



**WATER USE LICENSE APPLICATION
FOR THE PROPOSED URBAN DEVELOPMENT AT GROBLERSHOOP,
NORTHERN CAPE**

FRESH WATER REPORT

A REQUIREMENT IN TERMS OF SECTION 21 OF THE NATIONAL WATER ACT
MAY 2020



**watsan
AFRICA**

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Abbreviations

Northern Cape Department: Co-Operative Governance, Human Settlements and Traditional Affairs	COGHSTA
Critical Biodiversity Area	CBA
Department of Water and Sanitation	DWA
Ecological Importance	EI
Ecological Sensitivity	ES
Ecological Support Area	ESA
Environmental Impact Assessment	EIA
Electronic Water Use License Application (on-line)	eWULAA
Government Notice	GN
Hectares	ha
Legal water use	LWU
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
Non-government organization	NGO
Present Ecological State	PES
South Africa National Biodiversity Institute	SANBI
Section of an Act of Parliament	S
Water Use License Application	WULA

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NEMA PUBLIC PARTICIPATION PROCESS**PROPOSED TOWNSHIP DEVELOPMENT ON ERF 113, GARIEP, !KHEIS LOCAL MUNICIPALITY**

Notice is hereby given of the intention to submit a NEMA application and a Water Use License Application (WULA) as part of 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). The proposed township development on Erf 113, Gariep includes activities listed in terms of the NEMA EIA Regulations 2014.

EnviroAfrica cc has been appointed by the !Kheis 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, 24, 27, 56**
- Government Notice R324 (Listing Notice 3): Activity No. **4, 12, 14**

**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 !Kheis Local Municipality is proposing that a new township development, consisting of approximately 135 erven and associated infrastructure on Erf 113, Gariep. Gariep is located approximately 36km north-west of Groblershoop, on the eastern side of the Orange River, in the !Kheis Local Municipality, Northern Cape.

The proposed project entails the development of approximately 135 low income erven, including associated infrastructure such as roads, water, stormwater, effluent and electricity reticulation. The total area to be developed measures approximately 15 hectares.

Site co-ordinates: 28° 36' 39.33" S, 21° 46' 53.37" E.

Public Participation:

Interested and Affected Parties (I&APs) are hereby notified of the application and invited to register (in writing) and/or provide comments and identify any issues, concerns or opportunities relating to this project to the contact details provided below, **on or before 03 July 2020**. 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. Please note that future correspondence will only be sent to registered Interested and Affected Parties.

Please note that only Registered I&APs 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.

You are also requested to pass this information to any person you feel should be notified.

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



Figure 1 Public participation

1 Introduction

On 14 May 2020, an email message was received from Mr Len Fourie, director at Macroplan of Upington:

“The appointment of Gobetla Beplannings Dienste TA Macroplan by the Barzani Group (on behalf of COGHSTA) received on the 17th of April 2020 and the attached documentation have reference.

“We hereby confirm that Macroplan has been appointed as Town and Regional Planners to handle the formal Town Planning Process in accordance with the SPLUMA legislation (Act 16 of 2013). The mentioned process is for the provision of much needed residential erven in the sub-economic market that is of National and Provincial interest for towns in the !Kheis Local Municipality, ZF Mgcawu District Municipality, Northern Cape Province.

“Macroplan and all sub-consultants were requested to proceed with site verification, site visits, contour mapping, specialists environmental studies, geotechnical studies, as well as civil and engineering investigations for the mentioned project asap due to the importance of continued service delivery in the !Kheis Local Municipal area. Your firm as a sub-consultant of Macroplan is hereby requested to proceed with organising the site visits to the following areas that is located within the !Kheis Local Municipality.”

This adequately explains the situation.

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).

Likewise, WATSAN Africa was appointed to produce the Fresh Water Report and carry out the WULA in terms of the NWA. The required site visits were conducted on 20 and 21 May 2020.

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.

This then is the last of 7 reports. For each of these reports, the issues are very much the same, with a similar terrain and social-economic circumstances. Consequently, the reports are the same, being mirror images of one another, but adapted to the specific localities and specific issues for each of the townships.

2 Seven Townships

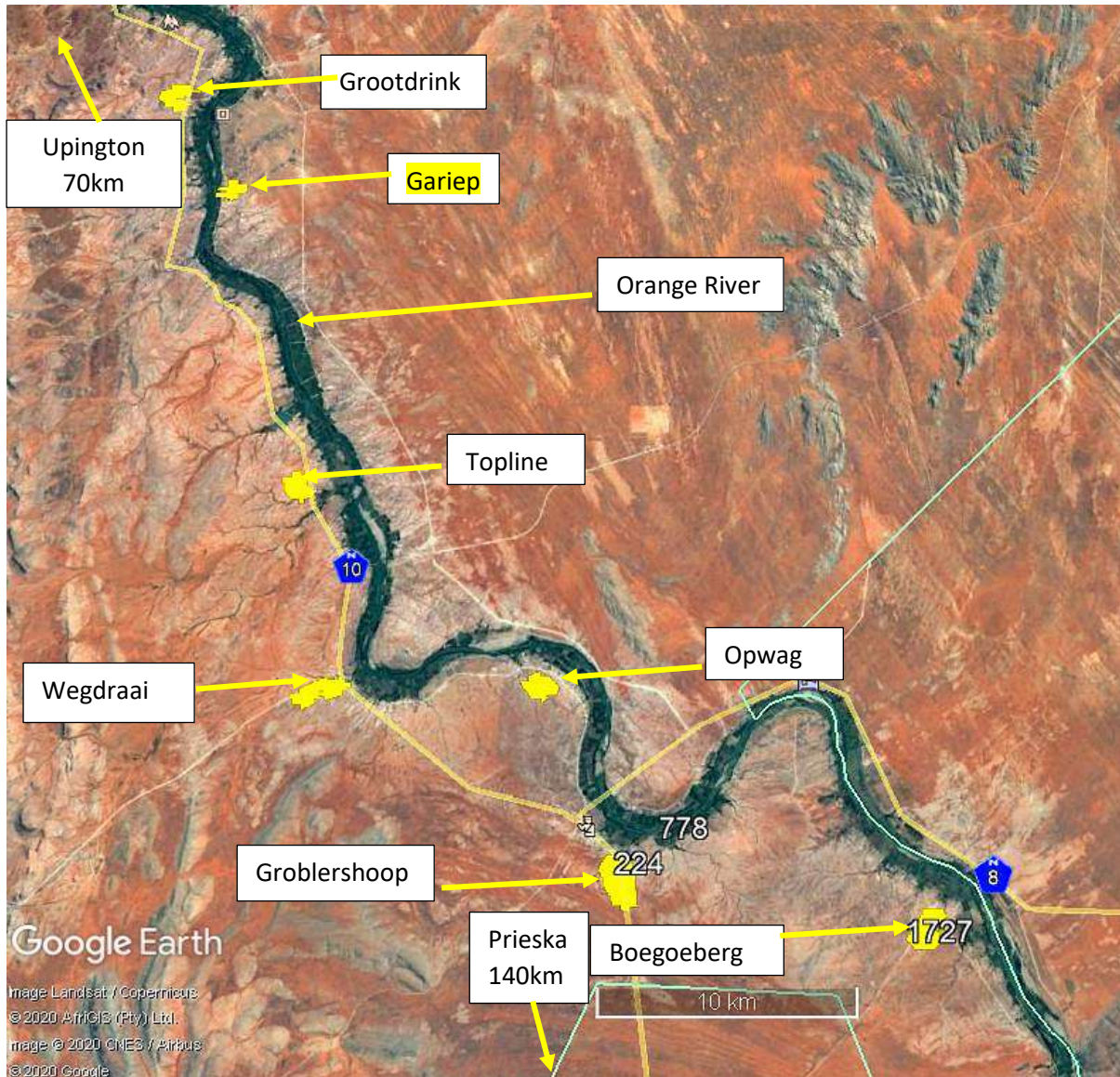


Figure 2 Seven townships

The seven townships that are being considered for extension are depicted in Figure 2. **Gariep** is highlighted in yellow and is the subject of this Fresh Water Report.

