FRESH WATER REPORT
Housing on Portion 128 and the Remainder of Farm Kousas 459 Gordonia RD
KEIMOES
NORTHERN CAPE

A requirement in terms of Section 21 (c) and (i) of the National Water Act (36 of 1998)

January 2020

Index

Abbreviations

Critical Biodiversity Area	CBA
Department of Water and Sanitation	DWA
Ecological Importance	EI
Ecological Sensitivity	ES
Ecological Support Area	ESA
Environmental Impact Assessment	EIA
Electronic Water Use License Application (on-line)	eWULAA
Government Notice	GN
Hectares	ha
Metres Above Sea Level	masl
National Environmental Management Act (107 of 1998)	NEMA
National Freshwater Environment Priority Area	NFEPA
National Water Act (36 of 1998)	NWA
Present Ecological State	PES
South Africa National Biodiversity Institute	SANBI
Section of an Act of Parliament	S
Water Use License Application	WULA

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1 Introduction

The Kai !Garib Municipality encompasses several towns in the Northern Cape. Keimoes on the banks of the Orange River is among these towns, where the expansion of a human settlement on 100ha of land is now necessary. This is on the farm Kousas 459 in the Gordonia registration district. In fact, this land has long been under discussion. Approximately half of it is already under informal housing and new residents arrive regularly. It has become urgent that the necessary administrative processes are now being concluded in order to officially establish the settlement.

The municipality appointed the town and regional planners Macroplan of Upington to deal with this administrative process. Macroplan, in turn, has appointed Enviro Africa of Somerset West to deal with the legally required EIA in terms of NEMA.

The proposed housing scheme at Keimoes stretches over mostly dry drainage lines, which are tributaries of the Orange River. These are, in terms of the NWA, deemed as legitimate water resources. In conjunction to the EIA, a WULA is required as well. Consequently, Dr Dirk van Driel of WATSAN Africa has been appointed to carry out the WULA, along with the Fresh Water Report and the Risk Matrix, as is prescribed on the DWS webpage.

The Fresh Water Report has been developed over a number of years to include aspects that now have officially been specified. Apart from answering to WULA requirements, an impact assessment is included to specifically satisfy the requirements of the EIA as well.

It is concluded that the drainage lines have only limited value as water resources and environmental assets. Hence it was advised that the development should go ahead and that a General Authorization is the correct level of authorization.

2 Legal Framework

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

S21 I *Impeding or diverting the flow of a water course*

The proposed housing scheme 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 housing scheme 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 I and I of the NWA.

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.

2 Climate Keimoes

Keimoes normally receives about 84mm of rain per year, with most rainfall occurring mainly during autumn. The chart below (Figure 1, lower left) shows the average rainfall values for Keimoes per month. It receives the lowest rainfall (0mm) in June and the highest (27mm) in March. The monthly distribution of average daily maximum temperatures (centre chart below) shows that the average midday temperatures for Keimoes range from 19.8°C in June to 33°C in January. The region is the coldest during July when the mercury drops to 3°C on average during the night.

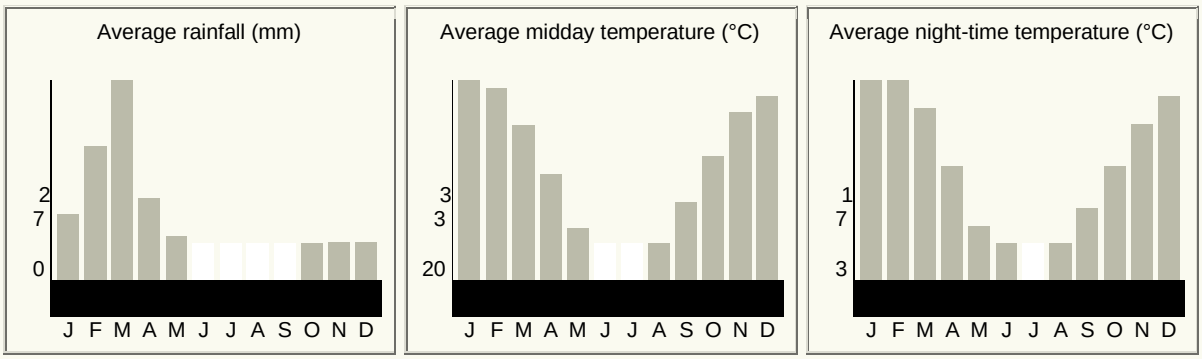


Figure 1 Climate Keimoes

The rainfall is really low, tantamount to desert conditions. Keimoes is located on the southern edge of the Kalahari Desert. The larger part of the economy and agriculture entirely depends on irrigation out of the Orange river.

Nevertheless, violent thunderstorms occur from time to time, with rainfall of 40mm and more over a period of 24 hours. This may cause flow in the drainage lines.

3 Quaternary Catchment

Keimoes is in the D42E quaternary catchment

4 Vegetation

The veld type where the proposed housing scheme is going to be is listed as Bushmanland Arid Grassland, which is least threatened, according to the SANBI webpage.

The vegetation type on the banks of the Orange River is listed as Lower Gariep Alluvial Vegetation, which is critically endangered. But then the housing development is not going to be anywhere near the banks of the river.

The kraal aalwyn *Aloe claviflora* (Figure 2) grows on the higher quartzites. These are valuable and should be transplanted and conserved prior to the area being developed into housing. The swarthaak *Senagalia mellifera* is the common in the lower drainage lines, but there are a number of other thorn tree species as well. The Kalahari, especially along the drainage lines, is dotted with the protected camel thorn tree *Vachellia erioloba*, but none were observed on the farm Kousas.

The vegetation was green on the day of the site visit (8 February 2019) following the recent rains.

Figure 23 *Aloe claviflora*

5 The Housing Scheme

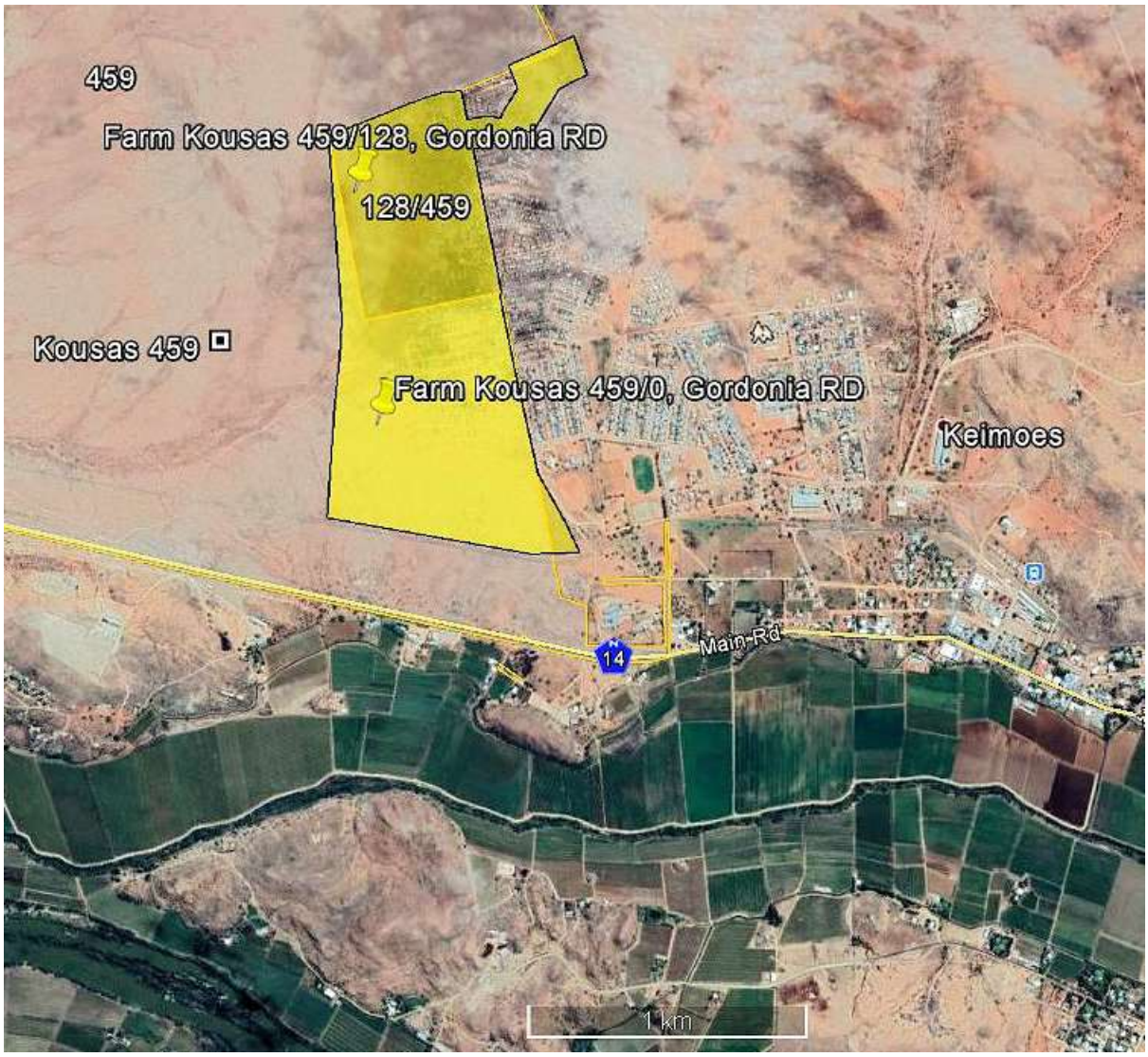


Figure 3 Housing Scheme (Macroplan)

The proposed housing scheme is demarcated in Figure 3. It is planned on Portion 128 of Farm Kousas 459 Gordonia and on the Remainder of the same farm. It covers a surface area of approximately 100 ha, with a circumference of 6km.

