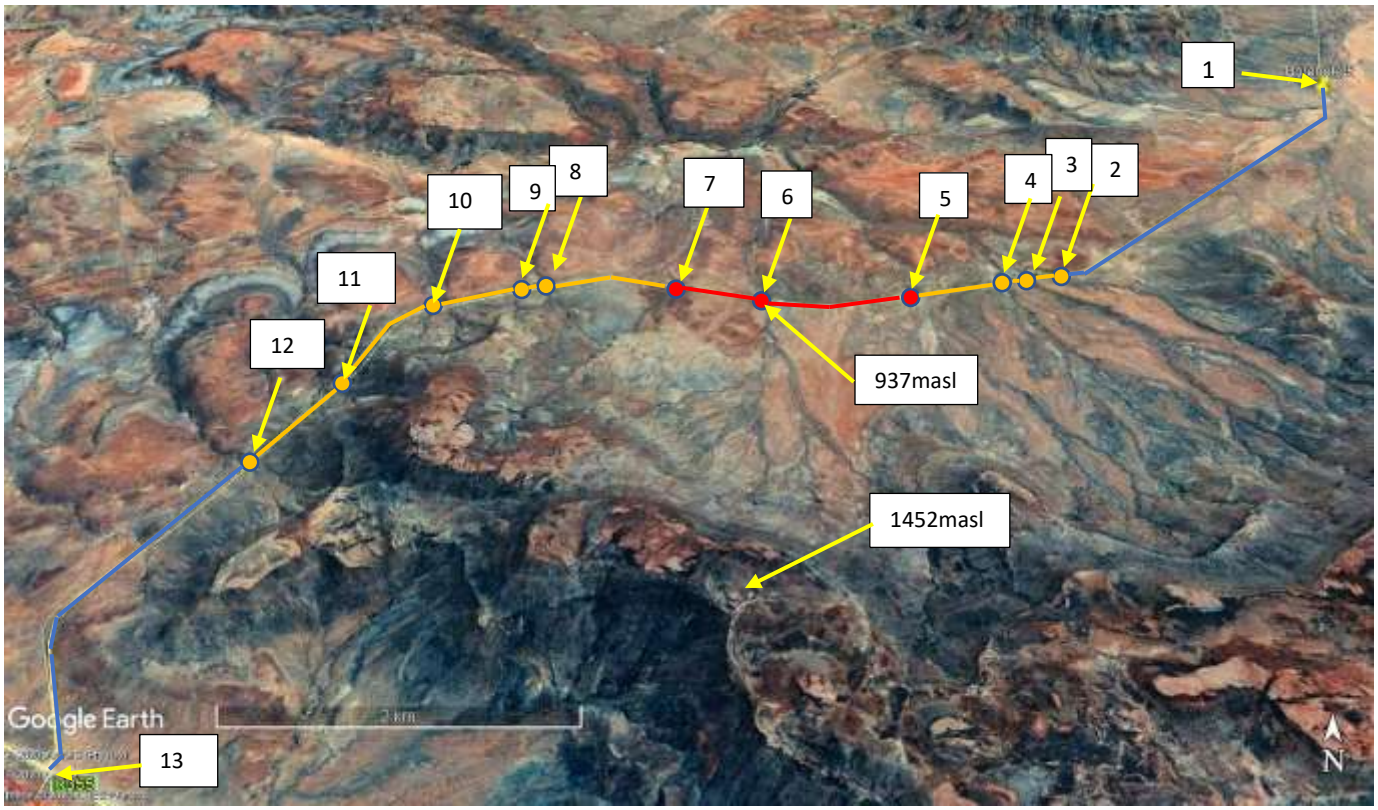


Figure 21 Minor Road 2886

Table 5 Minor Road AP2886 from Loeriesfontein trunk road

No.	Coordinates	
1	31°21.194'S 19.41.577'E	
2	31°22.833'S 19°39.552'E	
3	31°22.874'S 19°38.405'E	
4	31°22.861'S 19°39.271'E	
5	31°22.962'S 19°38.804'E	
6	31°22.946'S 19°37.616'E	
7	31°22.927'S 19°37.607'E	
8	31°22.947'S 19°36.959'E	
9	31°22.951'S 19°36.950'E	
10	31°23.109'S 19°36.428'E	
11	31°23.588'S 19°36.141'E	
12	31°23.990'S 19°35.865'E	
13	31°25.207'S 19°35.567'E	

The section of the pipeline from Borehole No.5 along Minor Road AP2886 to its connection with the pipeline on the Loeriesfontein Road is against the north-western slope of the Hantam Mountain (Figure 21). The mean slope from the highest point on the mountain ridge above the envisaged pipeline to Crossing No. 6 (Figure 21) is 12.9 vertical meters in every 100 horizontal meters. This, again, is a steep slope conducive for a very fast runoff with lots of erosion potential.

Figure 22 AP2886 Crossing No. 6

The drainage line coming ut of the mountain towards Crossing 6 (Figure 22) is well defined and probably will require protection structures such as Reno matrasses and gabions. The drainage line will have to be stabilized with such structures as well. The drainage line passes underneath the road through a double constructed box culvert. Downstream of the culvert, the drainage line is deeply scoured out, down the steep decline, which renders it expensive, with large anchors on the banks of the drainage line, if the proposed pipeline is to be constructed at this location. It would therefore be advisable and financially feasible to construct the pipeline upstream of the road, where the slope and erosion are less. This is applicable to all of the Class 4 and 5 crossings particularly on this section of the proposed pipeline.

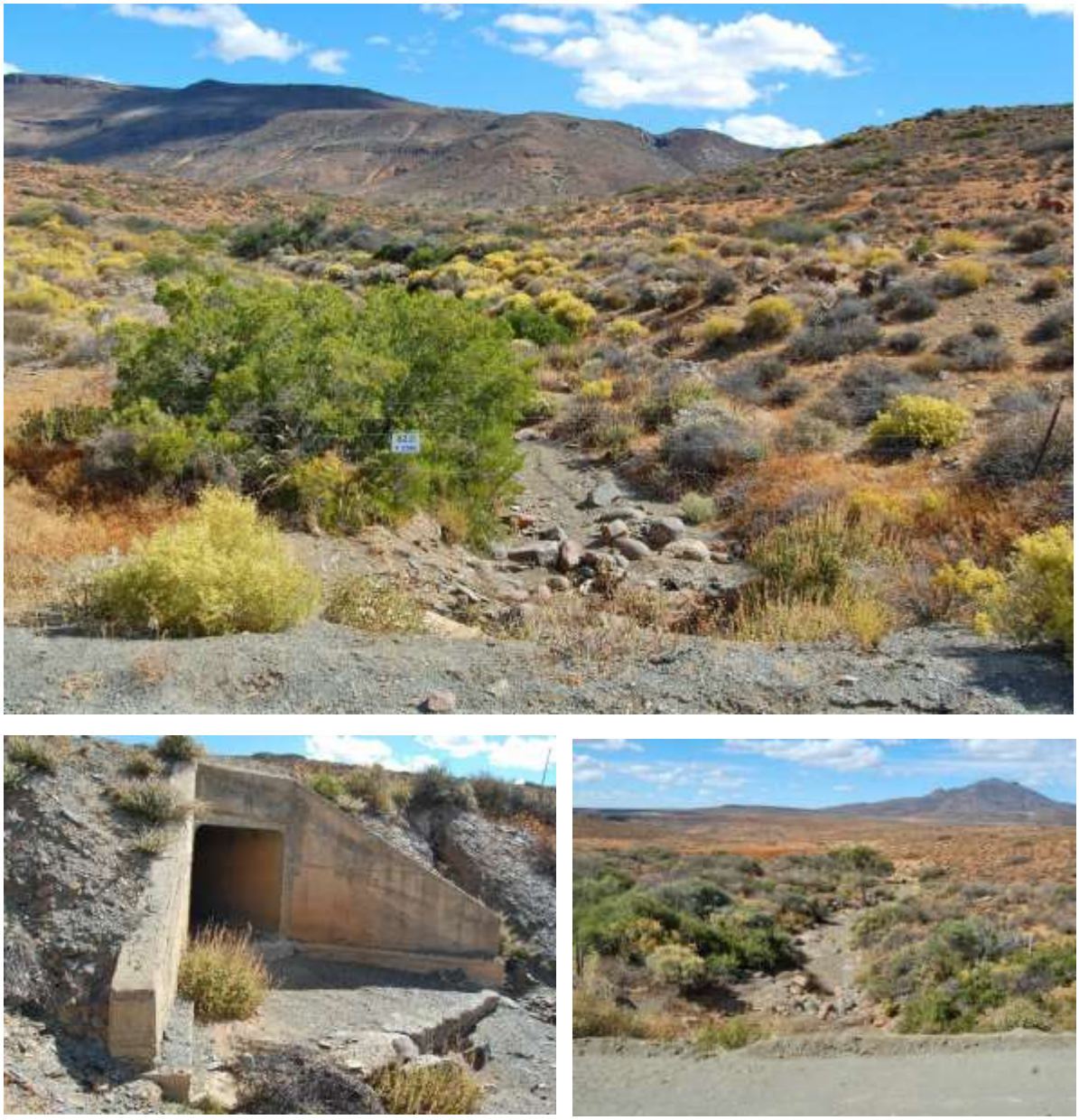


Figure 23 AP2886 Crossing No. 7

This drainage line has a prominent riparian zone around the crossing consisting of an assortment of mature trees.

