FRESHWATER IMPACT ASSESSMENT FOR THE PROPOSED VELD PV NORTH SOLAR ENERGY FACILITY GRID CONNECTION AND ASSOCIATED INFRASTRUCTURE, NAMAKWA DISTRICT, NORTHERN CAPE

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EXECUTIVE SUMMARY

Veld Solar One (Pty) Ltd (Veld) proposes to construct two Photovoltaic (PV) facility and associated infrastructure near Aggeneys in the Northern Cape. The proposed PV Facility will consist of two 75 Megawatt (MW) Photovoltaic (PV)facilities on the farm Haramoep (Remainder of Farm 53) which is located approximately 95km north-east of the town of Springbok. In addition, it is proposed to construct a transmission line from the facility adjacent to the 220kV line to an existing substation in the south. Aurecon South Africa (Pty) Ltd has been appointed to undertake the requisite environmental process as required in terms of the National Environmental Management Act (No. 107 of 1998) (NEMA), as amended, on behalf of Veld. This freshwater assessment is intended to inform the environmental authorisation process for the project.

The main freshwater features within the study area consist of the following:

- *a network of ephemeral streams that drain the inselbergs to form larger tributaries that drain northwards into the Orange River; and*
- *wide wash-like systems that drain the plains*

The ephemeral streams within the study area are still in a largely natural ecological condition, with a modification of the habitat occurring as a result of the surrounding farming activities (livestock grazing) and direct habitat disturbance as a result of roads and other infrastructure development. The Orange River within the study area is in a largely natural to moderately modified condition largely due to upstream impacts on flow and water quality. Current land and water use impacts on the ephemeral streams are low. Due to the ephemeral character of these surface water systems, they are also slow to recover from any impacts.

The ecological importance and sensitivity of the ephemeral streams are considered to be moderate while the Orange River within the study area is considered of a high ecological importance and sensitivity. This is due to the fact that the river provides a 'green' corridor within an arid environment and provides important aquatic habitat.

The Orange River and its tributaries in the north of the study area have been identified as Freshwater Ecosystem Priority Areas (FEPA) Rivers while the Orange River is also considered a Fish FEPA. The valley bottom wetlands along the Orange River are also mapped as FEPA wetland areas. The only aquatic feature identified as part of the Namakwa Critical Biodiversity Areas mapping as being of biodiversity conservation importance is the valley bottom wetland areas associated with the Orange River. The ecological corridors that are associated with the smaller tributaries within the unique terrestrial vegetation associated with the inselberg are included in the terrestrial Critical Biodiversity Areas.

The nature of the power projects allows them to have minimal impact on the surface water features with the correct mitigation measures (as are recommended in this report). Erosion and sedimentation from the project activities, together with the potential for invasive alien plant growth and the possible modification of surface water runoff and water quality may lead to additional impacts on the freshwater habitats within the study area. The proposed activities for this project are recommended to be located outside of the identified freshwater features. Provided the construction and operation activities of the projects remain contained within the allocated areas and any disturbed areas within the freshwater features rehabilitated, the overall impact should be limited and of a low significance.

Due to the wide and unconfined nature of the stream to the north of the PV North site, it is recommended that a buffer of approximately 175m from top of bank of the stream, narrowing to about 100m downstream, be allowed for as a development setback. Some modules may need to be moved slightly to accommodate the recommended buffer. The smaller stream to the east of the PV site is much smaller in extent and a buffer of approximately 100m is recommended from the stream. The proposed access road and the powerline for PV North occur within this buffer and should be slightly realigned.

Smaller streams occur to the west and south-east of the proposed PV South area. It is recommended that a buffer of approximately 100m from these streams be allowed for. In addition, the stream to the south-east of the site is wide and unconfined. It is recommended at the modules in this area be placed further away from the stream. As for PV North, the proposed access road and the powerline for PV South occur within this buffer and should be slightly realigned.

The potential freshwater impacts of the PV facility area likely to be low with mitigation. Key mitigation measurements would be on-site stormwater management; limiting disturbance within freshwater features and buffers; and control of alien vegetation of the potential for erosion. Provided the PV facilities are located outside of the freshwater features and recommended buffers, the technology alternatives would have limited potential freshwater impact. It is recommended that 1 in 50 year and 1 in 100 floodlines be determined for the PV sites to ensure that the proposed infrastructure is located outside of these flood risk areas.

All of the proposed access roads are associated with existing roads – either internal farm roads or larger public gravel roads. The potential freshwater impacts associated with the use of these roads for the proposed development is considered to be very low, provided the impacts are adequately mitigated.

The proposed transmission line to the south will need to cross a number of small ephemeral drainage lines however the potential impacts can be easily mitigated. No poles should be placed within any of the mapped aquatic features or 30m adjacent to the watercourses.

The risk rating for the proposed activities is considered to be moderate to low. The risks are of such a nature that if the proposed activities are properly mitigated and managed as recommended in this report, a low risk of impacting on the aquatic features is deemed likely. The proposed activity with mitigation, would thus meet with the General Authorisations for Section 21 (c) and (i) water uses.

Recommended mitigation measures are as follows:

***PV Facilities**: The solar facilities should be moved slightly to outside of the freshwater features and recommended buffers. Key mitigation measurements would be on-site stormwater management; limiting disturbance within freshwater features and buffers; and control of alien vegetation of the potential for erosion.*

***Access roads**: Existing road infrastructure should be utilized as far as possible to minimize the overall disturbance created by the proposed project. Where crossings associated with the access routes need to be constructed through ephemeral streams, disturbance of the channel should be limited. All crossings over drainage channels or stream beds should be such that the flow within the drainage channel is not impeded. Road infrastructure and transmission lines should coincide as much as possible to minimize the road network and impact of these activities. Any disturbed areas should be rehabilitated to ensure that these areas do not become subject to erosion or invasive alien plant growth.*

***Powerlines**: The pylons for the transmission lines should be placed at least 30m outside of the delineated stream channels or outside buffers. Where the access route for transmission lines needs to be constructed through the drainage channels, disturbance of the channels should be limited. These areas should be rehabilitated after construction is complete and the areas monitored for growth of invasive alien plants.*

***Longer term maintenance and management**: Stormwater and good housekeeping measures onsite to prevent flow and quality impacts on adjacent streams. Monitor and manage for invasive alien plant growth and erosion of stream channels. Maintain any culvert structures within watercourses.*

From a freshwater perspective, there is no reason why the proposed Veld PV Solar Energy Facility, as well as the associated access roads and transmission lines should not be approved.

