Large pools and extensive wetland conditions are also present within the system.

The Karabeeloop has a very wide floodplain dominated by riparian shrubs adapted to high salt concentrations.

Watercourse name:	**Coordinates of sampling:**	**Flow regime:**
#3 Drainage lines – Small watercourses which will be crossed by the grid connection powerline	S 29.725892°, E 22.864091° S 29.717965°, E 22.860993°	Ephemeral

Description of watercourse:

The proposed grid connection powerline will cross over four small drainage lines which form minor tributaries of the Karabeeloop. Two of these were surveyed to serve as representative samples of the description and condition of these small drainage lines. As with the Karabeeloop, these drainage lines do not seem to be affected by any significant impacts and are all fairly natural.

Because these drainage lines are so small, they are also fairly indistinct and do not contain clearly defined channels. They do however form depressions in the landscape, contain riparian vegetation and clearly function in the transport of surface runoff.

As indicated, the grid connection powerline will cross over these drainage lines and will result in at least some disturbance of them. Each of these will be crossed perpendicularly by the powerline and the footprint of disturbance should therefore be small and given the small size of the drainage lines the anticipated impacts should remain fairly low. The powerline construction should however also endeavour to place pylons on either side of these drainage lines and not to place pylons within these drainage lines as this will promote erosion.

Soils within these drainage lines consist of reddish sandy soils and are devoid of any wetland characteristics. Likewise, vegetation along these drainage lines contain a high degree of riparian grasses and dwarf shrubs while terrestrial species may also be abundant. No exotic weeds were noted which confirms the relatively natural condition of these watercourses. Despite being small, these drainage lines contain distinct riparian conditions and must therefore be regarded as watercourses.

Dominant plant species:
Shrub/tree layer: *Pentzia globosa, Galenia africana, Phaeoptilum spinosum*

Riparian grasses: *Eragrostis echinochloidea, Panicum coloratum* (FW), *Chloris virgata.*

Herbaceous species: *Moraea polystachya, Trianthema triquetra.*

Terrestrial species: *Senegalia melifera* subsp. *detinens, Enneapogon cenchroides, Rosenia humilis, Justicia cuneata, Felicia muricata, Enneapogon desvauxii, Geigeria pectidea.*

Protected plant species:
Ammocharis coranica, Orbea cooperi.

Soil sample:

The affected drainage lines are quite small. This specific drainage line does not contain a defined channel (blue) while terrestrial species also dominate.

A larger and somewhat better defined drainage line (blue). Note also more prominent riparian vegetation being visible and with a dense concentration of protected *Ammocharis coranica* (red) in the foreground.

Watercourse name:	**Coordinates of sampling:**	**Flow regime:**
#4 Artificial wetlands – Borrow pit	S 29.802021°, E 22.861753°	Artificial

Description of watercourse:

A historical borrow pit along the north eastern border of the solar development is clearly a manmade excavation which now accumulates surface water during the rainy season. The borrow pit is however completely artificial, does not form part of any surrounding surface water features and is therefore not regarded as forming either a natural watercourse or wetland. Due to the modification of the topography it does contain surface water for some periods which may form artificial wetland conditions though it is not considered to play any role in the surface drainage pattern of the site and is therefore not considered to be of consequence to the development. The borrow pit is simply listed here to confirm that it had been surveyed and confirmed to be of low sensitivity in terms of the development.

View of the historical borrow pit which is clearly manmade.

4.2.6 Condition and importance of the affected wetland

The determination of the condition of the watercourses which will be affected by the solar development will be confined to the stream system situated adjacent to the solar development footprint (Appendix A: Map 2). This will be the main watercourse affected by the development. It also forms a tributary of the Karabeeloop of which all the watercourses affected by the solar development form part of. These watercourses are also located in close proximity to each other, are affected by the same current impacts, situated in the same environmental setting and will all affect the same downstream section of the Orange River. Determining an overall condition of the stream system should therefore give an accurate indication of the condition of all of the watercourses which will be affected by the development. Therefore, one IHI will be conducted for these watercourses to represent the overall condition of the affected stream system, Karabeeloop and smaller drainage lines (Appendix D). This is considered to give a good representation of the condition of the system within the study area as the affected stream, drainage lines and Karabeeloop all drain into the Orange River and will affect the same downstream area. The IHI will be taken as representative of the Present Ecological State (PES) of this system.

Table 3 refers to the determination and categorisation of the Present Ecological State (PES; health or integrity) of various biophysical attributes of rivers relative to the natural or close to the natural reference condition. The purpose of the EcoClassification process is to gain insights and understanding into the causes and sources of the deviation of the PES of biophysical attributes from the reference condition. This provides the information needed to derive desirable and attainable future ecological objectives for the river (Kleynhans & Louw 2007).

Table 4 refers to the Ecological Importance and Sensitivity (EIS) of wetlands. "Ecological importance" of a water resource is an expression of its importance to the maintenance of ecological diversity and functioning on local and wider scales. "Ecological sensitivity" refers to the system's ability to resist disturbance and its capability to recover from disturbance once it has occurred. The Ecological Importance and Sensitivity (EIS) provides a guideline for determination of the Ecological Management Class (EMC).

Table 3: Ecological categories for Present Ecological Status (PES).

Ecolocial Category	Description
A	Unmodified, natural
B	Largely natural with few modifications. A small change in natural habitats and biota may have taken place but the ecosystem functions are essentially unchanged.
C	Moderately modified. Loss and change of natural habitat and biota have occurred, but the basic ecosystem functions are still predominately unchanged.
D	Largely modified. A large loss of natural habitat, biota and basic ecosystem function has occurred.
E	Seriously modified. The loss of natural habitat, biota and basic ecosystem functions is extensive.
F	Critically/Extremely modified. Modifications have reached a critical level and the system has been modified completely with an almost complete loss of natural habitat and biota. In the worst instances the

	basic ecosystem functions have been destroyed and the changes are irreversible.

Table 4: Ecological importance and sensitivity categories.

Ecological Importance and Sensitivity Category (EIS)	Range of Median	Recommended Ecological Management Class
Very High Wetlands that are considered ecologically important and sensitive on a national or even international level. The biodiversity of these wetlands is usually very sensitive to flow and habitat modifications.	>3 and <=4	A
High Wetlands that are considered to be ecologically important and sensitive. The biodiversity of these wetlands may be sensitive to flow and habitat modifications.	>2 and <=3	B
Moderate Wetlands that are considered to be ecologically important and sensitive on a provincial or local scale. The biodiversity of these wetlands is not usually sensitive to flow and habitat modifications.	>1 and <=2	C
Low/marginal Wetlands that are not ecologically important and sensitive at any scale. The biodiversity of these wetlands is ubiquitous and not sensitive to flow and habitat modifications.	>0 and <=1	D

The Karabeeloop has previously been assessed on desktop level (Van Deventer *et al* 2018) and listed as an endangered system with condition of Category C: Moderately Modified. This is however considered to be somewhat underestimated as the current survey has determined the watercourses in the area to be in a somewhat better condition.

The affected stream, associated Karabeeloop and the smaller drainage lines are only affected by a few impacts and which are generally not large impacts. Grazing and browsing by domestic livestock is the most widespread impact but is not considered to have a high impact. This may lead to an increase in bush encroachment by *Senegalia melifera* subsp. *detinens* (Blackthorn). Domestic livestock farming over a long period can cause degradation of the vegetation composition and may in some instances lead to a decrease in diversity and modification of the vegetation structure. In this instance, the vegetation is dominated by the shrub/small tree, *Senegalia melifera* subsp. *detinens* (Black Thorn). This species is well-known to proliferate in overgrazed areas and can become problematic. In the study area it is considered a natural and characteristic element of the vegetation type although a moderate proliferation caused by livestock overgrazing is considered likely. Domestic livestock are also known to concentrate around watering points, and where surface water may be present along the larger streams, this leads to an increase in trampling. The watercourses in the area were however not noted to contain high levels of trampling which is still considered as only moderate overall and this is not currently causing any significant modification or degradation of these systems. The study area contains a network of dirt tracks while the N10 National Road as well as a railway track cross over several of these watercourses. These act as flow barriers and alter the flow regime of the watercourses. They also alter the bed and banks to a low degree and act as sediment and

nutrient traps. This is considered one of the more substantial impacts on these watercourses. The stream adjacent to the solar development contains a small earthen impoundment which will have some impact on the flow and flooding regime but not to a large extent. The Karabeeloop contains numerous of these earthen berms and will have a somewhat larger effect on the flow and flooding regime of this watercourse.

