CA Bruwer Konstruksie
Kakamas, Northern Cape

Verneujkpan Trust
Kakamas, Northern Cape

Fresh Water Report
Proposed Agricultural Development
Plot 2372 of Alheidt, Kakamas

A requirement in terms of the National Water Act (36 of 1998).
March 2019

Index

Abbreviations

Critical Biodiversity Area	CBA
Department of Environmental Affairs	DEA
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

List of Figures

List of Tables

1 Introduction

Mr Charel Bruwer and his wife Mrs Marie Bruwer have amalgamated a number of properties into a single unit around Plot 2372 in the Alheidt District of Kakamas in the Northern Cape. A pumping station on the banks of the Orange River provides water for 100 hectares of arable land. Water is piped some 7km away from the Orange River. This represents an engineering feat and a significant financial investment. This has proven to be a successful farming operation. In order to render the investment economically viable, it has become necessary to expand the farming operation. Another 100 hectares of land has been earmarked for this purpose.

An Environmental Impact Assessment (EIA) in terms of the National Environmental Management Act (107 of 1998) is required for the approval of the new addition to the farming venture, as virgin land is to be tilled. Enviro Africa of Somerset West was appointed to conduct the EIA.

The proposed agricultural development is to take place across dry drainage lines, which triggers Section 21 (c) and (i) of the National Water Act (36 of 1998). A Water Use License Application (WULA) is required for the approval of the mining activity. This application is to be submitted to the Department of Water and Sanitation’s regional office in Upington. Dr Dirk van Driel of WATSAN Africa was appointed to conduct the WULA.

The success of the WULA is very much dependent on the concomitant Fresh Water Report (now named the Technical Report). This report is to provide adequate information to the decision-making authorities, in this case the DWS.

Together with the Fresh Water Report a Risk Matrix is to be submitted. The Risk Matrix will assist the DWA do decide if a General Authorisation or a License application is required.

This report should be red along with a WATSAN report on the same land to support the WULA for a sand mining venture on the same land.

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.

There are two off-channel dams of 25 000m^3 each.

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 proposed pipeline transverses a number of drainage lines. The drainage lines could possibly be altered, should the development go ahead.

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

The proposed pipeline may alter the characteristics of the drainage lines.

Government Notice 267 of 24 March 2017

Government Notice 1180 of 2002. *Risk Matrix.*

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

Government Notice 509 of 26 August 2016

An extensive set of regulations that apply to any development in a water course is listed in this government notice in terms of Section 24 of the NWA. No development take place within the 1:100 year-flood line without the consent of the DWS. If the 1:100-year flood line flood line is not known, no development may take place within a 100m from a water course without the consent of the DWS. 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 32m 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 Climate

Upington close to Kakamas normally receives about 94mm of rain per year, with most rainfall occurring mainly during autumn. The chart below (Figure 1, lower left) shows the average rainfall values for Upington per month. It receives the lowest rainfall (0mm) in June and the highest (29mm) in March. The monthly distribution of average daily maximum temperatures (centre chart below) shows that the average midday temperatures for Upington range from 19.8°C in June to 33°C in January. The region is the coldest during July when the mercury drops to 2.8°C on average during the night.

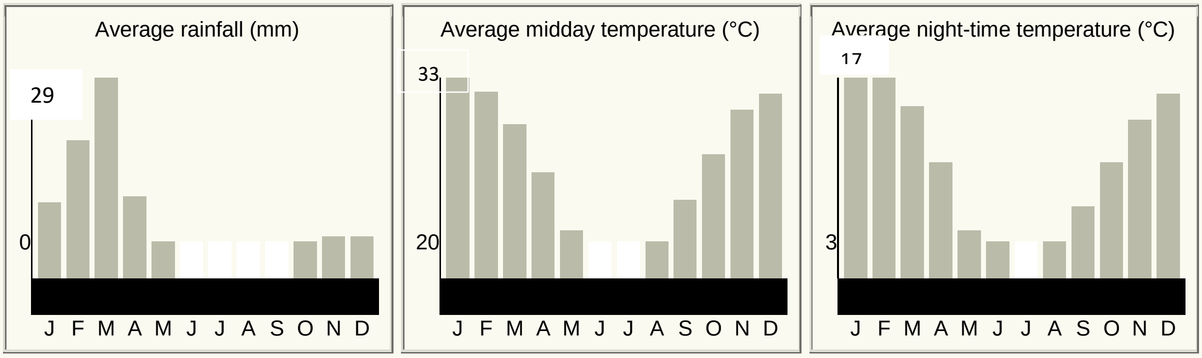

Figure 1 Upington Climate

It is evident from Figure 1 that this is an arid region. The drainage lines exist because of sudden and intense downpours that occur only once in several years. These must have been formed over millennia since historical times. The contribution to the flow in the Orange River is negligible.

4 Quaternary Catchment

The CA Bruwer farming operation is located in the D53J quaternary catchment

5 Vegetation

The South African National Biodiversity Institute (SANBI) indicated the vegetation type at the proposed mining area as Bushmanland Arid Grassland. Despite the general lack of water, the Hartbees River next to the site is classified as a National Freshwater Ecosystem Priority Area (NFEPA).

Swarthaak *Senegalia mellifera* is the dominant tree in the drainage lines, with a camel thorn tree *Vachellia eriobola* sparsely scattered over the landscape.

6 The Farming Operation

Figure 2 Pump on Orange River

Water is taken from the Orange River (Figure 2) with pumps driven by three phase electric power that is purchased along the regular channels from ESKOM. The water is being pumped in a southerly direction into a 25000m^3 dam. The dam is lined with a waterproof plastic liner. This is an off-channel, entirely constructed dam (Figure 3).

Figure 3 Balancing Dam

The length of the pipeline from the Orange River to the first dam is 1.5km. From here the water is being pumped for another 3.3km to another dam. This dam is lined as well (Figure 4).

Figure 4 Irrigation Dam

From here the water is being pumped for yet another 2.4km to a centre pivot irrigation system (Figure 5). Next to this centre pivot is yet another smaller one.

Figure 5 Centre Pivot

Right next to the irrigation dam is another centre pivot (Figure 6).

Figure 6 Centre pivot next to irrigation dam

The total length of the pipeline from the Orange River to the furthest centre pivot is 7.2km.

7 The Pipeline

The pipeline represents a very large capital spending and an engineering feat. From the Orange River is swings into the bed of the Hartbees River to the south.

At the confluence of the Hartbees River with the Orange River, the banks of the Hartbees River have been formalised through the agricultural area with large berms on both banks. These berms render the area next to the Orange River suitable for the large-scale vineyards (Figure 7) that forms the backbone of the local economy. These vineyards would have been submerged during the occasional floods, were it not for these berms.

The banks of the lower Orange River, from Groblershoop to Augrabies, have been formalised in a similar fashion, for the purpose of flood control. This was and still is a DWS national project.

Figure 7 The Berm at the confluence

Figure 8 N14 road bridge over Hartbees River

Figure 9 Pipeline crossing the irrigation canal

The pipeline follows the bank of the Hartbees River and passes under the N14 trunk road bridge (Figure 8).

A number of pipelines from other farming concerns share this route.

These pipelines have heavily been overgrown with *Phragmitis* reeds.

The pipeline crosses underneath the irrigation canal (Figure 9).

The pump station at the balancing dam has been provided with a backup generator, driven by a diesel engine, to be used in the event of an ESKOM power failure (Figure 10)

Figure 10 Generator

The overall impression of this pipeline is, given the expertise, energy and funding that went into it, that it warrants a reasonable payback period, acceptable return of capital and a substantial number of job opportunities. For this the current agricultural development needs to be expanded.

8 Future Growth

The current agricultural undertaking amounts to 117.6 ha, of which 36ha is under maize, 50.6ha under lucerne and 31ha under pecan nut trees. The current infrastructure on the ground represent a massive capital spending in relation to the land that is currently under irrigation. In order to render the venture financially viable, it is necessary that more land is added to the equation.

Only "red" land is suitable for development. Other land is either too rocky or devoid of nutrients, such as the "white" patches that can be seen on Google Earth images. The patchwork of areas that are suitable for development are indicated on Figure 19 on p22. This has been confirmed by laboratory soil tests, for which a number of test holes were dug on the ground to take the required soil samples.