Crossing No. 7 is similar (Figure 23). The road here is on a high embankment, with a very steep decline on the downstream side. The drainage line passes underneath through a single large box culvert. As with the other crossings along this section of pipleline, it is going to be difficult and expensive to put the pipeline on the much eroded downstream side of the culvert. Even upstream of the culvert, construction is going to be challenging, with a substantial measure of backfill, Reno matrasses and gabions required.

10.4 Klipwerf Road

Figure 24 Klipwerf Road Crossing No.4

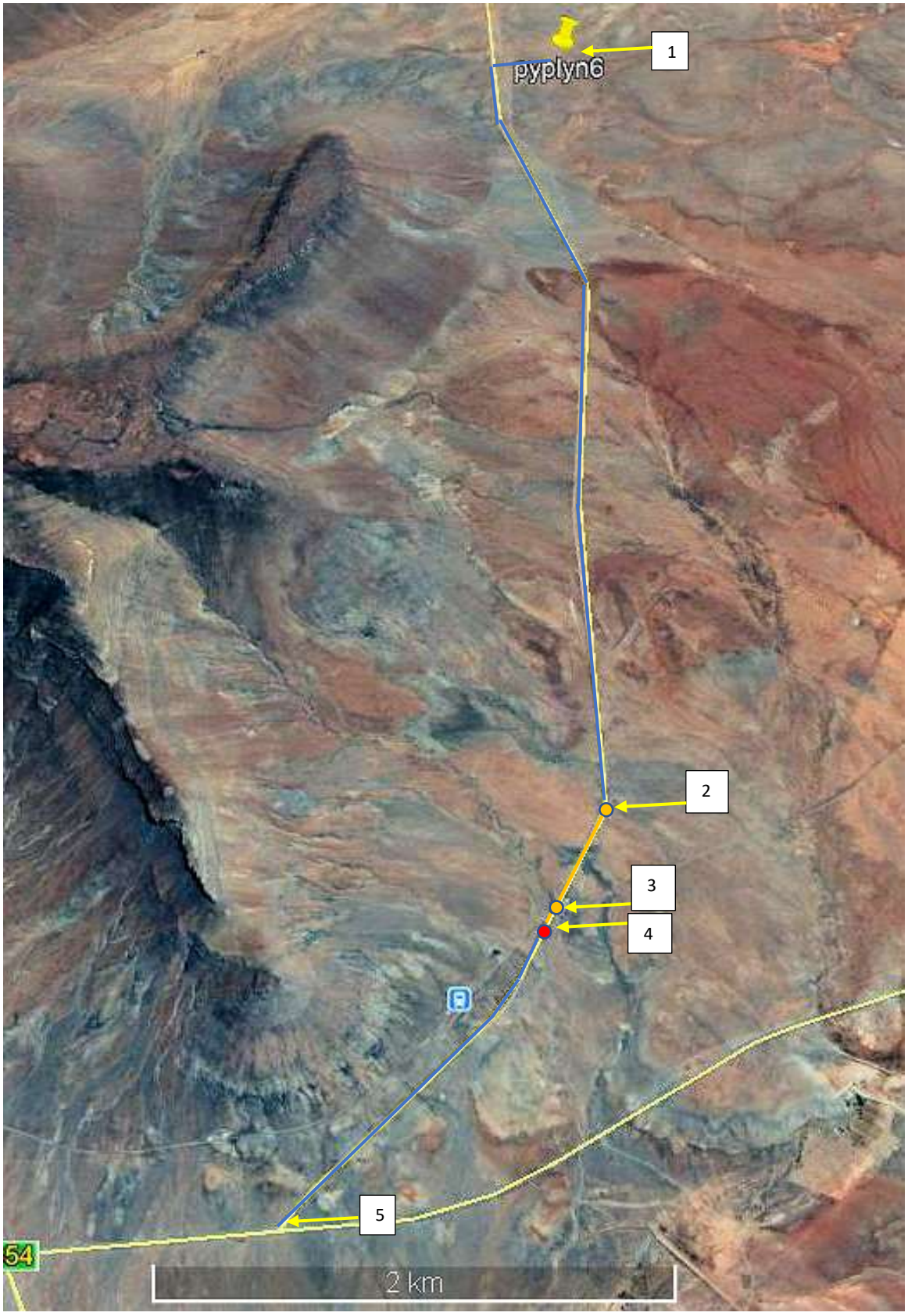


Figure 25 Klipwerf Road

Table 6 Klipwerf Road

No.	Coordinates	
1	31°26.161'S 19°57.073'E	
2	31°28.724'S 19°57.197'E	
3	31°28.418'S 19°57.175'E	
4	31°29.133'S 19°57.021'E	
5	31°29.781'S 19°56.397'E	

This section of the proposed pipeline is on rather flat ground, with only few drainage lines (Figure 25).

The most concerning crossing here is Crossing No. 4, where a prominent drainage line passes underneath the Klipwerf Road through 4 large-diametre pipes. Downstream, the railway bridge is railway bridge. Upstream, where the least effort would be required to place the envisaged pipeline, the drainage line is shallow, about 5 metres wide and its bed is covered with coarse sand. There is no discerible riparian zone. This drainage line has a fairly large cathment area, so in the event of a heavy rainfall event, storm water can come down in force.

10.5 Pipelines in and around Calvinia

There will have to be a connection between the proposed pipeline along the Loeriesfontein Road from the north west of Calvinia and the Calvinia water purification works located at the north east end of town (Figure 30). This pipeline of 4.1km long is to pass north of the WWTW, the municipal waste disposal site and to the north of town (Figure 26). Its position on Figure 26 is only estimated and it is not finally be established by the scheduled time this report was to be submitted. The pipeline is to roughly follow the route of the existing high voltage power line to the north of the town.

There are several drainage lines coming out of the Hantam Mountain to the north of town. The flow has been effectively cut off by a berm (Figure 25) that has been constructed along the northern boundary of Calvinia. Storm water is directed around the town to pass the built-up area at the west part of the town.

Figure 26 Pipeline in and around Calvinia

There are at least 10 Class 1 and 2 crossings is the pathway of the proposed pipeline, which should not pose any challenges apart from extra backfill. The crossing over the storm water trench (Class 5, Figure 28) would require sturdy concrete anchors on the banks, with probably an overhead, exposed pipeline above the high flow water line. But then this is for the engineers to decide how they wish to approach this challenge.

Initially, the proposed pipeline from the R355 Ceres Road was to angle to the east along the R27 trunk road into town. The pipeline was to cross the Oorlogskloof River adjacent and to the south of town. The pipeline would probably have been attached to the superstructure of the bridge (Figure 29), if SANRAL agreed, in which event no additional mitigation measures or construction is required. From here the proposed pipeline will integrate into the existing water provisioning system, for which no addition civil works are required. However, this option is not considered to be viable any longer. The pipeline will be treched through the Oorlogskloof River to the west of Calvinia.

Likewise, the Klipwerf Road pipeline will connect to an existig pipeline to the east of town and no further civil works are required.

Figure 27 Berm

Figure 28 Storm water trench

Figure 29 Oorlgskloof River bridge

Figure 30 Water purification works

11 Boreholes

The 5 boreholes will be equiped, each with an underground submersible pump, overhead electricity supply and a security structure on a 5m x 5m concrete slab (Figure 31). This is similar to existing borholes that have already been equiped.