3 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 development is spanning the banks of a drainage line. A drainage line 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 development will alter the characteristics of the banks of a drainage line.

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. The development is adjacent to drainage lines, which are defined as legitimate water resources.

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 adjacent to drainage lines. Consequently, this regulation is relevant to this application.

This Fresh Water Report is exclusively focussed in S21 (c) and (i) of the NWA

4 !Kheis Municipality Overview

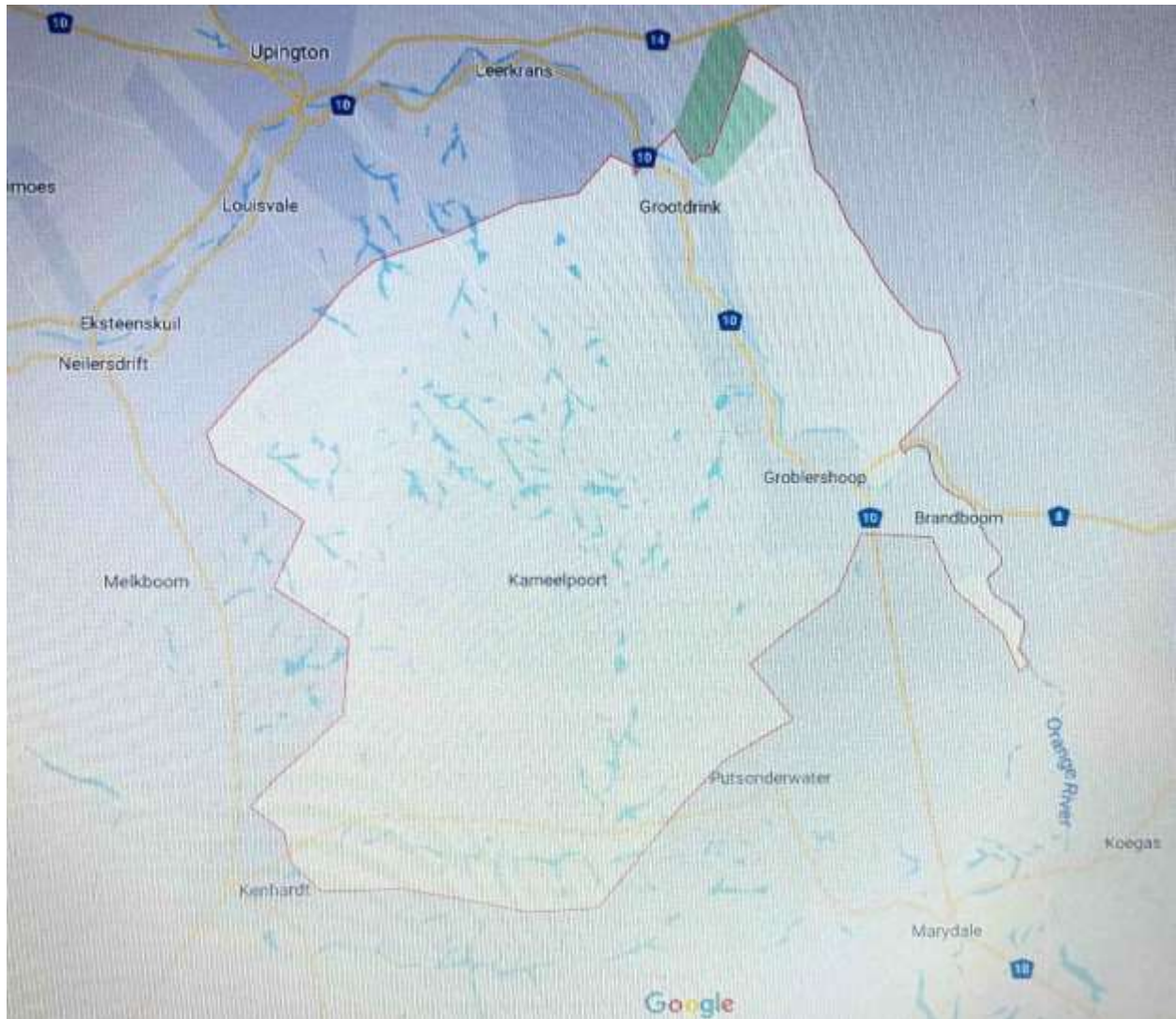


Figure 3 !Kheis Municipality

According to available information

(municipalities.co.za/1181/kheis-local-municipality)

Area	11 107km ²
Population	16 566 (2016)
Households	4344

The municipal offices are located in Groblershoop.

Only 59% of the houses were listed as formal dwellings, 41% were connected to the urban sewerage system, 62% had formal refuse removal, 21% had piped water and 74% had electricity. As from the year 2020, 500 more households were provided with solar panels and batteries to provide electricity.

The average fertility rate over the past 5 years was 2.67%

(<https://irr.org.za/reports/freefacts/files/00-2014-freefacts-2014-february-2020-draft.pdf>)

This means, according to available demographic data, that currently at least 116 new houses are required every year.

To address any backlog and to make provision for future housing requirements, new plots are demarcated in the following locations:

Groblershoop	1500
Boegoeberg	550
Opwag	730
Wegdraai	360
Topline	248
Grootdrink	370
Gariep	135

Urban development is specifically required along the Orange River, where large-scale and labour-intensive farming of vineyards under irrigation sparks human settlements.

The municipality appointed the town and regional planning company Macroplan of Upinton to lay out the new plots in these 7 townships.

5 Climate Groblershoop

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

Groblershoop is the closest locality to Gariep of which climatic data is available. Normally it receives about 108mm of rain per year, with most rainfall occurring mainly during autumn. The chart below (Figure 4, lower left) shows the average rainfall values for Groblershoop per month. It receives the lowest rainfall (0mm) in June and the highest (32mm) in March. The monthly distribution of average daily maximum temperatures (centre chart below) shows that the average midday temperatures for Groblershoop range from 19°C in June to 33°C in January. The region is the coldest during July when the mercury drops to 2°C on average during the night. Consult the chart below (lower right) for an indication of the monthly variation of average minimum daily temperatures.