The new ground that can be added adds up to 106.41 hectares, which increases the surface area with 90%. This would do much towards the financial viability of the agricultural development.

9 The Hartbees River, Sak River and the Pans

The agricultural development is located on the bank of the Hartbees River. The Hartbees River rises as the Sak River on the highlands to the south of Sutherland more than 450km to the south (Figure 11).

The catchment area of this river system is large and covers a sizable chunk of the Bushmanland and the western Karoo.

A series of pans separate the Sak River from the Hartbees River. Verneukpan is perhaps the one that is better known because the historical land speed record was set there. The Hartbees River only flows when these pans overflow. This happened in 1999 and in 2010. It is expected that these overflows will occur less often in future as water abstraction from the Sak River for agriculture increases.

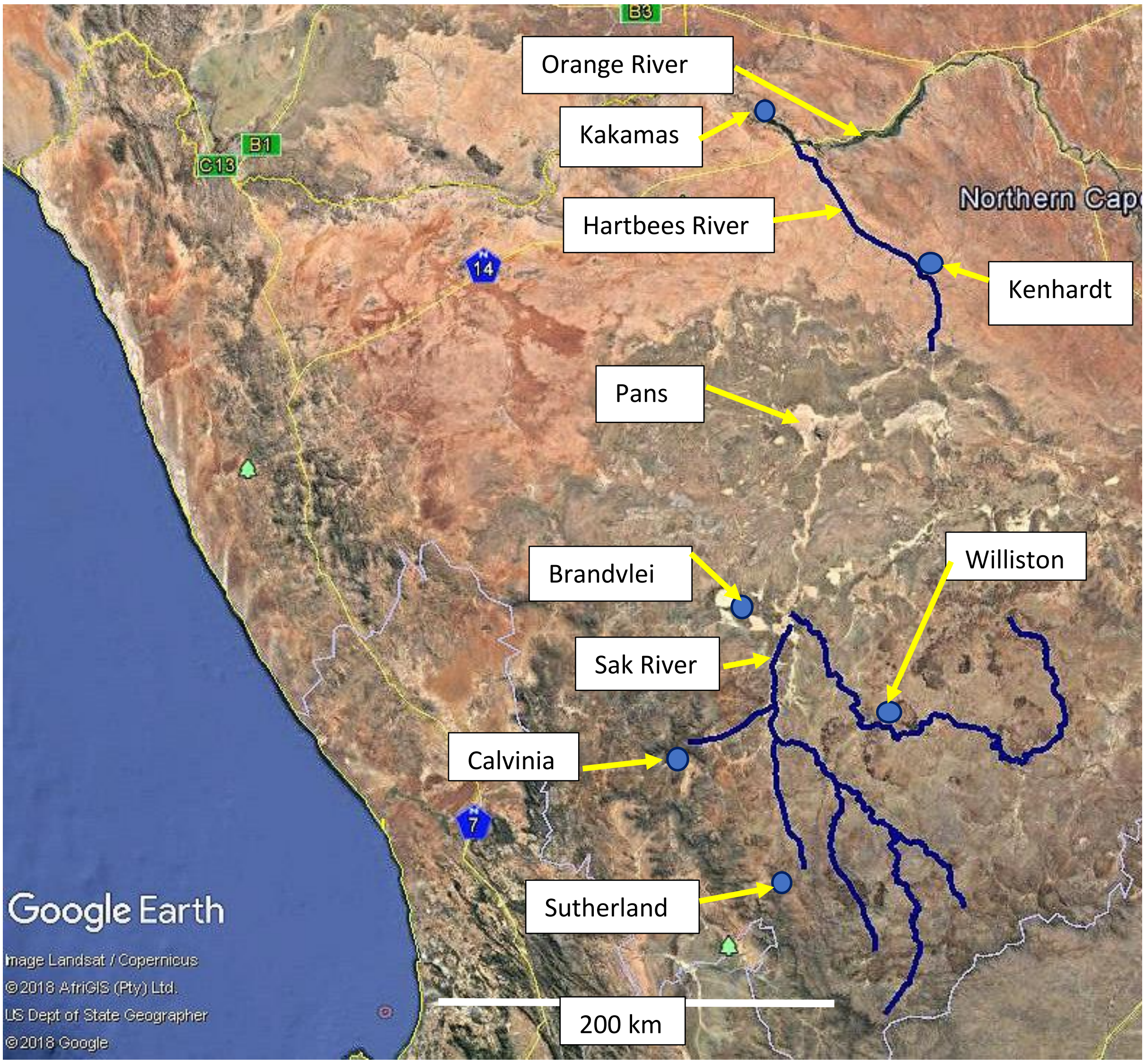

Figure 11 Sak / Hartbees River system

It is however important to note that the Sak River do not contribute towards the Mean Annual Runoff (MAR) of the Orange River (Department of Water and Environmental

Affairs, 2006, p8). This is an arid region and its contribution is negligible. The flow of the Orange River is mainly because of the contribution of the Lesotho Highlands.

The banks of the Hartbees River have been impacted since historical times, with agriculture leaving its mark. At this time there are several active agricultural concerns. In addition, there are several sand mines, some in the bed of the river, which are reportedly legally licenced entities.

10 Drainage Lines

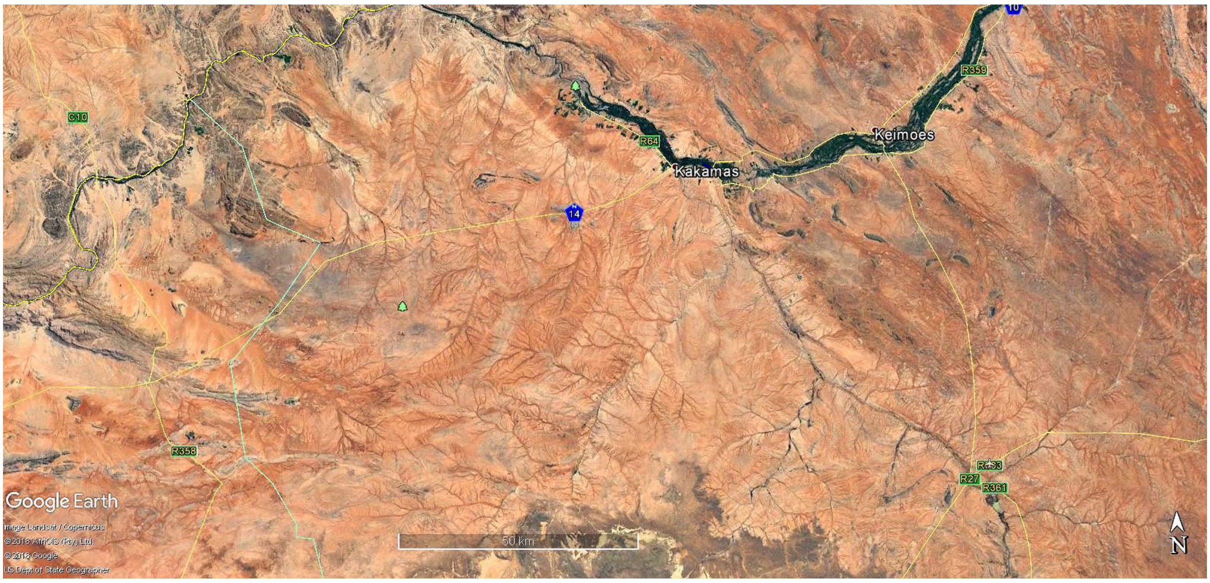

Figure 12 Drainage Lines

The landscape around much of the Lower Orange River and the Sak River is dominated by a dense succession of drainage lines. They 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 12).

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 form over millennia, even since geological times.

Much of the discussion in this report is about these drainage lines.

Around the Orange River and even the Sak 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.