Figure 31 Borehole

The equiped boreholes will have an insignificant to no impact at all on the above-ground aquatic environment, as they are located away from any surface water resources.

12 Present ecological state

The PES has been produced by Dr Neels Kleynhans (Table 7) in 1999 of the then DWAF to assess river reaches. The scores given are solely that of the practitioner and are based on expert opinion.

Table 7 Habitat Integrity according to Kleynhans, 1999

Category	Description	% of maximum score
A	Unmodified, natural	90 – 100
B	Largely natural with few modifications. A small change in natural habitats and biota, but the ecosystem function is unchanged	80 – 89
C	Moderately modified. A loss and change of the natural habitat and biota, but the ecosystem function is predominantly unchanged	60 – 79
D	Largely modified. A significant loss of natural habitat, biota and ecosystem function.	40 – 59
E	Extensive modified with loss of habitat, biota and ecosystem function	20 – 39
F	Critically modified with almost complete loss of habitat, biota and ecosystem function. In worse cases ecosystem function has been destroyed and changes are irreversible	0 - 19

With well over 100 drainage lines that can be assessed according to this methodology, the task is insurmountable. Obviously, some degree of lumping together, organising them into groups with similar characteristic, would make the task feasible. The question now arises which characteristics or attributes to use for such a classification.

With the exception of AP2886 section of the Loeriesfontein Road pipeline, the terrain is rather flat, with similar vegetation all over, with erodible sand containing a measure of clay, is heavily grazed by farm animals, mainly sheep, and is criss-crossed with a multitude of drainage lines, big and small. Sheet erosion seem to be a common attribute, all over the district, with dispersing clay and re-deposition of the sandy fraction. Karoo shale is a common denominator, with broken shale over the ground surface, from larger stones to fine gravel.

Upstream of the road culverts, drainage lines are generally shallow, even, not incised, with poorly defined shoulders and with not much of a riparian zone to speak of. Riparian vegetation resembles that of the surrounding land, with the exception of a couple of higher bushes in places. Downstream of the culverts, erosion is prominent, with deeply incised drainage lines.

AP2886 is against the incline of the Hantam Mountain, with a steep slope, with a prominent drainage line downstream of the road culverts. Some of the larger drainage lines have well developed riparian zones.

One aspect that seems to call for attention is the wide sheet-wash plain in the Ceres Road part of the Oorlogskloof River, which presents itself as a wide light-coloured patch on Google Earth images. This may be because of water and wind erosion or the re-deposition of sand or even over-grazing in this part of the sub-catchment. Or perhaps a combination of all of these. A large part of the upper catchment closer to Calvinia is ploughed over. These parts have not been re-planted since the drought.

There are a number of berms or dam walls in this part of the upper Oorlogskloof River, reportedly to keep the flow of storm water back to allow for percolating into the substrate for augmenting ground water, prior to its rapid evaporation in these dry climes. There are similar conditions in parts of the Klipwerf part of the project.

The drainage lines coming out of the south face of the Hantam Mountain and then running south right through town are different, as they are near-pristine up the mountain and entirely denaturised in town and further down to the Oorlogskloof River. This stark difference complicates sensible classification, but this seems to be enough reason to classify these drainage lines separate from the others.

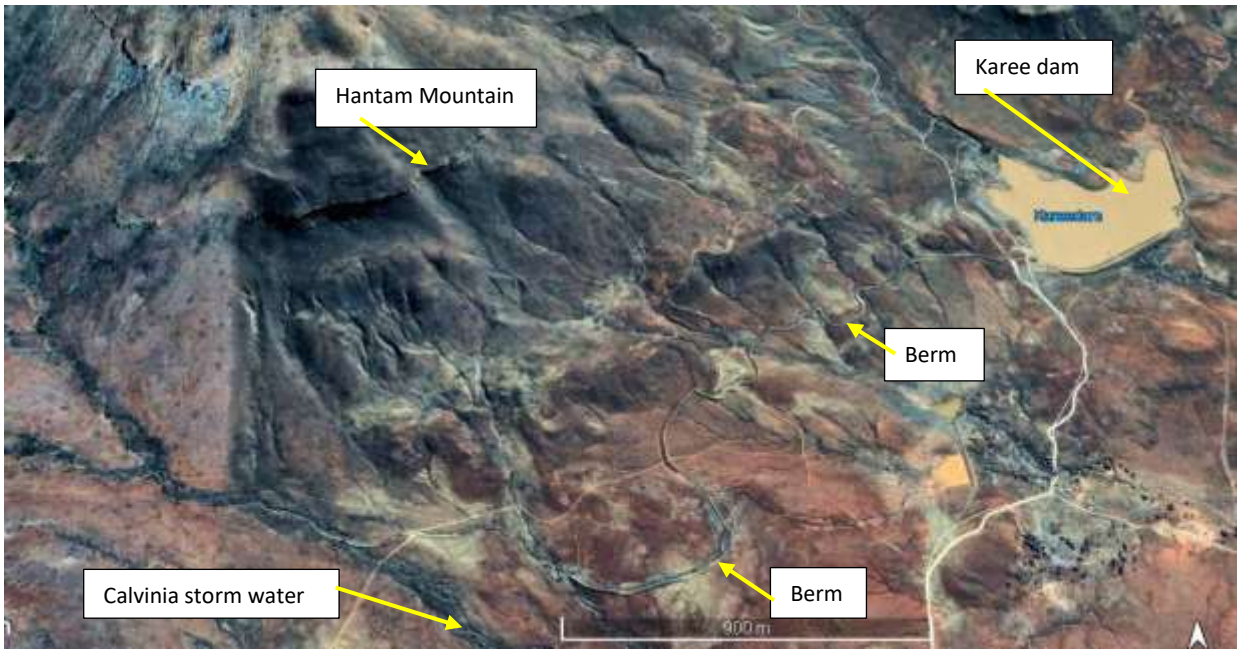


Figure 32 Karee Dam

The storm water canal through the centre of town has been diverted with a canal and berm system into the Karee Dam to the northeast of town (Figure 32). More drainage lines are included into this diversion to create a larger catchment area for the Karee Dam.

Given all of the above it was decided to group the Ceres Road, Loeriesfontein and Klipwerf drainage lines together for this assessment (Table 8). The AP2886 Road stood out as being different and was assessed separately (Table 9). Likewise, the drainage lines in and around Calvinia were assessed separately (Table 10).

The Oorlogskloof River was not assessed as the proposed pipeline would be attached to the bridge and would have no impact on the river at all.

Table 8 Present Ecological State of Ceres Road, Loeriesfontein Road and Klipwerf Road drainage lines combined

Instream				
	Score	Weight	Product	Maximum score
Water abstraction	24	14	336	350
Flow modification	17	13	238	325
Bed modification	19	13	247	325
Channel modification	18	13	234	325
Water quality	24	14	336	350
Inundation	17	10	170	250
Exotic macrophytes	24	9	216	225
Exotic fauna	15	8	120	200
Solid waste disposal	24	6	144	150
Total		100	2041	2500
% of total			81.6	
Class			B	
Riparian				
Water abstraction	24	13	312	325
Inundation	17	11	187	275
Flow modification	17	12	204	300
Water quality	24	13	312	325
Indigenous vegetation removal	24	13	312	325
Exotic vegetation encroachment	22	12	264	300
Bank erosion	15	14	210	350
Channel modification	18	12	216	300
Total			2017	2500
% of total			80.7	
Class			B	

The assessment was done for the drainage lines where they cross the roads and not further afield into the catchment area. The drainage lines at the road were generally in a better condition than the wider catchment, with the main concern the erosion downstream and adjacent to the road culverts.

Table 9 Present Ecological State of the AP2886 Road drainage lines

Instream	Score	Weight	Product	Maximum score
Water abstraction	24	14	336	350
Flow modification	16	13	208	325
Bed modification	17	13	221	325
Channel modification	15	13	195	325
Water quality	24	14	336	350
Inundation	16	10	160	250
Exotic macrophytes	24	9	216	225
Exotic fauna	15	8	120	200
Solid waste disposal	24	6	144	150
Total		100	1936	2500
% of total			77.4	
Class			C	
Riparian				
Water abstraction	24	13	312	325
Inundation	16	11	176	275
Flow modification	17	12	204	300
Water quality	24	13	312	325
Indigenous vegetation removal	24	13	312	325
Exotic vegetation encroachment	23	12	276	300
Bank erosion	12	14	168	350
Channel modification	14	12	168	300
Total			1964	2500
% of total			78.6	
Class			C	

The AP2886 drainage lines are somewhat worse than the ones on the Ceres Road, because of the worse erosion downstream of the road culverts, especially the larger drainage lines.

