THE LAIR TRUST

Portion 13 of Farm Orange Falls 16, Augrabies

Fresh Water Report (V3.1)

Water Use License Application

A requirement in terms of
section 21
of the

National Water Act (36 of 1998)

October 2019

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Abbreviations

Critical Biodiversity Area	CBA
Department of Environmental Affairs	DEA
Department of Environment and Nature Conservation	DENC
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
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
Northern Cape Department of Environment and Nature Conservation	DENC
Present Ecological State	PES
South Africa National Biodiversity Institute	SANBI
Water Use License Application	WULA

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1 Introduction

Lair Trust Farm is located at Augrabies along the Lower Orange River and belongs to the Fox family. The farming operation is exclusively focused on high quality table grapes for the export market.

The first impression of the farm is very much one of farming excellence and razor-sharp business acumen. This is an extremely neat and well-run operation that befits the top end quality of the product that is grown here to satisfy the most discerning consumer abroad.

There are already existing vineyards on the farm, of which 5ha were developed in 2010, 2.5ha in 2012 and another 2.5ha in 2016. These vineyards, when planted, were in the flow path of a number of drainage lines, which are nothing more than dry water courses that only run during a heavy thunder storm. Developing agriculture through drainage lines are unfortunately not in line with current environmental legislation. Hence Lair Trust was issued with a S24G. This was a notice from the Northern Cape Provincial Department of Nature Conservation (DENC) to conduct an Environmental Impact Assessment (EIA) in accordance to Section 24G of the National Environmental Management Act (NEMA, 107 of 1998).

Subsequently Enviro Africa (Pty) Ltd of Somerset West in the Western Cape was appointed to conduct the required EIA.

The Water Use License Application (WULA) is an integral part of the EIA. WATSAN Africa was appointed to deal with the WULA on behalf of Lair Trust. The WULA requires a Technical Report in accordance with Government Notice 267 of 24 March 2017 in terms of Section 21 (c) and (i) of the National Water Act (36 of 1998). This then is the required document.

During September 2019, Mr Floyd Fox of the Lair Trust requested Dr Dirk van Driel of WATSAN Africa to conduct a follow-up site visit on the farm. This was for upgrading the S24G report to a Fresh Water Report to include another 20 hectares of new vineyards as well as a new balancing dam for the irrigation of these vineyards. The site visit took place on 27 September 2019.

This then is the upgraded report to include the WULA requirements for the new vineyards and the new dam.

2 Legal Framework

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

S21 (a) Taking water from a water resource

Water is being pumped out of the Orange River for the farming operation.

S21 (b). Storage of water.

A small balancing dam for the irrigation of the new vineyards is envisaged.

S21 (a) and (b) will not be dealt with in this report. For these two sections of the NWA, a separate report and set of application forms will be submitted to the DWS.

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

The drainage lines crossing the new vineyards will be re-aligned. A cut-off trench will have to be dug for the protection of vineyards against floods.

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

Drainage lines will have to be altered.

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. Likewise, no development may take place within 500m of a wetland without the consent of the DWS.

This report deals with S21 (c) and I of the NWA.

Development within 100m of a water course.

National Environmental Management Act (107of 1998)

NEMA and regulations promulgated in terms of NEMA determines that no development without the consent and permission of the DEA and its regional agencies, in this case the DENC of the Northern Cape Provincial Government, may take place within 32m of a water course. The mostly dry drainage lines are perceived to be legitimate water courses.

3 Expansion of Vineyards

In addition to the EIA requirements, the Fox family wants to expand the current 10 hectares of vineyard on the property with another 4 blocks. Decision-making authorities should understand that the new vineyard will be expanded a little at a time, with 2.5 hectares, as water for irrigation becomes available.

Water for 2.5 hectares is legitimately available and this can be placed anywhere in the demarcated 20ha.

4 Lair Trust Farm Fact Sheet

- Lair Trust Farm is Portion 13 of Orange Falls Farm 19, Augrabies.
- It is located at 28°39’30.16” S and 20°20’28.81” E
- The cadastral number is C036000000000016000191.
- It is in the D53J quaternary catchment.
- The vegetation is listed as Bushmanland Arid Grassland (Least Threatened, Botes 2017).
- A permanent work force of 40 people is employed on the farm and a seasonal number of an additional 80.
- Wastewater and solid waste is collected and transported by the Kai!Garib Municipality
- A clean-up kit is kept on the premises ready for use in case of a fuel spill.

5 Climate

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

Kakamas normally receives about 62mm of rain per year, with most rainfall occurring mainly during autumn. The chart below (Figure 1, lower left) shows the average rainfall values for Kakamas per month. It receives the lowest rainfall (0mm) in June and the highest (19mm) in March. The monthly distribution of average daily maximum temperatures (centre chart below) shows that the average midday temperatures for Kakamas range from 20°C in July to 33°C in January. The region is the coldest during July when the mercury drops to 3.1°C on average during the night.

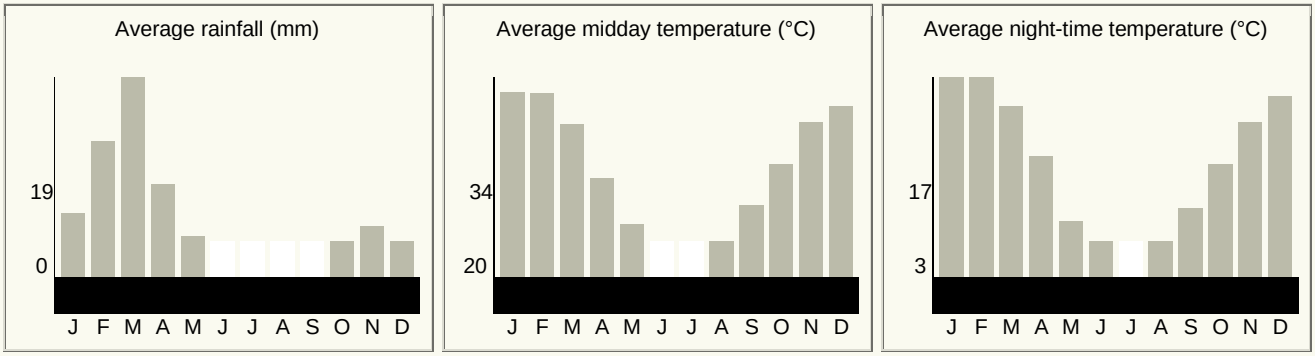


Figure 1 Climate Kakamas

The evaporation rate measured with a Symons Pan amounts to 2781 mm per year.

www.droughtsandfloods.com/Chapter%203%20Analytical%20methods.pdf

It is most obvious that this is an arid region with a huge water deficit. The table grape industry relies entirely on irrigation and not on rainfall at all.

It is hard to believe that marked drainage lines as are evident in the area can exist with such a low rainfall. The more prominent ones show prominent scouring by flowing water. There must be daily rainfall events of 40mm and higher at very low frequencies that shape the landscape and necessitates the construction of cut-off trenches around vineyards.

As the part of the catchment directly above the Lair Tryst vineyards amounts so approximately 75 hectares, at this rainfall the cut-off trenches and berms must have a design capacity to withstand a flow rate of 30 000 litres a day.

6 Lower Orange River Grape Producing Area

The grape producing area in the Lower Orange River Water Management Area stretches from the Boegoeberg Weir in the east to Augrabies in the west. It stretches over approximately 260 km, following the curve of the Orange River.

The vineyards are in the Orange River Valley, much of it in the actual flood plain (Figure 2). This is high intensity farming with an obvious environmental impact on the Orange River.

Figure 2 Vineyards in the Orange River Valley near Augrabies.

Figure 2 illustrates only a small section of the agricultural activities in the Lower Orange River and gives an impression of the massive scale of the overall operation. Yet new vineyards are perpetually established on a grand scale.