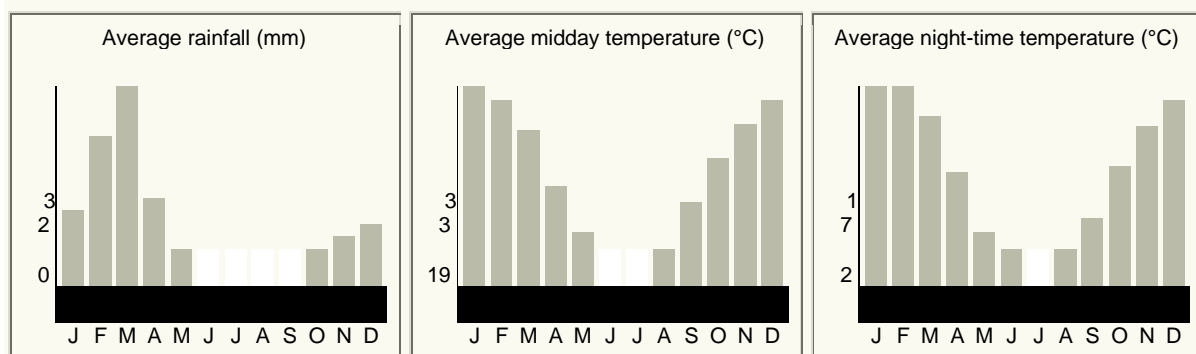


Figure 4 Climate Groblershoop

Groblershoop and surrounds is located in the Nama Karoo, which is from all points of view an arid area. For 4 months of the year there is no rainfall at all.

According to

<https://weatherspark.com/y/86570/Average-Weather-in-Groblershoop-South-Africa-Year-Round>

the dry season at Groblershoop lasts up to 6.4 months from April to November.

The evaporation rate in the nearby Upington, 70km to the north, is more than 2500mm per year. This is 27 times more than the annual precipitation.

http://www.dwaf.gov.za/orange/Low_Orange/upington.aspx

The local economy (agriculture) is entirely dependent on irrigation out of the Orange River.

6 Vegetation

The South African National Biodiversity Institute (SANBI) indicated the vegetation type on the property as Bushmanland Arid Grassland. The vegetation around the river is indicated as Lower Gariep Alluvial Vegetation. The Orange River is a National Freshwater Ecosystem Priority Area (NFEPA). The riparian area is indicated as Nama Karoo Bushmanland_Floodplain Wetland, despite that most of it today is manicured agriculture.

7 Quaternary Catchment

Gariep is in the D73D quaternary catchment.

8 Drainage Lines

The landscape around much of the Lower Orange River and the Sak River is dominated by a dense succession of drainage lines, each with their own sub-catchment. The drainage lines spread along the river with many smaller tributaries to cover the entire area. The iron oxides in the sands renders a red hue that is visible from space on the Google Earth images. These reds are concentrated in the drainage lines, making them even more visible (Figure 5).

The drainage lines are mostly dry, with water only during rains and perhaps shortly thereafter. During the odd thunder storm, drainage lines can come down in flood. These floods maintain the drainage line's morphological integrity, as sediments are moved and these water ways are scoured out.

Because rainfall events are far apart, the drainage lines must have been formed over millennia, even since geological times.

The vegetation in these arid parts is sparse, with a low diversity of plant species and a limited habitat variability. Drainage lines are often overgrown with a mature stand of sweet thorn *Vachellia karoo*, together with some other scrub and low trees such as *Searsia* species. In other parts the dominant tree is swarthaak *Senegalia mellifera*. This considerably adds to the habitat variability of the region. These tree lines stretch over the otherwise barren landscape and provide a linear connected habitat that would have been entirely absent if it was not for the shallow ground water in the unconfined aquifer in the drainage line's alluvium. Likewise, these tree lines provide habitat and nourishment to a variety of fauna that would have been entirely absent, was it not for the gradual migration of shallow ground water along the drainage lines.

All over the arid and semi-arid landscape of the western half of South Africa, these tree lines are considered to have a special and high conservation value.

Around the Orange River and even the Sak and Hartbees River, large-scale agriculture has changed the drainage lines into drainage channels among the vineyards and orchards. The upper reaches away from the rivers are less impacted,

even near-pristine, as intense agriculture is not possible, apart from those areas where water is piped over long distances from the Orange River.

The conservation of drainage lines along the Lower Orange River deserves and demands attention by decision-making authorities, environmental practitioners, the conservation and farming community alike. As more of these drainage lines are impacted upon, and because impacts are radical by nature, because sections of drainage lines are replaced by vineyards or other forms of agriculture, or transformed into return flow infrastructure, the necessity for a widely accepted conservation policy becomes urgent as development escalates.



Figure 5 Drainage Lines

9 The Gariiep Housing Project



Figure 6 Gariiep Housing (Macroplan)

The new housing is going to all around the existing housing, in three parts, 17 ha in total, with the centre part left out because there are already houses (Figure 6).

This is the only one of the seven developments across the bridge at Grootdrink on the other side of the Orange River. The river generally flows from east to west, but this particular reach is from south to north. Gariiep is located to the east of the Orange River