According to plan, there will be 1500 plots. A large part of the assigned land, perhaps half of it, has already been built up, just about all of it with informal housing.

6 Sub-Catchments and Drainage Lines

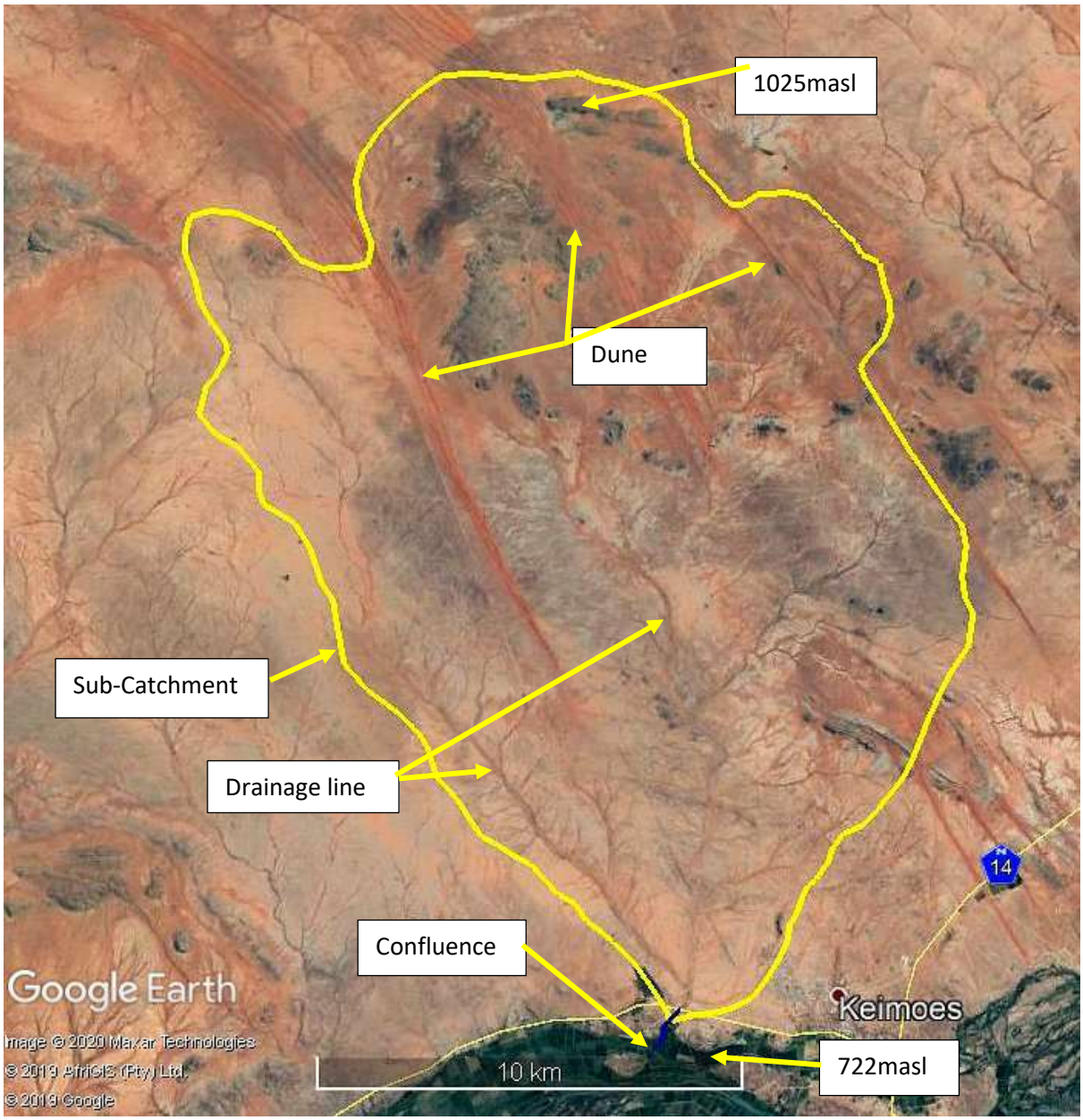


Figure 4 Sub-Catchment

The sub-catchment (Figure 4) is one of the larger ones along the banks of the lower Orange River. It covers an area of approximately 31 000 ha. It is approximately 26km long and it is 16.8km wide at its widest.

It was demarcated by connecting the highest points around the drainage line system with the polygon function of Google Earth. This is made possible by the coloration of the drainage lines, visible on Google Earth, as iron oxide accumulates in the sandy drainage lines (Figure 5), left there by the occasional storm water.

Figure 5 Sandy drainage line

Its highest point is a rocky outcrop in the very north. It is 1025masl. The lowest point at the confluence with the Orange River is 722masl. This is just less than a horizontal meter drop over a distance of 1km. This is a very gentle slope that does not make for fast flowing water downhill or a strong erosion potential.

The sub-catchment is intersected by typical red Kalahari sand dunes (Figure 4).

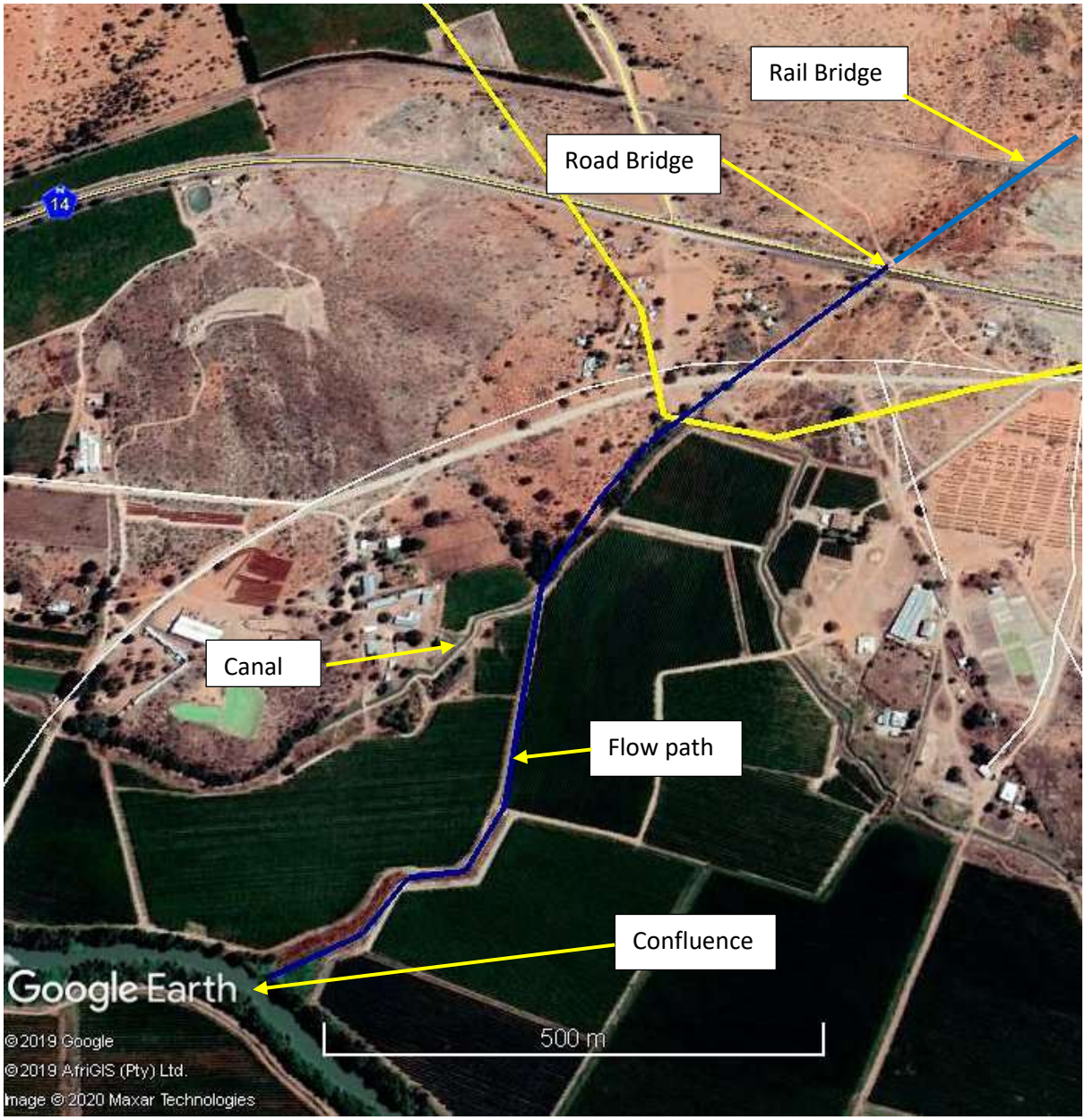


Figure 6 Confluence

The drainage line passes underneath the railway and the N14 trunk road through bridges. It has been interrupted by the vineyards and the irrigation canal. The final reach is flanked by vineyards (Figure 6).