This perspective is necessary to illustrate that the existing as well as the envisaged vineyards at Lair Trust Farm is negligible if compared to what already is present on the ground.

According to the then Department of Water Affairs (2004) the water demand for the Lower Orange River was 1 130 million m^3 per year and it will grow to 1 174 million m^3 per year in 2025. This includes the water demand for the 4000 hectares of new vineyards that are to be established for previously disadvantaged farmers.

7 Drainage Lines

The landscape around much of the Lower Orange River is dominated by a dense succession of drainage lines, each with its own sub-catchment. The sub-catchments can vary in size from a couple of hectares to many thousands of hectares. 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.

The Lower Orange River is lined with vineyards. These vineyards often cut off the flow from the numerous water courses that enter the Orange River. These are small tributaries that only flow during the occasional summer time heavy thunder storm. These tributaries are mostly dry drainage lines. Scouring and erosion are obvious in these drainage lines and closer to the confluence with the Orange River, some of these are deeply incised.

Water velocity down these small water courses can be quite fast and hence the erosion potential is great. If allowed to cross a vineyard, it stands to reason that the damage can be extensive. For this reason, these small water courses and even there bigger reaches lower down have been straightened and canalised since the onset of the table grape industry in the Lower Orange River valley many years ago.

The drainage lines have been cut off with berms and trenches to divert their flow around blocks of vineyards. Some of these trenches are substantial and the network of cut-offs extensive.

These storm water diversions have been constructed long before the promulgation of current environmental legislation.

Lower down closer to the Orange River these once natural tributaries have lost all their riverine characteristics and ecological function. This, however, is the trade-off that must be made for having a table grape industry. The drainage lines are dense over the landscape, despite of the semi-desert conditions and it cannot be avoided not to divert them when blocks of vines are planted, along with the access roads, irrigation and other infrastructure.

The drainage lines at the Lair Trust vineyards are not any different. The top end of these vineyards is marked by cut -off trenches (Figure 1). However, it is alleged that at least some of the vineyards were planted after the NEMA came into being and hence an EIA is now called for.

8 Agricultural Return Flow

For successful table grape farming it is most essential that vineyards are drained properly. Standing water and too much moist in the soil is detrimental. For this reason, typically a system of trenches is constructed around blocks of vineyards (Figure 3).

Most of this water derives from irrigation. Some of course is from the rainfall, which can be significant during intense thunder storms, but mostly has a small contribution because of the semi-arid nature of the Lower Orange River valley. The runoff from the vineyards are better described as agricultural return flow.

Likewise, the Lair Trust Vineyards have been provided with a similar drainage system and the envisaged addition will have a similar arrangement.

A less intrusive and visually more pleasing drainage system is the modern sub-surface pipes that have been introduced to the farming practice. The pipes are porous and let

Figure 3 Drainage trench between blocks of newly established vineyards

in ground water, while keeping out soil. This omits the need for gullies and trenches. Excess ground water is let out downhill from the vineyards to eventually enter the Orange River as agricultural return flow.

Such a modern system of sub-surface drains has been installed at the Lair Trust vineyards.

Figures as to how much of the irrigated water ends up as agricultural return flow are scarce and differ in various localities. It depends on a vastness of factors, which are out of the scope of this report and will not be discussed any further, but it is estimated at roughly 30%.

Agricultural return flow contains nutrients and dissolved salts, which are generally most detrimental to the receiving aquatic environment. It is widely held responsible for the salination and eutrophication of the Lower Orange River.

New vineyards are perpetually established in the region and nationally on a massive scale, with resulting increase in agricultural return flow. This calls for future innovative farming methods and technology. The existing and new vineyards at Lair Trust does not and would not make a noticeable difference to the overall nutrient and dissolved salt budget of the region. This is a national problem and to single out vineyards as culprits would not be helpful.

9 Brabeesmond Catchment

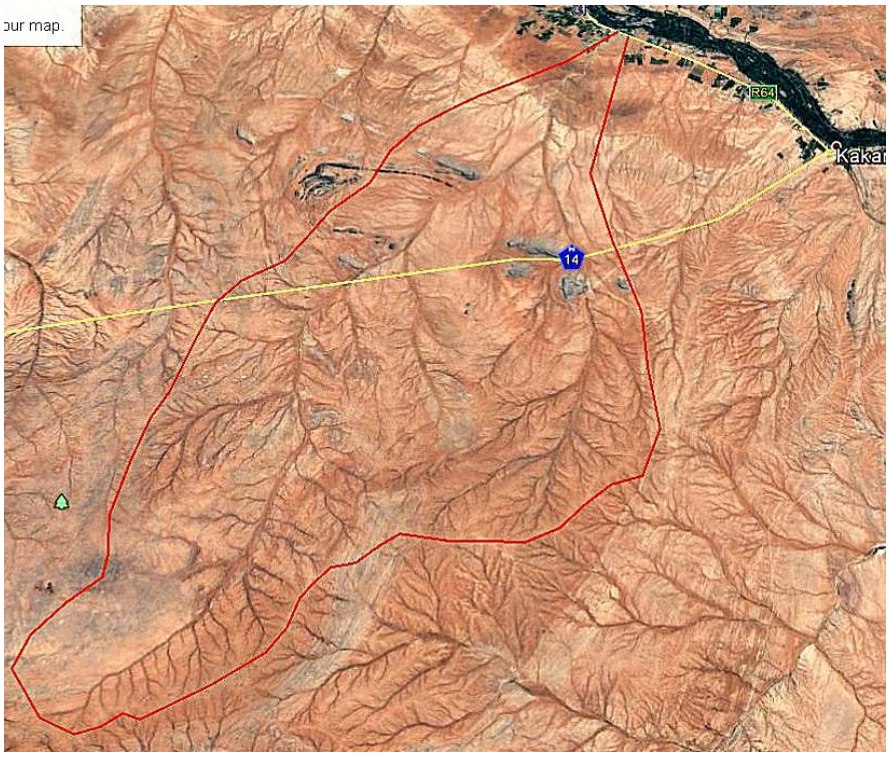


Figure 4 Brabeesmond Catchment

The Lair Trust Farm is located in a sub-catchment of a stream locally known as the Brabeesmond. The Brabeesmond is not really a river, but more fits the description of a mostly dry drainage line. Figure 4 is a rough outline (red line) of the sub-catchment as delineated with the path function of Google Earth Pro.

The sub-catchment is about 67 km long and 30 km wide at its wides point. It has a circumference of approximately 159 km and a surface area of approximately 1200ha