10 Gariiep housing drainage line

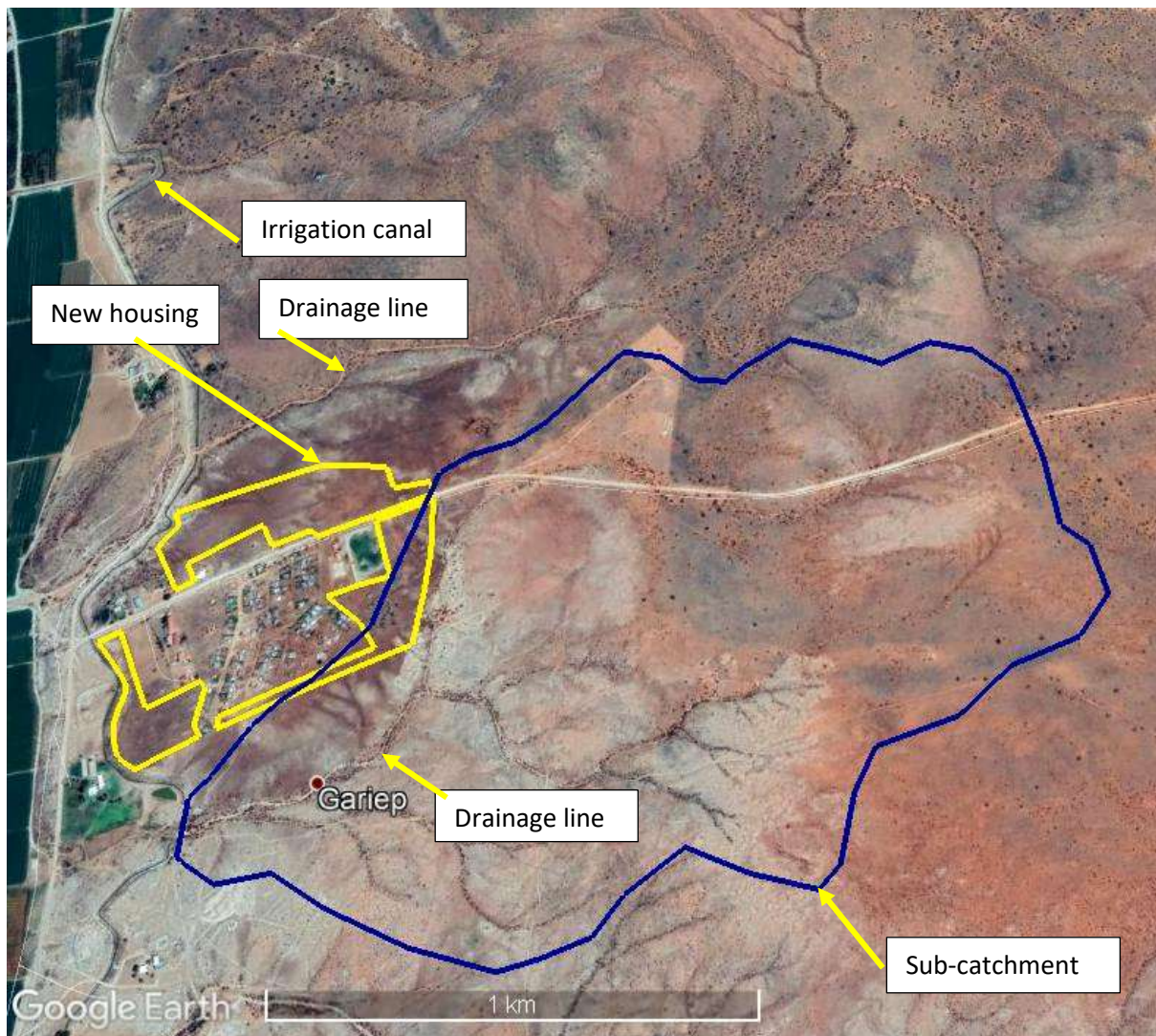


Figure 7 Gariiep Housing drainage line

Only one drainage line is of importance to the WULA. Its drainage line touches on the boundary of the new development on the eastern and southern sides (Figure 7). This sub-catchment is 192 ha in size, with a circumference of 5.8km. This is a small sub-catchment by any standards, with a short drainage line. Only a part of the sub-catchment crosses the boundary onto the new development.

To the north is another small sub-catchment, but its closest point to the boundary of the new development is 150m away, too far to justify any WULA action.

The new development borders onto the irrigation canal.

The closest point of the new development to the Orange River is 480m away.

It could be construed that the Orange River is well protected from any contamination from the urban area of Gariiep, with first the flood berm on the banks of the Orange River, then the large-scale farming all along the river, a cut-off trench to the east on the boundary of the farming area (Figure 8), then a dirt road as well as the irrigation canal (Figure 9).

This is not entirely true, as the irrigation canal dips underground and underneath the drainage line, with no impairment to storm water flowing down the drainage line. Storm water will run over the dirt road into the cut-off trench, from where storm water will flow to the south to a very large concrete gully (Figure 10) around the farming area right into the Orange River.



Figure 8 Cut-off trench



Figure 9 Irrigation canal

The irrigation canal was dry at the time of the site visit on 21 May 2020, because of *Similium* midge control.



Figure 10 Gulley

This gully was constructed to take the flood from the next adjacent drainage line to the south, which is somewhat larger than the Gariiep drainage line. A culvert underneath the dirt road marks the spot where this drainage line and the gully connect (Figure 11). The cut-off trench opens here through a large concrete pipe into the gully.



Figure 11 Culvert



Figure 12 Upper drainage line

Higher up in the sub-catchment, above Gariiep township, the drainage line is shallow, not incised, with a sandy bottom (Figure 12). Higher up the drainage line bed is pebbles with quartzite and calcrete rocks.

Above the town some dumping took place, with household waste (Figure 13), within the 100m buffer zone.



Figure 13 Waste

This waste (Figure 13) can pose a problem, as it can be washed down the drainage line, end up in the Orange River to the detriment of farming and the regional economy. A proper sanitary landfill is required.

The proximity of the proposed development to the irrigation canal can pose more problems. Downstream farmers would want to prevent household waste from townships entering into the irrigation canals and irrigation equipment. Just upstream from Gariiep township a structure was photographed to prevent storm water from the adjacent drainage line entering the irrigation canal (Figure 14).



Figure 14 Drainage line crossing irrigation canal

The engineers will know what structures to construct to keep urban waste out of the irrigation canals, but it can be well imagined that more of these would be required at the proposed Gariep township.

11 Biomonitoring the Lower Orange River

The biomonitoring was carried out according to the description of Dickens & Graham (2002).

Biomonitoring was carried out on the Lower Orange River during site visits for successive WULAs. So far 12 samples have been analyzed at 11 localities (Table 1). The site furthest east was at Hopetown and furthest west at Augrabies, with Upington in the middle. All of these are located upstream of the Augrabies Falls.

Another sample was analyzed at Styerkraal just east of the border post of Onseepkans downstream of the Augrabies Falls.

The river is mostly braided, with many smaller streams and with islands in the middle. The river sports many rapids and riffles, but also pool-like features where the river is broad and slower flowing.

The bottom is mainly muddy, with some large rocky outcrops in the middle of the river.

12 Impacts on the Lower Orange River

The river is heavily utilized for agriculture, with the banks entirely modified into cultured vineyards. A multitude of large electric water pumps have been placed in the river for abstracting large volumes of water for irrigation. Abstraction significantly lowers the flow in the river.

Berms for the purpose of flood protection have been constructed on the banks of the river for most of its length. These berms have been constructed by the Department of Water Affairs and now have been a feature of the landscape for many decades. The berms keep flood water out of adjacent agricultural land and has denaturalised the riparian zone.

The single most impact on the Orange River are the two very large dams, The Gariep Dam and the Vanderkloof Dam. The river flow has been modified to a much more even regime, different from the varied flow with high peak flows and low drought flows.

The Lower Orange River is lined with a dense system of mostly dry drainage lines. These drainage lines only flow during and shortly after heavy rains. Their contribution to the flow of the Orange River is insignificant. Most of the flow comes from the Lesotho Highlands and some from the Vaal River. However, many of these drainage lines have been transformed into engineered agricultural return flow furrows that carries the excess of over irrigation back to the Orange River. Agricultural return flow adds much to the nutrient load of the Orange River because runoff contains fertilizer. Nitrogen is added in large quantities. Since phosphorus readily binds to the soil, not much phosphorus is added.

Return flow can contain a heavy silt load, thereby elevating turbidity in the river.

It is suspected that pesticides in agricultural return flow have a heavy impact on biomonitoring results, significantly reducing the SASS5 score.

The banks of the Orange River in the area is densely overgrown with Spaanse Riet (*Arundo donax*). This is classified as an aggressive and exotic invasive plant, which effectively prevents access to the river. The reeds result in a homogeneous aquatic habitat. This lack of variation suppresses the SASS5 score, with only a limited number of aquatic macroinvertebrate species present in this habitat.

13 Lower Orange River Biomonitoring Results

The biomonitoring results have been captured in Table 1 and depicted in Figure 15.