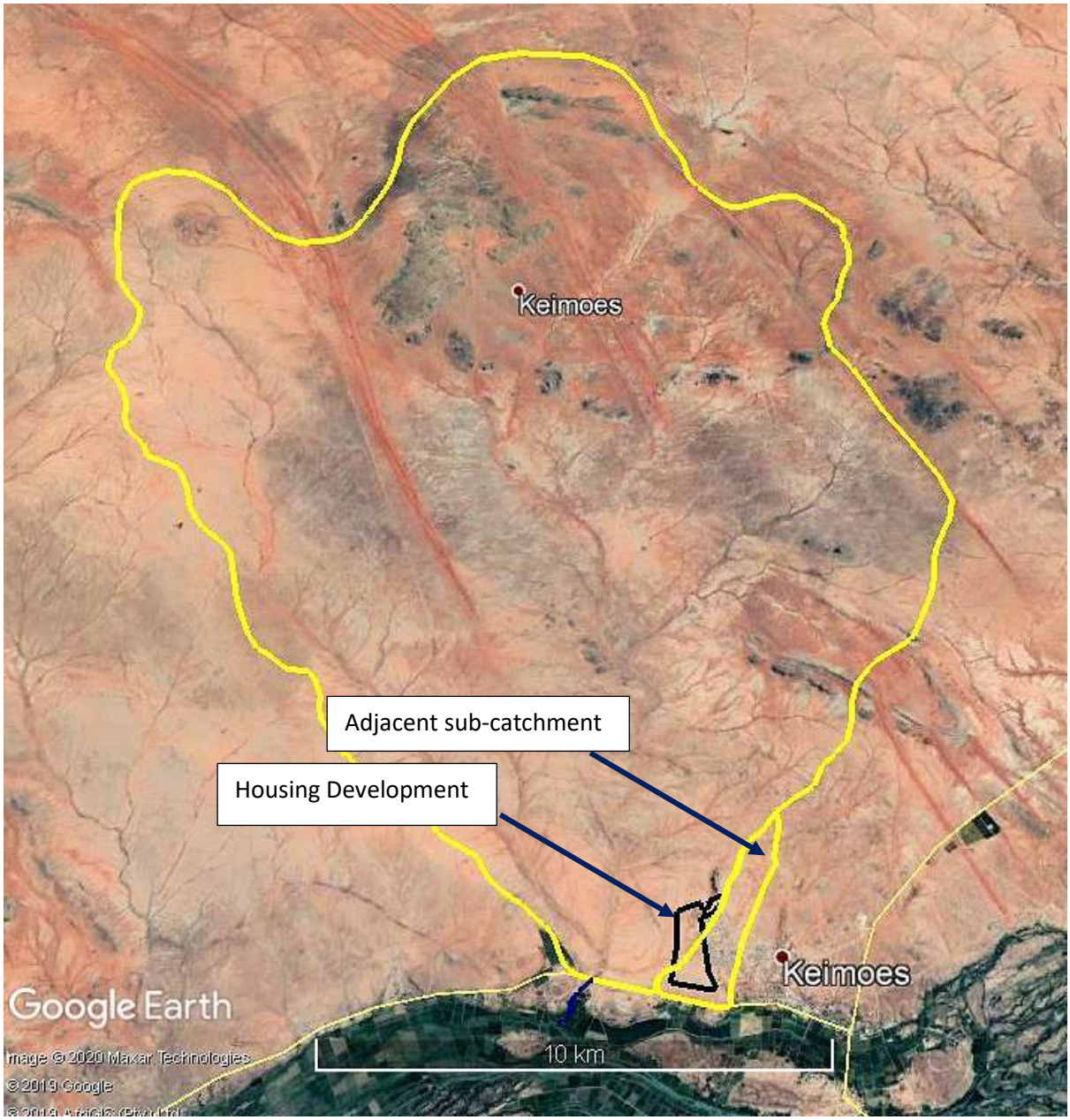


Figure 7 Adjacent Sub-Catchment

However, approximately only half of the proposed housing development it in this very large sub-catchment. The other half is located in the adjacent sub-catchment (Figure 7).

This is a much smaller sub-catchment.

In the past, prior to the development of Keimoes and the vineyards along the Orange River, the 3 drainage lines that run through the town of Keimoes (Figure 8) were probably all part of the same catchment, with a single confluence to the river. The locality where these drainage line came together now has been replaced with vineyards and constructed drainage canals in among the blocks of vineyard. This is

only guessing, we do not really know, because of the lost evidence. We do not really know where the original flow paths were.

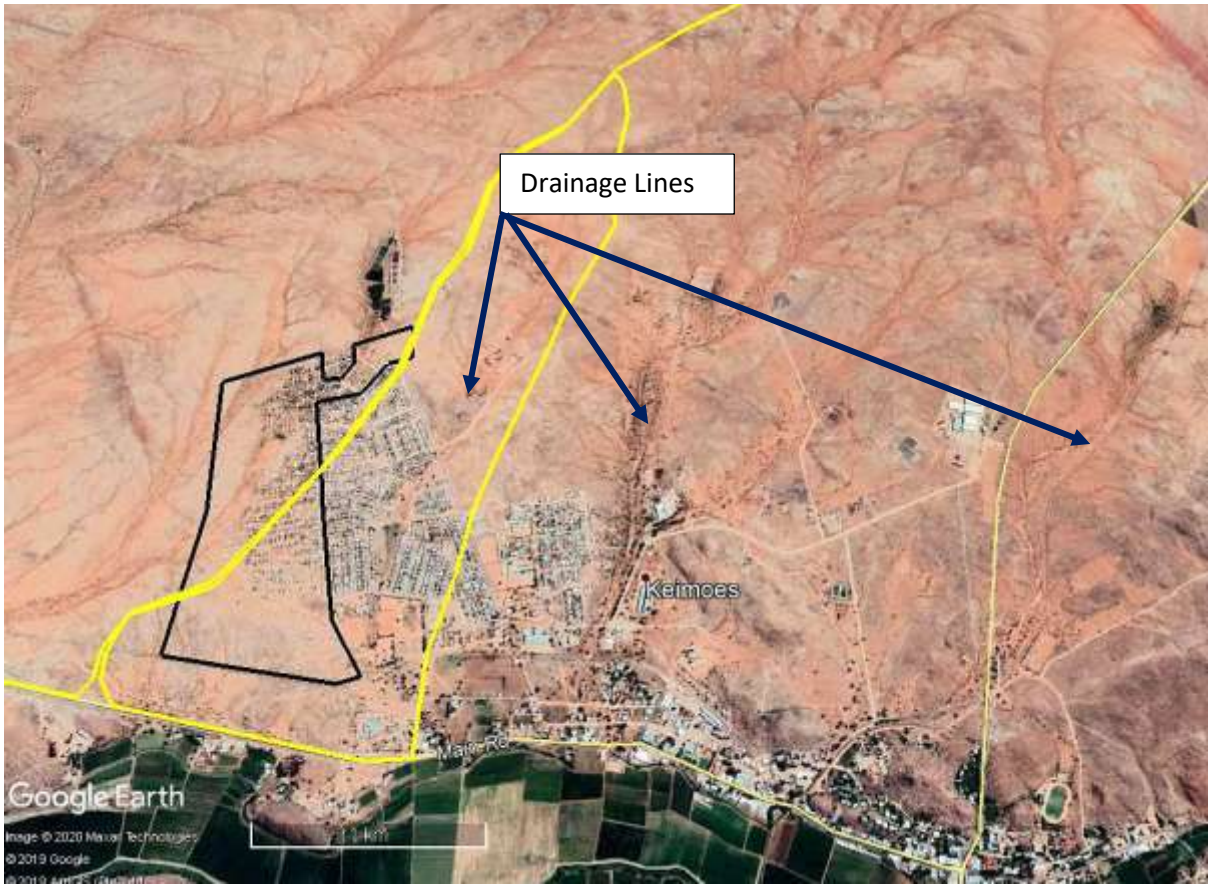


Figure 8 Keimoes drainage lines

The only part of this original sub-catchment of concern is the land around the eastern tributary of the original drainage line system. It is only 314ha in size. For the sake of this discussion it is named the adjacent sub-catchment.