11 Sub-Catchments

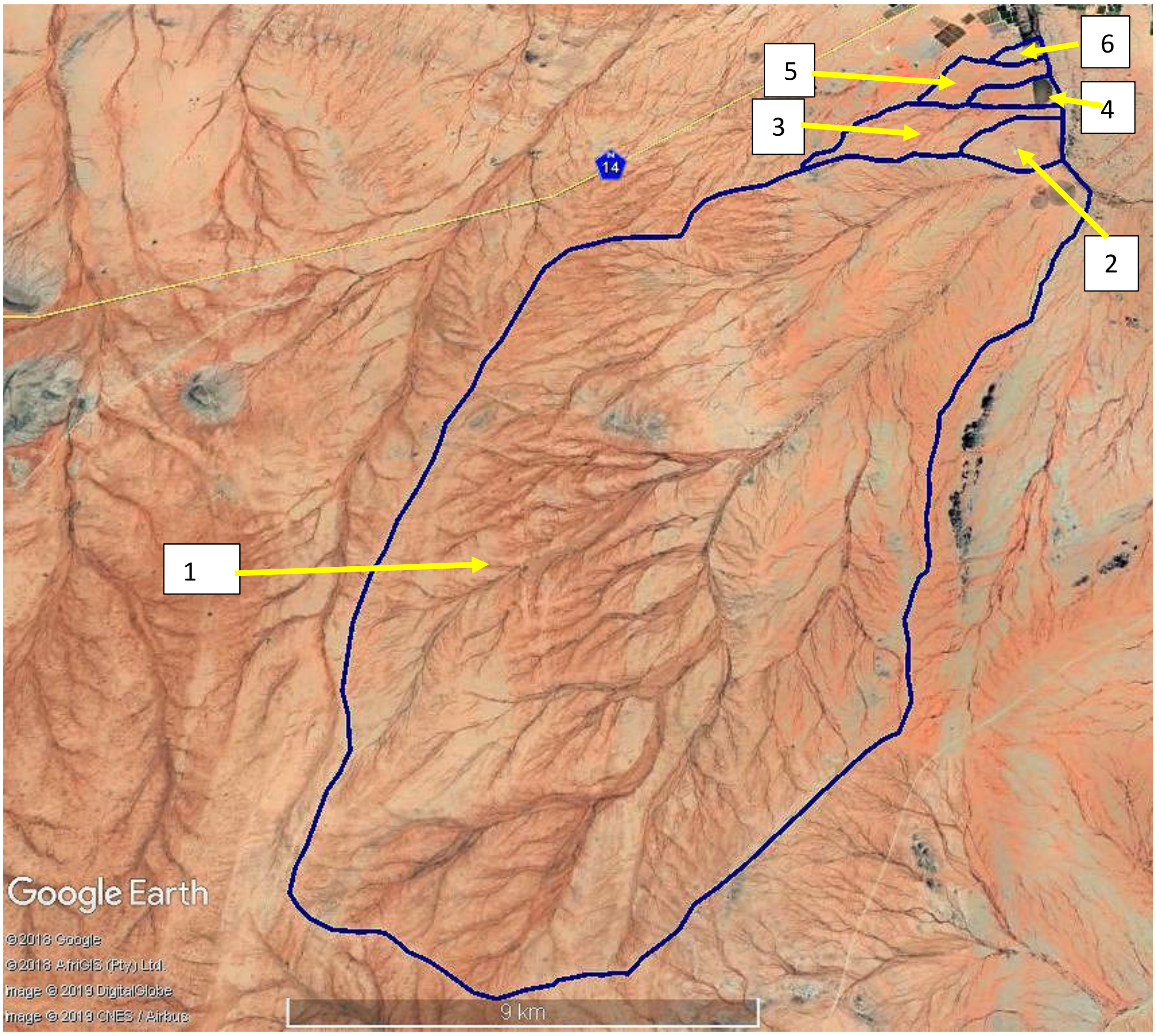

Figure 13 Sub-Catchments

The sub-catchments in which the agricultural developments are to take place have been demarcated in Figure 13.

The dimensions of each of these sub-catchments has been recorded in Table 1.

Sub-catchment 1 is much bigger that the others, with a strongly developed drainage line.

Table 1 Sub-Catchment statistics

No.	Surface Ha	Circumference km	Length km	Width km	Elevation Top masl	Elevation Bottom masl	Slope m vertical in 100m horizontal
1	19207	58	22.9	11.8	833	659	0.75
2	267	6.6	2.4	1.5	703	659	0.73
3	518	14.1	12.6	2.7	749	659	6.4
4	137	5.5	2.2	0.8	691	655	6.5
5	232	7.9	3.3	1.4	707	655	6.6
6	60	3.4	1.3	0.5	686	653	9.7

12 CA Bruwer Farm Drainage Lines

Next to the farm road along the Hartbees River, the drainage lines fan out to connect to one another in a broad and continuous fan, interconnected, with no visual demarcation between drainage lines. This is visible on Google Earth Images, as well as on the ground. During rainfall events, storm water spreads out all over, in a braided fashion, and the flow of water migrates sideways, left and right, to create this continuous fan of braided drainage lines.

The drainage lines only have water during very large rainfall events. Most of the time the drainage lines are dry, for months and even years on end.

The slope of sub-catchments 1 and 2 is very gradual. The slopes of sub-catchments 3 to 6 are much steeper, with 6 the steepest. It can be expected that steep slopes and large catchment areas will result in high velocities of surface water movement during rainfall events. None of these drainage lines are deeply incised. It seems as if the surface area combined with the slope in none of these sub-catchments result in sediment transport of a large enough volume to create proper water course banks. Instead the drainage lines fan out over a wide area, in some places up to 100m wide, with gradual banks.

In the area across the farm road from the half-circle centre pivot, a number of these drainage lines can be seen (Figure 14 and 15), where they come out of the bush, over the road and then into the irrigated maize field, where they disappear. These drainage lines are small, with signs of a little sediment erosion and deposition, because of the rain the previous two days. In Kakamas 45mm was recorded. The site visit was on 7 February 2019.

The drainage line next to the full circle centre pivot (planted with lucerne) is much wider. The one at the end of the pecan nut orchard is deeper, up to a metre, with a stronger defined channel (Figure 16). It was dry despite after the rain, a sign that the preferential flow paths have shifted.

Further on, adjacent to the full circle centre pivot, the drainage line is some 40m wide, still wet because of the rain, with wet soil because of the rain and with signs of moving sediments (Figure 17).

Figure 14 Drainage line across from maize field

Figure 15 Another drainage line across from maize field

Figure 16 Drainage line at end of pecan nut orchard

Figure 17 Drainage line adjacent to full circle centre pivot

13 Existing Infrastructure

At the end of sub-catchment 1, large full circle centre pivot irrigation systems have been installed. There is a smaller centre pivot alongside as well (Figure 19).

A sand mine is planned in the smaller tributary along the northern boundary alongside the centre pivot (WATSAN report, 2018).

Sub-catchments 2 and 3 have been altered by pecan nut orchards along the Hartbees River (Figure 18).

Figure 18 Pecan nut orchard

Sub-Catchment 3 has a large half-circle centre pivot irrigation system, as well as an off-channel farm dam that provides water for irrigation.

Sub-catchment 5 and 6 are heavily trampled and over-grazed, but apart from this is fairly un-impacted.

A farm road separates al of the sub-catchments from the Hartbees River.

The bottom end of sub-catchment 1 next to the orchard has been impacted upon by sand mining.