Table 10 Present Ecological State of the drainage lines in and around Calvinia

Instream	Score	Weight	Product	Maximum score
Water abstraction	7	14	98	350
Flow modification	8	13	104	325
Bed modification	8	13	104	325
Channel modification	8	13	104	325
Water quality	14	14	196	350
Inundation	9	10	90	250
Exotic macrophytes	24	9	216	225
Exotic fauna	12	8	96	200
Solid waste disposal	7	6	42	150
Total		100	954	2500
% of total			38.2	
Class			E	
Riparian				
Water abstraction	7	13	91	325
Inundation	9	11	99	275
Flow modification	8	12	96	300
Water quality	14	13	182	325
Indigenous vegetation removal	8	13	104	325
Exotic vegetation encroachment	22	12	264	300
Bank erosion	15	14	210	350
Channel modification	7	12	1130	300
Total			2017	2500
% of total			45.2	
Class			D	

Oorlogskloof River

At first it was unneccessary to classify the Ooorlogskloof River as the pipline wat to be hung underneath the R27 road bridge. After it became clear that the pipleine will be trenched through the river, classification became imperative.

The upper parts of the river has been impacted by agriculture, wit large parts of the sheet wash plain denuded of vegetation. Most of the middle parts are still intact, with the only I pact grazing by mainly sheep. The lower parts before the escarp at the Oorlogskloof Nature Reserve is protected, with fynbos elements. This contrast between the upper and lower reaches complicates classification.

Like most of the drainage lines, the river does not have any riparian vegetation, apart from a small number of exotic *Prosopis* trees. The river lacks the line of trees as is eveident where the rainfall is higher.

Table 11 Present Ecological State of the Oorlogskloof River

Instream	Score	Weight	Product	Maximum score
Water abstraction	20	14	240	350
Flow modification	21	13	273	325
Bed modification	19	13	247	325
Channel modification	22	13	286	325
Water quality	23	14	322	350
Inundation	18	10	180	250
Exotic macrophytes	24	9	216	225
Exotic fauna	15	8	120	200
Solid waste disposal	23	6	138	150
Total		100	2022	2500
% of total			80.9	
Class			A	
Riparian				
Water abstraction	20	13	230	325
Inundation	17	11	187	275
Flow modification	15	12	180	300
Water quality	23	13	299	325
Indigenous vegetation removal	16	13	208	325
Exotic vegetation encroachment	22	12	264	300
Bank erosion	17	14	238	350
Channel modification	18	12	216	300
Total			1822	2500
% of total			72.9	
Class			C	

The Oorlogskloof River differs from most other similar rivers as its instream habitat is in a much better ecological condition than its tributaries, the drainage lines. In most cases it is the orther way around. The riperian zone is in a worse state than the instream habitat because of the heavy farming practices in the upper reach and the extensive sheep farming.

Table 12 PES Classification Summary

Water Resource	Instream	Riparian
Ceres Road	B	B
Loersiesfontein Road	B	B
AP2886 Road	C	C
Klipwerf Road	B	B
Calvinia Drainage lines	E	D
Oorlogskloof River	A	C

Most of the drainage lines have little conservation value, but is still worthy of protection, with the exception of the Calvinia drainage lines, of which the lower reaches have been entirely altered. The envisaged pipelines are not about the change the classification of any of the drainage lines, provided that the ground is leveled and landscaped after the pipes have been covered. Likewise, the trenching of the pipleline trought the Oorlogskloof River is not about tyo change the classification.

13 Ecological importance

The Ecological Importance (EI) is based on the presence of especially fish species that are endangered on a local, regional or national level (Table 13).

There are no fish in the drainage lines and in the Oorlogskloof River, as there is no permanent water. According to this assessment, which is prescribed for WULA's, the drainage lines are not important.

Of concern in the district is the IUCN endangered bird Ludwig's bustard (*Neotis ludwigii*) with its propensity to collide in overhead power lines (Van Driel, 2020). This bird will probably not utilize drainage lines more than any other available habitat in the district. From this angle, the drainage lines are not more important than any other habitat in the area.

Drainage lines in arid regions often maintain a line of trees that are supported by a flow of underground water. This riparian vegetation adds to the available habitat as well as to habitat variability. This added habitat, in turn, supports a range of organisms that would not have been there, was it not for the riparian habitat. The drainage lines and river in and around Calvinia lack this type of riparian vegetation. It resembles that of the surrounding karroid, with little if any variability. From this perspective, not even the riparian vegetation can be regarded as ecologically important.

Table 13. Ecological Importance according to endangered organisms (Kleynhans,1999).

Category	Description
1	One species or taxon are endangered on a local scale
2	More than one species or taxon are rare or endangered on a local scale
3	More than one species or taxon are rare or endangered on a provincial or regional scale
4	One or more species or taxa are rare or endangered on a national scale (Red Data)

14 Ecological sensitivity

Ecological Sensitivity (ES) is often described as the ability of aquatic habitat to assimilate impacts. It is not sensitive if it remains the same despite of the onslaught of impacts. Put differently, sensitive habitat changes substantially, even under the pressure of slight impacts.

The Ecological Sensitivity also refers to the potential of aquatic habitat to bounce back to an ecological condition closer to the situation prior to human impact. If it recovers, it is not regarded as sensitive.

The question arises if the drainage lines would recover after the pipelines have been trenched through and after the trenches have been landscaped and rehabilitated. Will the vegetation re-establish itself and grow to cover the scar in the landscape? It is well known that such recovery is slow in areas with such a low rainfall, tantamount to semi-desert. It would take a long time, perhaps a decade or more. The ecological sensitivity can be described as “medium”.

The drainage lines in and around Calvinia have been heavily impacted. It is unlikely that Calvinia would ever cease to exist and it is obvious that the impact will persist. The drainage lines will not recover and from this point of view these drainage lines can be described as “sensitive”.

15 Impact assessment

Some of the decision-making authorities prescribe an impact assessment according to a premeditated methodology.

The main benefit of this exercise is that it allows for the evaluation of mitigation measures. Later follows a Risk Assessment. This is different from the Impact Assessment as it does not attempt to weigh the success of mitigation measures.

The methodology is set out in the appendix. The assessment is given in Table 14.

Table 14 Impact Assessment

Description of impact Loosening of soil during construction phase, washing of soil down the drainage line and into the Oorlogskloof River during a storm event **Mitigation measures** Compact back-fill. Use suitable back-fill material. Construction only during the dry season.								
Type Nature	Spatial Extent	Severity	Duration	Significance	Probability	Confidence	Reversibility	Irreplaceability
Without mitigation								
Direct	Regional	High	Temporary	High	Probable	Certain	Reversible	Replaceable
With mitigation measures								
Negative	Local	Low	Medium	Low	Unlikely	Sure	Reversible	Replaceable

Description of impact Building material, rubble and litter washing down the drainage line and into the Oorlogskloof River **Mitigation measures** Best industry practices, due diligence, cleaning up of site following construction								
Type Nature	Spatial Extent	Severity	Duration	Significance	Probability	Confidence	Reversibility	Irreplaceability
Without mitigation								
Direct	Regional	High	Long term	Low	Probable	Certain	Reversible	Replaceable
With mitigation measures								
Negative	Local	Low	Temporary	Very Low	Unlikely	Certain	Reversible	Replaceable

Description of impact Construction of Reno matrasses and gabions, further downstream erosion. **Mitigation measures** Construct flood-calming structures downstream of culverts								
Type Nature	Spatial Extent	Severity	Duration	Significance	Probability	Confidence	Reversibility	Irreplaceability
Without mitigation								
Direct	Regional	High	Long term	High	Probable	Certain	Reversible	Replaceable
With mitigation measures								
Negative	Local	Low	Temprary	Low	Unlikely	Sure	Reversible	Replaceable

Description of impact

Leaks in pipeline, formation of wetlands where it should be naturally dry

Mitigation measures

Maintain infrastructure, preventative maintenance
Regular inspection of infrastructure
Immediately repair pipeline

Type Nature	Spatial Extent	Severity	Duration	Significance	Probability	Confidence	Reversibility	Irreplaceability
Without mitigation								
Negative	Regional	High	Medium term	High	Definite	Certain	Reversible	Replaceable
With mitigation measures								
Direct	Local	Low	Temporary	Low	Possible	Sure	Reversible	Replaceable

The Impact Assessment shows that mitigation measures are readily attainable, with a reasonable success rate.