Approximately half of the proposed housing development is located in this adjacent part of the sub-catchment (Figure1).

The drainage line of the adjacent sub-catchment, still faintly visible on the Google Earth Image, where it passes through the urban area, has been impacted, obliterated. It just misses the south eastern corner of the new housing development.

Downstream from the proposed housing development, towards the N14 trunk road, all that remained of the original system are a number of faint drainage lines out of a broad area of sand deposition that each disappear where the vineyards start.

7 Runoff

If the very scarce, but quite possible heavy rainfall event occurs of 40mm in 24 hours, this very large sub-catchment of 31 000ha theoretically generates a runoff of 12.4 million m^3. If only a fraction of this reaches the point of discharge at the Orange River, it would be a significant flow capable of doing damage to infrastructure.

This explains the very long railway bridge with plenty of room underneath to accommodate these occasional large floods (Figure 9). Likewise, the N14 road bridge just downstream from the railway bridge is an equally sturdy structure (Figure 10).

These large floods are responsible for maintaining the integrity of the drainage lines. If it were not for these flows, the drainage lines would probably fill in with wind-driven sand.

Sand mobilized by flood water is deposited downstream that typically creates these wide floodplains lower down the catchment. Mobilized and deposited sand often makes it difficult to “read” the boundary between sub-catchments and in which direction the next flood will head, also because the land is very flat, with the elevation staying the same over a large swat of land.

The size of that part of the sub-catchment directly upstream of the housing development is small and the possibility of floods is remote.

Figure 9 Railway Bridge

Figure 10 N14 Road Bridge.

8 Wastewater Treatment Works

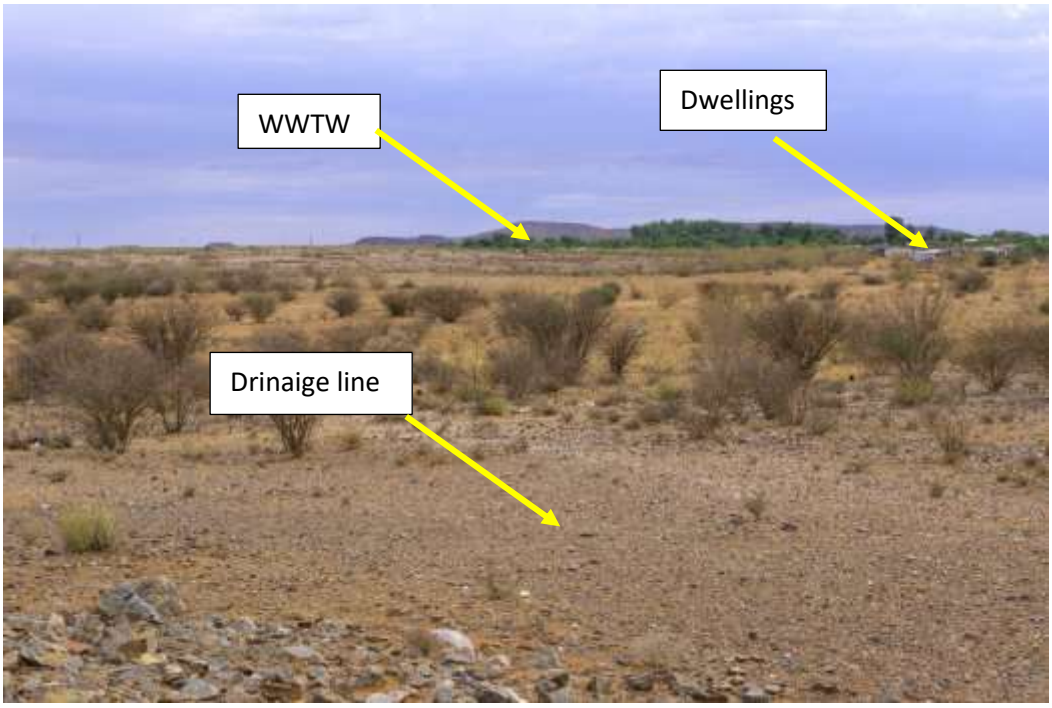


Figure 11 WWTW and dwellings

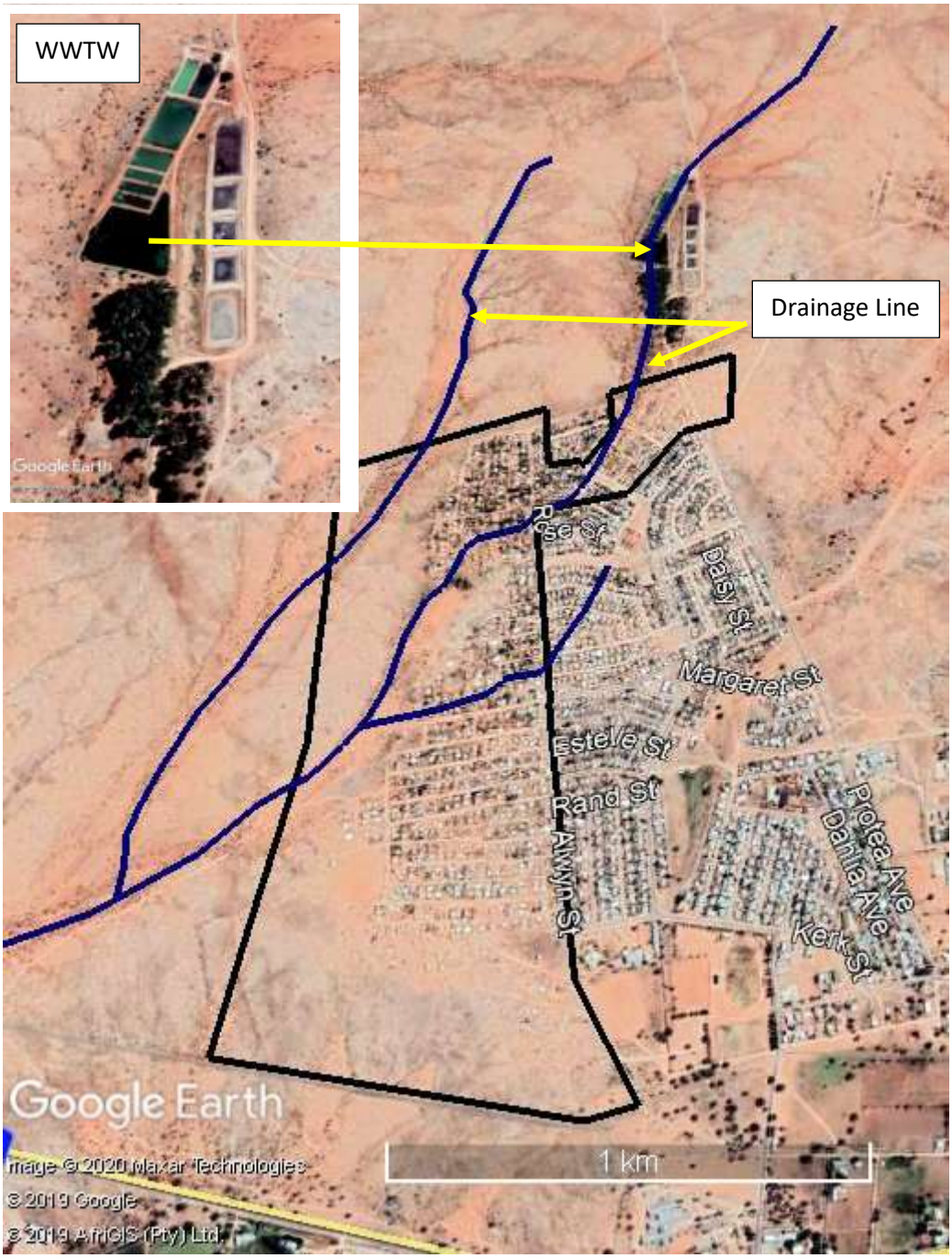


Figure 12 Wastewater Treatment Works Drainage

The Keimoes WWTWs (Figure 11 and 12) is located adjacent and just to the north of the proposed housing development. This is an anaerobic pond system. It was constructed in a drainage line. This drainage lines passes through the proposed housing development (Figure 12, details supplied by Macroplan).

The distance between the last active ponds and the first houses is less than 400m.

There are problems at the WWTW. Reportedly, spills occur from time to time, to the discomfort of the existing residents in the already built-up part of the proposed housing. Obviously, these problems need to be addressed, probably by constructing a proper and formalized drainage channel, where the drainage line is today.

Better still, an extra pond should be constructed large enough to contain spills, instead of letting partly treated sewage down the drainage line and through the housing. That is if the entire works in not in need of upgrading.

The other drainage lines running though the proposed development, as indicated in Figure 1, should be channelized as well, to contain storm water in the event of a high rainfall event.

9 Existing Housing

Figure 13 Existing Housing

Figure 14 Existing housing Continued

Figure 15 New dwellings

Existing housing in the proposed housing scheme is mostly of the informal type (Figure 13) Some residents have built themselves proper houses with brick and mortar (Figure 14).