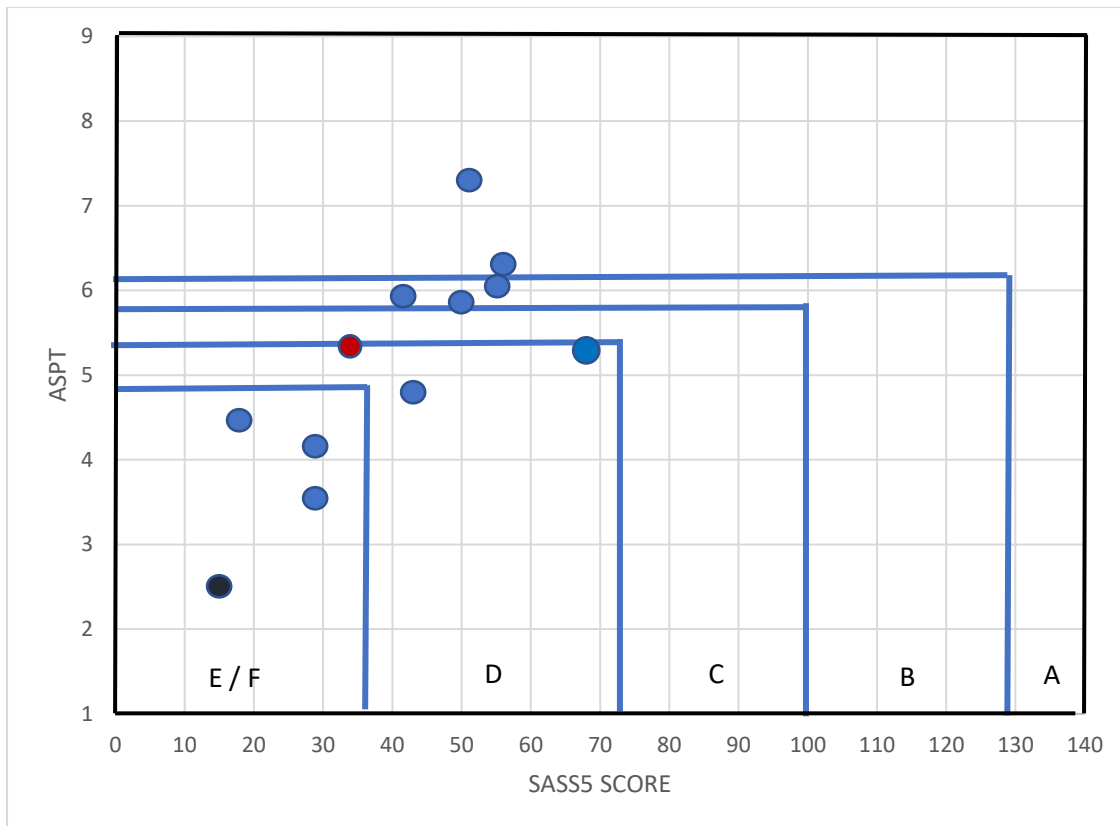
The classes from A to F in Figure 15 has been assigned for mature rivers on flood plains such as the Lower Orange River.

Only 2 of the samples were classified a good and relatively unimpacted (Class A). Four were in Class B and C, which can be regarded as acceptable under the circumstances of an impacted river reach. These classes can possible be labelled as the ideal, a compromise between agriculture and aquatic ecological functioning.

Four samples were poor (Classes E and F), an undesirable state of affairs.
 The one sample downstream of the Augrabies Falls was extremely poor.

Table 1 Biomonitoring in the Lower Orange River

Locality	Coordinates	Date	SASS 5	No Taxa	ASPT
Augrabies Lair trust	28°38'41.53S 20°26'08.49E	5/09/17	18	4	4.5
Augrabies Lair Trust	28°38'41.53S 20°26'08.49E	5/10/17	43	9	4.8
Grobbershoop	28°52'31.80S 21°59'13.49E	14/8/18	41	7	5.9
Kakamas Triple D	28°45'08.37S 20°35'06.16E	15/8/18	50	9	5.6
Hopetown Sewer	29°36'05.07S 24°06'05.00E	7/10/18	29	7	4.1
Hopetown Sewer	29°36'08.06S 24°21'06.16E	7/10/18	29	8	3.6
Keimoes Housing	28°42'37.12S 20°55'07.81E	8/02/19	51	7	7.3
Upington Erf 323	28°27'11.91S 21°16'14.02E	12/2/19	56	9	6.2
Upington Affinity	28°27'11.91S 21°16'14.02E	20/5/19	54	9	6
Styerkraal	28°27'25.28S 21°15'01.87E	21/5/19	15	6	2.5
Grootdrink Bridge	28°17'15.30S 21°03'50.87E	17/5/20	34	7	5.3
Turksvy Dam	28°27'09.21S 21°17'20.72E	17/5/20	69	13	5.3



Integrity Class	Description
A	Pristine; not impacted
B	Very Good; slightly impacted
C	Good; measurably impacted with most ecological functioning intact
D	Fair; impacted with some loss of ecological functioning
E	Poor; loss of most ecological function
F	Very Poor; loss of all ecological function

Figure 15 Lower Orange River Biomonitoring Results

The red dot on the graph represents the result at the Grootdrink Bridge. All of the other dots represent previous sampling.

14 Sampling Site



Figure 16 Sampling Site



Figure 17 Orange River at Sampling Point

The sampling point (Figure 16, Figure 17) was chosen downstream as far as possible in order to pick up the combined impact of all of the housing projects along the reach of the Orange River from Boegoeberg to Grootdrink. This, of course, is not a realistic view, because the impact of agriculture would dwarf any other, if it could be separated, which is not possible. So, the reasoning is rather theoretical, not entirely realistic, but nevertheless required in terms of the WULA requirements.

However, if the cumulative impact of raw sewage from the many townships in the Orange River would ever realize as a threat, a biomonitoring result at this location would be of great benefit to assess the situation.

Moreover, sewage and its concomitant microbiological contamination would be a serious threat to the grape, other fruit and food export industry.

The sampling point was chosen because of accessibility. The dense stand of reeds renders most of the river's banks out of reach. There was a break in the reeds, probably kept open by local fishermen.

The available habitat was emerging vegetation (reeds), submerged vegetation (a single strand of parrot's feather), bedrock and muddy bottom.

The SASS5 score was only 34, which low and can be attributed to the limited available habitat. The ASPT came to 5.3, which can be expected for a mature river reach such as the Orange River at Grootdrink Bridge. The score indicated a "fair" rating, with some if it lost but with most ecological functioning still intact.

15 Present Ecological State (PES)

Table 2 Habitat Integrity according to Kleynhans, 1999

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

The PES and EIS are protocols that have been produced by Dr Neels Kleynhans (Table 2 and 3) in 1999 of the then DWAF to assess river reaches. The PES is one of the evaluations that is prescribed for S21 (c) and (i) WULA's. The scores given are solely that of the practitioner and are based on expert opinion.

The very upper parts of the drainage line are within a private fenced game farm. The drainage line here is faint and overgrown with mostly swarthaak bushes and low trees. It passes the dumping site and then down the incline to the east of the town where it is still in a reasonable state. From the canal onwards to the dirt road the drainage line is trampled all over and from there on further to the river it is entirely denaturalised, with any ecological functioning in an artificial environment completely different of what it was prior to human impact.

This is a small drainage line, with the heavily impacted lower reach weighing proportionally more, if compared to the larger drainage lines in much larger catchment areas.

Table 3 Present Ecological State of the Drainage Line

	Score	Weight	Product	Maximum score
Instream				
Water abstraction	24	14	336	350
Flow modification	12	13	156	325
Bed modification	13	13	169	325
Channel modification	14	13	182	325
Water quality	15	14	210	350
Inundation	13	10	130	250
Exotic macrophytes	23	9	207	225
Exotic fauna	12	8	96	200
Solid waste disposal	8	6	49	150
Total		100	1328	2500
% of total			53.1	
Class			D	
Riparian				
Water abstraction	24	13	312	325
Inundation	13	11	143	275
Flow modification	12	12	144	300
Water quality	15	13	195	325
Indigenous vegetation removal	12	13	156	325
Exotic vegetation encroachment	21	12	252	300
Bank erosion	19	14	266	350
Channel modification	14	12	168	300
Total			1468	2500
% of total			58.7	
Class			D	

Both the instream and riparian habitat score a “D”, with the loss of ecological functioning. This is despite of the very upper reaches, that on its own would score a “B”, while the lower reach would score an “F”.

Much has been published on the ecological state of South African rivers and the Orange River is no exception. In fact, it seems somewhat arrogant to assess the Lower Orange River, even at the sampling point, with a team of one and with the financial backing of a single WULA. This is a large undertaking that is to be contemplated by a team of experts. Nevertheless, this is what the WULA requires.