16 Significance

Decision-makers often press on a numerical score for Significance**.** The score takes into consideration both the environmental value of the site and the degree of impact. Table 23.3, p63, Appendix provides a system for allocation values for each of the parameters Conservation Value, Extent, Duration, Severity and Likelihood with regard to possible impacts These values are then entered into the equation on p63 to derive at a value for Significance. The value for Significance can subsequently be evaluated according to Table 23.3.

Table 14 provides a yardstick for decision-making with regard to allow or disallow a development with its concomitant impact on the aquatic environment.

The scores that were given are entirely those of the specialist, based on his or her knowledge and experience. These scores form a bases for debate and consensus, should contemporaries and decision-makers wish to add to the process.

The scores apply under the assumption that mitigation measures will be in place.

The scores given were as follows:

Table 15 Significance Score Drainage Lines and Oorlogkloof River Combined

Parameter	Score
Conservation value	1
Likelihood	5
Duration	5
Extent	1
Severity	2
Significance	13

The significance came out as “Insignificant”. The drainage lines have low intrinsic value. Moreover, the envisaged pipelines will not lower the score for significance. According to the score, there should not be a valid reason to disallow the project.

The note must be added that the Fynbos reach of the Oorlogskloof River on the verge of the escarpment was not included in this assessment, as from here and further downstream, the ecological significance of the river and drainage lines is notably more because of a marked riparian zone and varied habitat.

12 Ecological Importance and Sensitivity Category

The EIS methodology is explained in Table 1 in the Appendix.

The Oorlogspoort River and the drainage line upper tributaries have been assigned a “Low” EISC.

The drainge lines combined as well as the Oorlogskloof River do not really fit into the scheme of Table 1 in the Appendix. These water reaches are ephemeral, with little conservation value. They are unique on a provicial level as they lack riparian vegetation. Most other drainage lines and rivers at least have a tree line, even though sparse. These reaches may not be sensitive to flow, but once the vegetation is disturbed, it may take decades to grow back.

Taking all of this into consideration, the EISC has been assigned as “Low”.

17 Risk Matrix

The purpose of the Risk Matrix is to determine if a General Authorisation or a License is applicable.

The assessment was carried out according to the interactive Excel table that is available on the DWS webpage. Table 16 is a replica of the Excel spreadsheet that has been adapted to fit the format of this report. The numbers in Table 16 (continued) represent the same activities as in Table 14, with sub-activities added.

The drainage lines and Oorlogskloof River have been combined for this assessment.

The environmental risks to the aquatic environment are low. This Risk Matrix indicates that the pipelines should be constructed in terms of a General Authorization and that a License is not required.

Table 16 Risk Matrix

No.	Activity	Aspect	Impact	Significance	Risk Rating
1.1	Construction of the pipeline, loosening of soil	Mobilisation of sediments	Sediments in drainage line and down the Oorlogskloof River	24	Low
1.2	Trench pipeline in drainage lines	Production of building rubble and litter	Rubble down the drainage line	24	Low
1.3	Construction of Reno matrasses and gabions	Further downstream erosion	Habitat destruction	45	Low
2	Pipeline failure	Spill	Habitat alteration, wet when it should be dry	24	Low

Table 16 Continued Risk Rating

No	Flow	Water Quality	Habitat	Biota	Severity	Spatial scale	Duration	Conse-quence
1.1 1.2 1.3. 2	1 1 2 1	1 1 1 1	1 1 2 1	1 1 1 1	1 1 1.5 1	1 1 1 1	1 1 2 1	3 3 4.5 3

No	Frequency of activity	Frequency of impact	Legal issues	Detection	Likelihood	Significance	Risk Rating
1.1 1.2 1.3 2	1 1 2 1	1 1 2 1	5 5 5 5	1 1 1 1	8 8 10 8	24 24 45 24	Low Low Low Low

18 Resource Economics

The goods and services delivered by the environment, in this case the Calvinia drainage lines, is a Resource Economics concept as adapted by Kotze *et al* (2009). The methodology was designed for the assessments of wetlands, but in the case of the drainage lines the goods and services delivered are particularly applicable and important, hence it was decided to include it in the report.

The diagram (Figure 33) is an accepted manner to visually illustrate the resource economic footprint the Oorlogskloof and drainage lines combined, from the data in Table 17.

Table 17. Goods and Services

Goods & Services	Score
Flood attenuation	4
Stream flow regulation	4
Sediment trapping	4
Phosphate trapping	1
Nitrate removal	1
Toxicant removal	1
Erosion control	4
Carbon storage	1
Biodiversity maintenance	2
Water supply for human use	3
Natural resources	0
Cultivated food	1
Cultural significance	1
Tourism and recreation	0
Education and research	1

0	Low
5	High

The drainage lines under investigation have been lumped together for this evaluation.

The size of the star shape of Figure 33 attracts the eyes of the decision-makers. This shape is small, indicating that the water courses have a small economic footprint. Apart from a small measure of flood attenuation, stream flow regulation and sediment trapping, the drainage lines are not important, from a resource economics point of view. The flow from the drainage lines on the south slopes of the Hantam Mountains are diverted into the Karee Dam and other drainage lines are dammed for the purpose of groundwater replenishment. This adds to the importance of the drainage lines.

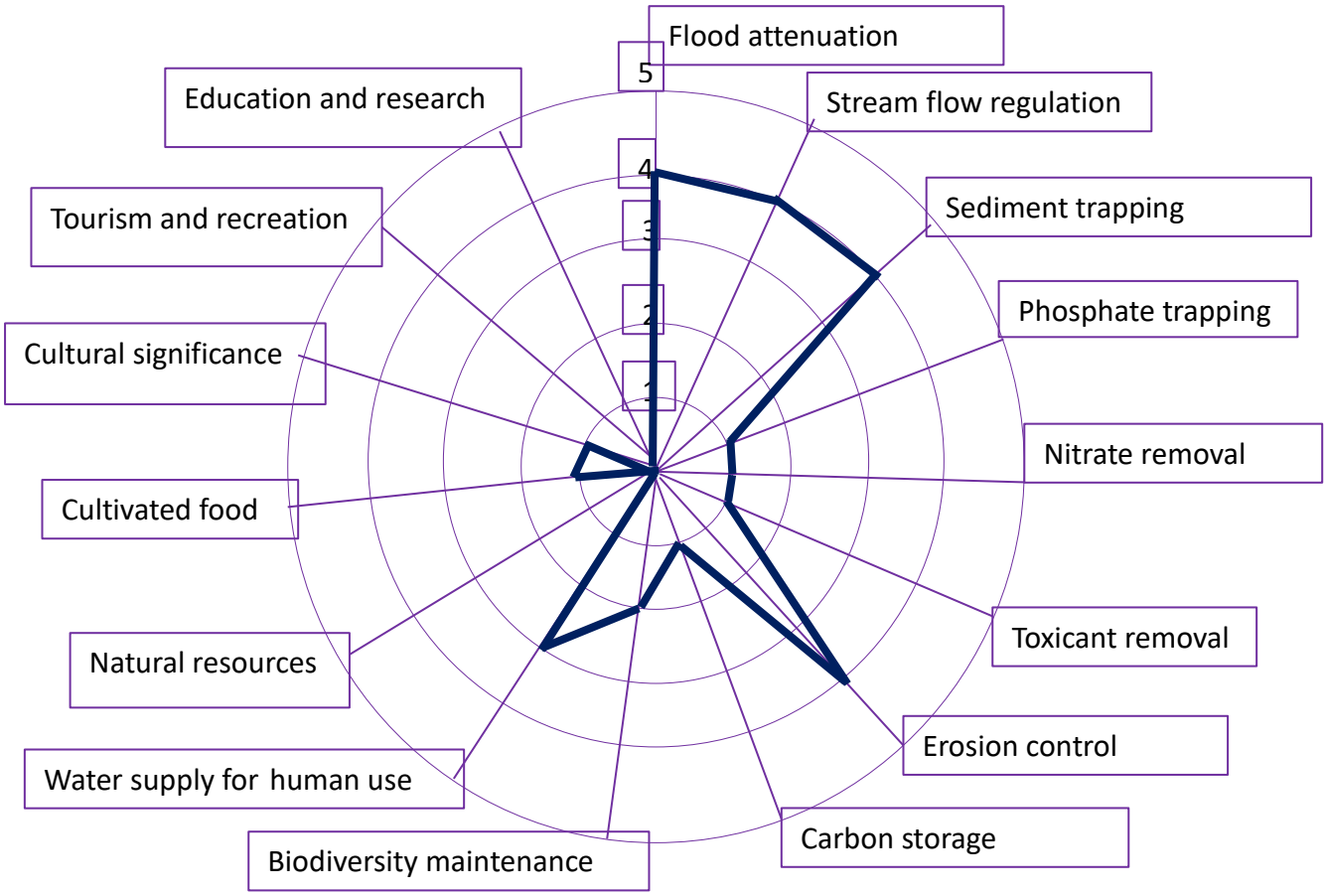


Figure 33 Resource Economics Footprint of the Drainage Lines

19 Conclusions

Figure 34 has been adapted from one of the most recent DWS policy documents.