From the above it should be evident that the stream system adjacent to the development is affected by several impacts but which all are of low magnitude. In combination they will have some effect on the stream though overall the system is still considered to be largely natural.

The stream system adjacent to the solar development as well as the Karabeeloop and smaller drainage lines being affected by the powerline is considered to be affected by relatively few impacts and consequently still in a relatively natural condition. The most widespread impact associated with the landuse is overgrazing, -browsing and trampling by livestock though this is not considered a high impact. An Index of Habitat Integrity (IHI) was conducted for these watercourses within the study area (Appendix D). The results of the IHI indicated that the stream system has an Instream IHI of category B: Largely Natural and Riparian IHI of Category B: Largely Natural. This is considered accurate since the stream is located entirety in a natural area with few impacts.

The EI&S of the floodplains associated with the ephemeral stream and associated tributaries has been rated as being Moderate: Wetlands that are considered to be ecologically important and sensitive on a provincial or local scale. The biodiversity of these wetlands is not usually sensitive to flow and habitat modifications.

4.4 Risk Assessment Matrix

A Risk Assessment for the proposed solar facility as well as the grid connection powerline which will affect the adjacent stream system, Karabeeloop and associated drainage lines have been undertaken according to the Department of Water & Sanitation's requirements for risk assessment and the provisional Risk Assessment Matrix for Section 21(c) & (i) water use (Appendix E). Aspects of the development that may have an impact on the surface water features of the site include, impacts of the solar development on the stream system adjacent to it and impacts that the powerline will have where it crosses over the Karabeeloop and drainage lines.

The stream system situated adjacent to the solar development is still a largely natural system and therefore regarded to have a high conservation value (Appendix A: Map 2). The proposed development should therefore not contribute any new impacts to it or modify it in any significant way. The stream system should therefore be completely excluded from the development and should not encroach into the riparian zone of the stream as delineated. The stream and associated riparian zone should also be regarded as no-go areas and no construction or operational activities including stockpiling, clearing, laydown areas, vehicle movement or any other associated activities should occur in or near this stream system. As long as this is implemented successfully, the anticipated risk on the stream should remain low. Furthermore, although it should not be directly affected, it may however still be indirectly affected by the development, most probably as a result of increased runoff from the panels and an increased sediment load. Erosion is therefore also probable. The development will therefore have to design and implement a comprehensive storm water management system in order to manage runoff and prevent erosion which will affect the stream system.

The proposed gird connection powerline will also cross over several small drainage lines and construction is likely to have some impact on these systems (Appendix A: Map 1). The powerline will cross these watercourses perpendicularly which will minimise the disturbance footprint. The powerline alignment should also endeavour to place pylons on either side of the drainage lines and not within the channel as this will increase erosion. Given the small size of these drainage lines and the low anticipated impact of the powerline, the risk is anticipated to remain low.

According to the current powerline alignment a large portion of it (Approximately 3 km section) will be situated within the main channel of the Karabeeloop and as can be expected this will result in significant disturbance of the stream (Appendix A: Map 1). Construction and pylons in the main channel is also likely to cause significant scouring and erosion of the stream. As a result, this will be regarded as a moderate risk and will consequently require significant mitigation. Re-alignment of the powerline should also be considered which should aim to perpendicularly cross the Karabeeloop only once and should not be located parallel within the main channel (Appendix A: Map 1). This will minimise the anticipated impacts of the powerline and should such an alignment be taken the risk is anticipated to be considerably lower. This is also subject to the powerline avoiding the placement of pylons directly within the main channel of this watercourse.

Low Risks: Acceptable as is or consider requirement for mitigation. Impact to watercourses and resource quality small and easily mitigated.

Moderate Risks: Risk and impact on watercourses are notable and require mitigation measures on a higher level.

Mitigation as recommended as well as any additional mitigation recommended by other specialist studies should be implemented in order to alleviate the risks on the stream system adjacent to the solar development as well as any impacts caused by the proposed powerline.

For the complete risk assessment please refer to Appendix E.

No.	Phases	Activity	Aspect	Impact	Risk Rating	Confidence level	Control measures
1	Mostly Construction Phase but also during operation	Construction of a solar facility.	A stream system situated adjacent to the solar footprint may be affected by the proposed development	The construction of the facility may encroach into the stream or riparian zone which will directly affect or may also impact on the catchment of the stream which will then have an indirect impact on it.	L	80	Provided that the solar footprint does not encroach into the stream or riparian zone and these areas are treated as no-go areas, the anticipated risk should remain low. The development may however still have an indirect impact in terms of runoff and erosion and a comprehensive storm water management system in order to manage runoff and prevent erosion which will affect the stream system.
	Mostly Construction Phase but also during operation	Grid connection powerline.	Several small drainage lines will be crossed perpendicularly by the powerline.	The construction of the powerline may result in disturbance of the drainage lines.	L	80	The powerline will cross these drainage lines perpendicularly which will minimise the disturbance footprint. The powerline alignment should also endeavour to place pylons on either side of the drainage lines and not within the channel as this will increase erosion. Given the small size of these drainage lines and the low anticipated impact of the powerline, the risk is anticipated to remain low.
	Mostly Construction Phase but also during operation	Grid connection powerline.	The current powerline alignment will occur within a long section of the main	Placement of the powerline parallel and within the main channel of the Karabeeloop will result in significant impacts in terms of	M	80	Should the alignment of the powerline be placed within the main channel of the Karabeeloop for a distance of about 3 km, it will result in significant disturbance which will entail a

			channel of the Karabeeloop.	construction disturbance, erosion and scouring.			moderate risk and will require significant mitigation.
	Mostly Construction Phase but also during operation	Grid connection powerline.	Re-alignment of the powerline should be considered in order to cross the Karabeeloop only once and perpendicularly.	Re-alignment of the powerline in order to cross the Karabeeloop only once and perpendicularly will decrease the disturbance footprint and therefore decrease the anticipated impact.	L	80	Should the re-alignment of the powerline be possible in order to cross the Karabeeloop only once and perpendicularly will minimise the anticipated impacts of the powerline and should such an alignment be taken the risk is anticipated to be considerably lower. This is also subject to the powerline avoiding the placement of pylons directly within the main channel of this watercourse.

5. Biodiversity Sensitivity Rating (BSR)

Habitat diversity and species richness:
Habitat diversity over the entire development area is considered as moderate. The solar footprint is fairly uniform though surrounding watercourses and varying topography along the powerline route significantly increases the habitat diversity. Furthermore, watercourses, especially the Karabeeloop, also provide unique habitats able to sustain a higher bio-load and therefore increase habitat diversity. Given the moderate habitat diversity, the species diversity was also moderate overall.

Presence of rare and endangered species:
The survey of the area did not indicate a high proportion of protected plant species. However, several protected species were observed which do retain a significant conservation value. Although none are considered to be in imminent danger of extinction a few are considered to be somewhat rare and uncommon and therefore also of high conservation value.

Observed protected species in the study area included (Appendix B): *Ammocharis coranica, Boscia albitrunca, Nerine laticoma, Oxalis haedulipes, Orbea cooperi, Hoodia officinalis, Piaranthus cornutus* subsp. *cornutus* and *Hoodia gordonii*.

The majority of these species are relatively widespread and common and therefore not of exceptionally high conservation value. However, as protected species all of them still retain some conservation significance.