New informal dwellings (Figure 15) are constructed on a daily basis.

Litter (Figure 1) is an enormous problem, with current clean-up services clearly not coping, apart from inadequate community awareness levels that is not helpful.

10 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.

11 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.

12 Lower Orange River Biomonitoring Results

The biomonitoring results have been captured in Table 1 and depicted in Figure 16.

The classes from A to F in Figure 1 has been assigned for mature rivers on flood plains such as the Lower Orange River.

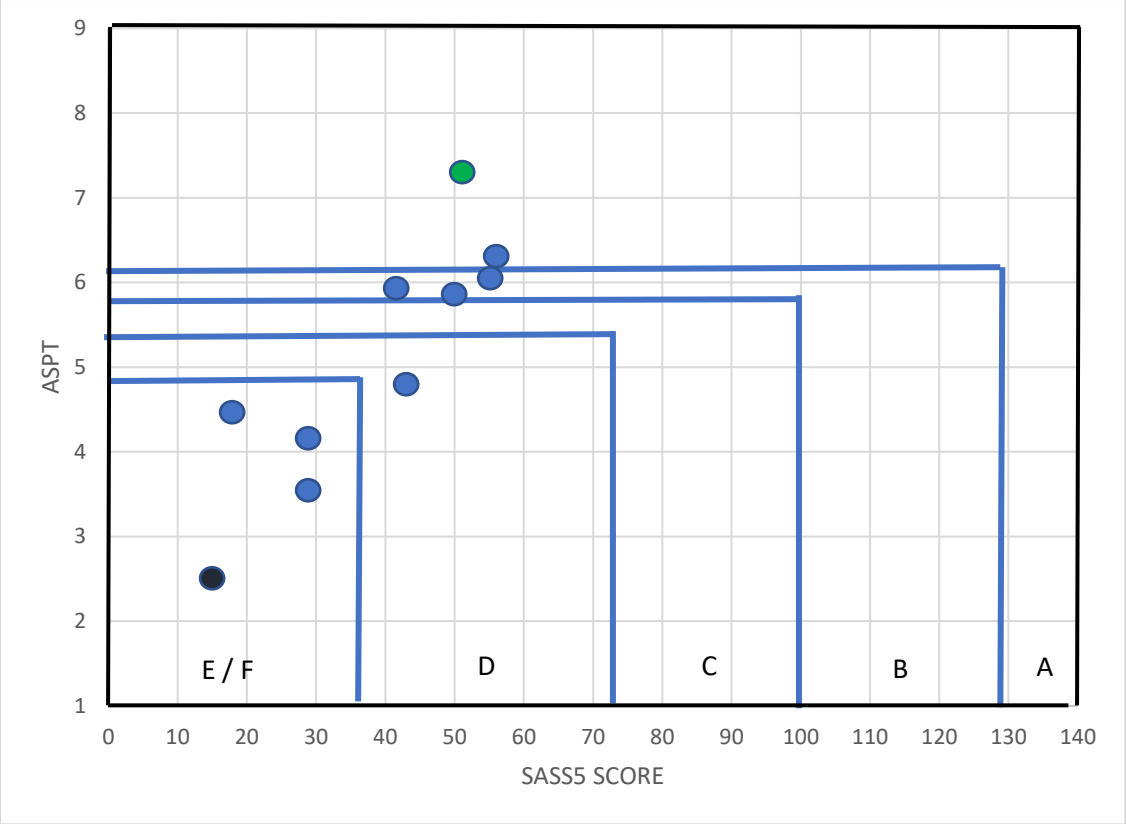
Only 2 of the samples were classified a good and relatively unimpacted (Class A). Four were in Class B and C, which can be regarded as acceptable under the circumstances of an impacted river reach. These classes can possible be labelled as the ideal, a compromise between agriculture and aquatic ecological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

Four samples were poor (Classes E and F), an undesirable state of affairs.

The one sample downstream of the Augrabies Falls was extremely poor.

Table 1 Biomonitoring in the Lower Orange River

Locality	Coordinates	Date	SASS 5	No Taxa	ASPT
Augrabies Lair trust	28°38’41.53S 20°26’08.49E	5/09/17	18	4	4.5
Augrabies Lair Trust	28°38’41.53S 20°26’08.49E	5/10/17	43	9	4.8
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 16 Lower Orange River Biomonitoring Results

13 Keimoes Biomonitoring

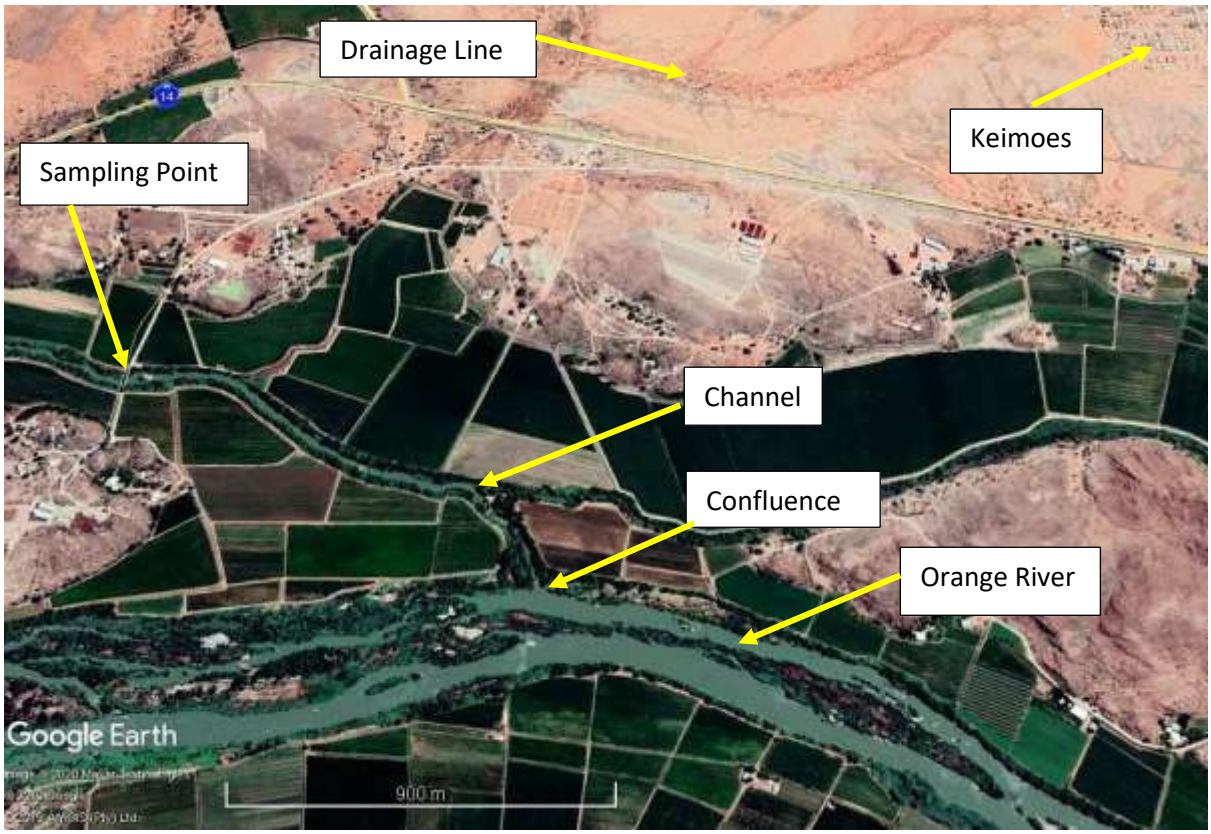


Figure 17 Sampling Point

The sampling point for biomonitoring was chosen as close as possible to the confluence of the drainage line with the Orange River (Figure 17). This is where the new housing development would have an impact, if approved. These two points were 350m apart.

Access to the river was a consideration, which was made possible by a road to a bridge (Figure 18). This bridge was over a side channel of the Orange River. The road and bridge led to a large island, cut off from the main land by the channel. The channel flows back into the Orange River 8.7km downstream, as the crow flies.

The river at the sampling points was fast flowing, $1ms^{-1}$ and more in the middle, slower on the sides. It was overgrown with spaanse riet *Arundo donax* and a willow tree *Salix* sp., probably *S. babylonica* (Figure 19). The river here was a homogeneous, fast-flowing channel without any features such as rapids and natural bedrock.

Access to the water was allowed over the pipes from the pump installation on the river's bank (Figure 20). The river here became deep quite abruptly that rendered sampling hazardous.

The substrate on the bottom was muddy. The bridge's pylons and the pipes where taken as bedrock, for the purpose of sampling and habitat diversity.