An anthropogenic activity can impact on any of the ecosystem drivers or responses and this can have a knock-on effect on all of the other drivers and responses. This, in turn, will predictably impact on the ecosystem services (Figure 34). The WULA and the EAI must provide mitigation measured for these impacts.

The driver of the drainage lines is the occasional flood that follows sudden and intense rainfall events. This is followed by prolonged droughts and intense summer heat that prevents the development of any viable aquatic habitat. This is apart from shallow ground water that explains the growth of a somewhat more prolific vegetation along some of the drainage lines.

The proposed pipeline is not about to change the ecological factors and its dynamics. It would not reduce the ability of the drainage line and surrounds to render the listed environmental services. The pipeline would not add in any meaningful way to the existing impacts. The aquatic environmental impacts are negligible, if the mitigation measures are adhered to.

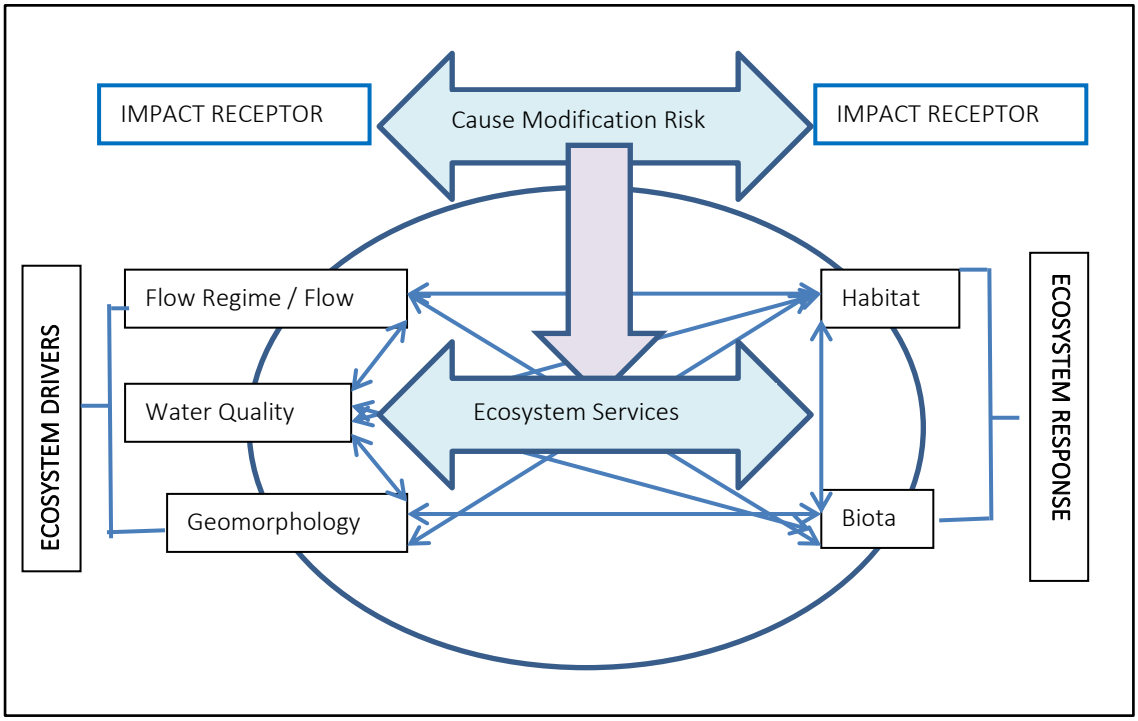


Figure 34 Minimum Requirements for a S21(c) and (i) Application

It is therefore recommended that the pipelines for the augmentation of Calvinia's bulk water supply be allowed in terms of a General Authorization.

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21 Declaration of Independence

I, Dirk van Driel, as the appointed independent specialist hereby declare that I:

- Act/ed as the independent specialist in this application
- Regard the information contained in this report as it relates to my specialist input/study to be true and correct and;
- Do not have and will not have any financial interest in the undertaking of the activity, other than remuneration for work performed in terms of the NEMA, the Environmental Impact Assessment Regulations, 2010 and any specific environmental management act;
- Have and will not have vested interest in the proposed activity;
- Have disclosed to the applicant, EAP and competent authority any material information have or may have to influence the decision of the competent authority or the objectivity of any report, plan or document required in terms of the NEMA, the environmental Impact Assessment Regulations, 2010 and any specific environmental management act.
- Am fully aware and meet the responsibilities in terms of the NEMA, the Environmental Impacts Assessment Regulations, 2010 (specifically in terms of regulation 17 of GN No. R543) and any specific environmental management act and that failure to comply with these requirements may constitute and result in disqualification;
- Have ensured that information containing all relevant facts on respect of the specialist input / study was distributed or made available to interested and affected parties and the public and that participation by interested and affected parties facilitated in such a manner that all interested and affected parties were provided with reasonable opportunity to participate and to provide comments on the specialist input / study;
- Have ensured that all the comments of all the interested and affected parties on the specialist input were considered, recorded and submitted to the competent authority in respect of the application;
- Have ensured that the names of all the interested and affected parties that participated in terms of the specialist input / study were recorded in the register of interested and affected parties who participated in the public participation process;
- Have provided the competent authority with access to all information at my disposal regarding the application, weather such information is favourable or not and;
- Am aware that a false declaration is an offence in terms of regulation 71 of GN No. R543.

Signature of the specialist:  13 September 2021

22 Résumé

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Water Scientist

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Experience

WATSAN Africa, Cape Town. Scientist **2011 – present**

USAID/RTI, ICMA & Chemonics. Iraq & Afghanistan **2007 -2011**

Program manager.

City of Cape Town **1999-2007**

Acting Head: Scientific Services, Manager: Hydrobiology.

Department of Water & Sanitation, South Africa **1989 – 1999**

Senior Scientist

Tshwane University of Technology, Pretoria **1979 – 1998**

Head of Department

University of Western Cape and Stellenbosch University **1994- 1998** part-time

- Lectured post-graduate courses in Water Management and Environmental Management to under-graduate civil engineering students
- Served as external dissertation and thesis examiner

Service Positions

- Project Leader, initiator, member and participator: Water Research Commission (WRC), Pretoria.
- Director: UNESCO West Coast Biosphere, South Africa
- Director (Deputy Chairperson): Grotto Bay Home Owner's Association
- Member Dassen Island Protected Area Association (PAAC)

Membership of Professional Societies

- South African Council for Scientific Professions. Registered Scientist No. 400041/96
- Water Institute of South Africa. Member