The river at the Grootdrink sampling point, as elsewhere, has been impacted by major dams, large-scale water abstractions, an influx of agricultural chemicals,

encroachment of reeds and exotic macrophytes, translocated and exotic fish, levees, bridges and many other infarctions.

Table 4 Present Ecological State Orange River

Instream				Maximum
	Score	Weight	Product	score
Water abstraction	15	14	210	350
Flow modification	15	13	195	325
Bed modification	20	13	260	325
Channel modification	22	13	286	325
Water quality	15	14	210	350
Inundation	12	10	120	250
Exotic macrophytes	18	9	162	225
Exotic fauna	15	8	120	200
Solid waste disposal	20	6	120	150
Total		100	1593	2500
% of total			63.7	
Class			C	
Riparian				
Water abstraction	15	13	195	325
Inundation	14	11	154	275
Flow modification	15	12	180	300
Water quality	15	13	195	325
Indigenous vegetation removal	15	13	195	325
Exotic vegetation encroachment	15	12	180	300
Bank erosion	20	14	280	350
Channel modification	18	12	216	300
Total			1595	2500
% of total			63.8	
Class			C	

However, the river at Grootdrink was less impacted than further downstream, as at Kakamas. The river at Grootdrink was stronger flowing, with much more water. The condition of the river gradually deteriorates as water abstraction and return flows increases downstream.

Hence the river was scored a C (Table 4), which signifies that it has been impacted, but despite these impacts still exhibits appreciable ecological functioning. The riparian zone scores a C as well.

There is a good chance that other practitioners would score the river very much the same.

Importantly, the proposed development at Groblershoop is not about to change the PES of the Orange River at Grootdrink.

16 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 5).

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

No other endangered species, either plant or animal, were detected in or near the drainage line.

Table 5 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)

As has been stated before, the higher vegetation in and around the drainage lines are of particular importance in these arid regions and add significantly to biodiversity. These should be considered as ecologically important.

The Orange River is most important, according to this assessment.

According to Skelton (1993) 12 species of indigenous fish occur in the Lower Orange River. Since 2011 another one was added, as well as 3 exotic species. These are the following:

Barbus trimaculatus

B paludinosus

B. hospus

Labeobarbus kimberleyensis (Near threatened)

L aenus

Labeo umbratus

L capensis

Austroglanis sclateri (Widespread elsewhere)

Clarias gariepinus

Pseudocrenilabrus philander (Threatened locally but abundant elsewhere)

Pseudobarbus quathlabae

Mesobola brevianalis (critically endangered)

Exotic and translocated fish:

Cyprinus carpio

Tilapia sparrmanii

Oreochromus mossambicus

Those in blue are endangered to a varying extent. Those indicated in red are exotic or translocated fish.

The only one that causes real concern in the largemouth yellow-fish *Labeobarbus kimberleyensis*. It is endemic to the Orange River system and hence is threatened not only on a local scale, but on a national scale as well. This puts the Lower Orange in category 4. This renders the Orange River as important.

According to the owners of the Kalahari River and Safari Co. along the northern bank of the Orange River on the Riemvasmaak Road, mature blue kurper *Oreochromus mossambicus* are regularly captured in increasing numbers. It now takes at least 4 man-days to capture a single yellow fish.

Yellow fish are generally infected with cestode bladder worms, while darters (*Anhinga rufa*) that predate on these fish are heavily infected with tape worms. It seems as if the translocated Tilapia are not affected by these parasites.

According to Mr Chris van der Post, a renown angling guide and the owner of the Gkhui Gkhui River Lodge near Hopetown, there are still many smallmouth-yellow fish around, but largemouth yellow-fish are scarce.

17 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.

17.1 Ecological Sensitivity Drainage Line

The question arises, according to the ES definition, if the drainage lines would recover to its original ecological state prior to any human impact. If the roads and vineyards, along with the rubble and trash be removed, would the drainage line recover? The answer is probably yes, even though the drainage lines would find new routes and even though it would take many decades, perhaps more than a century, in this semi-arid region where re-growth of vegetation can take a long time. However, this is not a realistic scenario. Development is here to stay, together with its impacts. From this point of view the drainage line can be considered as ecologically sensitive.

17.2 Ecological Sensitivity Orange River

The Lower Orange River has absorbed numerous and deep-cutting human impacts. Yet it still functions as an aquatic ecosystem. In the highly improbable event of ceased human impact, the river here would probably bounce back to its previous glory. In this respect the river cannot be categorised as sensitive. It is dreaded among conservation minded people that the Lower Orange River might have some more capacity to absorb further impact.

18 Probable Impacts

The drainage line in the northern corner of the proposed development is small, almost insignificant. The catchment area is small. Even so, it still has some conservation value. The houses should not be built right through the drainage line on the eastern and southern boundary. A buffer strip of at least 20m should be maintained. There won't be a need for the construction of a formalised storm water conduit.

The impact on the irrigation canal as well as on the Orange River is of concern because of the household waste situation. The current waste disposal site has a more direct link to the Orange River than some of the other townships, with the cut-off trench and the gully. The construction of at least some infrastructure would be advisable

here, such as grids and collection ponds, which can be cleaned out from time to time. Better still, a proper waste collection and disposal system should be provided.

The threat of untreated sewage in the water ways does not seem to be a problem right now, but may well grow into something bigger if the township grows, without proper wastewater facilities.

The cumulative impact of all developments along the Orange River in the !Kheis municipality can be substantial.

19 Mitigation Measures

The construction of litter and household waste collection infrastructure in the drainage line is advisable.

A proper waste collection and municipal disposal system should be instated. Adequate municipal services should resume.

A buffer zone of at least 20m wide should be maintained from the drainage line.

20 Impact Assessment

Table 6 Impact Assessment

Description of impact								
Cumulative impact of solid waste ending up in the irrigation canal, drainage line and Orange River								
Mitigation measures								
Construction only during the dry season, limit the foot print, vegetate disturbed areas.								
Type Nature	Spatial Extent	Severity	Duration	Significance	Probability	Confidence	Reversibility	Irreplaceability
Without mitigation								
Cumulative	Regional	Medium	Long term	Medium	Probable	Certain	Reversible	Replaceable
With mitigation measures								
Cumulative	Local	Low	Long term	Low	Unlikely	Sure	Reversible	Replaceable

Some of the decision-making authorities prescribe an impact assessment according to a premeditated methodology (Table 23.1, Appendix).

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

The assessment indicates that the impacts are acceptable, provided that the mitigation measures are adequate to contain these impacts (Table 6).

21 Risk Matrix

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

The assessment was carried out according to the interactive Excel table that is available on the DWS webpage. Table 7 is a replica of the Excel spreadsheet that has been adapted to fit the format of this report. The numbers in Table 7 (continued) represent the same activities as in Table 7, with sub-activities added.

The methodology is tabled in the Appendix.

This is a small drainage line of little significance. The only risk of importance is the possibility of urban waste down the drainage line and into the Orange River. The risk increases because of the cumulative risks posed by the various developments along the reach of the Orange River. It is supposed that if the contamination in the river rises and the farming community becomes aware of it, that there would be a strong reaction, leading to curbing or ending the problem. This assumption influenced the score for “duration”, as the problem was perceived not to continue.

In most cases loosened soil and silt that can be washed down the drainage lines during construction are considered to be a risk to the aquatic environment. In the event of the Gariep development, the risk is so small that it is not worth considering in a Risk Matrix.

The Risk Matrix indicates that the risks to the aquatic environment are low. A General Authorisation should be in order for this application and a License is deemed not to be the indicated level of authorisation.