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1. BACKGROUND

Veld Solar One (Pty) Ltd (Veld) proposes to construct two Photovoltaic (PV) facility and associated infrastructure near Aggeneys in the Northern Cape. The proposed PV Facility will consist of two 75 Megawatt (MW) Photovoltaic (PV) facilities on the farm Haramoep (Remainder of Farm 53) which is located approximately 95km north-east of the town of Springbok (Figure 1). Aurecon South Africa (Pty) Ltd has been appointed to undertake the requisite environmental process as required in terms of the National Environmental Management Act (No. 107 of 1998) (NEMA), as amended, on behalf of Veld. This freshwater assessment is intended to inform the environmental authorisation process for the project.

The two PV facilities will also have their own substation that would connect onto an existing Eskom powerline. In addition, it is proposed to construct a transmission line from the facility adjacent to the 220kV line to an existing substation in the south.

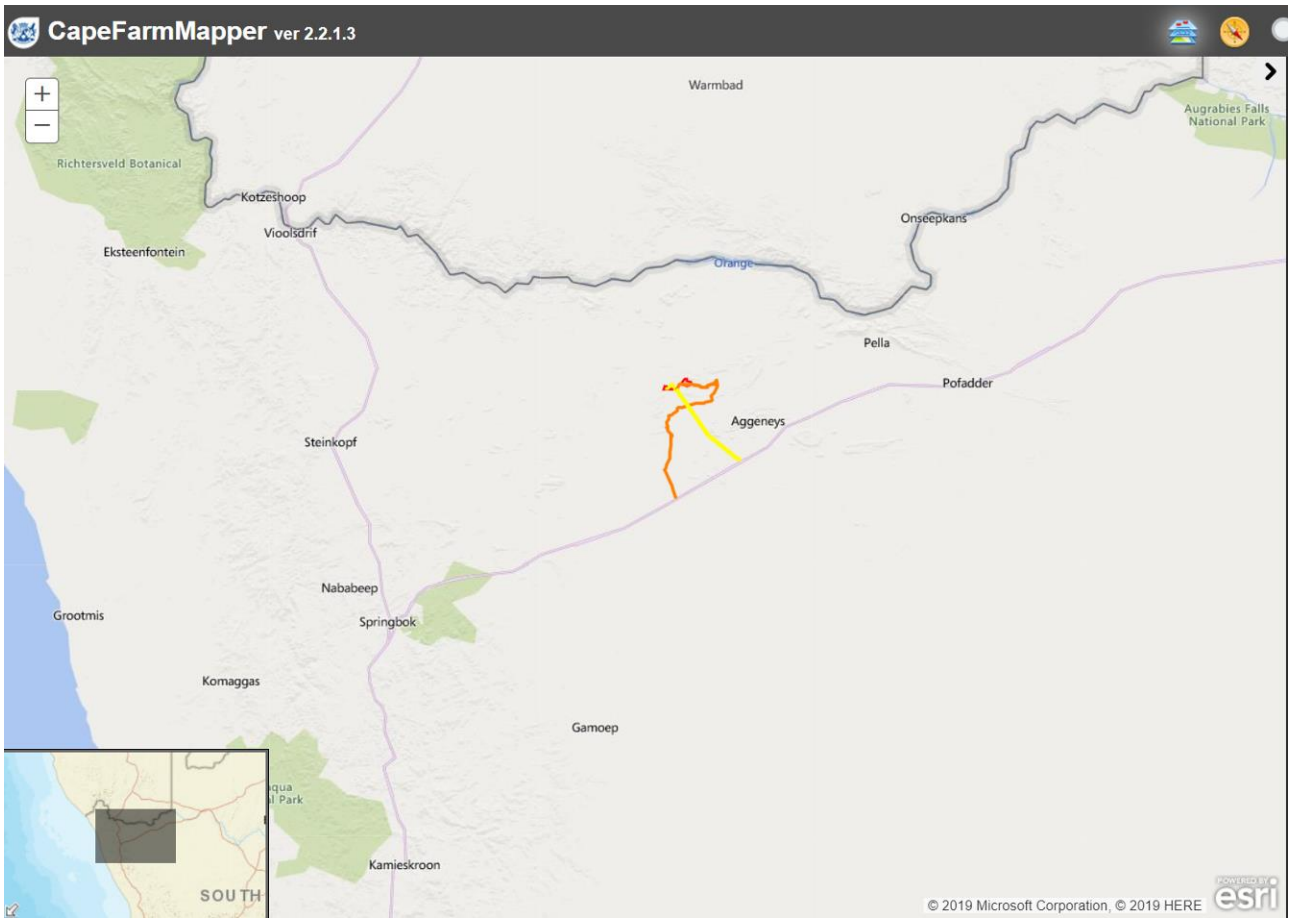


Figure 1. Locality map of the proposed solar energy facilities

Table 1 provides a summary of the main features of the freshwater and hydrological features of the area.

Table 1: Key information related to the water resources which may be impacted by the proposed activities

Descriptor	Name / details	Notes
Water Management Area	Lower Orange WMA	
Catchment Area	Lower Orange River	
Quaternary Catchment	D82C	
Present Ecological state	Orange River: B (Largely natural); Not determined for ephemeral streams	DWA 2013 (Appendix C)
EISC – Ecological Importance and Sensitivity	Orange River: High/High Ephemeral Stream: Moderate	
Type of water resource	Ephemeral and endorheic streams and the Lower Orange River	
Latitude	29° 6'46.13"S	Proposed Substation
Longitude	18°36'31.93"E	

2. TERMS OF REFERENCE

The indicated scope of works for the freshwater assessment of the proposed Namakwa (Veld) Solar Facility near Aggeneys was as follows: Compile a scoping report (alternatives screening and spatial aquatic sensitivities or red flags) and freshwater impact assessment report assessed in accordance with Aurecon's impact assessment methodology.