10 Drainage Line Intersections

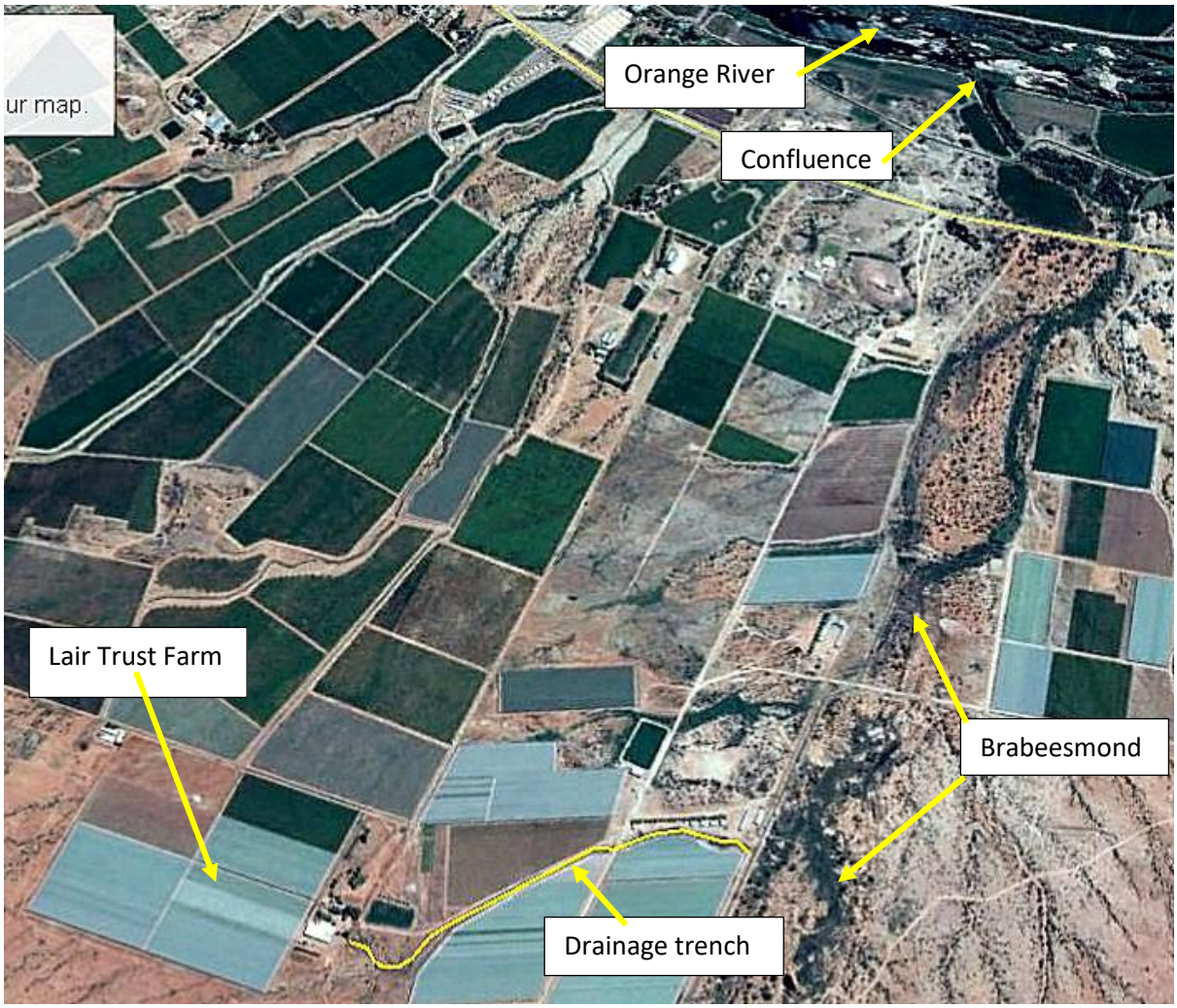


Figure 5 Brabeesmond Confluence

The runoff from the Lair Trust Farm was channelled through a constructed drainage channel to the Brabeesmond from where it flowed into the Orange River over a distance of approximately 3.3 km. The top end of this channel was still fairly natural, but the part indicated by the yellow line on Figure 5 was highly modified.

The confluence of the Brabees and Orange is at:

28°38’44.87” E
20°21’44.81” S

Most of the drainage lines in the area have been straightened and engineered into ditches for least flow resistance and optimal drainage. However, the Brabees has escaped this and it still in a morphologically natural state.

In most places, it is heavily overgrown with *Phragmitis* reeds.

The site visit in September was during the driest period of the year and it could be expected that the Brabees should be dry and without any flow at all. However, closer to the confluence there was a constant flow of between 5 and 10 $l s^{-1}$. This was possibly agricultural return flow, with no contribution from rainfall.

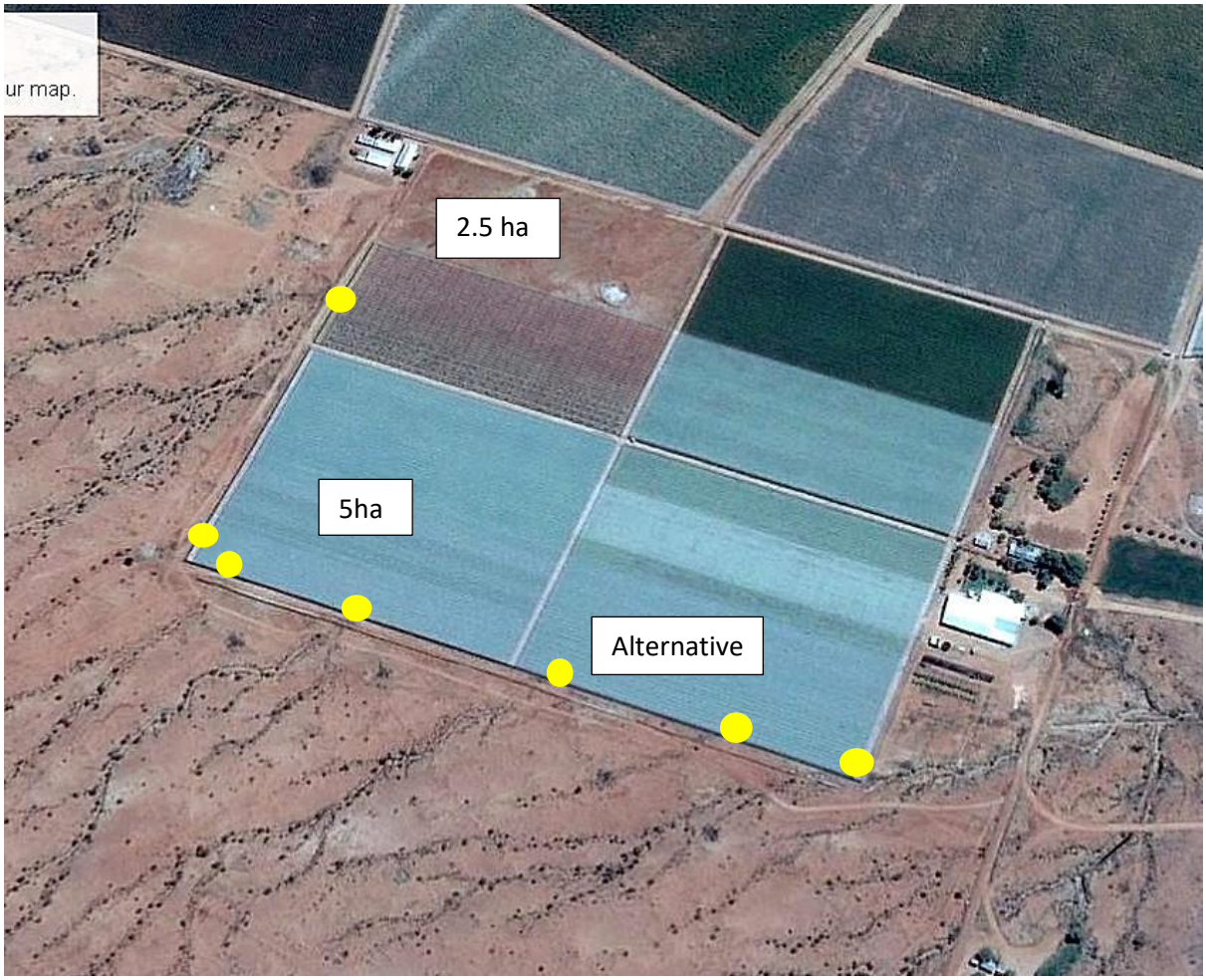


Figure 6 Drainage Lines Intersections

Figure 6 shows the drainage lines that intersect the current vineyards at Lair Trust Farm. There are at least 7 such intersections, as indicated by the yellow dots on Figure 6.

The natural drainage lines upstream of the vineyards are depicted in Figure 7.

From these points, the flow has been interrupted and channelled around the vineyards with a cut-off trench (Figure 8).