Figure 18 Bridge

Figure 19 Vegetation at sampling point

Figure 20 Irrigation pipes

Table 2 Water Quality

Parameter	Value
Dissolved Oxygen mgl^{-1} Temperature °C pH Electrical conductivity mSm^{-1}	5.8 27.5 8.2 34

Table 3 Biomonitoring Score

Parameter	Score
SASS5 score Number of taxa ASPT	51 7 7.3

The oxygen concentration (Table 2) was rather low on the day of sampling, which is not unusual for such a high temperature of more than 27 degrees centigrade. The oxygen concentration was still high enough to support a varied macro-invertebrate fauna.

The electrical conductivity indicated that the water was fresh, without much saltiness.

The pH was slightly on the alkaline side, but not enough to have an impact on the score. But then a purposeful effort with the sampling collection net only rendered 7 taxa.

The SASS5 score (Table 3) was 51, which was quite high for such a homogeneous habitat, with only a little submerged vegetation, emerging vegetation, muddy bottom and bedrock, impacted by surrounding vineyards. In fact, it rendered an “A” classification (Figure 16), which was much better than the rest of samples that were taken by WATSAN along the Orange River for the purpose of comparison. This is perhaps unusual and it can be expected that the score will be lower during follow-up sampling rounds.

It is not expected that the proposed housing development will significantly lower the score at the sampling point, unless something disastrous happens, such as a large sewage spill during a high rainfall event.

14 Present Ecological State

The PES is a protocol that have been produced by Dr Neels Kleynhans (Table 4, 5 and 6) 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 4 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 larger drainage line and its catchment (31 000ha) is for most of its surface area still in a near-pristine condition. The proposed Keimoes housing scheme in the south eastern corner covers only 0.16% of the sub-catchment. The sub-catchment is heavily impacted along the Orange River, with the drainage line entirely transformed into irrigation return flow canals and with most of its original ecological functioning lost. This stark contrast complicates the PES evaluation. Cattle and sheep in the sub-catchment were regarded as exotic fauna. There is a patch of exotic blue gum trees around and downstream of the WWTW. Water quality is affected by the WWTW and the large-scale agriculture.

The assessment of the much smaller adjacent drainage line rendered an entirely different result as the proposed development is 16.9% of the total surface area and as

much of the adjacent sub-catchment has already been developed. Moreover, the lower part of the adjacent sub-catchment makes up a much larger portion and is entirely transformed.

The reason that it did not score much lower than it did is because there is little if any water abstraction from the drainage line. A classification of C for both instream and riparian are probably a class too high for the conditions on the ground. In these arid environments the scope for water abstraction is limited and it should weigh much less for this specific assessment.

Table 5 Present Ecological State of the larger drainage line

Instream	Score	Weight	Product	Maximum score
Water abstraction	24	14	336	350
Flow modification	18	13	234	325
Bed modification	18	13	234	325
Channel modification	17	13	221	325
Water quality	22	14	308	350
Inundation	19	10	190	250
Exotic macrophytes	22	9	198	225
Exotic fauna	15	8	120	200
Solid waste disposal	16	6	96	150
Total		100	1937	2500
% of total			77.5	
Class			C	
Riparian				
Water abstraction	24	13	312	325
Inundation	19	11	209	275
Flow modification	18	12	216	300
Water quality	22	13	286	325
Indigenous vegetation removal	22	13	286	325
Exotic vegetation encroachment	22	12	264	300
Bank erosion	23	14	322	350
Channel modification	17	12	204	300
Total			2099	2500
% of total			84.0	
Class			B	

Table 6 Present Ecological State of the adjacent drainage line

Instream	Score	Weight	Product	Maximum score
Water abstraction	24	14	336	350
Flow modification	8	13	104	325
Bed modification	9	13	117	325
Channel modification	8	13	104	325
Water quality	10	14	140	350
Inundation	5	10	50	250
Exotic macrophytes	18	9	162	225
Exotic fauna	4	8	32	200
Solid waste disposal	4	6	24	150
Total		100	1069	2500
% of total			42.8	
Class			C	
Riparian				
Water abstraction	24	13	312	325
Inundation	5	11	55	275
Flow modification	8	12	96	300
Water quality	12	13	156	325
Indigenous vegetation removal	4	13	52	325
Exotic vegetation encroachment	18	12	216	300
Bank erosion	23	14	322	350
Channel modification	8	12	96	300
Total			1305	2500
% of total			52.2	
Class			C	

The proposed housing development is not about to change the classification of the larger sub-catchment. The development's surface area as a part of the whole is too small to have a significant impact. Unless a mishap such as a major sewage spill happens, but only of the WWTW is upgraded into a much larger plant capable of larger spills.

It can be expected that the classification of the smaller adjacent sub-catchment will be adjusted to a lower class, once the new expansion of the housing takes hold. The question can be asked if it really matters, because there is little if any of the original ecological function left and that not much more can be lost if impacts increase.

15 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 the drainage lines, as there is no permanent water. According to this assessment, which is prescribed for WULA's, the drainage lines are not important. Neither were any other organisms observed during the site visit that could be described as endangered.

Table 7 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)

16 Ecological Sensitivity

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

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

The drainage lines will predictably not recover to anything resembling their original, un-impacted state, despite the housing development being removed. Once developed, it is most unlikely that the houses and streets will ever be removed.

From this perspective, the aquatic environment and its surrounds can be regarded as ecologically sensitive.

17 Possible Impacts

The impacts of the new housing development would be severe on the aquatic environment and surrounds, as all housing development do. The smaller, fainter drainage lines would inevitably make way for streets and houses and the larger more prominent ones will have to be canalised with formal structures to accommodate any flood water during large rainfall events.

18 Mitigation Measures

The footprint of the proposed housing scheme should be kept as small as possible. Construction vehicles and building material should be kept inside of the demarcated development area and not be allowed onto adjacent land.

Loose sediments, rubble and building material should not be allowed to wash down the catchment during rainfall events.

Litter collection systems should be installed in the drainage lines downstream of the new housing scheme. Litter that accumulates here should be regularly collected and disposed of properly on the municipal waste disposal site.

Protection measures should be put in place to conserve those drainage lines of the larger sub-catchment that are relatively untouched and still in a reasonably good state. Trampling by cattle and goats, as well as humans, is always a concern in similar developments.

Leaky sewerage and potable water provision systems can change the arid state of the drainage lines and surrounds. Leaks should be prepared as not to change the status of the aquatic environment.

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 results of the impact assessment are given in Table 8.

Like with most urban developments, the impact on the aquatic environment is definite and severe. In this case mitigation measures are not about to make a difference.

Environmental authorities will have to decide if the little and degraded aquatic habitat that was and probably still is available on the site is worth saving, instead of giving the go-ahead for the proposed development.

It is surmised that the aquatic habitat that consists of already degraded drainage lines do not have adequate conservation value prevent the proposed urban development.

The inefficiency of mitigation should therefore not be a consideration. The best that can be done is to ensure that the near-pristine drainage lines adjacent to the new housing scheme are not impacted.

Table 8 Impact Assessment

Description of impact Clearing of the site Construction of roads Trenching of potable water supply and sewage lines Trenching of electricity supply Construction of houses Landscaping of terrain Removal of vegetation Destruction of aquatic habitat, drainage lines **Mitigation measures** Do not disturb any land outside of designated site Construct outside of rainy season Construct underground storm water system.								
Type Nature	Spatial Extent	Severity	Duration	Significance	Probability	Confidence	Reversibility	Irreplaceability
Without mitigation								
Direct	Local	High	Permanent	High	Definite	Certain	Irreversible	Irreplaceable
With mitigation measures								
Direct	Local	High	Permanent	High	Definite	Certain	Irreversible	Irreplaceable

20 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 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.

Table 9 Risk Matrix

No.	Activity	Aspect	Impact	Significance	Risk Rating
1	Clearing of the site Construction of roads Trenching of potable water supply and sewage lines Trenching of electricity supply Construction of houses Landscaping of terrain	Mobilise sediments	Sediment deposition of downstream drainage lines. Altering of habitat	32,5	Low
2	Hardening of urban surfaces	Alter flow regime	Altering aquatic habitat	45	Low
3.1	Habitation of new housing scheme	Litter	Litter in drainage line	40	Low
3.2		Trampling	Altering of drainage lines	47.5	Low

Table 9 Continued Risk Rating

No	Flow	Water Quality	Habitat	Biota	Severity	Spatial scale	Duration	Conse-quence
1	1	2	1	1	1.25	1	1	3.25
2	2	2	1	1	1.5	1	2	4.5
3.1	1	1	1	1	1	1	2	4
3.2	1	1	3	2	1.75	1	2	4.75

No	Frequency of activity	Frequency of impact	Legal issues	Detection	Likelihood	Significance	Risk Rating
1	2	2	5	1	10	32.5	Low
2	2	2	5	1	10	45	Low
3.1	2	2	5	1	10	40	Low
3.2	2	2	5	1	10	47.5	Low

The following assumptions were made for the completion of the Risk Matrix:

- Since the housing development would destroy aquatic habitat, it would serve no purpose to assess the area that is about to be destroyed. The outcome is predictable. It would inevitably result a “Medium” or “High” rating.
- Moreover, a direct environmental risk will predictably render a rating of high, for which a License is required. To expect the DWS head office in Pretoria to produce a License for each and every small housing development in the country would prove an enormous task, untenable, an impossible situation.
- It is assumed that the decision-making authorities will decide that the sacrifice of the aquatic habitat is permissible for the sake of providing essential housing.
- In this event, at Keimoes, the sacrifice will be small, as the area to be developed forms a miniscule part of the available sub-catchment area.
- The assessment should made provision for the fact that the affected parts of the sub-catchments are already heavily impacted.
- The assessment is best done on the drainage lines and aquatic habitat downstream and adjacent of the proposed housing scheme, as this is the only area that can realistically be assessed, given the nature of most housing developments.
- For the construction phase, the frequency of activity and the frequency of the impact, it can be reasoned that it only once, only during construction, after which it ends.
- It can be reasoned that the diversion of flow only happens during very occasional rainfall events, once in several years, during the operational phase, post-construction, of the development. The impact is permanent and would last in perpetuity. However, the altering of the flow regime will make little if any difference to the downstream PES.