Reports

- Process Review Kathu Wastewater Treatment Works
- Effluent Irrigation Report Tydstroom Abattoir Durbanville
- River Rehabilitation Report Slangkop Farm, Yzerfontein
- Fresh Water and Estuary Report Erf 77 Elands Bay
- Ground Water Revision, Moorreesburg Cemetery
- Fresh Water Report Delaire Graff Estate, Stellenbosch
- Fresh Water Report Quantum Foods (Pty) Ltd. Moredou Poultry Farm, Tulbagh
- Fresh Water Report Revision, De Hoop Development, Malmesbury
- Fresh Water Report, Idas Valley Development Erf 10866, Stellenbosch
- Wetland Delineation Idas Valley Development Erf 10866, Stellenbosch
- Fresh Water Report, Idas Valley Development Erf 11330, Stellenbosch
- Fresh Water Report, La Motte Development, Franschhoek
- Ground Water Peer Review, Elandsfontein Exploration & Mining
- Fresh Water Report Woodlands Sand Mine Malmesbury
- Fresh Water Report Brakke Kuyl Sand Mine, Cape Town
- Wetland Delineation, Ingwe Housing Development, Somerset West
- Fresh Water Report, Suurbraak Wastewater Treatment Works, Swellendam
- Wetland Delineation, Zandbergfontein Sand Mine, Robertson
- Storm Water Management Plan, Smalblaar Quarry, Rawsonville
- Storm Water Management Plan, Riverside Quarry
- Water Quality Irrigation Dams Report, Langebaan Country Estate
- Wetland Delineation Farm Eenzaamheid, Langebaan
- Wetland Delineation Erf 599, Betty's Bay
- Technical Report Bloodhound Land Speed Record, Hakskeenpan
- Technical Report Harkerville Sand Mine, Plettenberg Bay
- Technical Report Doring Rivier Sand Mine, Vanrhynsdorp
- Rehabilitation Plan Roodefontein Dam, Plettenberg Bay
- Technical Report Groenvlei Crusher, Worcester
- Technical Report Wiedouw Sand Mine, Vanrhynsdorp
- Technical Report Lair Trust Farm, Augrabies
- Technical Report Schouwtoneel Sand Mine, Vredenburg
- Technical Report Waboomsrivier Weir Wolseley
- Technical Report Doornkraal Sand Mine Malmesbury
- Technical Report Berg-en-Dal Sand Mine Malmesbury
- Wetland Demarcation, Osdrif Farm, Worcester
- Technical Report Driefontein Dam, Farm Agterfontein, Ceres
- Technical Report Oewerzicht Farm Dam, Greyton
- Technical Report Glen Lossie Sand Mine, Malmesbury
- Preliminary Report Stellenbosch Cemeteries
- Technical Report Toeka & Harmony Dams, Houdenbek Farm, Koue Bokkeveld
- Technical Report Kluitjieskraal Sand & Gravel Mine, Swellendam
- Fresh Water Report Urban Development Witteklip Vredenburg
- Fresh Water Report Groblershoop Resort, Northern Cape
- Fresh Water Report CA Bruwer Quarry Kakamas, Northern Cape
- Fresh Water Report, CA Bruwer Sand Mine, Kakamas, Northern Cape
- Fresh Water Report, Triple D Farms, Agri Development, Kakamas
- Fresh Water Report, Keren Energy Photovoltaic Plant Kakamas
- Fresh Water Report, Keren Energy Photovoltaic Plant Hopetown
- Fresh Water Report Hopetown Sewer
- Fresh Water Report Hoogland Farm Agricultural Development, Touws River

- Fresh Water Report Calvinia Sports Grounds Irrigation
- Fresh Water Report CA Bruwer Agricultural Development Kakamas
- Fresh Water Report Zwartfontein Farm Dam, Hermon
- Statement Delsma Farm Wetland, Hermon
- Fresh Water Report Lemoenshoek Farms Pipelines Bonnyvale
- Fresh Water Report Water Provision Pipeline Brandvlei
- Fresh Water Report Erf 19992 Upington
- Botanical Report Zwartejongensfontein Sand Mine, Stilbaai
- Fresh Water Report CA Bruwer Feldspath Mine, Kakamas
- Sediment Yield Calculation, Kenhardt Sand Mine
- Wetland Demarcation, Grabouw Traffic Center
- Fresh Water Report, Osdrift Sand Mine, Worcester
- Fresh Water Report, Muggievlak Storm Water Canal, Vredenburg
- Fresh Water Report, Marksman's Nest Rifle Range, Malmesbury
- Biodiversity Report, Muggievlak Storm Water Canal, Vredenburg
- Strategic Planning Report, Sanitation, Afghanistan Government, New Delhi, India
- Fresh Water Report, Potable Water Pipeline, Komaggas
- Fresh Water Report, Wastewater Treatment Works, Kamieskroon
- Fresh Water Report, Turksvy Farm Dam, Upington
- Fresh Water Report, Groblershoop Urban Development, IKheis Municipality
- Fresh Water Report, Boegoeberg Urban Development, IKheis Municipality
- Fresh Water Report, Opwag Urban Development, IKheis Municipality
- Fresh Water Report, Wegdraai Urban Development, IKheis Municipality
- Fresh Water Report, Topline Urban Development, IKheis Municipality
- Fresh Water Report, Grootdrink Urban Development, IKheis Municipality
- Fresh Water Report, Gariep Urban Development, IKheis Municipality
- Fresh Water Report, Bonathaba Farm Dam, Hermon
- Botanical Report, Sand Mine Greystone Trading, Vredendal
- Botanical Report Namakwa Klei Stene, Klawer
- Fresh Water Report Buffelsdrift Quarry, George
- Fresh Water Report Styerkraal Agricultural Development, Onseepkans.
- Technical Report Arabella Country Estate Wastewater Treatment Works, Kleinmond
- Fresh Water Report Scherpen Heuvel Farm Dam, Worcester

23 Appendix

23.1 Methodology used in determining significance of impacts

The methodology to be used in determining and ranking the nature, significance, consequences, extent, duration and probability of potential environmental impacts and risks associated with the alternatives is provided in the following tables:

Table 21.1.1 Nature and type of impact

Nature and type of impact	Description
Positive	An impact that is considered to represent an improvement to the baseline conditions or represents a positive change
Negative	An impact that is considered to represent an adverse change from the baseline or introduces a new negative factor
Direct	Impacts that result from the direct interaction between a planned project activity and the receiving environment / receptors
Indirect	Impacts that result from other activities that could take place as a consequence of the project (e.g. an influx of work seekers)
Cumulative	Impacts that act together with other impacts (including those from concurrent or planned future activities) to affect the same resources and / or receptors as the project

Table 23.1.2 Criteria for the assessment of impacts

Criteria	Rating	Description
Spatial extent of impact	National	Impacts that affect nationally important environmental resources or affect an area that is nationally important or have macro-economic consequences
	Regional	Impacts that affect regionally important environmental resources or are experienced on a regional scale as determined by administrative boundaries or habitat type / ecosystems
	Local	Within 2 km of the site
	Site specific	On site or within 100m of the site boundary
Consequence of impact/ Magnitude/ Severity	High	Natural and / or social functions and / or processes are severely altered
	Medium	Natural and / or social functions and / or processes are notably altered
	Low	Natural and / or social functions and / or processes are slightly altered
	Very Low	Natural and / or social functions and / or processes are negligibly altered
	Zero	Natural and / or social functions and / or processes remain unaltered
Duration of impact	Temporary	Impacts of short duration and /or occasional
	Short term	During the construction period
	Medium term	During part or all of the operational phase
	Long term	Beyond the operational phase, but not permanently
	Permanent	Mitigation will not occur in such a way or in such a time span that the impact can be considered transient (irreversible)

Table 23.1.3 Significance Rating

Significance Rating	Description
High	High consequence with a regional extent and long-term duration High consequence with either a regional extent and medium-term duration or a local extent and long-term duration Medium consequence with a regional extent and a long-term duration
Medium	High with a local extent and medium-term duration High consequence with a regional extent and short-term duration or a site-specific extent and long-term duration High consequence with either local extent and short-term duration or a site-specific extent with a medium-term duration Medium consequence with any combination of extent and duration except site-specific and short-term or regional and long term Low consequence with a regional extent and long-term duration
Low	High consequence with a site-specific extent and short-term duration Medium consequence with a site-specific extent and short-term duration Low consequence with any combination of extent and duration except site-specific and short-term Very low consequence with a regional extent and long-term duration
Very low	Low consequence with a site-specific extent and short-term duration Very low consequence with any combination of extent and duration except regional and long term
Neutral	Zero consequence with any combination of extent and duration

Table 23.1.4 Probability, confidence, reversibility and irreplaceability

Criteria	Rating	Description
Probability	Definite	>90% likelihood of the impact occurring
	Probable	70 – 90% likelihood of the impact occurring
	Possible	40 – 70% likelihood of the impact occurring
	Unlikely	<40% likelihood of the impact occurring
Confidence	Certain	Wealth of information on and sound understanding of the environmental factors potentially affecting the impact
	Sure	Reasonable amount of useful information on and relatively sound understanding of the environmental factors potentially influencing the impact
	Unsure	Limited useful information on and understanding of the environmental factors potentially influencing this impact
Reversibility	Reversible	The impact is reversible within 2 years after the cause or stress is removed
	Irreversible	The activity will lead to an impact that is in all practical terms permanent
Irreplaceability	Replaceable	The resources lost can be replaced to a certain degree
	Irreplaceable	The activity will lead to a permanent loss of resources.