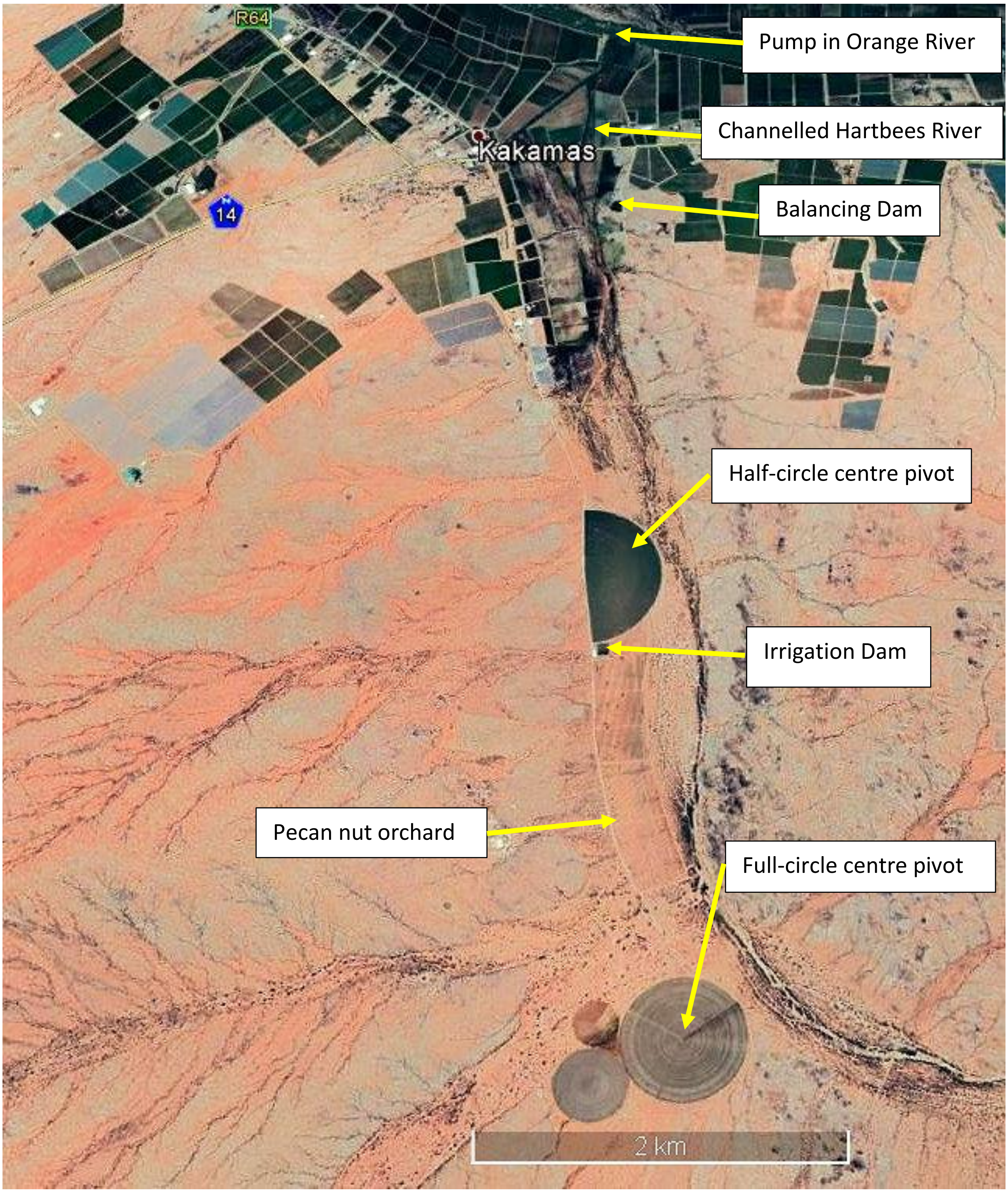

Figure 19 Irrigation system lay-out

A berm has been constructed on the banks of the Hartbees River to protect the half-circle centre pivot from flooding (Figure 20).

The necessity for the protection of crops from floods is fully understood, but it should be done in such a way that rivers are not unduly impacted. The bank of the Hartbees River has been partially denuded of riparian vegetation (Figure 21), while the berm was constructed. It is recommended that a restoration plan be devised and implement under the supervision of a qualified restoration ecologist.

Figure 20 Berm on Hartbees River bank

Figure 21 Hartbees River riparian zone

Figure 22 Berm at the full-circle centre pivot

There is another berm as well along the full-circle centre pivot to divert storm water out of the catchment around the circle of agricultural land (Figure 22).

14 Possible impacts of new agricultural developments

The new patches of land that are to added to the current farming practice are depicted in Figure 23.

In order to visualise the impacts of these new developments on the sub-catchments and their drainage lines, the new patches of land have been superimposed on the sub-catchments (Figure 24).

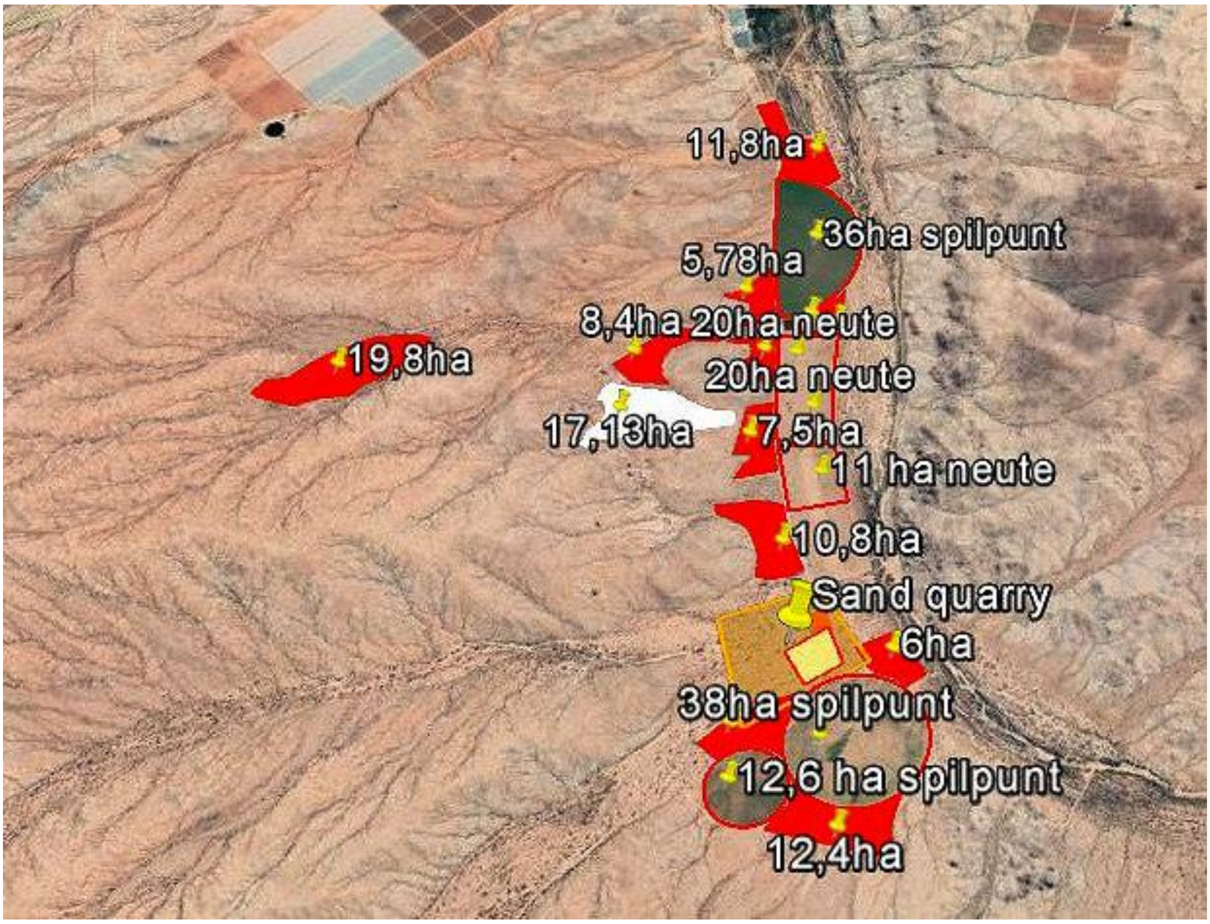

Figure 23 New Agricultural Development

From a hydrobiological and aquatic habitat conservation point of view it would be ideal if drainage lines could flow unhindered from their upper catchments through to their confluences with rivers. This, however, is not possible when agricultural development is taking place in sub-catchments across drainage lines. Drainage lines are inevitably cut off from rivers. Alternatively, drainage lines are diverted to follow other, artificial flow paths to rivers.

Should the 100m protected zone in terms of the NWA and even the 32m protected zone in terms of the NEMA be enforced, it will not be possible to develop any of the indicated patches of land. These patches are so small that there won't be much land left for development if legislation is applied. If the developments are to go ahead, there is no option left but to waive the need for protected zones.

If allowed, the standard practice of berms to direct storm water around developments should be allowed for.