These conditions and assumptions are in a high degree valid for all of the new housing developments in the arid areas in the Northern Cape.

The environmental risk, given these assumptions, came out as “Low”.

Hence, it is recommended that a General Authorization is granted for this proposed housing development. A License is not required.

21 Resource Economics

The goods and services delivered by the environment, in this case the 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 these environments, the goods and services delivered are particularly applicable, hence it was decided to include it in the report.

The diagram (Figure 21 and 22) is an accepted manner to visually illustrate the resource economic footprint the drainage line, from the data in Table 10. The size of the star shape is important. Large star shape will attract the attention of the decision-making authorities.

Table 10. Goods and Services

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

Again, these assessments were carried out for only the drainage lines directly downstream of the proposed housing scheme.

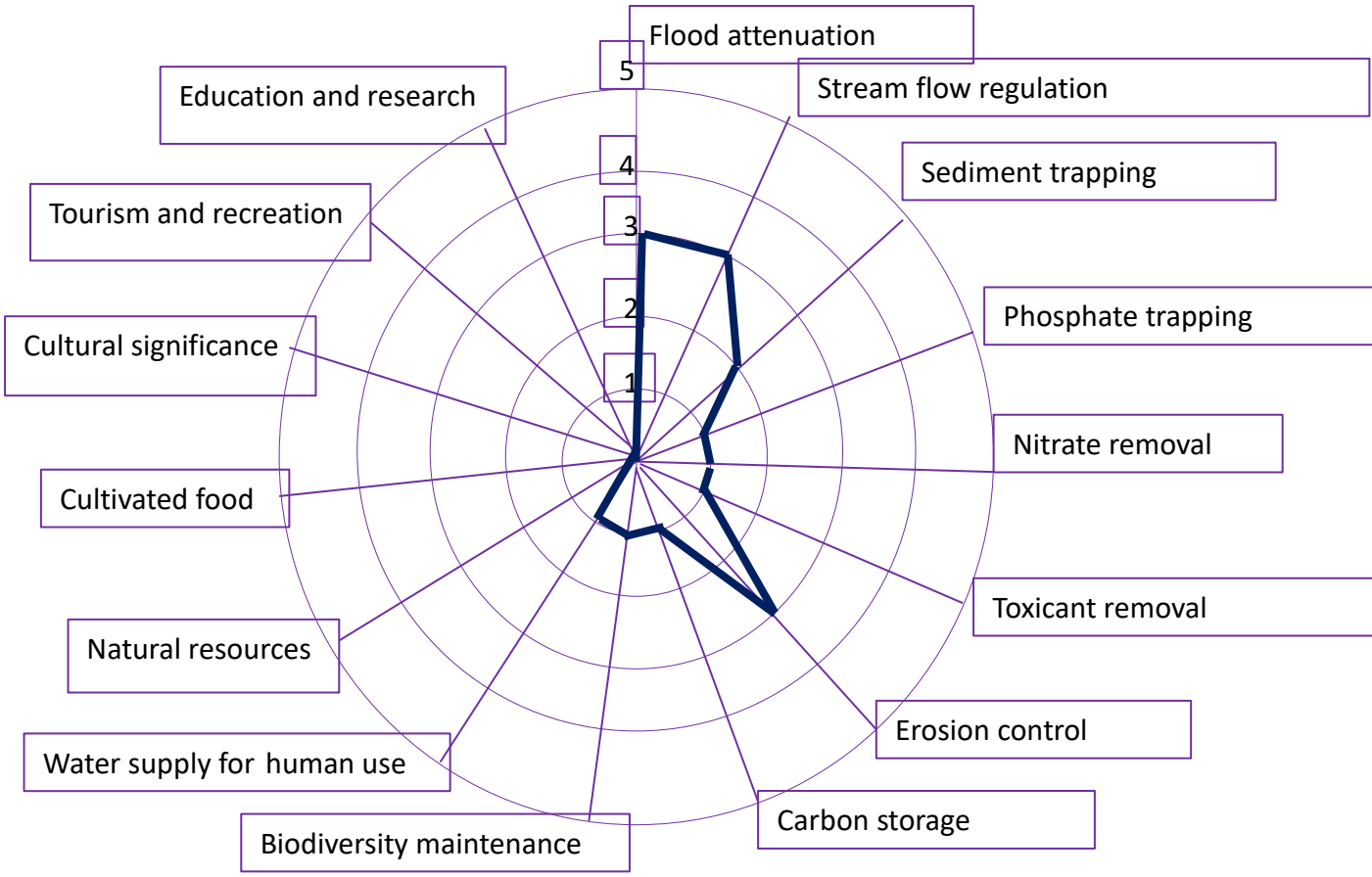


Figure 21. Resource Economics Footprint of the Larger Drainage Lines

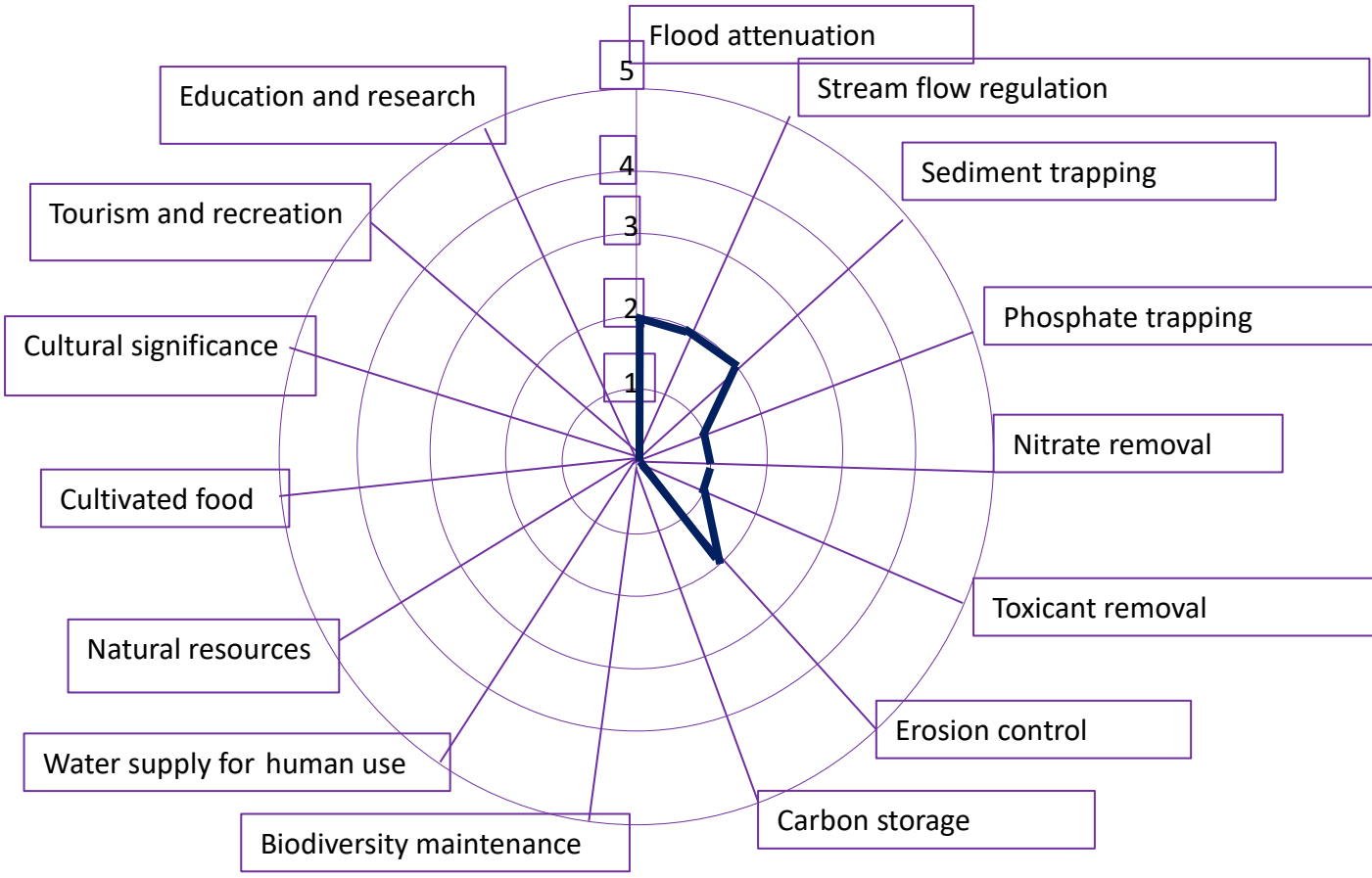


Figure 22. Resource Economics Footprint of the Adjacent Drainage Lines

The star shapes of these spider diagrams are small to very small. The environmental goods and services of the drainage lines are extremely limited. As the houses and streets are constructed, the environmental services will decrease even more.