Table 7 Risk Matrix

No.	Activity	Aspect	Impact	Significance	Risk Rating
1	Urban solid waste	Waste ending up in the drainage line and in the river	Pollution of the river	48	Low

Table 7 Continued Risk Rating

No	Flow	Water Quality	Habitat	Biota	Severity	Spatial scale	Duration	Consequence
1	1	1	1	1	1	1	2	4

No	Frequency of activity	Frequency of impact	Legal issues	Detection	Likelihood	Significance	Risk Rating
1	3	3	5	1	12	48	Low

22 Resource Economics

Table 8. Goods and Services

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

0	Low
5	High

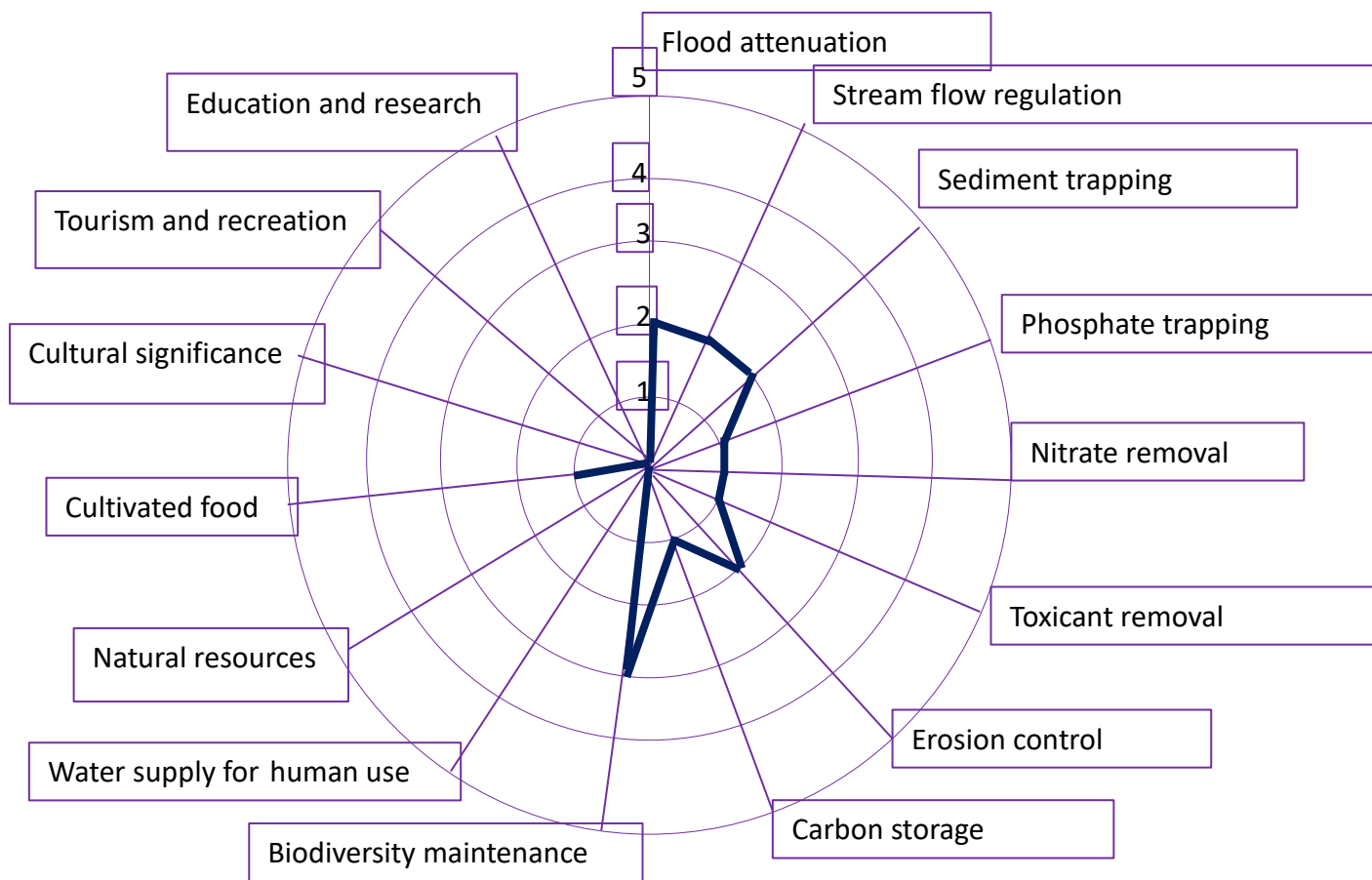


Figure 18. Resource Economics Footprint of the Drainage Line

The goods and services delivered by the environment, in this case the drainage line at the new Gariiep housing development, 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 line the goods and services delivered are particularly applicable and important, hence it was decided to include it in the report.

The diagram (Figure 18) is an accepted manner to visually illustrate the resource economic footprint the drainage line, from the data in Table 8.

The size of the star shape attracts the attention of the decision-makers. This shape (spider diagram, Figure 18) is very small, indicating that the water course has a small economic foot print. If this drainage line is lost because of development, it won't represent a mentionable loss in environmental goods and services.

23 Site Visits: General Observations

Pertaining to Fresh Water Reports in general, urban wastewater is of importance because untreated waste ends up in water ways, which rebels against the NWA and other contemporary South African environmental legislation. Photographic evidence is presented in several of the seven !Kheis townships where anaerobic pond systems for the treatment of sewage lie idle and are not being utilized for the treatment of urban sewage. Instead raw sewage is dumped in drainage lines. Likewise, several sewage pump stations are dysfunctional, overflowing, with large quantities of raw sewage flowing down drainage lines.

Household solid waste is not collected and removed according to standard municipal operating procedures. Very large quantities of waste accumulate in the townships and the streets. Large quantities of waste end up in the drainage lines as well.

These two aspects are crucial to the WULA and environmental authorisation of any further urban development. If these malpractices are allowed to continue and if the normal municipal services continue to be absent, this untenable situation would become worse when these townships expand.

It should be noted that functional municipal services are part and parcel of the !Kheis Municipality's Technical Director's KPA's, stated in his published service contract. However, wastewater and solid waste management are not pertinently mentioned in this contract, which may explain why these services are not satisfactory.

This is not only a tangible threat to human health and human well-being at !Kheis, but in many South African municipalities, as well as in cities elsewhere in the world where WATSAN Africa concluded contracts.

In a number of the townships, graveyards are illegally located right in drainage lines or within the 32m buffer zone from drainage lines.

There is no shortage of the aloe *Aloe claviflora* (Figure 19) in the district. They are plentiful and not endangered in any way, although aloes are protected plants in terms of legislation. These aloes are cleared from plots where people are putting up their houses. There will be a major clearance once the new housing schemes are launched. These aloes have a considerable monetary value if sold in cities such as Pretoria, Johannesburg and Cape Town. A formal scheme should be devised to collect and sell these aloes, the proceeds could be transferred to a reputable NGO, for community-based projects, such as building class rooms or additions to clinics.

From a Fresh Water Report perspective, a Licence or General authorisation should probably not be granted until the sewage and waste issues are satisfactory and

sustainably resolved. But then this is entirely the prerogative of the DWS and its officials.



Figure 19 *Aloe claviflora*

24 Conclusions

Figure 20 has been adapted from one of the most recent DWS policy documents.