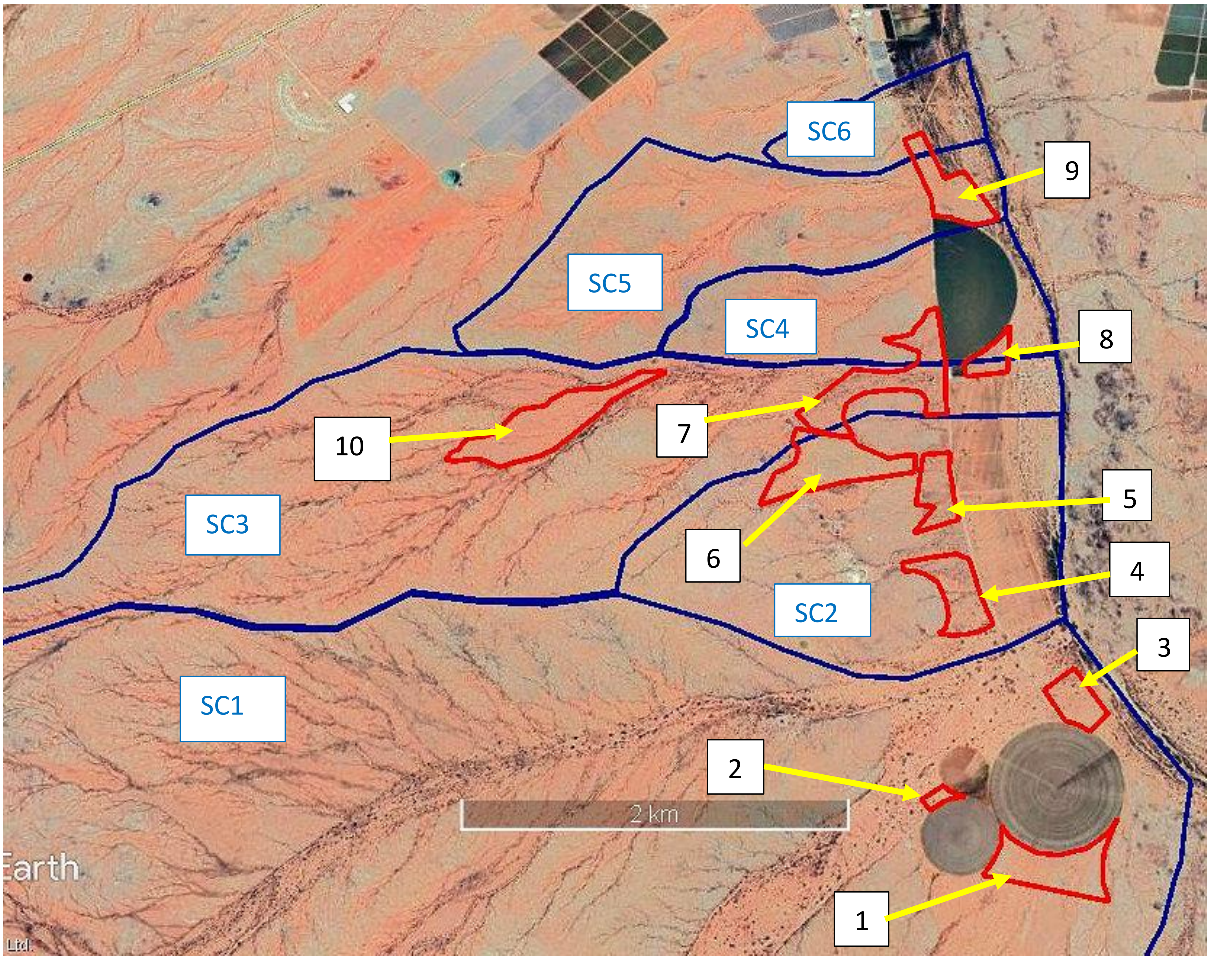

Figure 24 New development superimposed on sub-catchments

The worst farmers visualize pertains to their freshly created lands to wash away during the first severe thunder storm. Conservationists and aquatic scientists probably share this fear because a heavy silt and sediment load would wash down the catchment and further down the river, with possible habitat destruction in its wake.

A formalised channel with stabilised banks and bottoms to take storm water through is preferable to a wide donga following a thunderstorm through a newly patch of developed land. Even a cut-off berm upstream of the development is preferable. Large-scale erosion should be prevented at any cost.

Since the patches of land depicted in Figure 23 are small, with limited runoff, cut-off berms are indicated, with storm water flow directed around developments, as is already present on the ground at the centre pivots.

The selected crops would determine the storm water management infrastructure. Pecan nut orchards would hardly need any, as the land between trees could stabilise, with relatively little sediment transport. Maize would require sturdy infrastructure, as the land is perpetually tilled.

Sub-catchment 1 is already impacted by two centre pivots. The addition of patches 1,2 and 3 would not add to existing impacts in an unacceptable manner.

Sub-catchment 2 and 3 are already impacted by pecan nut orchards. Should patches 4, 5 and 6 be planted with similar crops, the impact would not increase significantly, even though sub-catchment 2 is small and the new development would cover a significant portion of its surface area.

Sub-catchment 4 would be cut off from the Hartbees River in a similar fashion than the current pecan nut orchard does. The additional impact would be small, especially as the sub-catchment is comparatively larger than the new patch of agricultural development.

Sub-catchment 4 is already cut off by the semi-circular centre pivot. A small patch of pecan nuts would not make a material difference.

Likewise, the area along the Hartbees River of patch 5 and 6 are trampled all over and the envisaged agricultural development would not significantly add to the impact.

In the event of agricultural return flow, it can be expected that a patch of reeds will develop in a drainage line or in the Hartbees River. With large vineyard this can be substantial. The return flow from pecan nut trees is usually small and the change of habitat will probably be insignificant to small.

Much of the above are assumptions. The following prescribed assessment will indicate how much value can be attached to these assumptions.

15 Mitigation Measures

The land outside of the indicated agricultural development patches should be left unimpacted as much as possible. Should any of this be developed in future, it must be done following proper official approval procedures in terms of current legislation.

Storm water should be diverted around worked agricultural land with berms, or contained in formalised channels through agricultural land. Erosion should be addressed as soon as it becomes evident.

Storm water infrastructure should be regularly monitored and repaired whenever necessary.

The bank of the Hartbees River and its riparian zone, where impacted upon, should be restored according to an officially approved plan.

The sand mine in the bottom of sub-catchment 1 should be legitimised or restored.

Agricultural return flow as a result of over-irrigation should be avoided at all costs. The Hartbees River is mostly and naturally dry and should remain that way. Contemporary farming practices and the cost of energy and irrigation are extremely high, with serious inroads on profitability, hence soil moisture should be telemetrically monitored with sophisticated instruments and the irrigation regime perpetually and accordingly adjusted.

The access road should be maintained and not be allowed to become a source of sediments that could end up along with storm water in the Hartbees River. Any signs of erosion of the road should be adequately addressed.

16 Present Ecological State (PES)

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 scores given are solely that of the practitioner and are based on expert opinion.

Table 2 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

Table 3 Present Ecological State

Table 3.1 Present Ecological State of the drainage line in Sub-Catchment 1

	Score	Weight	Product	Maximum score
Instream				
Water abstraction	25	14	350	350
Flow modification	15	13	195	325
Bed modification	18	13	234	325
Channel modification	19	13	247	325
Water quality	20	14	280	350
Inundation	22	10	220	250
Exotic macrophytes	24	9	216	225
Exotic fauna	24	8	192	200
Solid waste disposal	24	6	144	150
Total		100	2078	2500
% of total			83.1	
Class			B	
Riparian				
Water abstraction	25	13	325	325
Inundation	22	11	242	275
Flow modification	16	12	192	300
Water quality	20	13	260	325
Indigenous vegetation removal	18	13	234	325
Exotic vegetation encroachment	18	12	216	300
Bank erosion	23	14	322	350
Channel modification	18	12	216	300
Total			2007	2500
% of total			80.2	
Class			B	

Sub-catchment 1 is largely near-pristine, with the only marked impact a couple of sheep grazing, but with a partial “plug” near the point of discharge. It has been classified as a “B”, largely natural. The development of the new patches of agricultural land, as indicated, would probably not change the classification of the sub-catchment.