Table 23.2 Numerical Significance

Table 23.2.1 Conservation Value

Conservation Value		
Refers to the intrinsic value of the area or its relative importance towards the conservation of an ecosystem or species or even natural aesthetics. Conservation status is based on habitat function, its vulnerability to loss and fragmentation or its value in terms of the protection of habitat or species	Low 1	The area is transformed, degraded not sensitive (e.g. Least threatened), with unlikely possibility of species loss.
	Medium / Low 2	The area is in good condition but not sensitive (e.g. Least threatened), with unlikely possibility of species loss.
	Medium 3	The area is in good condition, considered vulnerable (threatened), or falls within an ecological support area or a critical biodiversity area, but with unlikely possibility of species loss.
	Medium / High 4	The area is considered endangered or, falls within an ecological support area or a critical biodiversity area, or provides core habitat for endemic or rare & endangered species.
	High 5	The area is considered critically endangered or is part of a proclaimed provincial or national protected area.

Table 23.2.2 Numerical Significance Score

Significance	Score	Description
Insignificant	4 - 22	There is no impact or the impact is insignificant in scale or magnitude as a result of low sensitivity to change or low intrinsic value of the site.
Low	23 - 36	An impact barely noticeable in scale or magnitude as a result of low sensitivity to change or low intrinsic value of the site, or will be of very short-term or is unlikely to occur. Impact is unlikely to have any real effect and no or little mitigation is required.
Medium / Low	37 - 45	Impact is of a low order and therefore likely to have little real effect. Mitigation is either easily achieved. Impacts may have medium to short term effects on the natural environment within site boundaries.
Medium	46 - 55	Impact is real, but not substantial. Mitigation is both feasible and fairly easily possible, but may require modification of the project design or layout. These impacts will usually result in medium to long term effect on the natural environment, within site boundary.
Medium High	56 - 63	Impact is real, substantial and undesirable, but mitigation is feasible. Modification of the project design or layout may be required. These impacts will usually result in medium to long-term effect on the natural environment, beyond site boundary within local area.
High	64 - 79	An impact of high order. Mitigation is difficult, expensive, time-consuming or some combination of these. These impacts will usually result in long-term change to the natural environment, beyond site boundaries, regional or widespread.
Unacceptable	80 - 100	An impact of the highest order possible. There is no possible mitigation that could offset the impact. The impact will result in permanent change. Very often these impacts cannot be mitigated and usually result in very severe effects, beyond site boundaries, national or international.

Table 23.2.3 Scoring system

Parameter	1	2	3	4	5
Conservation value Likelihood Duration Extent Severity	Low Unlikely Temporary Site specific Zero	Medium /Low Possible Short term Local Very low	Medium More possible Medium term Regional Low	Medium / High Probable Long term National Medium	High Definite Permanent International High

Significance = Conservation value (Likelihood + Duration + Extent + Severity)

Table 23.3 EISC

Table 23.3.1 EIS Categories (Kleynhans & Louw, 2007).

EISC	Description	Range of Median
Very High	Quaternaries / Delineations are unique on a national and international level based on unique biodiversity (habitat diversity, species diversity, unique species, rare and endangered species). These rivers (in terms of biota and habitat) are usually very sensitive to flow modifications and have no or only a small capacity for use.	>3 - 4
High	Quaternaries / Delineations are unique on a national scale based on their biodiversity (habitat diversity, species diversity, unique species, rare and endangered species). The rivers (in terms of biota and habitat) may be sensitive to flow modifications but in some cases may have a substantial capacity for use.	>2 - ≤ 3
Moderate	Quaternary / Delineations are unique on a provincial or local scale due to biodiversity (habitat diversity, species diversity, unique species, rare and endangered species). These rivers (in terms of biota and habitat are usually not very sensitive to flow modifications and often have a substantial capacity for use.	>1 - ≤ 2
Low / Marginal	Quaternaries/ Delineations are not unique on any scale. These rivers (in terms of biota and habitat) are generally not very sensitive to flow modifications and usually have a substantial capacity for use.	≤1

Table 23.3.2 EIS Categories Rating Scheme (Kleynhans & Louw, 2007)

Score	Channel Type	Conservation Context			Vegetation and Habitat Integrity	Connectivity	Threat status of Vegetation Type
0	Ephemeral Stream	Non-FEPA River	No status	None/ Excluded	No natural remaining	None	No status
1	Stream non-perennial		Upstream management area	Available	Very poor	Very poor	Least threatened
2	Stream perennial flow		Rehab FEPA		Poor	Low	Vulnerable
3	Minor river non-perennial flow		Fish corridor	Earmarked for conservation	Moderately modified	Moderate	Near threatened
4	Minor river perennial flow		Fish support area		Largely natural	High	Endangered
5	Major river perennial flow	FEPA river	River FEPA	Protected	Unmodified/ natural habitat	Very high	Critically endangered

23.4 Risk Matrix Methodology

RISK ASSESSMENT KEY (Referenced from DWA RISK-BASED WATER USE AUTHORISATION APPROACH AND DELEGATION GUIDELINES)

Negative Rating

TABLE 1- SEVERITY

How severe does the aspects impact on the environment and resource quality characterisitics (flow regime, water quality, geomorfology, biota, habitat)

Insignificant / non-harmful	1
Small / potentially harmful	2
Significant / slightly harmful	3
Great / harmful	4
Disastrous / extremely harmful and/or wetland(s) involved	5

Where "or wetland(s) are involved" it means

TABLE 2 – SPATIAL SCALE

How big is the area that the aspect is impacting on?

Area specific (at impact site)	1
Whole site (entire surface right)	2
Regional / neighbouring areas (downstream within quaternary catch	3
National (impacting beyond seconday catchment or provinces)	4
Global (impacting beyond SA boundary)	5

TABLE 3 – DURATION

How long does the aspect impact on the environment and resource quality?

One day to one month, PES, EIS and/or REC not impacted
One month to one year, PES, EIS and/or REC impacted but no change in status
One year to 10 years, PES, EIS and/or REC impacted to a lower status but can be improved over this period through mitigation
Life of the activity, PES, EIS and/or REC permanently lowered
More than life of the organisation/facility, PES and EIS scores, a E or F

TABLE 4 – FREQUENCY OF THE ACTIVITY

How often do you do the specific activity?

Annually or less	1
6 monthly	2
Monthly	3
Weekly	4
Daily	5

TABLE 5 – FREQUENCY OF THE INCIDENT/IMPACT

How often does the activity impact on the environment?

Almost never / almost impossible / >20%	1
Very seldom / highly unlikely / >40%	2
Infrequent / unlikely / seldom / >60%	3
Often / regularly / likely / possible / >80%	4
Daily / highly likely / definitely / >100%	5

TABLE 6 – LEGAL ISSUES

How is the activity governed by legislation?

No legislation	1
Fully covered by legislation (wetlands are legally governed)	5

Located within the regulated areas

TABLE 7 – DETECTION	
How quickly can the impacts/risks of the activity be observed on the environment (water resourc	
Immediately	
Without much effort	
Need some effort	
Remote and difficult to observe	
Covered	

TABLE 8: RATING CLASSES		
RATING	**CLASS**	**MANAGEMENT DESCRIPTION**
1 – 55	(L) Low Risk	Acceptable as is or consider requirement for mitigation. Impact to watercourses and resource quality small and easily mitigated. Wetlands may be excluded.
56 – 169	M) Moderate Risk	Risk and impact on watercourses are notably and require mitigation measures on a higher level, which costs more and
170 – 300	(H) High Risk	Always involves wetlands. Watercourse(s) impacts by the activity are such that they impose a long-term threat on a large scale
A low risk class must be obtained for all activities to be considered for a GA		

TABLE 9: CALCULATIONS

Consequence = Severity + Spatial Scale + Duration
Likelihood=Frequency of Activity + Frequency of Incident +Legal Issues + Detection
Significance \Risk= Consequence X Likelihood