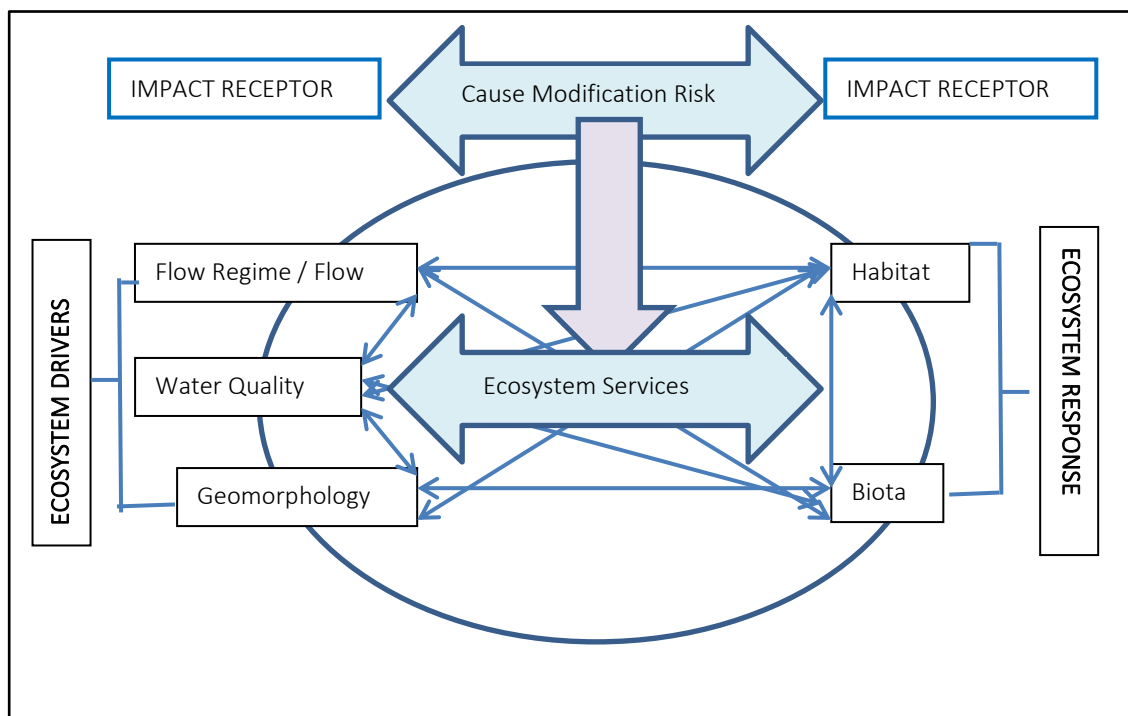


Figure 20 Minimum Requirements for a S21(c) and (i) Application

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 20). 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 the drainage lines.

The current sewage and solid waste situation are threats to the WULA. The authorities may insist that these issues be resolved before a General Authorization is approved.

Apart from this, the findings of this Fresh Water Report indicate that a general Authorization would be in order for the development of an urban housing scheme at Gariiep.

25 References

Dickens, CWS & PM Graham. 2002. *The South African Scoring System (SASS) Version 5 Rapid Bioassessment Method for Rivers*. African Journal of Aquatic Science 27: 1–10

Kleynhans, C.J. 1999. *Assessment of Ecological Importance and Sensitivity*. Department of Water Affairs and Forestry. Pretoria.

Kotze, G., G. Marneweck, A. Batchelor, D. Lindley & Nacelle Collins. 2009. *A technique for rapidly assessing ecosystem services supplied by wetlands*. Water Research Commission, Pretoria.

Skelton, P. 1993. *Freshwater Fishes of Southern Africa*. Southern Book Publishers, Halfway House.

26 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:



15 June 2020

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 PhD, MBA, PrSciNat, MWISA
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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 Roedfontein 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 Klaarstroom Waste Water Treatment Works
- 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 Agricultural Development, Upington

28 Appendix

28.1 Biomonitoring Score Sheet

SASS5 Score Sheet										
Date	17 May 20	Taxon	Weight	Score	Taxon	Weight	Score	Taxon	Weight	Score
Locality	Orange River	Porifera	5		Hemiptera			Diptera		
	Grootdrink Bridge	Coelenterata	1		Belostomatidae	3		Athericidae	10	
		Turbellaria	3		Corixidae	3	3	Blepharoceridae	15	
		Oligochaeta	1		Gerridae	5		Ceratopogonidae	5	
Coordinates	28°27' 15.30"	Huridinea	3		Hydrometridae	6		Chironomidae	2	2
	21°17'03.50"	Crustacea			Naucoridae	7		Culicidae	1	
		Amphipodae	13		Nepidae	3		Dixidae	10	
DO mg/l	8.6	Potamonautidae	3		Notonectidae	3	3	Empididae	6	
Temperature °C	17.2	Atyidae	8	8	Pleidae	4	4	Ephyridae	3	
pH	7.15	Palaemonidae	10		Veliidae	5		Muscidae	1	
EC mS/m	33	Hydracarina	8		Megaloptera			Psychodidae	1	
		Plecoptera			Corydalidae	10		Simuliidae	5	5
SASS5 Score	34	Notonemouridae	14		Sialidae	8		Syrphidae	1	
Number of Taxa	7	Perlidae	12		Trichoptera			Tabanidae	5	
ASPT	5.3	Ephemeroptera			Dipseudopsidae	10		Tipulidae	5	
		Baetidae 1 sp	4	4	Ecnomidae	8		Gastropoda		
Other Biota	Tadpoles	Baetidae 2 sp	6		Hydropsychidae 1 sp	4		Ancylidae	6	
		Baetidae >3 sp	12		Hydropsychidae 2 sp	6		Bulinidae	3	
		Caenidae	6		Hydropsychidae <2 sp	12		Hydrobiidae	3	
		Ephemeridae	15		Phlypotamidae	10		Lymnaeidae	3	
		Heptageniidae	13		Polycentropodidae	12		Physidae	3	
		Leptophlebiidae	9		Psychomyidae	8		Planorbidae	3	
		Oligoneuridae	15		Cased Caddis			Thiaridae	3	
Comments		Polymitarcyidae	10		Barbarochthonidae	13		Viviparidae	5	
		Prosopistomatida	15		Calamoceratidae	11		Pelecipoda		
		Teloganodidae	12		Glossostomatidae	11		Corbiculidae	5	
		Trichorythidae	9		Hydroptilidae	6		Sphariidae	3	
		Odonata			Hydrosalpingidae	15		Unionidae	6	
		Calopterygidae	10		Leptostomatidae	10				
		Clorocyphidae	10		Leptoceridae	6				
		Chorolestidae	8		Petrothrincidae	11				
		Coenagrionidae	4		Pisulidae	10				
		Lestidae	8		Sericostomatidae	13				
		Platycnemidae	10		Coleoptera					
		Protoneuridae	8		Dyticidae	5	5			
		Aesthidae	8		Elmidae Dryopidae	8				
		Corduliidae	8		Gyrinidae	5				
		Gomphidae	6		Halilidae	5				
		Libellulidae	4		Helodidae	12				
		Lepidoptera			Hydraenidae	8				
		Pyralidae	12		Hydrophilidae	5				
					Limnichidae	10				
					Psephenidae	10				
Score				12			15			7

28.2 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 28.2.1 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 28.2.2 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 28.2.3 Significance Rating

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

Table 28.2.4 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.

28.3 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 characteristics (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 catchment)	3
National (impacting beyond secondary 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 resource)	
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