Ecological function:
The ecological functioning and condition of watercourses in the study area is still largely intact and natural and therefore in a good condition. They also play a vital role in the continued functioning in terms of water transport and drainage of the area (Appendix A: Map 1 & 2). The habitat provided by the watercourses and associated habitats support a rich faunal component and is considered to perform an important ecological function in this regard. These watercourses will therefore provide several vital services including water transportation, flood dissipation, wetland and riparian habitat and support of ecological processes. The stream system adjacent to the solar footprint, the Karabeeloop and all affected drainage lines should therefore be regarded as having a very high sensitivity with a high conservation value. As these watercourses are also direct tributaries of the Orange River near the site they will also increase the resilience of this river and alleviate any impacts on it and this will even further increase their importance.

The terrestrial component of the study area also performs several ecological functions. The study area functions in the support of a natural vegetation type, which in turn sustains a specific faunal community and acts as part of the catchment of surrounding watercourses. Being of natural and unmodified composition these functions are still considered to be intact.

Degree of rarity/conservation value:
According to Mucina & Rutherford (2006) the area consists of Northern Upper Karoo (NKu 3) and Bushmanland Arid Grassland (Aza 4). These vegetation types are currently listed as being of Least Concern (LC) within the National List of Threatened Ecosystems (Notice 1477 of 2009) (National Environmental Management Biodiversity Act, 2004). They are not currently subjected to any pronounced development pressures.

The Northern Cape Critical Biodiversity Areas Plan (2016) has recently been published and has identified areas which are essential to meeting conservation targets for specific vegetation types, i.e., Critical Biodiversity Areas. The solar footprint and majority of the powerline route is listed as an Ecological Support Area (ESA) as it supports the functioning of the surrounding watercourses and wetlands.

Numerous protected species were observed in the study area (Appendix B). However, though some are Red Listed and considered rare the majority is widespread and relatively common. The conservation value is nonetheless still considered as high.

Percentage ground cover:
The region is in an arid area with a low annual rainfall. As a result, the percentage ground cover is only considered as moderate. This is natural to the area and is considered largely unchanged by any significant anthropogenic impacts. Although grazing by domestic stock takes place it is not considered to lead to a significant change in percentage ground cover.

Vegetation structure:
The study area is situated within the Nama Karoo Biome. A well-developed grass layer is present with a prominent dwarf karroid shrub component also being present. However, the small tree, *Senegalia melifera* subsp. *detinens* dominates the vegetation. This species is well-known to proliferate in overgrazed areas and can become problematic. In the study area it is considered a natural and characteristic element of the vegetation type although a moderate proliferation caused by livestock overgrazing is considered likely.

Infestation with exotic weeds and invader plants:
The majority of the study area has almost no occurrence of any exotic species (Appendix B). This is mostly attributed to the almost natural condition of the vegetation.

Degree of grazing/browsing impact:
The study area is mostly being utilised as grazing by domestic stock but does not cause any significant alteration or impacts of the natural vegetation and is therefore considered relatively low.

Signs of erosion:
Signs of erosion are abundant along the watercourses in the study area. This is all considered part of the natural landscape and not affected by anthropogenic impacts. However, where dirt tracks ascend slopes or cross over the watercourses a moderate amount of erosion is visible.

Terrestrial animals:
As the development area consist of natural vegetation in relatively good condition and being utilised almost exclusively for stock farming the study area contains a varied faunal population with relatively high density. Being situated in an arid area the carrying capacity will be somewhat lower. From available literature of species likely to occur in the region it is clear that numerous Red Listed species occur and is likely to occur in the study area. The mammal population on the site therefore has a high conservation value.

Table 5: Biodiversity Sensitivity Rating for the Wonderpan solar development.

	Low (3)	Medium (2)	High (1)
Vegetation characteristics			
Habitat diversity & Species richness		2	
Presence of rare and endangered species		2	
Ecological function			1
Uniqueness/conservation value			1
Vegetation condition			
Percentage ground cover			1
Vegetation structure		2	
Infestation with exotic weeds and invader plants or encroachers			1
Degree of grazing/browsing impact			1
Signs of erosion		2	
Terrestrial animal characteristics			
Presence of rare and endangered species			1
Sub total	0	8	6
Total		14	

6. Biodiversity Sensitivity Rating (BSR) interpretation

Table 6: Interpretation of Biodiversity Sensitivity Rating.

Site	Score	Site Preference Rating	Value
Wonderpan solar development	14	Good condition	2

7. Discussion and conclusions (Appendix A: Map 1 & 2)

The proposed development area has been rated as being in a relatively good condition. This is mostly as a result of the area still consisting of natural vegetation while also containing sensitive elements such as unique ephemeral watercourses and several protected plant species.

The proposed solar development is situated on the Farm Karabee 50, Portion 4 while a powerline will also connect to a northern solar facility and will cross over Portion 2 and 8 of the same farm (Appendix A: Map 1). This area is situated approximately 15 km to the south of the town of Prieska. The development will consist of a PV solar development with extent of 134 hectares with grid connection powerline with length of approximately 10 km. The area contains a multitude of watercourses ranging from small indistinct drainage lines to larger seasonal streams. The site itself contains no watercourses but will border along the north west on a small stream system (Appendix A: Map 2). The powerline will also cross over several watercourses of which the Karabeeloop forms a large stream system with prominent wetland areas (Appendix A: Map 1).

According to Mucina & Rutherford (2006) the area consists of Northern Upper Karoo (NKu 3) and Bushmanland Arid Grassland (Aza 4). These vegetation types are currently listed as being of Least Concern (LC) within the National List of Threatened Ecosystems (Notice 1477 of 2009) (National Environmental Management Biodiversity Act, 2004). The Northern Cape Critical Biodiversity Areas Plan (2016) has recently been published and has identified areas which are essential to meeting conservation targets for specific vegetation types, i.e., Critical Biodiversity Areas. The solar footprint and majority of the powerline route is listed as an Ecological Support Area (ESA) as it supports the functioning of the surrounding watercourses and wetlands.

The topography is dominated by fairly flat plains but with interspersed low hills and ridges. These hills and ridges are also associated with the watercourses in the area and uneven terrain and also increase along the Karabeeloop watercourses which is a fairly large system.

The study area still consists almost exclusively of natural vegetation without any significant transformation (Appendix A: Map 1). It is currently utilised for grazing by domestic livestock and consequently the only impacts are associated with this and include dirt tracks, tarred road, railway line, fencelines, a homestead and associated disturbances and stock watering points with local disturbance. This should clearly indicate that the area is largely natural with few impacts.

The surface water features in this area is dominated by the Karabeeloop which is a large stream system but will only be affected by the proposed grid connection powerline where this line will be constructed in the watercourse (Appendix A: Map 1). A smaller but still fairly significant tributary of the Karabeeloop occurs adjacent to the PV solar footprint and will most likely be affected by it (Appendix A: Map 2). A few smaller drainage lines will also be crossed by the powerline and will also be assessed in overview. The Karabeeloop will most likely contain some surface water during the rainy season while the smaller tributary adjacent to the PV solar site and those being crossed by the powerline are all ephemeral, i.e. they will only flow during times of high rainfall. Flood debris within these watercourses does however indicate that flash floods do occur from time to time. All of these watercourses contain prominent riparian vegetation while wetland areas are uncommon but still present in some areas. The Karabeeloop does however contain quite extensive wetland areas.

The watercourses in the study area do contain prominent riparian conditions while wetland conditions are absent from the small drainage lines, only present in patches within the larger

tributary adjacent to the site, while the Karabeeloop contain prominent wetland conditions within its main channel. This was also confirmed by using obligate riparian vegetation which are confined to watercourses in this arid region and obligate wetland species which are confined to wetlands and cannot occur in conditions outside of these systems. As a result, where they occur, wetland conditions can be considered to occur.

Where the tributary watercourse adjacent to the site contains some wetland conditions as well as the main channel of the Karabeeloop which contains quite prominent wetland conditions these systems can be classified into a specific wetland type. The tributary adjacent to the site as well as the Karabeeloop in the study area can mostly be characterised as channel systems (SANBI 2009). This accurately described those areas containing wetland conditions where these saturated conditions occur only within patches or within the main channel of these system and are clearly absent from the banks, floodplain and riparian zone.