Table 3.2 Present Ecological State of the drainage line in Sub-Catchment 2 and 3

Instream	Score	Weight	Product	Maximum score
Water abstraction	25	14	350	350
Flow modification	12	13	156	325
Bed modification	14	13	182	325
Channel modification	16	13	208	325
Water quality	19	14	266	350
Inundation	22	10	220	250
Exotic macrophytes	15	9	135	225
Exotic fauna	24	8	192	200
Solid waste disposal	24	6	144	150
Total		100	1853	2500
% of total			74.1	
Class			C	

Riparian				
Water abstraction	25	13	325	325
Inundation	22	11	242	275
Flow modification	16	12	192	300
Water quality	19	13	247	325
Indigenous vegetation removal	16	13	208	325
Exotic vegetation encroachment	18	12	216	300
Bank erosion	23	14	322	350
Channel modification	16	12	192	300
Total			1944	2500
% of total			77.8	
Class			C	

Sub-catchment 2 and 3 have been lumped together as the impacts are similar, the pecan nut trees at the end near the discharge. Up the slopes the sub-catchments are near-pristine. The new development would probably not change the rating of sub-catchment 2, but it would lower the classification of sub-catchment 3 with at least one level, as the planned development is rather large in relation to the size of the sub-catchment.

Table 3.3 Present Ecological State of the drainage line in Sub-Catchment 4

Instream	Score	Weight	Product	Maximum score
Water abstraction	25	14	350	350
Flow modification	9	13	117	325
Bed modification	9	13	117	325
Channel modification	9	13	117	325
Water quality	15	14	210	350
Inundation	9	10	90	250
Exotic macrophytes	15	9	135	225
Exotic fauna	24	8	192	200
Solid waste disposal	24	6	144	150
Total		100	1472	2500
% of total			58.8	
Class			D	

Riparian				
Water abstraction	25	13	325	325
Inundation	9	11	99	275
Flow modification	9	12	108	300
Water quality	15	13	195	325
Indigenous vegetation removal	9	13	117	325
Exotic vegetation encroachment	13	12	156	300
Bank erosion	23	14	322	350
Channel modification	9	12	108	300
Total			1430	2500
% of total			57.2	
Class			D	

Sub-catchment 4 is rather small with a centre pivot that takes up much of its surface area. Therefore, it can only score a D, with much of its ecological functioning lost. The new development is small and will probably not change the classification.

Table 3.4 Present Ecological State of the drainage line in Sub-Catchment 5 and 6

Instream	Score	Weight	Product	Maximum score
Water abstraction	25	14	350	350
Flow modification	15	13	195	325
Bed modification	15	13	195	325
Channel modification	15	13	195	325
Water quality	20	14	280	350
Inundation	15	10	150	250
Exotic macrophytes	15	9	135	225
Exotic fauna	24	8	192	200
Solid waste disposal	24	6	144	150
Total		100	1701	2500
% of total			68.0	
Class			C	

Riparian				
Water abstraction	25	13	325	325
Inundation	15	11	99	275
Flow modification	15	12	180	300
Water quality	15	13	195	325
Indigenous vegetation removal	15	13	195	325
Exotic vegetation encroachment	12	12	144	300
Bank erosion	23	14	322	350
Channel modification	15	12	180	300
Total			1540	2500
% of total			61.6	
Class			C	

Again, the impacts on these two sub-catchments are similar and therefore they have been lumped together for this assessment. They score a "C". It is surmised that the classification of sub-catchment 5 will drop with one level because of the new development, but that of sub-catchment 6 will probably stay the same.

Table 3.5 Present Ecological State of the Hartbees River

Instream	Score	Weight	Product	Maximum score
Water abstraction	15	14	210	350
Flow modification	18	13	234	325
Bed modification	20	13	234	325
Channel modification	20	13	260	325
Water quality	20	14	280	350
Inundation	18	10	180	250
Exotic macrophytes	22	9	198	225
Exotic fauna	24	8	192	200
Solid waste disposal	24	6	144	150
Total		100	1932	2500
% of total			77.2	
Class			C	

Riparian				
Water abstraction	15	13	325	325
Inundation	18	11	198	275
Flow modification	18	12	216	300
Water quality	20	13	260	325
Indigenous vegetation removal	22	13	286	325
Exotic vegetation encroachment	18	12	216	300
Bank erosion	20	14	280	350
Channel modification	20	12	240	300
Total			2021	2500
% of total			80.8	
Class			B	

It seems preposterous for one person to come up with a score for the Hartbees River, as this is in the domain of a team of specialists. However, such a grand undertaking is beyond the scope and budget of the usual WULA. Since this is required for approval, an assessment is submitted, together with its shortcomings.

Upstream the Sak and Hartbees River's water is heavily used for agriculture and irrigation. However, when the occasional flood happens, the volume of water that flows down the catchment is of such a magnitude that it overruns the abstraction capacity by far. The abstraction does indeed shorten the hydroperiod of the river system.

This assessment pertains to the lower Hartbees River. At the CA Bruwer development (Figure 25), the river and its riparian zone is relatively intact. Near the confluence with the Orange River it has been canalized for the protection of vineyards against floods.

Figure 25 Hartbees River at CA Bruwer

Table 4 PES Summary

Sub-Catchment	Instream		Riparian	
	Score	Class	Score	Class
1	83.1	B	80.2	B
2 & 3	74.1	C	77.7	C
4	58.8	D	57.2	D
5 & 6	68.0	C	61.6	C
Hartbees River	77.2	C	80.8	B

17 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 7).

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

No other endangered species, either plant or animal, were detected in or near the drainage line. Camel thorn *Vachellia erioloba* is listed as "least concern" on the SANBI Red List, but is not particular associated with the riparian zone of drainage lines.

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)

18 Ecological Sensitivity

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 CA Bruwer agricultural development and its associated infrastructure were to be removed, along with the livestock, would the drainage lines recover?

The in-stream habitat, with its sandy bottom, would probably resemble its current characteristics, even though it might have shifted over time across the sandy landscape, as water ways do.

This is an arid region, with vegetation recovery rates very slow, it would take many decades, perhaps a century, for the impacted riparian habitat around the drainage lines to recover. However, this is not a realistic scenario. Agriculture is here to stay, together with its impacts. From this point of view the drainage lines can be listed as ecologically sensitive.

Likewise, the lower Hartbees River is ecologically sensitive because of the same reasons. If the riparian vegetation were to be removed, it would take many years to recover.

19 Impact Assessment

Some of the decision-making authorities prescribe an impact assessment according to a premeditated methodology (Table 26.1, 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 proposed agricultural development would inevitably destruct the affected sections of the drainage lines. This is essentially the decision that the authorities will have to take; the tilling of new land and the resulting destruction of some sections the CA Bruwer drainage lines as opposed to the preservation of these drainage lines. If the preservation of drainage lines rules out agricultural development, any further impact assessment and the further pursuance of a WULA would be ruled out. Hence the following assessments have been carried out under the assumption that some sections of drainage line will suffer destruction with the consent of the authorities. The destruction of these sections of drainage lines is not included in this assessment. This peculiar situation always faces assessors when habitat is destroyed in favour of development.

The impact assessment (Table 6) suggest that the mitigation measures can be implemented successfully. It suggests that the proposed development can go ahead, without unacceptable impacts outside of the agricultural development.

Table 6 Impact Assessment

Description of impact Tilling of new land, washing of soil down the drainage lines and into the Hartbees River during a storm event Construction of berms, drainage swales and storm water management infrastructure Construction of irrigation infrastructure **Mitigation measures** Do not disturb any land outside of designated agricultural area. Construct storm water management infrastructure Construct outside of rainy season Refrain from making new roads, use existing roads. Conserve 32m riparian zone of Hartbees River								
Type Nature	Spatial Extent	Severity	Duration	Significance	Probability	Confidence	Reversibility	Irreplaceability
Without mitigation								
Direct	Regional	Medium	Temporary	Medium	Probable	Certain	Reversible	Replaceable
With mitigation measures								
Negative	Local	Low	Medium	Low	Unlikely	Sure	Reversible	Replaceable

Description of impact Operation of new farming venture Irrigation of crops **Mitigation measures** Do not over-irrigate Monitor soil moisture levels and irrigate accordingly Monitor and record agricultural return flow Prevent erosion of road and agricultural areas Repair eroded areas								
Type Nature	Spatial Extent	Severity	Duration	Significance	Probability	Confidence	Reversibility	Irreplaceability
Without mitigation								
Direct	Regional	Medium	Temporary	Medium	Probable	Certain	Reversible	Replaceable
With mitigation measures								
Negative	Local	Low	Medium	Low	Unlikely	Sure	Reversible	Replaceable

20 Risk Matrix

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 original risk assessment as on the DWS webpage has been submitted on the included DVD.