The study should include the following aspects:

1. Provide an overview of your approach and methodologies as well as indicate any limitations, assumptions, uncertainties or gaps in knowledge;
2. Undertake a site visit and describe main characteristics of the sites in terms of the specialist field;
3. Produce a sensitivity map in the scoping phase and following site visit (Google Earth KMZ during the scoping phase showing sensitivity levels 1,2 and 3 with buffers);
4. Identify main impacts, indicating significance and acceptability of impact after mitigation
5. Compile a scoping or screening report, which comparatively assesses the potential project alternatives from an impact perspective and motivate a preferred alternative (we are working on a pair wise type methodology for this to keep reports short and to the point).
6. Compile an impact report assessing the direct, indirect and cumulative impacts for the preferred alternatives against the no go (both before and after proposed mitigations). Provide a list of reasonable mitigation measures for inclusion into the EMP.

3. APPROACH TO THE STUDY AND STUDY LIMITATIONS AND ASSUMPTIONS

Input into this report was informed by a combination of desktop assessments of existing freshwater ecosystem information for the study area and catchment, as well as by a more detailed assessment of the freshwater features along the proposed routes. The study area was visited in November 2016. During the field visit, the mapping, characterisation and integrity assessments of the freshwater features were undertaken. Mapping of the freshwater features was undertaken using PlanetGIS and Google Earth Professional. The SANBI Biodiversity GIS website was also consulted to identify any constraints in terms of fine-scale biodiversity conservation mapping as well as possible

freshwater features mapped in the Freshwater Ecosystem Priority Areas maps. This information/data was used to inform the resource protection related recommendations.

Limitations and uncertainties may exist within the various techniques adopted to assess the condition of ecosystems. The following techniques and methodology utilized to undertake this study:

- Analysis of the freshwater ecosystems was undertaken at a rapid level and did not involved detailed habitat and biota assessments;
- The guideline document, "A Practical Field Procedure for the Identification and Delineation of Wetlands and Riparian Areas" document, as published by DWAF (2005) was followed for the delineation of the riparian areas;
- The present ecological status of the watercourses in the study area was undertaken using nationally developed aquatic ecosystem assessment methodologies;
- The ecological importance and sensitivity assessment was conducted according to the guidelines as developed by DWAF (1999).
- Recommendations are made with respect to the adoption of buffer zones within the site based on the watercourse functioning and site characteristics and making use of the nationally developed tool for determination of riparian buffer zone;
- Lists of plants, both alien and indigenous are for the purpose of describing the general and dominant habitat conditions and not comprehensive. A comprehensive botanical survey was not conducted.

The level of aquatic assessment undertaken was considered to be adequate for this study.

4. USE OF THIS REPORT

This report reflects the professional judgment of its authors. The full and unedited content of this should be presented to the client. Any summary of these findings should only be produced in consultation with the authors.

5. LEGAL REQUIREMENTS

The following Acts, regulations and ordinances are applicable to the development:

5.1. THE NATIONAL ENVIRONMENTAL MANAGEMENT ACT (ACT NO. 107 OF 1998)

Chapter Seven of the NEMA states that:

"Every person who causes, has caused or may cause significant pollution or degradation of the environment must take reasonable measures to prevent such pollution or degradation from occurring, continuing or recurring, or, in so far as such harm to the environment is authorised by law or cannot reasonably be avoided or stopped, to minimise and rectify such pollution or degradation of the environment".

The Act also clearly states that the landowner, or the person using or controlling the land, is responsible for taking measures to control and rectify any degradation. These may include measures to:

"(a) investigate, assess and evaluate the impact on the environment;

(b) inform and educate employees about the environmental risks of their work and the manner in which their tasks must be performed in order to avoid causing significant pollution or degradation of the environment:

(c) cease, modify or control any act, activity or process causing the pollution or degradation:

(d) contain or prevent the movement of pollutants or degradation: or

(e) eliminate any source of pollution or degradation: or

(f) remedy the effects of the pollution or degradation."

NEMA ENVIRONMENTAL IMPACT ASSESSMENT REGULATIONS

NEMA provides for the identification of activities which will impact the environment, in terms of Section 24. These activities were promulgated in terms of Government Notice No. R. 983, 984 and 985, dated 4 December 2014 and require environmental authorisation. The impacts of the listed activities must be investigated, assessed and reported to the competent authority before authorisation to commence with such listed activities can be granted.

5.2. NATIONAL WATER ACT, 1998 (ACT NO. 36 OF 1998)

The purpose of the National Water Act is to provide a framework for the equitable allocation and sustainable management of water resources. Both surface and groundwater sources are redefined by the Act as national resources which cannot be owned by any individual, and rights to which are not automatically coupled to land rights, but for which prospective users must apply for authorisation and register as users. The National Water Act also provides for measures to prevent, control and remedy the pollution of surface and groundwater sources.

REGULATIONS REQUIRING THAT A WATER USER BE REGISTERED, GN R.1352 (1999)

Regulations requiring the registration of water users were promulgated by the Minister of the Department of Water Affairs (DWA) in terms of provision made in section 26(1)(c), read together with section 69 of the National Water Act, 1998. Section 26(1)(c) of the Act allows for registration of all water uses including existing lawful water use in terms of section 34(2). Section 29(1)(b)(vi) also states that in the case of a general authorisation, the responsible authority may attach a condition requiring the registration of such water use. The Regulations (Art. 3) oblige any water user as defined under section 21 of the Act to register such use with the responsible authority and effectively to apply for a Registration Certificate as contemplated under Art.7(1) of the Regulations.