Figure 7 Natural drainage lines adjacent to the vineyards

It is precisely this requirement of contemporary viticulture that rebels against current environmental legislation. It is now required that such environmental infarctions should be motivated by EIA's and WULA's.

The impact is local, on the spot where the drainage lines are diverted. It is not foreseen that that the current impact or the planting of the envisaged additional vineyard would make a noticeable hydrological difference to the existing situation in the Brabees or the Orange River.

Figure 8 Cut-off Trench

11 The New Cut-off Trench

As it stands, according to the owners, the farm too small for an economically viable unit. For its long-term survival it is obligatory that another 20ha is added. This extra land will be added, according to plan, as indicated in Figure 9.

The intersections of the drainage lines will accordingly move higher up the catchment, as are indicated by the blue dots on Figure 9. The drainage lines are smaller and even more faint higher up the catchment.

Again, it will be necessary to establish a new cut-off trench to keep storm water running down the drainage lines out of the new vineyards.

The larger drainage lines will be formalised into drainage channel. The smaller ones will simply be transformed into vineyard.

12 The New Dam

A new balancing dam will be required for irrigating the new vineyards. This will be a simple earthen dam. A pump will be placed on the dam to deliver the water to the vineyards. The dam will be filled with a HDPE pipe from the existing reticulation in the old vineyards. This is a short length of pipe that will not cross any drainage lines. Its position is indicated on Figure 9 and its coordinates in Table 1.

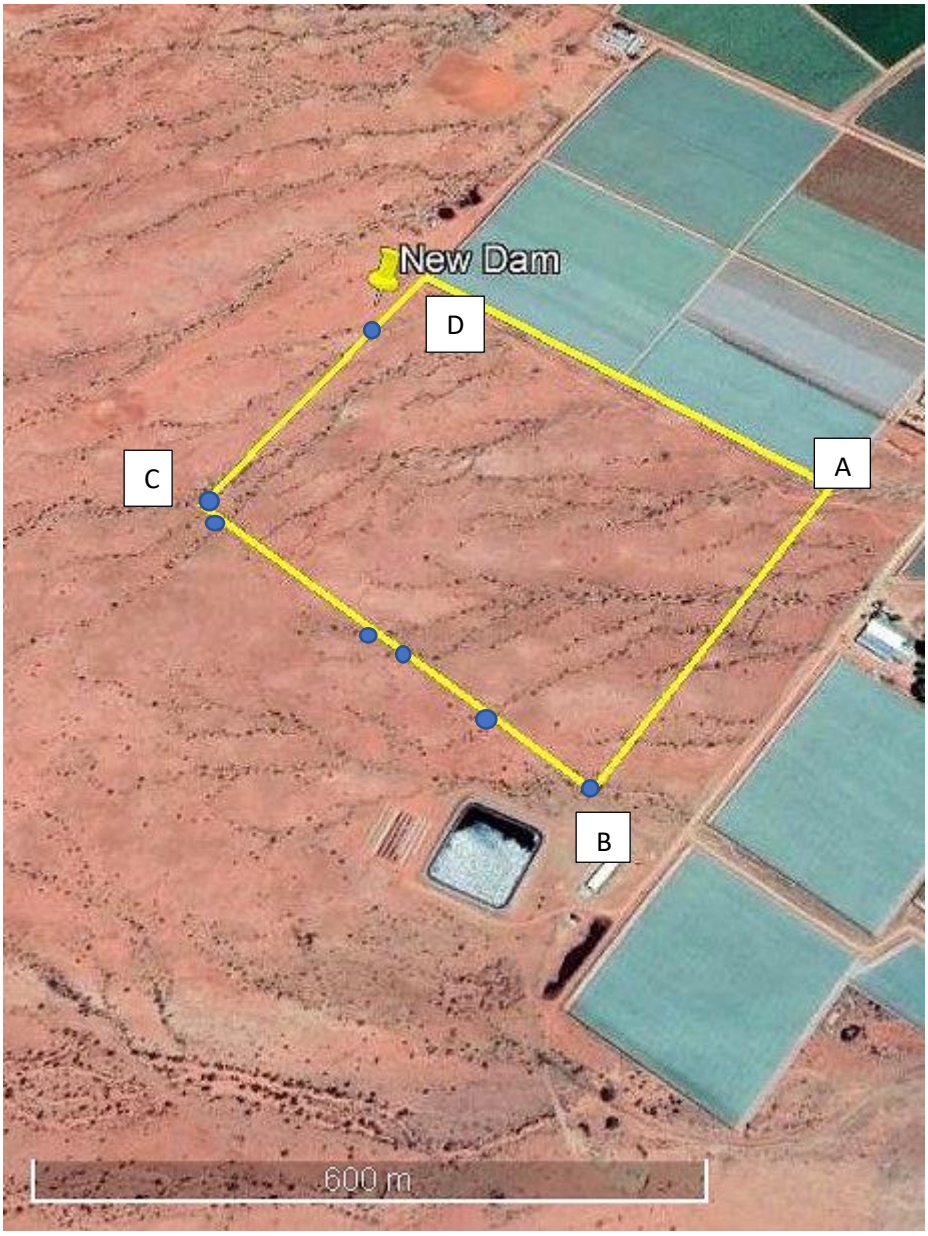


Figure 9 New vineyards

Table 1 New vineyards coordinates

Point	Coordinates	Distance m
A B C D New Dam	28°39’43.60”S 20°20’32.47”E 28°39’54.54”S 20°20’24.21”E 28°39’44.04”S 20°20’08.48”E 28°39’35.20”S 20°20’15.75”E 28°39’36.20”S 20°20’14.30”E	AB 408 BC 530 CD 348 DA 525

13 Sampling Point Orange River

Figure 10 Sampling Point downstream of the Brabees Confluence

The banks of the Orange River in the area (Figure 10) 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.

Moreover, the river banks have been built up with large berms to keep flood water out of adjacent agricultural land. This has denaturalised the riparian zone.

A strip of reeds is kept clean to accommodate pipes that connect the pumps on a raft in the river to a small reservoir some 100 meters away from the river. This infrastructure is for the irrigation of the extensive vineyards along the Orange River. This strip was the only access to a sampling point close to the study area.

The habitat is monotonous as the entire bank was taken over by reeds. Up the river was bedrock that could be sampled, if a boat and a launching ramp was available. Perhaps, somewhere close by, was sandy bottom that could be sampled, if a boat was available.

The reeds along the banks was only available habitat to be sampled, as well as a cluster of submerged vegetation, parrot's feather, *Myriophylum*. This is another invasive plant that does not naturally belong in the Orange River.

The sampling point thus was highly impoverished and denaturalised.

14 Biomonitoring the Lower Orange River

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

Biomonitoring was carried out on the Lowers Orange River during site visits for successive WULAs. So far 10 samples have been analyzed at 9 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.

14.1 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 even regime, different from the varied flown 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 supresses the SASS5 score, with only a limited number of aquatic macroinvertebrate species present in this habitat.

14.2 Lower Orange River Biomonitoring Results

The biomonitoring results have been captured in Table 2 and depicted in Figure 11.

The classes from A to F in Figure 10 has been assigned for mature rivers on flood plains such as the Lower Orange River.