The study area contains the tributary stream adjacent to the PV solar footprint and the Karabeeloop and smaller drainage lines being crossed by the grid connection powerline (Appendix A: Map 1 & 2). A short description of each of these has also been given (Table 2 & 7). The small drainage lines will be combined as a whole to serve as representative of the system.

Table 7: Summary of watercourses and wetlands in the study area and the location of survey sites (Appendix A: Map 1 & 2).

Watercourse	Position of survey
#1 Ephemeral Stream – Adjacent to the PV Solar footprint and forms tributary of the Karabeeloop	S 29.806837°, E 22.850461° S 29.798267°, E 22.852635° S 29.794004°, E 22.854021°
#2 Karabeeloop – Large stream system which will be affected by the grid connection powerline	S 29.766969°, E 22.880342° S 29.751511°, E 22.874572° S 29.723147°, E 22.855339°
#3 Drainage lines – Small watercourses which will be crossed by the grid connection powerline	S 29.725892°, E 22.864091° S 29.717965°, E 22.860993°
#4 Artificial wetlands – Borrow pit	S 29.802021°, E 22.861753°

The stream system adjacent to the solar footprint may not the largest watercourse in the area, though it will be the main watercourses being affected by the PV solar development (Appendix A: Map 2). The stream system is situated along the western border of the solar footprint and a 2 km section of the stream will likely be affected by the development. The stream is a tributary of the Karabeeloop and flows into it approximately 4 km to the east of the solar footprint. It is notable that over its entire course it is affected by almost no impacts apart from a few small road crossings and farming activities associated with domestic livestock. It is therefore almost completely natural and unmodified. The stream forms the low point in the landscape and forms a shallow valley. It contains a substantial floodplain and the entire valley bottom consists of alluvial sand deposits. A defined channel is generally poorly defined and represented by shallow channels in the valley bottom. It discharges by flash floods which contains substantial volumes but which are fast flowing, draining away within a short period.

The affected stream, associated Karabeeloop and the smaller drainage lines are only affected by a few impacts and which are generally not large impacts. Grazing and browsing by domestic livestock is the most widespread impact but is not considered to have a high impact. The study area contains a network of dirt tracks while the N10 National Road as well as a railway track

cross over several of these watercourses. These act as flow barriers and alter the flow regime of the watercourses. They also alter the bed and banks to a low degree and act as sediment and nutrient traps. This is considered one of the more substantial impacts on these watercourses. The stream adjacent to the solar development contains a small earthen impoundment which will have some impact on the flow and flooding regime but not to a large extent. The Karabeeloop contains numerous of these earthen berms and will have a somewhat larger effect on the flow and flooding regime of this watercourse. An Index of Habitat Integrity (IHI) was conducted for these watercourses within the study area (Appendix D). The results of the IHI indicated that the stream system has an Instream IHI of category B: Largely Natural and Riparian IHI of Category B: Largely Natural. This is considered accurate since the stream is located entirety in a natural area with few impacts. The EI&S of the floodplains associated with the ephemeral stream and associated tributaries has been rated as being Moderate.

A Risk Assessment for the proposed solar facility as well as the grid connection powerline which will affect the adjacent stream system, Karabeeloop and associated drainage lines have been undertaken according to the Department of Water & Sanitation's requirements for risk assessment and the provisional Risk Assessment Matrix for Section 21(c) & (i) water use (Appendix E).

The stream system situated adjacent to the solar development is still a largely natural system and therefore regarded to have a high conservation value (Appendix A: Map 2). The stream system should therefore be completely excluded from the development and should not encroach into the riparian zone of the stream as delineated. The stream and associated riparian zone should also be regarded as no-go areas and no construction or operational activities including stockpiling, clearing, laydown areas, vehicle movement or any other associated activities should occur in or near this stream system. As long as this is implemented successfully, the anticipated risk on the stream should remain low. Furthermore, although it should not be directly affected, it may however still be indirectly affected by the development, most probably as a result of increased runoff from the panels and an increased sediment load. Erosion is therefore also probable. The development will therefore have to design and implement a comprehensive storm water management system in order to manage runoff and prevent erosion which will affect the stream system.

The proposed gird connection powerline will also cross over several small drainage lines and construction is likely to have some impact on these systems (Appendix A: Map 1). The powerline will cross these watercourses perpendicularly which will minimise the disturbance footprint. The powerline alignment should also endeavour to place pylons on either side of the drainage lines and not within the channel as this will increase erosion. Given the small size of these drainage lines and the low anticipated impact of the powerline, the risk is anticipated to remain low.

According to the current powerline alignment a large portion of it (Approximately 3 km section) will be situated within the main channel of the Karabeeloop and as can be expected this will result in significant disturbance of the stream (Appendix A: Map 1). Construction and pylons in the main channel is also likely to cause significant scouring and erosion of the stream. As a result, this will be regarded as a moderate risk and will consequently require significant mitigation. Re-alignment of the powerline should also be considered which should aim to perpendicularly cross the Karabeeloop only once and should not be located parallel within the main channel (Appendix A: Map 1). This will minimise the anticipated impacts of the powerline and should such an alignment be taken the risk is anticipated to be considerably lower. This is also subject to the powerline avoiding the placement of pylons directly within the main channel of this watercourse.

8. Recommendations

- The following recommendations and mitigation measures should be implemented in order to manage impacts on the stream system adjacent to the solar footprint as well as areas where the grid connection powerline will cross over watercourses (Appendix A: Map 1 & 2):
    - The stream system including the riparian zone as delineated situated adjacent to the solar footprint should be completely excluded from the development footprint in order to ensure no impacts on it occur (Appendix A: Map 2).
    - The stream system and associated riparian zone adjacent to the site should be regarded as no-go areas and no construction or operational activities including stockpiling, clearing, laydown areas, vehicle movement or any other associated activities should occur in or near this stream system.
    - The development should design and implement a comprehensive storm water management system in order to manage runoff and prevent erosion which will affect the stream system.
    - The storm water management system should include design of erosion prevention structures such as soakaways, attenuation areas and dissipation structures.
    - The re-alignment of the grid connection powerline should be considered which should aim to perpendicularly cross the Karabeeloop only once and should not be located parallel within the main channel (Appendix A: Map 1).
    - The powerline alignment should also endeavour to place pylons on either side of the watercourses being crossed and not within the channel as this will increase erosion.
    - All structures and mitigation measures should be maintained throughout the lifetime of the development.
    - It will be important to implement a monitoring programme so that any changes to the surrounding watercourses can be identified quickly before it leads to irreversible changes. This monitoring programme should include, at least during the construction phase, a bi-annual biomonitoring of the affected watercourses. This should be conducted by a suitable qualified wetland specialist.
    - The necessary authorisations should be obtained from the Department of Water and Sanitation (DWS).

- Where the grid connection powerline will cross over watercourses and cause disturbance during construction, the following additional mitigation measures should be implemented (Appendix A: Map 1):
    - After the powerline has been constructed any disturbance that has been caused to watercourses should be rehabilitated. Any disturbance of the banks and bed should be kept to a minimum and erosion remediated where it occurs. Removal of vegetation should also be kept to a minimum.
    - Where the construction of the powerline will occur within watercourses this should be undertaken as far as possible during the winter months when flooding is least possible (June to September). The survey of the area indicates that the watercourses drain by means of flash floods after heavy rainfall and which will severely hamper construction and may also result in further disturbance of the watercourse where construction materials are washed downstream. This also

substantiates the need to complete construction during the winter months when floods are unlikely to occur.

- Adequate monitoring of weed establishment and their continued eradication must be maintained (Appendix B). Where category 1 and 2 weeds occur, they require removal by the property owner according to the Conservation of Agricultural Resources Act, No. 43 of 1983 and National Environmental Management: Biodiversity Act, No. 10 of 2004.

- No littering must be allowed and all litter must be removed from the site.

- Construction should be confined to the site footprint and should not encroach into adjacent areas.

- After construction has ceased all construction waste should be removed from the area.