GENERAL AUTHORISATION IN TERMS OF S. 39 OF THE NATIONAL WATER ACT, GN R 1199 OF 2009

According to the preamble to Part 6 of the NWA, "*This Part established a procedure to enable a responsible authority, after public consultation, to permit the use of water by publishing general authorisations in the Gazette…*" *"The use of water under a general authorisation does not require a licence until the general authorisation is revoked, in which case licensing will be necessary…"*

The General Authorisations for Section 21 (c) and (i) water uses (impeding or diverting flow or changing the bed, banks or characteristics of a watercourse) as defined under the NWA have recently been revised (Government Notice R509

of 2016). Determining if a water use licence is required for these water uses is now associated with the risk of degrading the ecological status of a watercourse. A low risk of impact could be authorised in terms of a General Authorisations (GA). It is likely that the proposed activities associated with the aquatic ecosystems in the area can be mitigated such that they can be authorised in terms of the new GA.

6. GENERAL DESCRIPTION OF THE STUDY AREA

6.1. OVERVIEW OF THE STUDY AREA

The larger study area consists of a mix of small hills and inselbergs together with open, flat plains (Figure 2) that are drained by ephemeral watercourses. The varied rocky and shallow soil substrate of the area is known to support a wide range of plants, animals, birds and insects, including rare and endemic species within its semi-desert landscape. The vegetation cover consists largely of sparse low-growing shrubs and grasses. The drainage lines and ephemeral streams on the site are all tributaries of the lower Orange River. The site falls in the Lower Orange River Water Management Area, largely within the DWS Quaternary Catchment D82C.

The site has a rural, agricultural characteristic and is considered to be remote due to its considerable distance from major populated areas and even from tourist routes (the N14). The closest town is Aggeneys which is a small mining town situated between Pofadder and Springbok that mines primarily copper, lead and zinc (Figure 3).

6.2. PHYSICAL CHARACTERISTICS

The greater study region falls within both the Bushmansland and Namaqualand areas. The topography of the area is relatively flat and in general slopes very gently towards the north. A few isolated ridges of “granite inselbergs’ are scattered throughout the landscape (Figure 5). The site is largely spread between the T_Goog se Laagte River to the east and a number of smaller northward flowing tributaries of the Orange River. Along the Orange River to the north of the study area a mix of sheet wash sandy plains and rocky desert occurs with a range of east-west hills immediately south of the river. The altitude within the study area ranges from about 820m above mean sea level (amsl) at Aggeneys to 780m amsl at the proposed PV facilities.

Figure 2. A view of the typical topography of the site with an isolated ridges or inselberg in the background

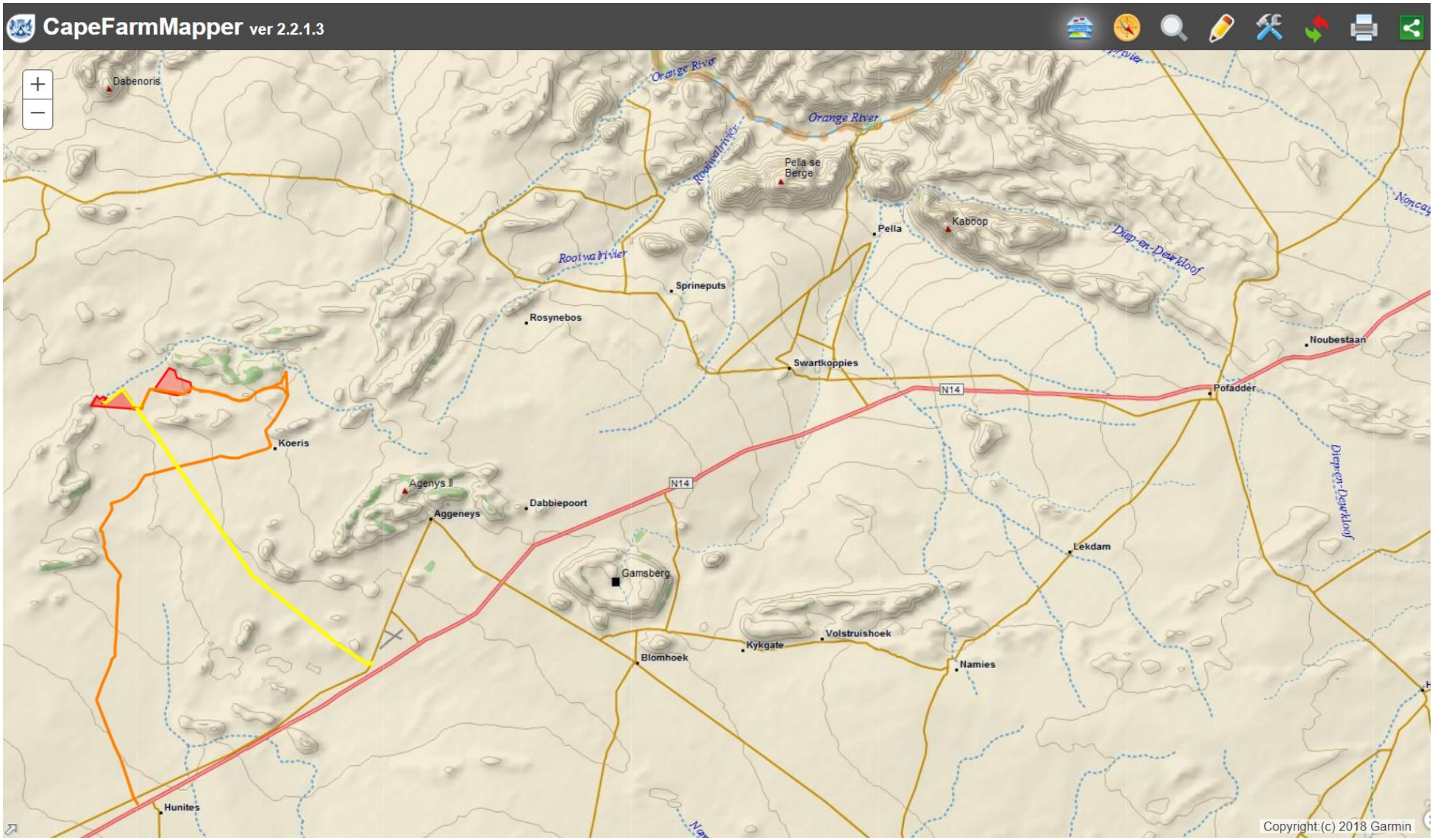


Figure 3. Esri Delorme map for the study area (CapeFarmMapper, 2019)