Table 7 Risk Matrix

No.	Activity	Aspect	Impact	Significance	Risk Rating
1	Tilling of new land	Mobilisation of sediments	Sediments in drainage line and Hartbees River	36	Low
2	Construction of storm water management infrastructure	Mobilisation of sediments	Sediments in Hartbees River	26	Low
3	Construction of new irrigation infrastructure	Mobilisation of sediments	Sediments in river	24	Low
4.1	Operation of agricultural venture	Agricultural return flow	Agrichemicals in river	54	Low
4.2		Alteration of flow regime	Alteration of aquatic habitat	54	Low

Table 7 Continued Risk Rating

No	Flow	Water Quality	Habitat	Biota	Severity	Spatial scale	Duration	Conse-quence
1	1	2	2	1	1.5	2	1	4.5
2	1	1	2	1	1.25	1	1	3.25
3	1	1	1	1	1	1	1	3
4.1	1	1	2	2	1.5	1	2	4.5
4.2	2	2	1	1	1.5	1	2	4.5

No	Frequency of activity	Frequency of impact	Legal issues	Detection	Likelihood	Significance	Risk Rating
1	1	1	5	1	8	36	Low
2	1	1	5	1	8	26	Low
3	1	1	5	1	8	24	Low
4.1	3	3	5	1	12	54	Low
4.2	3	3	5	1	12	54	Low

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

The methodology is set out in the Appendix. It has been copied directly out of the DWS webpage.

The risks are “Low”.

The Risk Matrix indicate that a General Authorisation should be considered.

21 Resource Economics

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

The diagram (Figure 26 and 27) is an accepted manner to visually illustrate the resource economic footprint of the drainage lines, from the data in Table 8 and 9.

Table 8. Goods and Services CA Bruwer Drainage Lines

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

0	Low
5	High

The drainage lines are readily erodible. The sands are easily washed away. Instead of trapping sediments, it produces sediments. The swarthaak trees in and around the drainage lines are higher than that of the surrounding landscape, thereby providing habitat and biodiversity. Sand is mined from many of these drainage lines in the region, providing natural resources.

The size of the star shape in Figure 1 is the feature that attracts the attention of the decision-makers. The star shape is rather small. The environmental goods and serviced rendered by these drainage lines are limited.

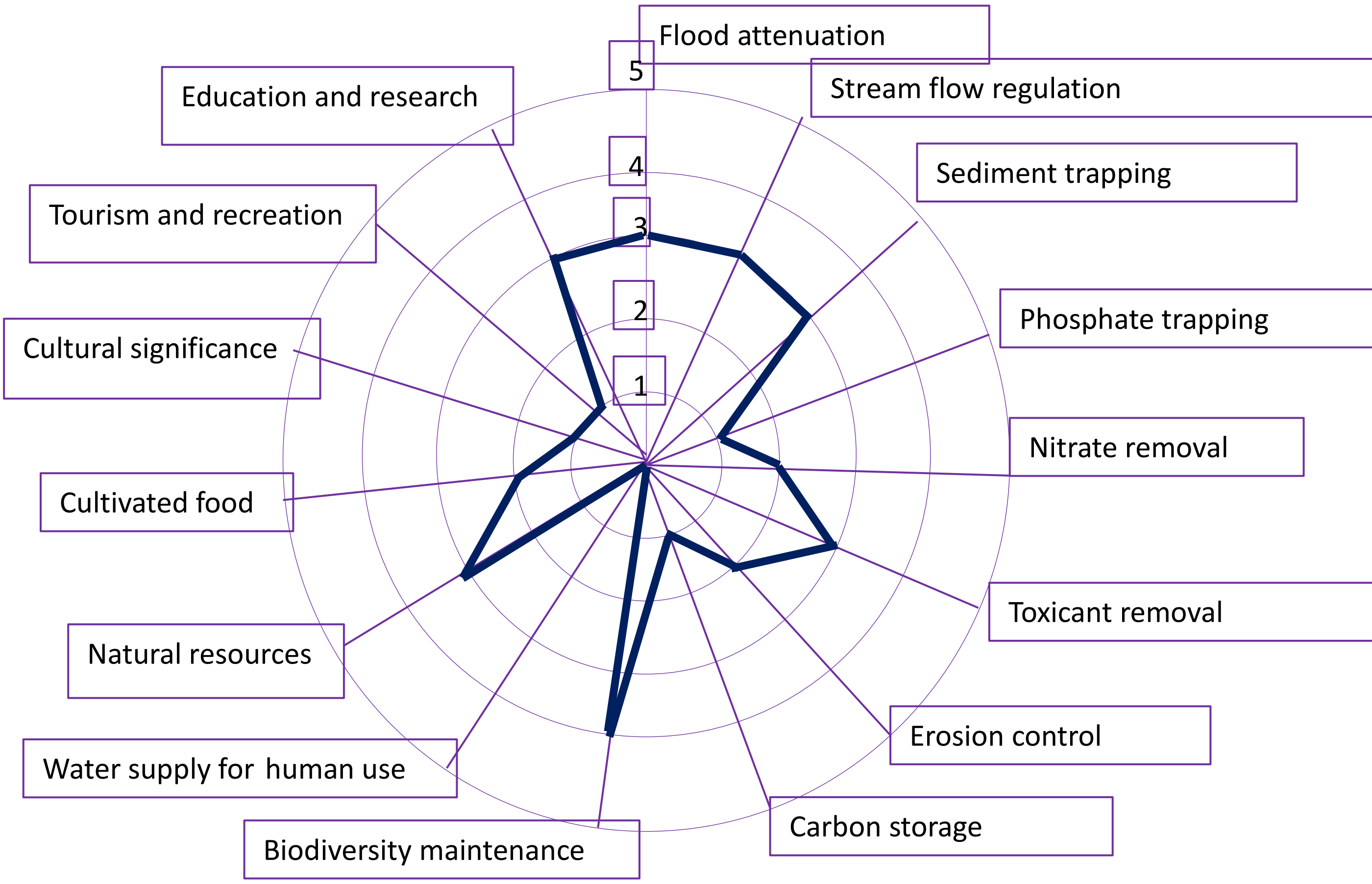

Figure 26. Resource Economics Footprint of the CA Bruwer Drainage Lines

. **Table 9** Goods and Services lower Hartbees River

Goods & Services	Score
Flood attenuation	5
Stream flow regulation	5
Sediment trapping	3
Phosphate trapping	4
Nitrate removal	4
Toxicant removal	3
Erosion control	4
Carbon storage	3
Biodiversity maintenance	5
Water supply for human use	4
Natural resources	3
Cultivated food	4
Cultural significance	2
Tourism and recreation	2
Education and research	3