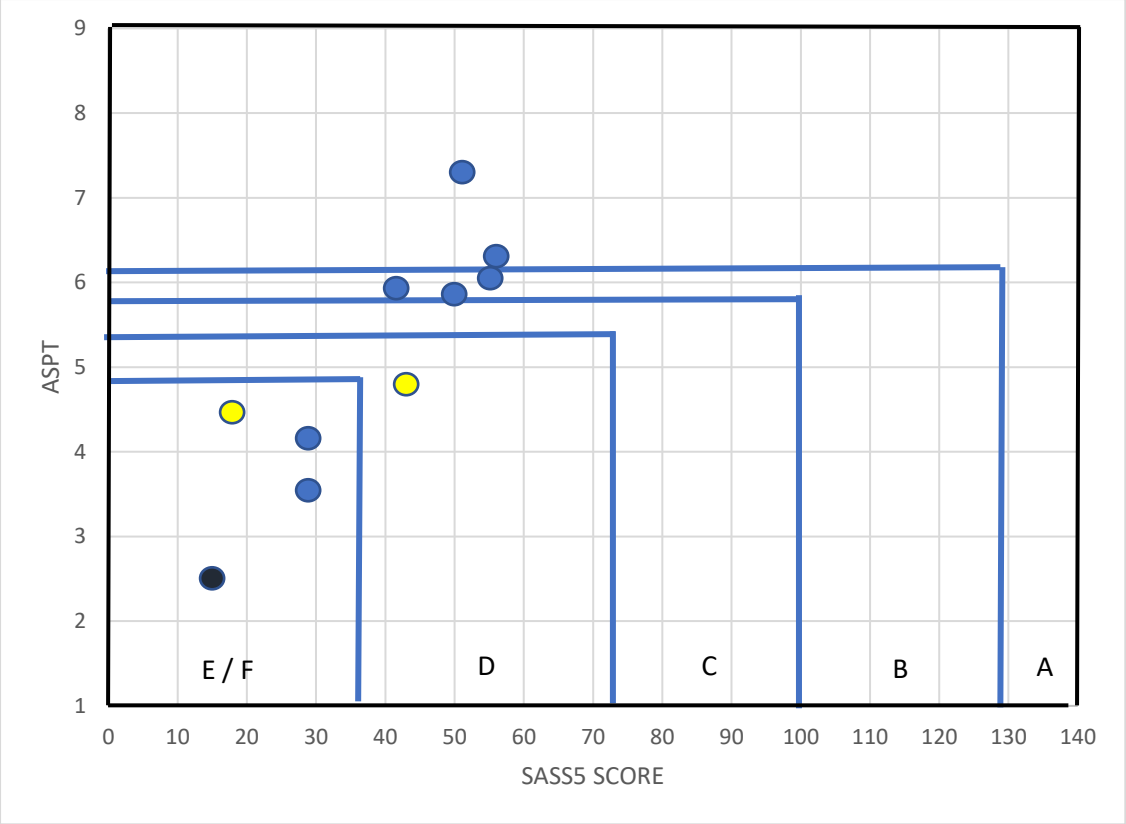
Only 2 of the samples were classified a good and relatively unimpacted (Class A). Four were in Class B and C, which can be regarded as acceptable under the circumstances of an impacted river reach. These classes can possible be labelled as the ideal, a compromise between agriculture and aquatic ecological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



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 11 Lower Orange River Biomonitoring Results

14.3 Biomonitoring at the Sampling Point

During the site visit of 5 September 2017, the only macroinvertebrate taxa that were encountered during SASS5 sampling were the following:

Atyidae shrimps (many of them)
Pleidae back swimmers (a couple)
Chironomidae midges
Coenagrionidae damsel flies

This resulted in a SASS5 score of only 18 and an ASPT of 4.5, indicating a class E, which is a measurably impacted habitat, with a loss of most ecological functioning (Figure 11).

At the time of sampling large barbels *Clarias gariepinus* were observed swimming close to the surface. There was a tadpole in the sampling net. A wide range of avifuana was observed.

This round of sampling was not accepted as valid and a next round was done on 5 October 2017, this time at a sampling point higher up the Orange River at the town of Augrabies. The sampling point had much the same attributes as the one at the Brabees, but was accessible, had a sandy bottom in the shallows that could be sampled, had emerging vegetation (*Phragmitis* reeds) and submerged vegetation (*Potamogeton pectinatus* and *Myriophylum*). It had a couple of stones along the bank that were probably put there by local fishermen. The SASS5 score sheet is attached in the Appendix.

The SASS5 score was much higher at 43, with 9 taxa and an ASPT of 4.8.

The higher score could be expected because of the availability of a more varied habitat. This is a more credible result than the previous attempt. The score indicated a classification of D, which means that some ecological functioning was lost. This can be expected from a river with surrounded by agriculture and with a large return flow.

15 Sampling Point Brabeesmond Stream

Figure 12 Brabees sampling point

A sampling point in the Brabees (Figure 12) was chosen because it allowed for the opportunity to investigate the agricultural return flow. Since the water sample was taken during the driest time of the year the flow in the Brabees was solely agricultural return flow at the time.

The sampling point was right next to the irrigation canal (Figure 13) alongside the Orange River. At this point the canal dips into a large pipe underneath the bed of the Brabees, to re-surface on the downstream side and to continue as a canal.

Most of the Brabees was thoroughly overgrown with reeds. The water was very clear and no algal growth was observed.

Obviously, this experiment would not isolate the return flow from Lair Trust farm, but was rather aimed at giving an idea of what the return flow was like for all the farms in the Brabees sub-catchment.

Figure 13 Irrigation Canal

16 Water Quality

Table 3 Water Quality

Parameter	5 Sep 2017		5 Oct 2017			
	Orange	Brabees	Orange	Brabees	Canal	Augrabies
pH	7.6	8.1	8.8	8.4	9.1	8.8
Electrical conductivity mSm^{-1}	49	228	57	204	38	41
Temperature °C			19.3	14.2	18.6	20.8
Oxygen mgl^{-1}			7.3	5.9	10.6	9.3
Ammonia mgl^{-1}	0.08	0.19				
Nitrite mgl^{-1}	0.02	0.02				
Nitrate mgl^{-1}	>0.36	>0.36				
Total nitrogen mgl^{-1}	7	10				
Total phosphorus mgl^{-1}	>0.01	0.04				

According to the sampling round on 5 September 2017 the Water of the Orange River seemed to be quite fit for use for the aquatic environment (Table 3). The ammonia input from agriculture and animal husbandry was effectively transformed through the process of nitrification, as the nitrite and nitrate concentrations were low. However, the total nitrogen concentration was high, which is characteristic of surface water in agricultural areas, because of the presence of fertilisers in return flow.

Phosphorus added in fertilisers readily binds with the soil and is not leached out easily, hence the rather low concentration. However, a concentration such as encountered in the sample was enough to explain the prolific growth of reeds on the river banks.

The parameters measured do not explain the impoverished biodiversity on 5 September as illustrated by the SASS5 score. Perhaps the monotonous habitat was responsible for this, rather than the water quality.

The salt load as illustrated by the electrical conductivity from the Brabees was significant. The pH was elevated. It shows that the water in the Brabees is impacted upon, probably the same as many of similar tributaries in the area. The Orange River obviously dilutes these impacts to the levels shown by the values of the water analyses.

There was a significant impact because of the elevated nitrogen concentration in the Brabees. However, it cannot be said that all impacts are solely from the vineyards, as some of it albeit small may have been from the undisturbed sub-catchment of the Brabees.

On the other hand, the impacts may be masked by a leaking canal as it dips under the Brabees just upstream and adjacent to the sampling point. This is quite possible, as the Brabees upstream of the road bridge was stagnant, with no obvious release downstream towards the sampling point, but with a strong flow downstream of the canal. This theory was proven unsubstantiated by the sampling round of 5 October, this time with a functional YSI field instrument. The electrical conductivity (EC) of the water in the canal was comparably low and if the canal was leaking, the figures for the EC in the canal and Brabees would have been much closer together.

The EC paints an insightful picture. The take off point in the Orange River to feed the canal is at Marchant approximately 22 km upstream, following the curve of the braided river. The EC here amounts to 38mSm^{-1}, presumably the same as in the canal. At the SASS5 sampling site at Augrabies approximately 8.5 km upstream it has risen to 41 mSm^{-1} and at the sampling point downstream of the Brabees confluence is was elevated to 57 mSm^{-1}. This represents an increase of 50%, of which the most was added in the last 8.5 km.