6.3. CLIMATE

The annual average rainfall for the area is low and highly variable. The annual average rainfall is less than 100mm, occurring mainly as thunderstorms in late summer. The greatest precipitation (mean monthly of 24mm) thus usually occurs between January/February and April (Figure 6). The lowest recorded annual rainfall (11mm) was measured in 1992, while the 'wettest' year (220mm) was recorded in 2006. The area usually receives its lowest rainfall (0mm) in January and the highest (9mm) in March (Figure 4).

In contrast, flows in the lower Orange River are dependant in inland rainfall and the management of the water resource at the large instream dams (Gariep and Vanderkloof Dams). The perennial Orange River also forms a green strip in an otherwise arid landscape. All other watercourses in the area however have ephemeral flow as a result of the very low rainfall within the area. Due to the poor rainfall in the area, groundwater is also the main source of water for the area, with the exception of the irrigation farmers that are located along the banks of the Orange River. Water is also transferred from the Orange River for urban and mining use in the area.

Temperatures in the area vary as a result of topography but are in general characterised by desert or semi-desert conditions. Average temperatures range between 30°C and 41°C in summer and between -3°C and 20°C in winter. The region is the coldest during July when the mercury drops below 3°C on average during the night. Prevailing winds in the region are southerly mostly at night in summer and spring and westerly during the daytime in autumn and winter. Average wind speeds are approximately 3 m/s. The mean annual evaporation for the area is 2 650mm.

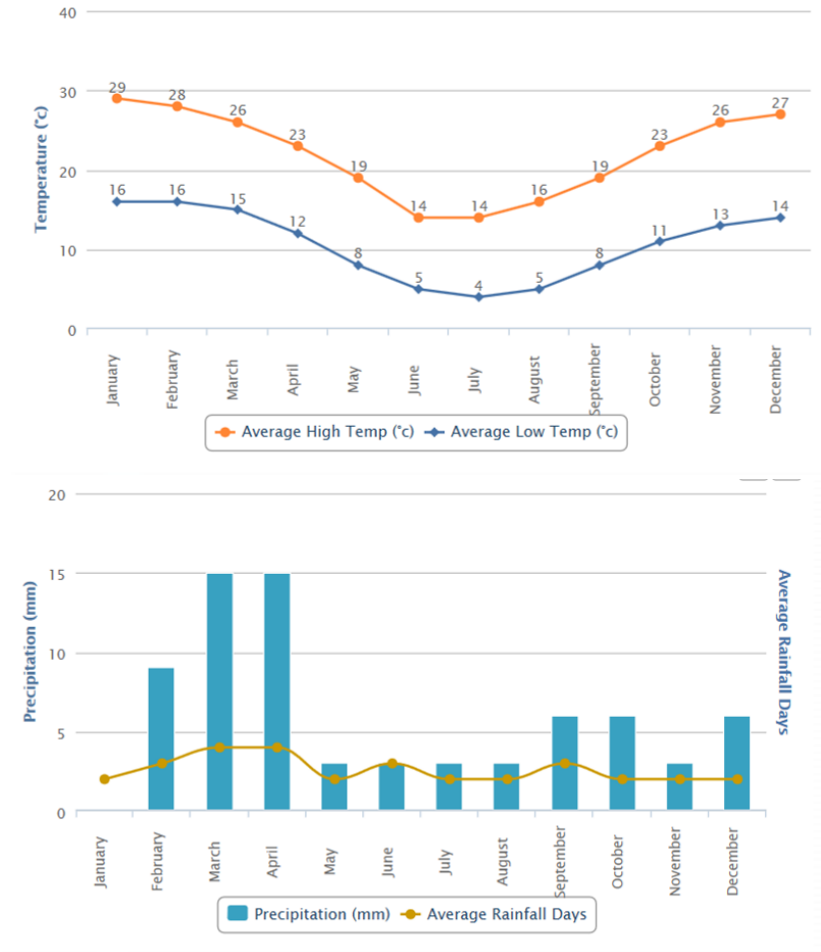


Figure 4. Average monthly temperature and rainfall for the area (Worldweatheronline, 2016)

6.4. GEOLOGY AND SOIL

The geology of the area consists largely of plains of Quaternary sediments sheet wash (sand and calcrete) with some contribution of pre-Pleistocene Kalahari Group sediments in the east. The inselbergs consist of high-grade metamorphic rocks. The metamorphic volcano-sedimentary succession that occurs in the area belongs to the Aggeneys Sub-Group of the Bushmanland Group. This Group is composed of basement granite rocks, supra-crustal sequences of sedimentation and volcanic origin and intrusive granite rock. It is bordered by the Hartbees River Thrust in the east and the Groothoek Thrust and Wortel Belt in the north.

The overlying soils on the plains tend to be shallow and stony. They are freely drained structure-less soils with excessive drainage, high erodibility and low fertility (pale grey / brown areas in Figure 5). The soils on the higher lying areas are shallow with rock. Soils found on the inselberg are characterised by bare rock, boulders and shallow gravelly soils. Within and south of the area proposed for the CSP and PV facilities, red dune sands generally occur (tan areas in Figure 5).