- Monitoring of construction including weed establishment and erosion should take place.

9. References

Bromilow, C. 1995. Problem Plants of South Africa. Briza Publications CC, Cape Town.

Bromilow, C. 2010. Problem plants and alien weeds of South Africa. Briza Publications CC, Cape Town.

Coates-Palgrave, M. 2002. Keith Coate-Palgrave Trees of Southern Africa, edn 3, imp. 4 Random House Struik (Pty.) Ltd, Cape Town.

Collins, N.B. 2005. Wetlands: The basics and some more. Free State Department of Tourism, Environmental and Economic Affairs.

Conservation of Agricultural Resources Act, 1983 (ACT No. 43 OF 1983) Department of Agriculture.

Department of Water Affairs and Forestry. 2005. A practical field procedure for identification and delineation of wetlands and riparian areas. Edition 1. Department of Water Affairs and Forestry, Pretoria.

Duthie, A. 1999. Appendix W5: IER (floodplain and wetlands) determining the Ecological Importance and Sensitivity (EIS) and Ecological Management Class (EMC). In: MacKay (Ed.), H. Resource directed measures for protection of water resources: wetland ecosystems. Department of Water Affairs and Forestry, Pretoria.

DWAF. 2008. Updated manual for the identification and delineation of wetlands and riparian areas, prepared by M.Rountree, A.L. Batchelor, J. MacKenzie and D. Hoare. Stream Flow Reduction Activities, Department of Water Affairs and Forestry, Pretoria, South Africa.

Fish, L., Mashau, A.C., Moeaha, M.J. & Nembudani, M.T. 2015. Identification guide to the southern African grasses. An identification manual with keys, descriptions and distributions. *Strelitzia* 36. South African National Biodiversity Institute, Pretoria.

Gerber, A., Cilliers, C.J., Van Ginkel, C. & Glen, R. 2004. Easy identification of aquatic plants. Department of Water Affairs, Pretoria.

Government of South Africa. 2008. National Protected Area Expansion Strategy for South Africa 2008: Priorities for expanding the protected area network for ecological sustainability and climate change adaptation. Government of South Africa, Pretoria.

Germishuizen, G. & Meyer, N.L. (eds) 2003. Plants of Southern Africa: an annotated checklist. *Strelitzia* 14. National Botanical Institute, Pretoria.

Gibbs Russell, G.E., Watson, L., Koekemoer, M., Smook, L., Barker, N.P., Anderson, H.M. & Dallwitz, M.J. 1990. Grasses of Southern Africa. Memoirs of the Botanical Survey of South Africa No. 58. Botanical Research Institute, South Africa.

Griffiths, C., Day, J. & Picker, M. 2015. Freshwater Life: A field guide to the plants and animals of southern Africa. Penguin Random House South Africa (Pty) Ltd, Cape Town.

Hughes, D.A. 2008. Hydrological information requirements and methods to support the determination of environmental water requirements in ephemeral river systems, WRC Report No. KV 205/08. Water Research Commission, Gezina.

Jacobson, P.J. 1997. An ephemeral perspective of fluvial ecosystems: viewing ephemeral rivers in the context of current lotic ecology. Dissertation submitted to the Faculty of the Virginia Polytechnic Institute and State University in partial fulfilment of the requirements for the degree of Doctor of Philosophy in Biology. Blacksburg. Virginia.

Kleynhans, N. & Louw, D. 1999. The issues around environmental flows in semi-arid regions. Convention on Biodiversity.

Kleynhans, C.J. 2000. Desktop estimates of the ecological importance and sensitivity categories (EISC), default ecological management classes (DEMC), present ecological status categories (PESC), present attainable ecological management classes (present AEMC), and best attainable ecological management class (best AEMC) for quaternary catchments in South Africa. DWAF report, Institute for Water Quality Studies, Pretoria, South Africa.

Kleynhans, C.J. & Louw, M.D. 2007. Module A: EcoClassification and EcoStatus determination in River EcoClassification: Manual for EcoStatus Determination (version 2). Joint water Research Commission and Department of Water Affairs and Forestry report. WRC Report No. TT 329/08.

Le Maitre, D.C., Seyler, H., Holland, M., Smith-Adao, L., Nel, J.L., Maherry, A. and Witthüser, K. (2018) Identification, Delineation and Importance of the Strategic Water Source Areas of South Africa, Lesotho and Swaziland for Surface Water and Groundwater. Report No. TT 743/1/18, Water Research Commission, Pretoria.

Manning, J. 2009. Field Guide to Wild Flowers. Struik Nature, Cape Town.

Marnewecke, G. & Kotze, D. 1999. Appendix W6: Guidelines for delineation of wetland boundary and wetland zones. In: MacKay (Ed.), H. Resource directed measures for protection of water resources: wetland ecosystems. Department of Water Affairs and Forestry, Pretoria.

Mucina, L. & Rutherford, M.C. (eds.) 2006. The Vegetation of South Africa, Lesotho and Swaziland. *Strelitzia* 19.South African National Biodiversity Institute, Pretoria.

National Environmental Management: Biodiversity Act (10/2004): National list of ecosystems that are threatened and in need of protection. Government Notice 1002 of 2011, Department of Environmental Affairs.

National Water Act (Act No. 36 of 1998). Republic of South Africa.

Nel, J.L., Murray, K.M., Maherry, A.M., Petersen, C.P., Roux, D.J., Driver, A., Hill, L., Van Deventer, H., Funke, N., Swartz, E.R., Smith-Adao, L.B., Mbona, N., Downsborough, L. and Nienaber, S. (2011). Technical Report for the National Freshwater Ecosystem Priority Areas project. WRC Report No. K5/1801.

Ollis, D.J., Snaddon, C.D., Job, N.M. & Mbona, N. 2013. Classification System for Wetlands and other Aquatic Ecosystems in South Africa. User Manual: Inland Systems. *SANBI Biodiversity Series 22*. South African National Biodiversity Institute, Pretoria.

Raymondo, D. Van Staden, L. Foden, W. Victor, J.E. Helme, N.A. Turner, R.C. Kamundi, D.A. Manyama, P.A. (eds.) 2009. Red List of South African Plants. *Strelitzia* 25. South African National Biodiversity Institute, Pretoria.
Roberts, B.R. & Fourie, J.H. 1975. Common grasses of the Northern Cape. Northern Cape Livestock Co-Operative Limited, Vryburg.

SANBI. 2009. Further Development of a Proposed National Wetland Classification System for South Africa. Primary Project Report. Prepared by the Freshwater Consulting Group (FCG) for the South African National Biodiversity Institute (SANBI).

Shearing, D. & Van Heerden, K. 2008. Karoo: South African wild flower guide 6. Botanical Society of South Africa, Cape Town.

Smith, G.F., Chesselet, P., Van Jaarsveld, E., Hartmann, H., Van Wyk, B.E., Burgoyne, P., Klak, C. & Kurzweil, H. 1998. Mesembs of the World. Briza Publications, Pretoria.

Smith, G.F. & Crouch, N.R. 2009. Guide to succulents of Southern Africa. Random House Struik (Pty) Ltd, Cape Town.

Strahler, A.N. 1952. Hypsometric (area-altitude) analysis of erosional topology. *Geological Society of American Bulletin* 63 (11): 1117-1142.

Stromberg, J.C., Lite, S.J. & Dixon, M.D. 2010. Effects of stream flow patterns on riparian vegetation of a semiarid river: implications for a changing climate. *River Research and Applications* 26(6): 712-729.

Uys, M.C. & Keeffe, J.H.O. 1997. Simple words and fuzzy zones: early directions for temporary river research in South Africa. *Environmental Management* 21(4): 517- 531

Van Coller, A.L., Rogers, K.H. & Heritage, G.L. 1997. Linking riparian vegetation types and fluvial geomorphology along the Sabie River within the Kruger National Park, South Africa. *African Journal of Ecology* 35: 194-212.