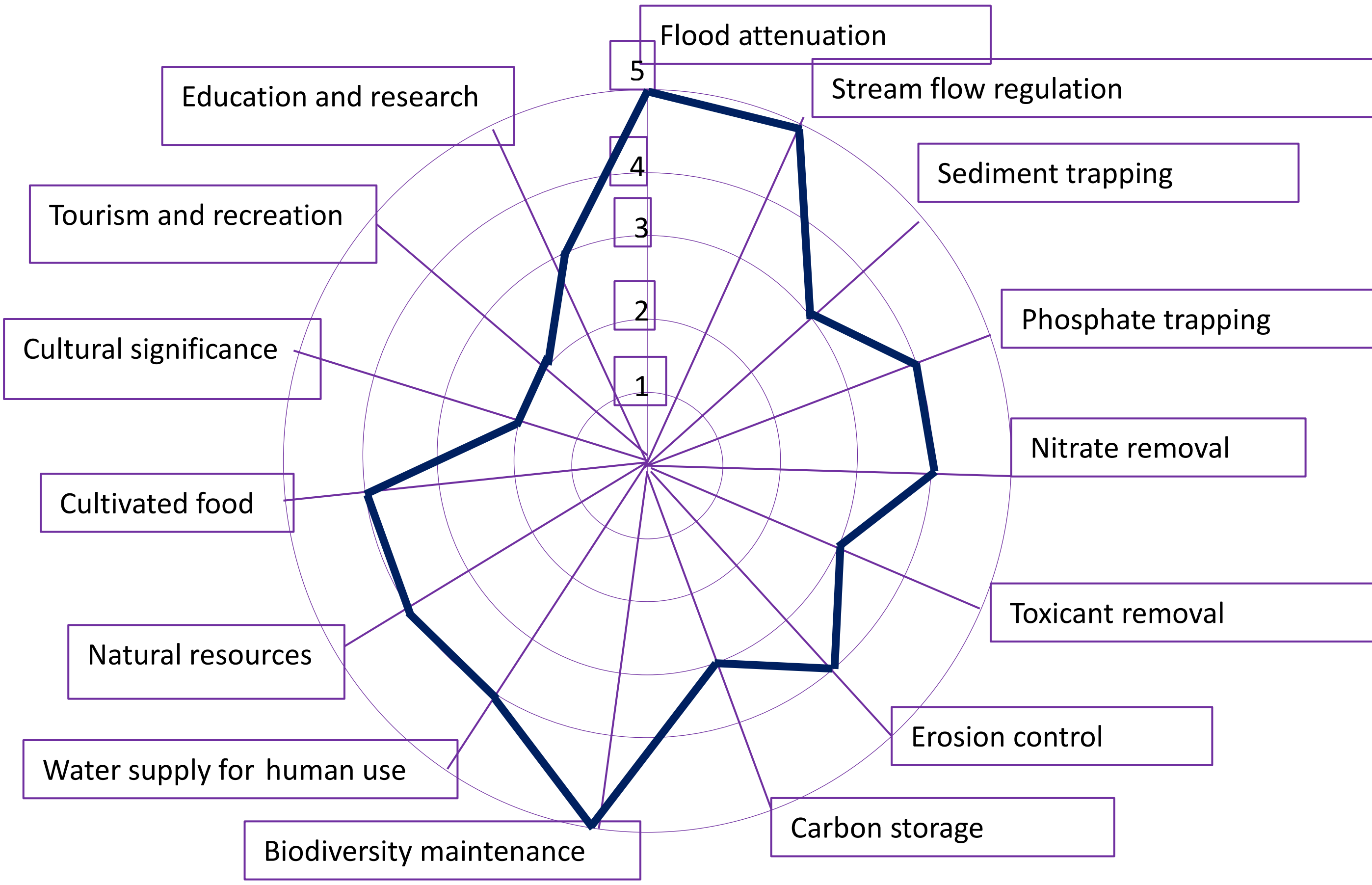

Figure 27. Resource Economics Footprint of the Lower Hartbees River

The star shape of the Hartbees River is significantly bigger than that of the drainage lines. The green line of higher vegetation in a barren landscape provides habitat for a diversity of organisms such as birds, reptiles and mammals that would have been absent, were it not for the Hartbees River riparian zone. From an economic resource point of view the Hartbees River demands conservation measures.

22 Conclusions

Figure 28 has been adapted from one of the most recent DWS policy documents.

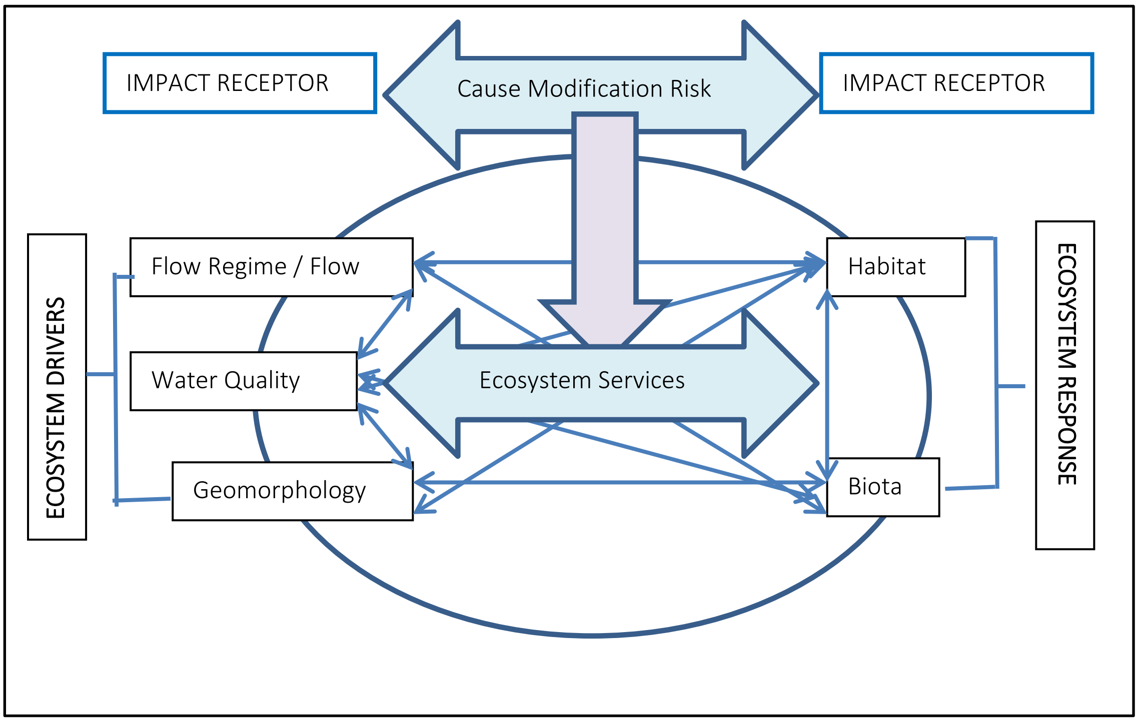

Figure 28 Minimum Requirements for a S21(c) and (i) Application

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 28). The WULA and the EAI must provide mitigation measured for these impacts.

The driver of the mostly dry 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 vegetation along the drainage lines that provides habitat in an arid region where habitat and habitat variability is hard to come by.

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.

A percentage of still unimpacted drainage lines should be identified, prioritised and set aside for conservation. Only specified practices with no or limited impacts should be allowed in these sub-catchments and their drainage lines.

It remains for the decision-making authorities to decide if the proposed agricultural developments in the Lower Hartbees River are acceptable and if they should go ahead. Since impacts are already evident and since a vast amount of money has already been invested in this venture, with many job opportunities at stake, the proposed development should go ahead, but the eminent approval would increase the urgency and pressure for a known and accepted Lower Orange River Drainage Lines conservation policy.

The Risk Matrix suggests that a General Authorisation is the appropriate level of official approval.

23 References

Department of Water and Environmental Affairs (DWA), 2009*. Development of an Integrated Water Quality Management Strategy for the Upper and Lower Orange Water Management Areas, Desktop Catchment Assessment Study: Lower Orange Water Management Area (WMA 14).* Report No. 2.2 (P RSA D000/00/7909/3). Edition 1. DWA, Pretoria.

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.

Van Driel D. 2018. *Proposed Sand Mining Operation on Plot 2372 of Alheidt, Kakamas*. WATSAN. Cape Town

24 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 5 March 2019

25 Résumé

Dr Dirk van Driel
PhD, MBA, PrSciNat, MWISA
Water Scientist

PO Box 681
Melkbosstrand 7437
saligna2030@gmail.com
079 333 5800 / 022 492 2102

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

Recent Reports &
Water Use License Applications

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

26 Appendix

26.1 Methodology used in determining significance of impacts

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

Table 26.1.1 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 26.1.2 Criteria for the assessment of impacts

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

Table 26.1.3 Significance Rating

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

Table 26.1.4 Probability, confidence, reversibility and irreplaceability

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

26.2 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