6.5. FLORA

The study area lies within the Nama Karoo, Succulent Karoo and Desert Biomes. The natural vegetation types mapped according to the national vegetation types (Mucina *et al*, 2006 – the updated National Vegetation Map of 2012 has not changed from the 2006 mapping for this area) as follows:

- Bushmanland Sandy Grassland (NKb4 or red/pink areas in Figure 6) occurs on the deeper red soils of the Bushmanland. It is the main vegetation type underlying the area proposed for the CSP and PV areas;
- Bushmanland Arid Grassland (NKb3 or darker red/pink areas in Figure 6) occurs on the shallower soils of the Bushmanland;
- Bushmanland Inselberg Shrubland (SKr18 or light olive-brown areas in Figure 6) occurs on the higher lying, rocky outcrops of the inselberg;
- Eastern Gariep Plains Desert (Dg9 or mauve in Figure 6) occurs on the sheet wash plains in the north of the study area; and
- Eastern Gariep Rocky Desert (Dg10 or blue-grey in Figure 6) occurs on the rocky hills along the Orange River in the north of the study area.

There is relatively little disturbance on the site, with only limited presence of invasive alien plants (mesquite) where disturbance has taken place. Areas outside of the study area, on the watercourse, are dominated by the white grasses of the *Stipagrostis* genus such as *S. ciliate* and *S. Uniplumis,* with succulents such as bushveld ghaab (*Hoodia gordonii*) and quiver trees (*Aloe dichotoma*). Shepherd's trees (*Boscia albitrunca*), Camel Thorn trees (*Acacia erioloba*), white karee (*Searsia pendulina*), tamarisk (*Tamarix usneoides*), stink bush (*Boscia foetida*) and desert broom (*Sisyndite spartea*) occur within the watercourses (Figure 7). In the larger streams, patches of common reeds (*Phragmites australis*) dominate the instream habitat. Along the Orange River, *Phragmites* reeds dominate the instream habitat, while sweet-thorn (*Acacia karoo*) dominates the riparian zones (Figure 9). Areas that have been disturbed have been invaded by mesquite (*Prosopis glandulosa*).

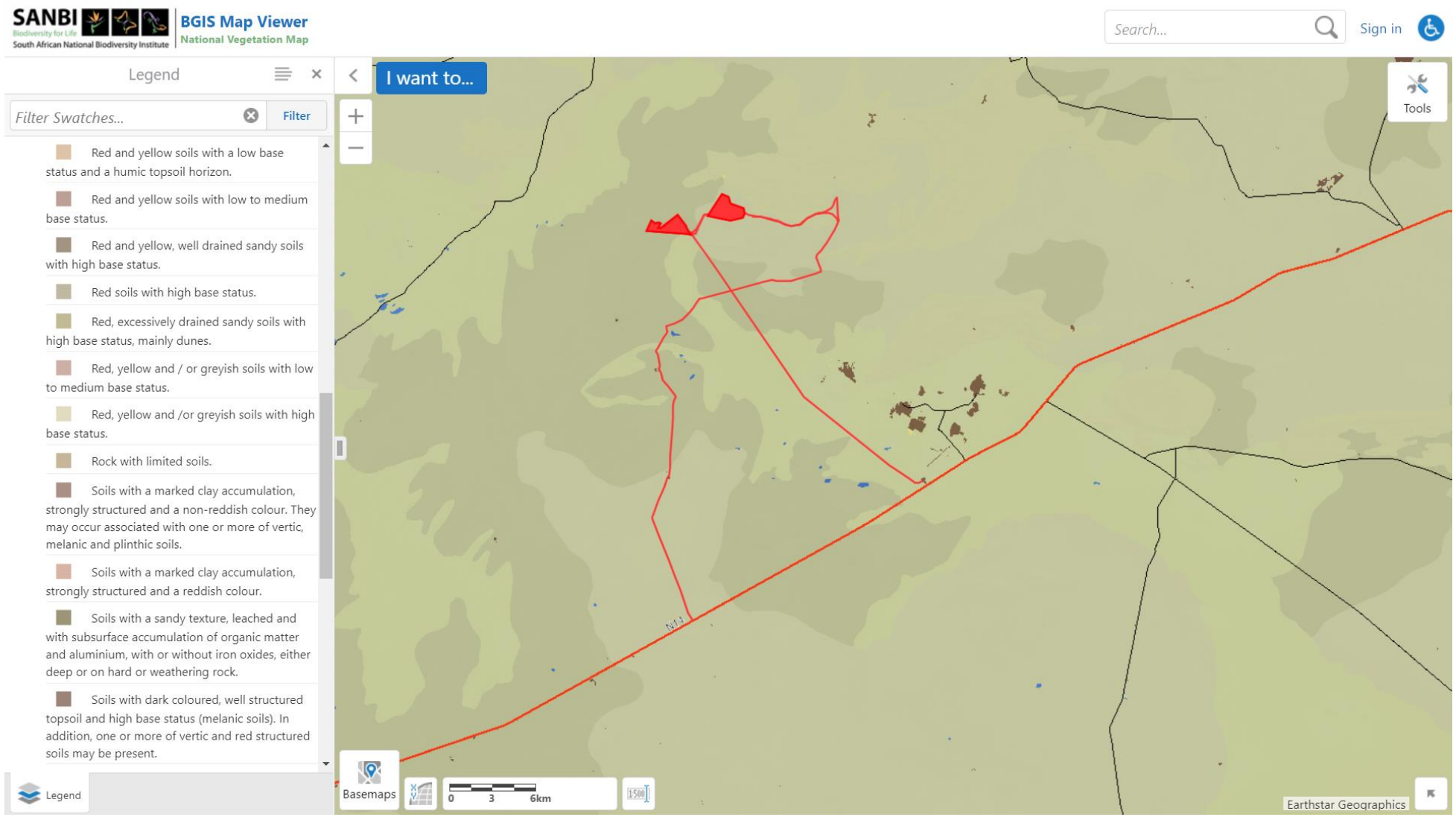


Figure 5. Soil map for the area (SANBI Biodiversity GIS, 2019)