Van Deventer, H.; Smith-Adao, L.; Mbona, N.; Petersen, C.; Skowno, A.; Collins, N.B.; Grenfell, M.; Job, N.; Lötter, M.; Ollis, D.; Scherman, P.; Sieben, E.; Snaddon, K. 2018. South African Inventory of Inland Aquatic Ecosystems (SAIIAE). Version 2, released on 2018/11/06. South African National Biodiversity Institute, Pretoria. Report Number: CSIR report number CSIR/NRE/ECOS/IR/2018/0001/A; SANBI report number http://hdl.handle.net/20.500.12143/5847.

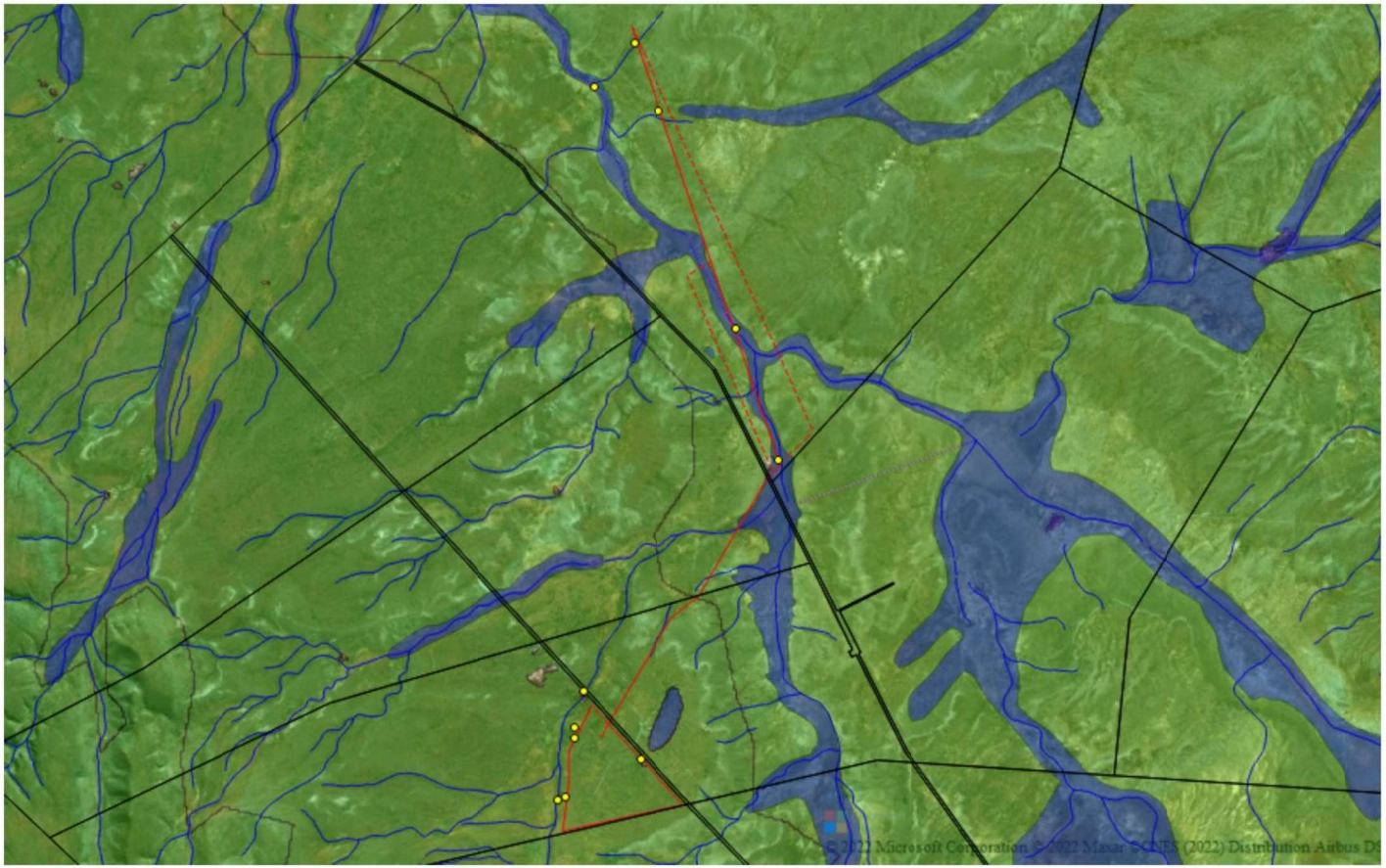
Van Ginkel, C.E. & Cilliers, C.J. 2020. Aquatic and wetland plants of Southern Africa. Briza Publications, Pretoria.

Van Ginkel, C.E., Glen, R.P., Gordon-Grey, K.D., Cilliers, C.J., Musaya, M. & Van Deventer, P.P. 2011. Easy Identification of some South African Wetland Plants. WRC Report No. TT 479/10.

Van Oudtshoorn, F. 2004. Gids tot Grasse van Suider-Afrika. Briza Publications, Pretoria.

Annexure A: Maps

Locality map for the proposed solar development (extent of 134 hectares) for the Wonderpan solar facility located near Prieska, Northern Cape Province.



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Legend:

- Property boundaries
- Watercourses
- Solar footprint and powerline
- Alternative powerline option
- National Wetland Map 5
- Remaining natural vegetation
- Sampling points

Map Information

Spheroid: WGS 84

Quantum GIS

Scale: 1:85 000

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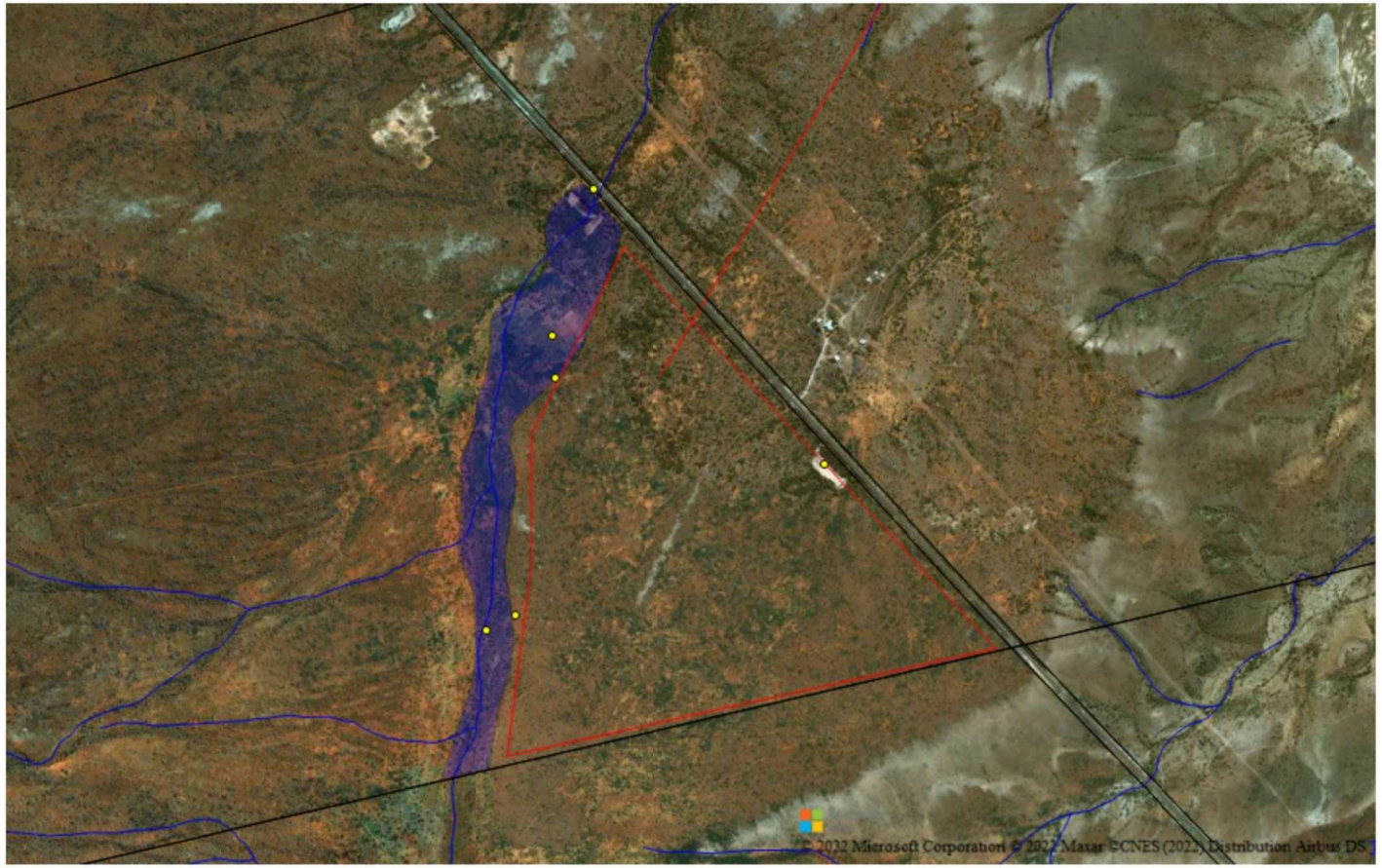
Map 1: Locality map of the proposed Wonderpan solar development near Prieska. Areas identified as being wetland areas according to the National Wetland Map 5 are indicated as well as smaller watercourses and drainage lines. Sampling points along affected watercourses are also indicated. A small stream system to the west of the solar development is clearly visible as well as the Karabeeloop and smaller drainage lines which will be affected by the grid connection powerline. It is notable that a large portion of the powerline will be situated within the Karabeeloop and will cause significant disturbance, alternative powerline alignment is also indicated which should considerably decrease the impact on this stream system. The remaining natural vegetation in the area is also indicated and confirms that the area remains largely natural.