The pH in the system was elevated, especially in the canal, for reasons not yet known.

17 Present Ecological State (PES)

17.1 Present Ecological State Orange River

Table 4 Lower Orange River Habitat Integrity

Instream	**score**	**weight**	**Product**	**Maximum Score**
Water Abstraction	11	14	154	350
Flow modification	10	13	130	325
Bed modification	4	13	52	325
Channel modification	8	13	104	325
Water quality	5	14	70	350
Inundation	12	10	120	250
Exotic macrophytes	22	9	198	225
Exotic fauna	22	8	176	200
Solid waste disposal	1	6	6	150
max score		100	1010	2500
% of total			40	
Inverse			60	
Class			**C**	
Riperian Zone				
Water abstraction	12	13	156	325
Inundation	12	11	132	275
Flow modification	12	12	144	300
Water quality	5	13	65	325
Indigenous vegetation removal	22	13	286	325
Exotic vegetation encroachment	22	12	264	300
Bank erosion	5	14	70	350
Channel modification	22	12	264	300
		100	1381	2500
% of total			55	
Inverse			45	
Class			**D**	

Table 5 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

The PES and EI are protocols that have been produced by Dr Neels Kleynhans 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.

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 Kakamas, 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. 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 D, which signifies that ecological functioning has been lost.

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

The extra vineyards that are planned would make hardly any difference to this situation. The riparian habitat is greatly changed with a significant loss in ecological functioning. The addition of envisaged vineyards would not change this either.

17.2 Present Ecological State Brabeesmond Drainage Line

Table 6 Brabeesmond Habitat Integrity

Instream	**score**	**weight**	**Product**	**Maximum Score**
Water Abstraction	24	14	336	350
Flow modification	20	13	260	325
Bed modification	19	13	247	325
Channel modification	17	13	221	325
Water quality	24	14	336	350
Inundation	20	10	200	250
Exotic macrophytes	24	9	216	225
Exotic fauna	24	8	192	200
Solid waste disposal	24	6	144	150
max score		100	1960	2500
% of total			78.4	
Class			**C**	
Riperian Zone				
Water abstraction	24	13	312	325
Inundation	21	11	231	275
Flow modification	20	12	240	300
Water quality	24	13	312	325
Indigenous vegetation removal	21	13	273	325
Exotic vegetation encroachment	23	12	276	300
Bank erosion	23	14	322	350
Channel modification	19	12	228	300
		100	2194	2500
% of total			87.8	
Class			**B**	

The upper reaches of the drainage lines along the Lower Orange River are mostly near-pristine, with only sheep grazing there from time to time. This is an arid region, with sparse and low vegetation. The dry drainage lines, because of the shallow ground water that lingers on longer than the vast evaporating surface water, offers sustenance to a somewhat higher and denser vegetation. This line of vegetation adds to the biodiversity of the region, with habitat and its associated organisms that would have been absent, were it not for these drainage lines.

The lower reaches have been entirely modified, as has been explained before. This stark contrast renders the PES evaluation difficult, as a weighted average of the two opposites. The near-pristine upper sub-catchment is by far the largest.

The instream habitat has been scored a C Table 6), moderately modified. The riparian habitat was scored a B, with little impact, apart from the occasional grazing and the exotic *Prosopis* trees. This will change when the new blocks of vineyards are developed, with yet another small area of the sun-catchment ending up in the E and F class.

18 Ecological Importance (EI)

The EI is based on the presence of especially fish species that are endangered on a local, regional or national level (Table 7).

Table 7. Ecological Importance Categories (EI) 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)

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.

According to Skelton (1993) 11 species of fish occur in the Lower Orange River. These are the following:

Barbus trimaculatus
B paludinosus
Labeobarbus kimberleyensis (Near threatened)
L aenus
Labeo umbratus
L capensis
Cyprinus carpio
Austroglanis sclateri (Widespread elsewhere)
Clarias gariepinus

Pseudocrenilabrus philander (Threatened locally but abundant elsewhere)
Tilapia sparrmanii

Those in blue are endangered to some extent. However, 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 yellow fish is artificially cultured and hence is not in any real danger of extinction. This renders the Orange River as important.

19 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.

19.1 Ecological Sensitivity Orange River

The Orange River at Kakamas has absorbed numerous and deep-cutting human impacts. Yet is 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.

19.2 Ecological Sensitivity Brabeesmond Drainage Line

If left to its own devices, the drainage line would remain as it is now, without the need for protection measures. However, if the agricultural development is allowed to proceed, the drainage line would probably never recover to any resemblance of its current state. In this regard it can be considered to be ecologically sensitive.

20 Impact Assessment

Some of the decision-making authorities prescribe an impact assessment according to a premeditated methodology. The methodology is outlined in the Appendix.

The drainage lines on the land where vineyards are established are to be altered, if not destroyed. If accepted criteria were to be applied a no-go decision would automatically follow. If the decision-making authorities were not willing to sacrifice these sections of the drainage lines, very view vineyards will ever be established in the Lower Orange River valley. Yet new vineyards are established at a grand scale, for which official approval have been granted. Hence lost drainage lines seemingly do not govern decision-making. The significance of this impact is regarded as low because only short sections of the drainage lines are impacted. The impact is very much local.

Likewise, the impact of large-scale commercial viticulture has an enormous impact on the Orange River. The impacts are stream reduction, siltation, salination and eutrophication. If commercial viticulture was to be the deciding factor, no new vineyards would ever be planted. Yet new vineyards are springing up everywhere in the valley. These must have been approved and hence the scale of the overall operation cannot be the governing factor.

If the Lair Farm Trust application is eventually to be successful, the impact of only the envisaged new blocks of vineyards are to be assessed in isolation, separate from the already existing impacts.

Above are the main steps in the life cycle of the block of vines that impact on the aquatic environment. It is not foreseen that the vineyard will even be rehabilitated and allowed to some state closer to the original prior to development, but that it would rather be re-planted after many years, once the vines become too old to be render the expected yield.

There is not much that can be done in the line of mitigation of the environmental impact when the soil is prepared and the vines planted. The only significant mitigation that can be implemented is to make sure that vineyards are not over-irrigated and that as little as possible agricultural return flow is created.

The impact of a couple of new blocks of vineyard is negligible and therefore should be given the go-ahead. This, however rebels against the desperate situation on the ground. Decision-making authorities are free to press on amendments to what is presented here.

The mitigating measures that are available indeed lower the significance of impacts from “medium” to “low” (Table 8).

Table 8 Impact Assessment

Description of impact

Tilling of new land
Removal of vegetation
Construction of irrigation infrastructure
Planting of vines

Movement of sediments down the drainage line, through the Brabees and into the Orange River during storm events

Mitigation measures

Do not disturb any land outside of designated agricultural area.
Construct outside of rainy season

Type Nature	Spatial Extent	Severity	Duration	Significance	Probability	Confidence	Reversibility	Irreplaceability
Without mitigation								
Direct	Regional	Medium	Short term	Medium	Probable	Certain	Irreversible	Irreplacable
With mitigation measures								
Negative	Local	Low	Short term	Low	Probable	Sure	Irreversible	Irreplaceable

Description of impact

Digging of cut-off trench through drainage lines at upstream boundary of new blocks
Re-alignment of drainage lines into irrigation return flow channels.

Alteration of drainage lines

Mitigation measures

Do not disturb upstream drainage lines
Stay away 9m from main drainage line
Landscape altered drainage lines

Type Nature	Spatial Extent	Severity	Duration	Significance	Probability	Confidence	Reversibility	Irreplaceability
Without mitigation								
Direct	Local	Medium	Permanent	Medium	Probable	Certain	Irreversible	Irreplaceable
With mitigation measures								
Direct	Local	Low	Permanent	Low	Probable	Sure	Irreversible	Irreplaceable

Description of impact

Operation of vineyards.