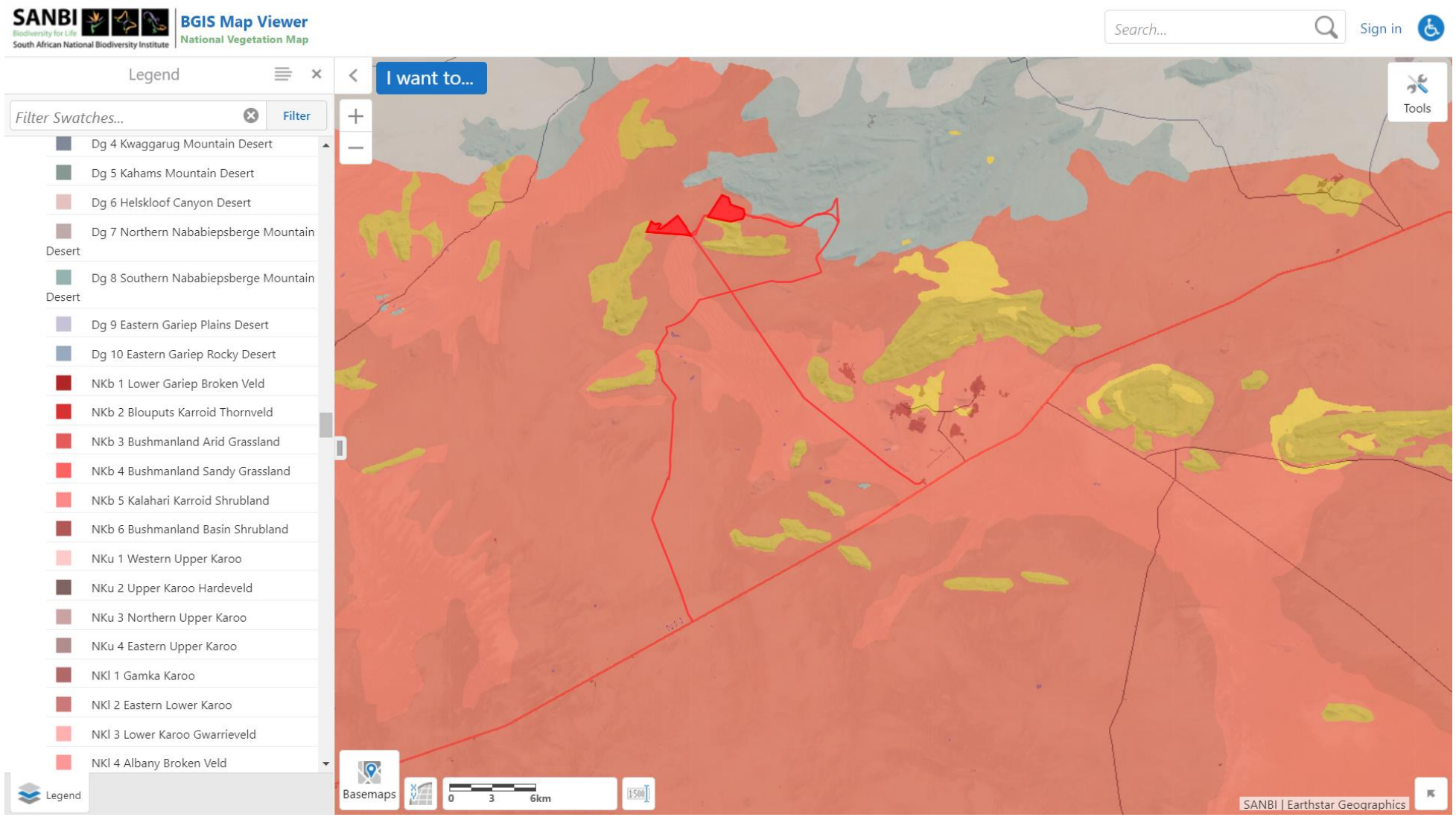


Figure 6. Vegetation map for the area (CapeFarmMapper, 2019)

Figure 7. View of a Shepard's tree together with white grasses within the watercourse adjacent to the proposed site

6.6. AQUATIC FEATURES AND FAUNA

The study area is situated within the lower Orange River. The main freshwater features within the study area consist of the following:

- a network of ephemeral streams that drain the inselbergs to form larger tributaries that drain northwards into the Orange River; and
- wide wash-like systems that drain the plains (Figure 10).

The T_Goob se Laagte River is the largest tributary of the Orange River in the area and occurs east of the study area. Smaller tributaries of the Orange River to the north of the study area are the Mik, Fontein se and Hartbees Rivers. Within the area proposed for the CSP and PV facilities, the freshwater features tend to be of an endorheic nature and do not drain into the Orange River.

The drainage channels only contain water for short periods of time following rainfall events and are discernible mostly only as slightly shallow depressions with very little clear associated vegetation. The channels are more distinct on the lower slopes of the inselbergs. Where the gradient of the slope is flat the drainage channels tend to be wide shallow channels and are dominated by driedoring shrubs *Rhigozum trichotomum* and grasses (Figure 8).

Shepherd's trees (*Boscia albitrunca*), Camel Thorn trees (*Acacia erioloba*), white karee (*Searsia pendulina*), tamarisk (*Tamarix usneoides*), stink bush (*Boscia foetida*) and desert broom (*Sisyndite spartea*) also occur within the watercourses. In the larger streams, patches of common reeds (*Phragmites australis*) dominates the instream habitat.

The ecological condition of the ephemeral streams in the study area is described in more detail in the following section.