Surface water delineation for the proposed solar development (extent of 134 hectares) for the Wonderpan solar facility located near Prieska, Northern Cape Province.



Map 2: Surface water delineation map of the proposed Wonderpan solar development near Prieska. The solar development footprint is indicated. A small stream system is clearly visible to the west of the site. The stream, floodplain and associated riparian zone has been delineated. Though the stream does not form part of the site it may still be affected by it due to it close proximity (50 meters) to it. Survey sampling points are also indicated.

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Legend:

- Property boundaries
- Watercourses
- Solar footprint and powerline
- Riparian zone
- Sampling points

Map Information

Spheroid: WGS 84

Quantum GIS

Scale: 1:20 000

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Appendix B: Species list

Species indicated with an * are exotic.

Protected species are coloured orange and Red Listed species red.

Species	Growth form
**Atriplex nummularia*	Shrub
**Datura ferox*	Herb
**Prosopis glandulosa*	Tree
Alternanthera sessilis	Herb
Ammocharis coranica	Geophyte
Aristida congesta	Grass
Asparagus suaveolens	Dwarf shrub
Boerhavia cordobensis	Herb
Boscia albitrunca	Tree
Cenchrus ciliaris	Grass
Chenopodium carrinatum	Herb
Chloris virgata	Grass
Cyperus cf. betchuanus	Sedge
Cyperus difformis	Sedge
Digitaria eriantha	Grass
Ehretia rigida	Shrub
Enneapogon cenchroides	Grass
Enneapogon desvauxii	Grass
Eragrostis bicolor	Grass
Eragrostis biflora	Grass
Eragrostis echinochloidea	Grass
Eragrostis rotifer	Grass
Felcia muricata	Dwarf shrub
Galenia africana	Dwarf shrub
Galenia crystallina	Herb
Garuleum schinzii subsp. *schinzii*	Herb
Geigeria filifolia	Herb
Geigeria pectidea	Herb
Hoodia gordonii	Succulent
Isolepis sp.	Sedge
Justicia cuneata	Dwarf shrub
Lycium bosciifolium	Shrub
Lycium cinerium	Shrub
Lycium pumillum	Shrub
Malephora crocea	Succulent
Marsilea sp.	Fern
Melinis repens	Grass
Mesembryanthemum sp.	Succulent
Moraea polystachya	Geophyte
Nerine laticoma	Geophyte

Ophioglossum sp.	Fern
Orbea cooperi	Succulent
Oxalis haedilupes	Geophyte
Panicum coloratum	Grass
Pavonia burchellii	Herb
Pentzia globosa	Dwarf shrub
Phaeoptilum spinosum	Shrub
Pupalia lappachea	Herb
Radyera urens	Herb
Rhigozum trichotomum	Shrub
Rosenia humilis	Dwarf shrub
Salsola aphylla	Shrub
Schoenoplectus corymbosus	Sedge
Senegalia melifera subsp. *detinens*	Shrub
Setaria verticillata	Grass
Sporobolus ioclados	Grass
Tetragonia arbuscula	Succulent
Trianthema triquetra	Herb
Ziziphus mucronata	Tree

Appendix C: Soil Samples Methodology

Obligate wetland vegetation was utilised to determine the presence and border of wetlands. Soil samples were used to confirm the wetland conditions in the study area. Soil samples were investigated for the presence of anaerobic evidence which characterises wetland soils.

Within wetlands the hydrological regime differs due to the topography and landscape. For instance; a valley bottom wetland would have a main channel that is below the water table and consequently permanently saturated, i.e. permanent zone of wetness. As you move away from the main channel the wetland would become dependent on flooding in order to be saturated. As a result along this hydrological regime areas of permanent saturation, seasonal and temporary saturation would occur. At some point along this gradient the saturation of the soil would be insufficient to develop reduced soil conditions and therefore will not be considered as wetland.

Within wetland soils the pores between soil particles are filled with water instead of atmosphere. As a result available oxygen is consumed by microbes and plantroots and due to the slow rate of oxygen diffusion oxygen is depleted and biological activity continues in anaerobic conditions and this causes the soil to become reduced.

Reduction of wetland soils is a result of bacteria decomposing organic material. As bacteria in saturated soils deplete the dissolved oxygen they start to produce organic chemicals that reduce metals. In oxidised soils the metals in the soil give it a red, brown, yellow or orange colour. When these soils are saturated and metals reduced the soil attains a grey matrix characteristic of wetland soils.

Within this reduction taking place in the wetland soils there may be reduced matrix, redox depletions and redox concentrations. The reduced matrix is characterised by a low chroma and therefore a grey soil matrix. Redox depletions result in the grey bodies within the soil where metals have been stripped out. Redox concentrations result in mottles within the grey matrix with variable shape and are recognised as blotches or spots, red and yellow in colour.

Soil wetness indicator is used as the primary indicator of wetlands. The colour of various soil components are often the most diagnostic indicator of hydromorphic soils. Colours of these components are strongly influenced by the frequency and duration of soil saturation. Generally, the higher the duration and frequency of saturation in a soil profile, the more prominent grey colours become in the soil matrix.

Coloured mottles, another feature of hydromorphic soils, are usually absent in permanently saturated soils and are at their most prominent in seasonally saturated soils, becoming less abundant in temporarily saturated soils until they disappear altogether in dry soils (Collins 2005).

The following soil wetness indicators can be used to determine the permanent, seasonal and temporary wetness zones. The boundary of the wetland is defined as the outer edge of the temporary zone of wetness and is characterised by a minimal grey matrix (<10%), few high chroma mottles and short periods of saturation (less than three months per year). The seasonal zone of wetness is characterised by a grey matrix (>10%), many low chroma mottles and significant periods of wetness (at least three months per year). The permanent zone of wetness is characterised by a prominent grey matrix, few to high chroma mottles, wetness all year round and sulphuric odour (rotten egg smell). According to convention hydromorphic soil must display signs of wetness within 50 cm of the soil surface (DWAF 2005).

Appendix D: WET-Health

For the complete WET-Health please contact the author of this report.