Agri-chemicals down the drainage lines

Mitigation measures

Do not over-irrigate
Monitor soil moisture
Adhere to scientifically defined irrigation program
Prevent over-use of agri-chemicals and fertilizers
Prevent plant remnants to wash down drainage line following pruning season.

Type Nature	Spatial Extent	Severity	Duration	Significance	Probability	Confidence	Reversibility	Irreplaceability
Without mitigation								
Cumulative	Regional	Medium	Medium term	Medium	Probable	Certain	Reversible	Replaceable
With mitigation measures								
Cumulative	Local	Low	Medium term	Low	Unlikely	Sure	Reversible	Replaceable

Description of impact

Construction of new balancing dam.

Sediments down drainage lines

Mitigation measures

Do now work outside of the foot print of the dam
Landscape the surroundings of the completed dam

Type Nature	Spatial Extent	Severity	Duration	Significance	Probability	Confidence	Reversibility	Irreplaceability
Without mitigation								
Negative	Local	Medium	Short term	Medium	Probable	Certain	Reversible	Replaceable
With mitigation measures								
Negative	Local	Low	Short term	Low	Unlikely	Sure	Reversible	Replaceable

21 Risk Matrix

The assessment was carried out according to the interactive Excel table that is available on the DWS webpage. Table 9 is a replica of the Excel spreadsheet that has been adapted to fit the format of this report. The numbers in Table 9 (continued) represent the same activities as in Table 9.

The Risk Matrix is a requirement of Government Notice 1180 of 2002 in terms of the National Water Act (36 of 1998).

Table 9 Risk Matrix

No.	Activity	Aspect	Impact	Significance	Risk Rating
1	Removal of vegetation	Vegetation	Sediments down drainage lines during rainfall events	24	Low
2	Preparation of soil	Tilling	Silt in Brabees & Orange	24	Low
3	Infrastructure	Trellis, irrigation, Disturb soil	Silt	24	Low
4	Planting	Disturb soil	Silt	24	Low
5	Dig cut-off trench	Alter drainage lines	Flow diversion during floods	54	Low
6	Irrigation	Return flow	Water quality	24	Low
7	Re-planting	Disturb soil	Silt	24	Low
8	Construction of new dam	Loosen soil	Silt in drainage lines	24	Low

Table 9 Continued Risk Rating

No	Flow	Water Quality	Habitat	Biota	Severity	Spatial scale	Duration	Conse-quence
1	1	1	1	1	1	1	1	3
2	1	1	1	1	1	1	1	3
3	1	1	1	1	1	1	1	3
4	1	1	1	1	1	1	1	3
5	3	1	1	1	1.5	1	2	4,5
6	2	3	1	2	2	1	3	6
7	1	1	1	1	1	1	1	3
8	1	1	1	1	1	1	1	3

No	Frequency of activity	Frequency of impact	Legal issues	Detection	Likelihood	Significan-ce	Risk Rating
1	1	1	5	1	8	24	Low
2	1	1	5	1	8	24	Low
3	1	1	5	1	8	24	Low
4	1	1	5	1	8	24	Low
5	3	3	5	1	12	54	Low
6	3	3	5	1	12	36	Low
7	1	1	5	1	8	24	Low
8	1	1	5	1	8	24	Low

The destroying of the drainage lines in the new proposed vineyards have not been assessed. If the decision-making authorities regarded this as significant, no new agricultural developments would have been allowed in the Lower Orange River region.

The only reason that the irrigation impact came out as low is because the volume is little that originates from a couple of blocks of vineyard. The impact of the viticulture irrigation on the Lower Orange River is immense. In the past, the DWS decided that the addition of a small block of vineyard hardly makes any difference to the already existing impact and hence allowed new developments under a General Authorisation.

22 Resource Economics

The goods and services delivered by the environment, in this case the Brabeesmond drainage line, 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 14) is an accepted manner to visually illustrate the resource economic footprint of the drainage lines, from the data in Table 10.

Table 10. Goods and Services Brabeesmond Drainage Line

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

0	Low
5	High

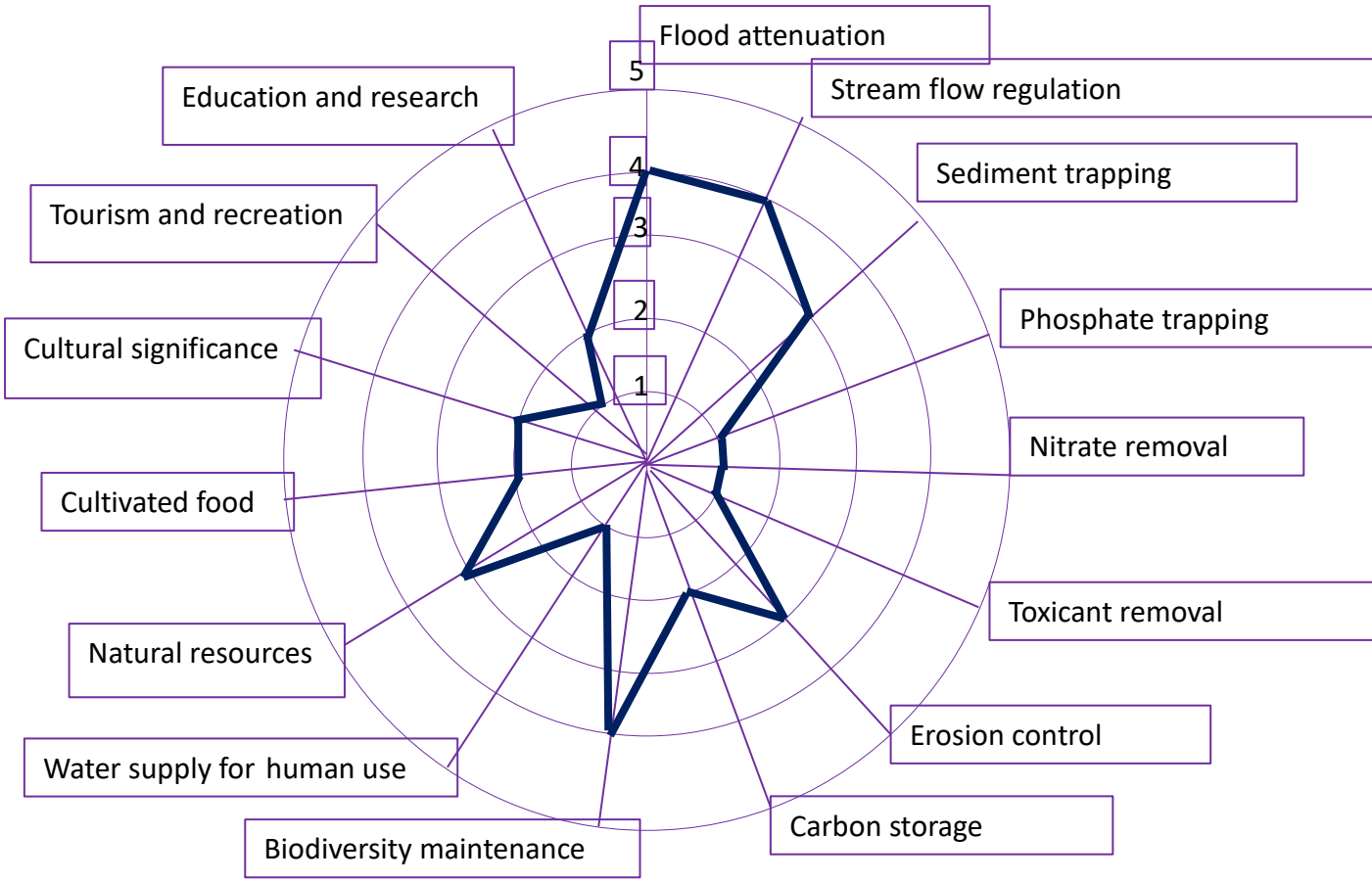


Figure 14. Resource Economics Footprint of the Brabeesmond Drainage Line

The riparian zone is poorly defined, with some higher vegetation, but it cannot serve as a carbon or nitrogen sink of any significance. Nevertheless, the higher vegetation provided habitat to a range of organisms, which would have been absent if there were no drainage lines. In this respect drainage lines adds to biodiversity, albeit in a small degree in this arid region.