Not much will be lost in terms of services because of the proposed housing scheme.

22 Conclusions

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

Figure 23 has been adapted from one of the most recent DWS policy documents.

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.

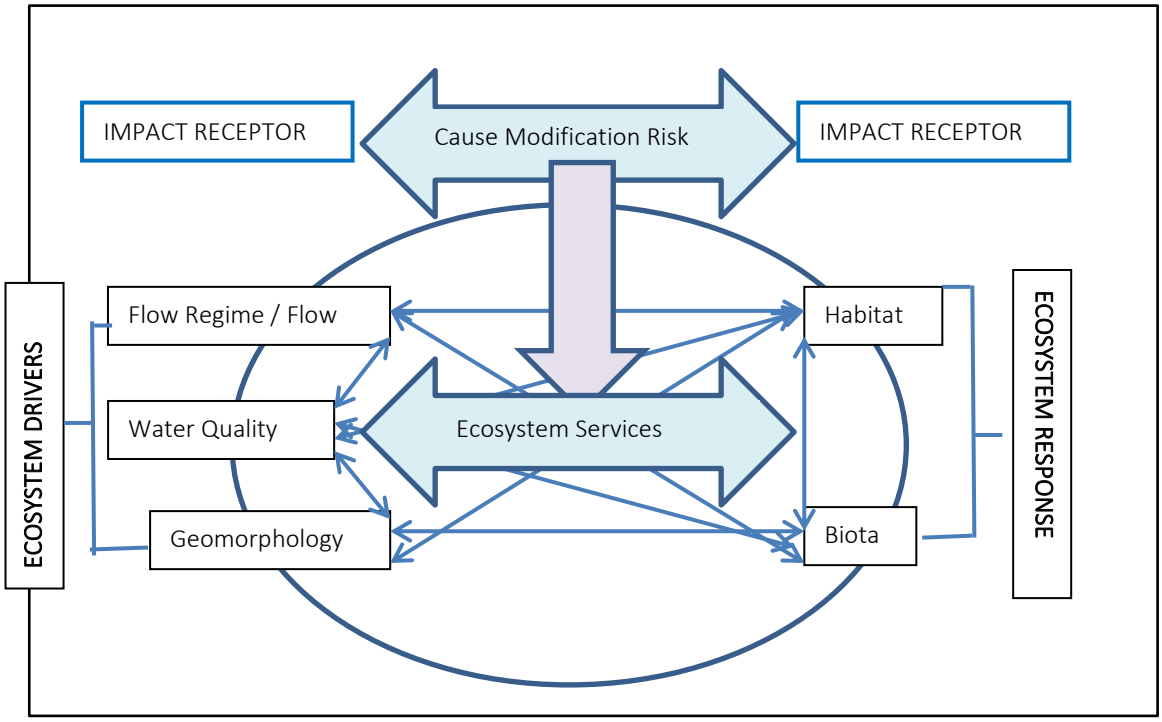


Figure 23 Minimum Requirements for a S21(c) and (i) Application

The proposed urban development will entirely alter the drainage lines. The lines would be replaced with streets and houses. As the aquatic habitat is insignificant, this does not indicate a loss of aquatic ecosystem functioning.

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, or housing schemes, 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.

A General Authorization is the appropriate level of approval for this particular WULA. A License is not called for.

23 References

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

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

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

Mucina, L. & M. Rutherford. 2006. *The Vegetation of South Africa, Lesotho and Swaziland.* Strelitzia 19: 1 – 2019. SANBI, Pretoria

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:  31 January 2020

25 Résumé

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Water Scientist

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Experience

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

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

City of Cape Town **1999-2007**
Acting Head: Scientific Services, Manager: Hydrobiology.

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

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

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

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

Service Positions

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

Membership of Professional Societies

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

Reports

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

- Fresh Water Report Klaarstroom Waste Water Treatment Works
- Fresh Water Report Calvinia Sports Grounds Irrigation
- Fresh Water Report CA Bruwer Agricultural Development Kakamas
- Fresh Water Report Zwartfontein Farm Dam, Hermon
- Statement Delsma Farm Wetland, Hermon
- Fresh Water Report Lemoenshoek Farms Pipelines Barrydale
- Fresh Water Report Water Provision Pipeline Brandvlei
- Fresh Water Report Erf 19992 Upington
- Botanical Report Zwartejongensfontein Sand Mine, Stilbaai
- Fresh Water Report CA Bruwer Feldspath Mine, Kakamas
- Sediment Yield Calculation, Kenhardt Sand Mine
- Wetland Demarcation, Grabouw Traffic Center
- Fresh Water Report, Osdrift Sand Mine, Worcester
- Fresh Water Report, Muggievlag Storm Water Canal, Vredenburg
- Fresh Water Report, Marksman's Nest Rifle Range, Malmesbury
- Fresh Water Report Bruintjiesrivier Farm Dam, Bonnievale

26 Appendix

26.1 Biomonitoring Score Sheet

SASS5 Score Sheet										
Date	08 Feb 19	**Taxon**	**Weight**	**Score**	**Taxon**	**Weight**	**Score**	**Taxon**	**Weight**	**Score**
Locality	Orange River	Porifera	5		**Hemiptera**			**Diptera**		
	Keimoes	Coelenterata	1		Belostomatidae	3		Athericidae	10	
		Turbellaria	3		Corixidae	3		Blepharoceridae	15	
		Oligochaeta	1		Gerridae	5	5	Ceratopogonidae	5	
Coordinates	28°42' 37.12"	Huridinea	3		Hydrometridae	6		Chironomidae	2	
	20°55'07.81"	**Crustacea**			Naucoridae	7	7	Culicidae	1	
		Amphipodae	13		Nepidae	3		Dixidae	10	
DO mg/l	5.8	Potamonautidae	3		Notonectidae	3		Empididae	6	
Temperature °C	27.5	Atyidae	8	8	Pleidae	4		Ephydridae	3	
pH	8.2	Palaemonidae	10		Veliidae	5		Muscidae	1	
EC mS/m	34	Hydracarina	8		**Megaloptera**			Psychodidae	1	
		Plecoptera			Corydalidae	10		Simuliidae	5	
SASS5 Score	51	Notonemouridae	14		Sialidae	8		Syrphidae	1	
Number of Taxa	7	Perlidae	12		**Trichoptera**			Tabanidae	5	
ASPT	7,3	**Ephemeroptera**			Dipseudopsidae	10		Tipulidae	5	
		Baetidae 1 sp	4		Ecnomidae	8		**Gastropoda**		
Other Biota	*Oreochromis*	Baetidae 2 sp	6	6	Hydropsychidae 1 sp	4		Ancylidae	6	
	mossambica	Baetidae >3 sp	12		Hydropsychidae 2 sp	6		Bulinidae	3	
	Cyprinus carpio	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**		
		Teloganodidae	12	12	Glossostomatidae	11		Corbiculidae	5	
		Trichorythidae	9		Hydroptilidae	6		Sphariidae	3	
		Odonata			Hydrosalpingidae	15		Unionidae	6	
		Calopterygidae	10		Leptostomatidae	10				
		Clorocyphidae	10		Leptoceridae	6				
		Chorolestidae	8		Petrothrincidae	11				
		Coenagrionidae	4		Pisulidae	10				
		Lestidae	8		Sericostomatidae	13				
		Platycnemidae	10		**Coleoptera**					
		Protoneuridae	8		Dyticidae	5	5			
		Aesthnidae	8		Elmidae Dryopidae	8				
		Corduliidae	8	8	Gyrinidae	5				
		Gomphidae	6		Haliplidae	5				
		Libellulidae	4		Helodidae	12				
		Lepidoptera			Hydraenidae	8				
		Pyralidae	12		Hydrophilidae	5				
					Limnichidae	10				
					Psephenidae	10				
Score				34			17			0

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 26.2.1 Nature and type of impact

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

Table 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 6 – LEGAL ISSUES

How is the activity governed by legislation?

No legislation
Fully covered by legislation (wetlands are legally governed)
Located within the regulated areas

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

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

TABLE 9: CALCULATIONS

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