ASSESSMENT UNIT INFORMATION	
ASSESSMENT UNIT INFORMATION	Wonderpan Water Assessment
UPPER LATITUDE	S 29.806837°
UPPER LONGITUDE	E 22.850461°
UPPER ALTITUDE	1003m
LOWER LATITUDE	S 29.794004°
LOWER LONGITUDE	E 22.854021°
LOWER ALTITUDE	991m
SURVEY SITE (if applicable)	Wonderpan Solar
SITE LATITUDE (if applicable)	
SITE LONGITUDE (if applicable)	
SITE ALTITUDE (if applicable)	
WMA	Low er Orange
QUATERNARY	D72A
ECOREGION 2	26_2
DATE	12/04/2022
RIVER	Ephemeral Stream
TRIBUTARY	Karabeeloop
PERENNIAL (Y/N)	**N**
GEOMORPH ZONE	**LOWLAND**
WIDTH (m)	**2-15**

METRIC GROUP	RATING	CONFIDENCE
HYDROLOGY MODIFICATION	0.7	1.7
PHYSICO-CHEMICAL MODIFICATION	0.4	1.1
BED MODIFICATION	1.2	4.0
BANK MODIFICATION	1.0	3.0
CONNECTIVITTY MODIFICATION	1.3	4.0
INSTREAM IHI%	82.1	
CATEGORY	B	
CONFIDENCE	2.8	

HABITAT INTEGRITY CATEGORY	DESCRIPTION	RATING (% OF TOTAL)
A	Unmodified, natural.	90-100
B	Largely natural with few modifications. A small change in natural habitats and biota may have taken place but the ecosystem functions are essentially unchanged.	80-89
C	Moderately modified. Loss and change of natural habitat and biota have occurred, but the basic ecosystem functions are still predominantly unchanged.	60-79
D	Largely modified. A large loss of natural habitat, biota and basic ecosystem functions has occurred.	40-59
E	Seriously modified. The loss of natural habitat, biota and basic ecosystem functions is extensive.	20-39
F	Critically / Extremely modified. Modifications have reached a critical level and the system has been modified completely with an almost complete loss of natural habitat and biota. In the worst instances the basic ecosystem functions have been destroyed and the changes are irreversible.	0-19

METRIC GROUP	RATING	CONFIDENCE
HYDROLOGY	0.84	3.00
BANK STRUCTURE MODIFICATION	0.70	4.00
CONNECTIVITY MODIFICATION	1.25	4.00
RIPARIAN HABITAT INTEGRITY (%)	82.61	
CATEGORY	B	
CONFIDENCE	3.67	

HABITAT INTEGRITY CATEGORY	DESCRIPTION	RATING (% OF TOTAL)
A	Unmodified, natural.	90-100
B	Largely natural with few modifications. A small change in natural habitats and biota may have taken place but the ecosystem functions are essentially unchanged.	80-89
C	Moderately modified. Loss and change of natural habitat and biota have occurred, but the basic ecosystem functions are still predominantly unchanged.	60-79
D	Largely modified. A large loss of natural habitat, biota and basic ecosystem functions has occurred.	40-59
E	Seriously modified. The loss of natural habitat, biota and basic ecosystem functions is extensive.	20-39
F	Critically / Extremely modified. Modifications have reached a critical level and the system has been modified completely with an almost complete loss of natural habitat and biota. In the worst instances the basic ecosystem functions have been destroyed and the changes are irreversible.	0-19

	MRU
INSTREAM IHI	
Base Flows	-1.0
Zero Flows	0.0
Floods	1.0
HYDROLOGY RATING	**0.7**
pH	0.0
Salts	1.0
Nutrients	1.0
Water Temperature	0.0
Water clarity	1.0
Oxygen	0.0
Toxics	0.0
PC RATING	**0.4**
Sediment	1.5
Benthic Growth	1.0
BED RATING	**1.2**
Marginal	1.0
Non-marginal	1.0
BANK RATING	**1.0**
Longitudinal Connectivity	1.5
Lateral Connectivity	1.0
CONNECTIVITY RATING	**1.3**
INSTREAM IHI %	**82.1**
INSTREAM IHI EC	**B**
INSTREAM CONFIDENCE	**2.8**

	MRU
RIPARIAN IHI	
Base Flows	-1.0
Zero Flows	0.0
Moderate Floods	1.0
Large Floods	1.0
HYDROLOGY RATING	**0.8**
Substrate Exposure (marginal)	0.0
Substrate Exposure (non-marginal)	0.0
Invasive Alien Vegetation (marginal)	1.0
Invasive Alien Vegetation (non-marginal)	0.0
Erosion (marginal)	1.0
Erosion (non-marginal)	0.0
Physico-Chemical (marginal)	0.5
Physico-Chemical (non-marginal)	0.5
Marginal	1.0
Non-marginal	0.5
BANK STRUCTURE RATING	**0.7**
Longitudinal Connectivity	1.5
Lateral Connectivity	1.0
CONNECTIVITY RATING	**1.3**
RIPARIAN IHI %	**82.6**
RIPARIAN IHI EC	**B**
RIPARIAN CONFIDENCE	**3.7**

Appendix E: Risk Assessment Matrix

RISK MATRIX (Based on DWS 2015 publication: Section 21 c and I water use Risk Assessment Protocol)

Risk to be scored for construction and operational phases of the project. MUST BE COMPLETED BY SACNASP REGISTERED PROFESSIONAL MEMBER REGISTERED IN AN APPROPRIATE FIELD OF EXPERTISE

					Severity																
No.	Phases	Activity	Aspect	Impact	Flow Regime	Physico & Chemical (Water Quality)	Habitat (Geomorph+Vegetation)	Biota	Severity	Spatial scale	Duration	Consequence	Frequency of activity	Frequency of impact	Lega Issues	Detection	Likelihood	Significance	Risk Rating	Confidence level	Control Measures
1	Mostly Construction Phase but also during operation	Construction of a solar facility.	A stream system situated adjacent to the solar footprint may be affected by the proposed development	The construction of the facility may encroach into the stream or riparian zone which will directly affect or may also impact on the catchment of the stream which will then have an indirect impact on it.	1	1	2	1	1.25	1	1	3.25	1	1	5	3	10	32.5	L	80	Provided that the solar footprint does not encroach into the stream or riparian zone and these areas are treated as no-go areas, the anticipated risk should remain low. The development may however still have an indirect impact in terms of runoff and erosion and a comprehensive storm water management system in order to manage runoff and prevent erosion which will affect the stream system.
	Mostly Construction Phase but also during operation	Grid connection powerline.	Several small drainage lines will be crossed perpendicularly by the powerline.	The construction of the powerline may result in disturbance of the drainage lines.	2	2	2	1	1.75	2	1	4.75	2	2	5	2	11	52.25	L	80	The powerline will cross these drainage lines perpendicularly which will minimise the disturbance footprint. The powerline alignment should also endeavour to place pylons on either side of the drainage lines and not within the channel as this will increase erosion. Given the small size of these drainage lines and the low anticipated impact of the powerline, the risk is anticipated to remain low.
	Mostly Construction Phase but also during operation	Grid connection powerline.	The current powerline alignment will occur within a long section of the main channel of the Karabeeloop.	Placement of the powerline parallel and within the main channel of the Karabeeloop will result in significant impacts in terms of construction disurbance, erosion and scouring.	3	3	3	2	2.75	3	2	7.75	2	2	5	2	11	85.25	M	80	Should the alignment of the powerline be placed within the main channel of the Karabeeloop for a distance of about 3 km, it will result in significant disturbance which will entail a moderate risk and will require significant mitigation.
	Mostly Construction Phase but also during operation	Grid connection powerline.	Re-alignment of the powerline should be considered in order to cross the Karabeeloop only once and perpendicularly.	Re-alignment of the powerline in order to cross the Karabeeloop only once and perpendicularly will decrease the disturbance footprint and therefore decrease the anticipated impact.	2	2	2	1	1.75	1	2	4.75	2	2	5	2	11	52.25	L	80	Should the re-alignment of the powerline be possible in order to cross the Karabeeloop only once and perpendicularly will minimise the anticipated impacts of the powerline and should such an alignment be taken the risk is anticipated to be considerably lower. This is also subject to the powerline avoiding the placement of pylons directly within the main channel of this watercourse.