The drainage lines are dammed with small walls all over the district, with the hope that surface water will percolate down to replenish the aquifers. Hence these drainage lines have at least some value when it comes to the provision of water to livestock.

Sand is mined from many of these drainage lines. So, they add to the score for natural resources.

Late stone age tools are regularly found in and around these drainage lines. Hence it has some archaeological value.

The star shape is not particularly large so that it would attract the attention of the decision-makers.

It would be somehow a futile exercise to draft the same star shape for the Lower Orange River, as full marks for all of the line items of Table 1 must be given. This would render a complete circle, as all of the goods and services are fully covered by a large river such as the Orange.

23 Conclusions

Figure 15 has been adapted from one of the most recent DWS policy documents.

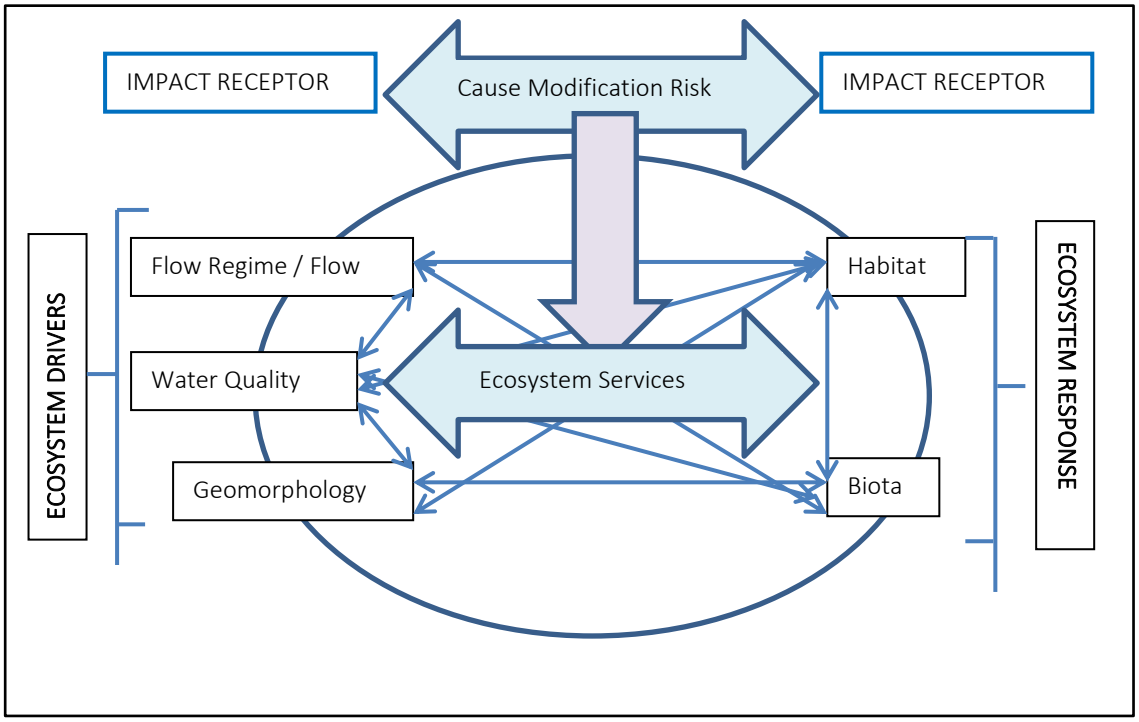


Figure 15 Minimum Requirements for a S21(c) and (i) Application.

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

The conclusions can be structured along the outline that is provided by Figure 15.

The main driver of the system is the water that comes from the Upper Orange River. The other determining factors are the water abstraction and the salination.

Agriculture has a marked deleterious impact on the Lower Orange River. This is weighed against the need for nourishment and economic benefit for the region as well as the country. Up to now the authorities could allow expansion of the industry, to the detriment of the aquatic environment. Obviously decision-making authorities have

environmental quality objectives and once these are compromised, it can be expected that further expansion would be disallowed.

Considering the large expanse of existing vineyards as well as large scale establishment of new vineyards in the region, the two blocks of envisaged vineyards are entirely insignificant.

The addition of the two blocks of vineyards at The Lair Trust Farm should be permitted under a General Authorisation.

24 References

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Skelton, P. 1993. *A Complete Guide to the Fresh Water Fishes of Southern Africa*. Tutorial Press, Harare.

25 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: D VAN DRIEL

Name of the company: WATSAN Africa Date: 6 November 201

26 Appendix

26.1 Biomonitoring Score Sheet

SASS5 Score Sheet										
Date	05 Oct 17	**Taxon**	**Weight**	**Score**	**Taxon**	**Weight**	**Score**	**Taxon**	**Weight**	**Score**
Locality	Orange River	Porifera	5		**Hemiptera**			**Diptera**		
	Augrabies	Coelenterata	1		Belostomatidae	3		Athericidae	10	
		Turbellaria	3		Corixidae	3	3	Blepharoceridae	15	
		Oligochaeta	1		Gerridae	5		Ceratopogonidae	5	
Coordinates	28°38' 41.53"	Huridinea	3		Hydrometridae	6		Chironomidae	2	2
	20°26'08.49"	**Crustacea**			Naucoridae	7		Culicidae	1	
		Amphipoda	13		Nepidae	3		Dixidae	10	
DO mg/l	7.3	Potamonautidae	3		Notonectidae	3		Empididae	6	
Temperature °C	20.8	Atyidae	8	8	Pleidae	4		Ephydridae	3	
pH	8.9	Palaemonidae	10		Veliidae	5		Muscidae	1	
EC mS/m	41	Hydracarina	8		**Megaloptera**			Psychodidae	1	
		Plecoptera			Corydalidae	10		Simuliidae	5	
SASS5 Score	43	Notonemouridae	14		Sialidae	8		Syrphidae	1	
Number of Taxa	9	Perlidae	12		**Trichoptera**			Tabanidae	5	
ASPT	4,8	**Ephemeroptera**			Dipseudopsidae	10		Tipulidae	5	
		Baetidae 1 sp	4	4	Ecnomidae	8		**Gastropoda**		
Other Biota		Baetidae 2 sp	6		Hydropsychidae 1 sp	4		Ancylidae	6	
		Baetidae >3 sp	12		Hydropsychidae 2 sp	6		Bulinidae	3	3
		Caenidae	6		Hydropsychidae <2 sp	12		Hydrobiidae	3	
		Ephemeridae	15		Phylopotamidae	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**		
		Teloganodiadae	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				
		Aesthnidae	8	8	Elmidae Dryopidae	8				
		Corduliidae	8		Gyrinidae	5	5			
		Gomphidae	6	6	Haliplidae	5				
		Libellulidae	4	4	Helodidae	12				
		Lepidoptera			Hydraenidae	8				
		Pyralidae	12		Hydrophilidae	5				
					Limnichidae	10				
					Psephenidae	10				
Score				30			8			5

26.2 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 25.1.1 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 26.2.2 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 26.2.3 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 26.2.4 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.

26.3 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 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 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