Figure 8. The wide endorheic stream that passes through the centre of the area proposed for the PV facilities

Figure 9. View of the Orange River in the north of the wider study area

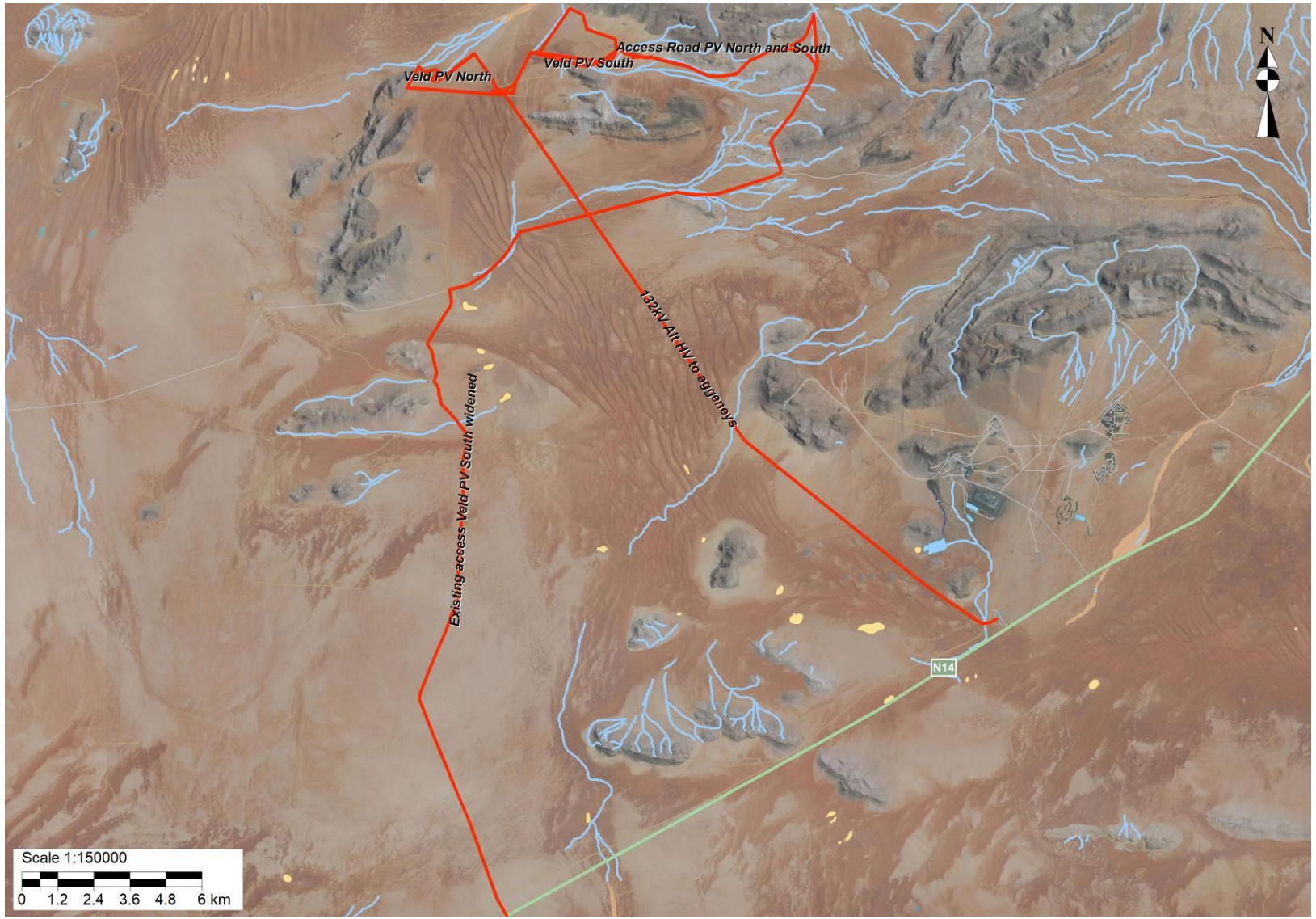


Figure 10. Mapped freshwater features in the study area

6.7. LAND USE

Much of the study area is undeveloped (low shrubland and bare soils – white and violet areas in Figure 11) with some homesteads. The veld mainly used for low density grazing of sheep. The closest rural towns near the study area are Springbok approximately 90km to the south-west and Aggeneys approximately 25km to the south-east of the study area. Namies lies approximately 130km east of the town of Springbok. Mining and degraded areas (red and yellow areas in Figure 11) occur adjacent to Aggeneys. Some cultivated areas occur along the Orange River. Mapped wetlands within the larger study area consist of small pans are located within the dunes and valley bottom wetland areas along the Orange River.

6.8. FRESHWATER BIODIVERSITY AND CONSERVATION

In South Africa two sets of mapping initiatives are available for the study area that are of relevance to the conservation and biodiversity importance of the aquatic ecosystems, that is, the Namakwa Critical Biodiversity Areas (CBA) map and the national Freshwater Ecosystem Priority Areas (FEPA) map.

In the study area, the Orange River and its tributaries in the north of the study area have been identified as FEPA rivers (green areas in Figure 12). In addition, the Orange River is a Fish FEPA. FEPAs are strategic spatial priorities for conserving freshwater ecosystems and associated biodiversity. FEPAs were determined through a process of systematic biodiversity planning and were identified using a range of criteria for serving ecosystems and associated biodiversity of rivers, wetlands and estuaries. The light green areas in Figure 12 (northern extent of the study area) are Upstream Management Areas. The valley bottom wetlands along the Orange River are also mapped as FEPA wetland areas (blue areas in Figure 12).

The only aquatic feature identified as part of the Namakwa Critical Biodiversity Areas mapping (blue areas in Figure 13) as being of biodiversity conservation importance is the valley bottom wetland areas associated with the Orange River. The ecological corridors that are associated with the smaller tributaries within the unique terrestrial vegetation associated with the inselberg are included in the terrestrial CBAs (green areas and green hatched areas in Figure 13) are where the vegetated cover should be maintained in a natural state with no further biodiversity loss (only game farms and livestock production allowed). The surrounding terrestrial landscape is seen as an ecological support area (ESA) (yellow areas in Figure 13) which should be managed for limited loss of ecological functioning.

The proposed PV facilities as well as most of the proposed transmission line and the northern portions of access roads are located with a river FEPA and within terrestrial ESAs. A smaller portion of the transmission line and access road is located with terrestrial CBAs.

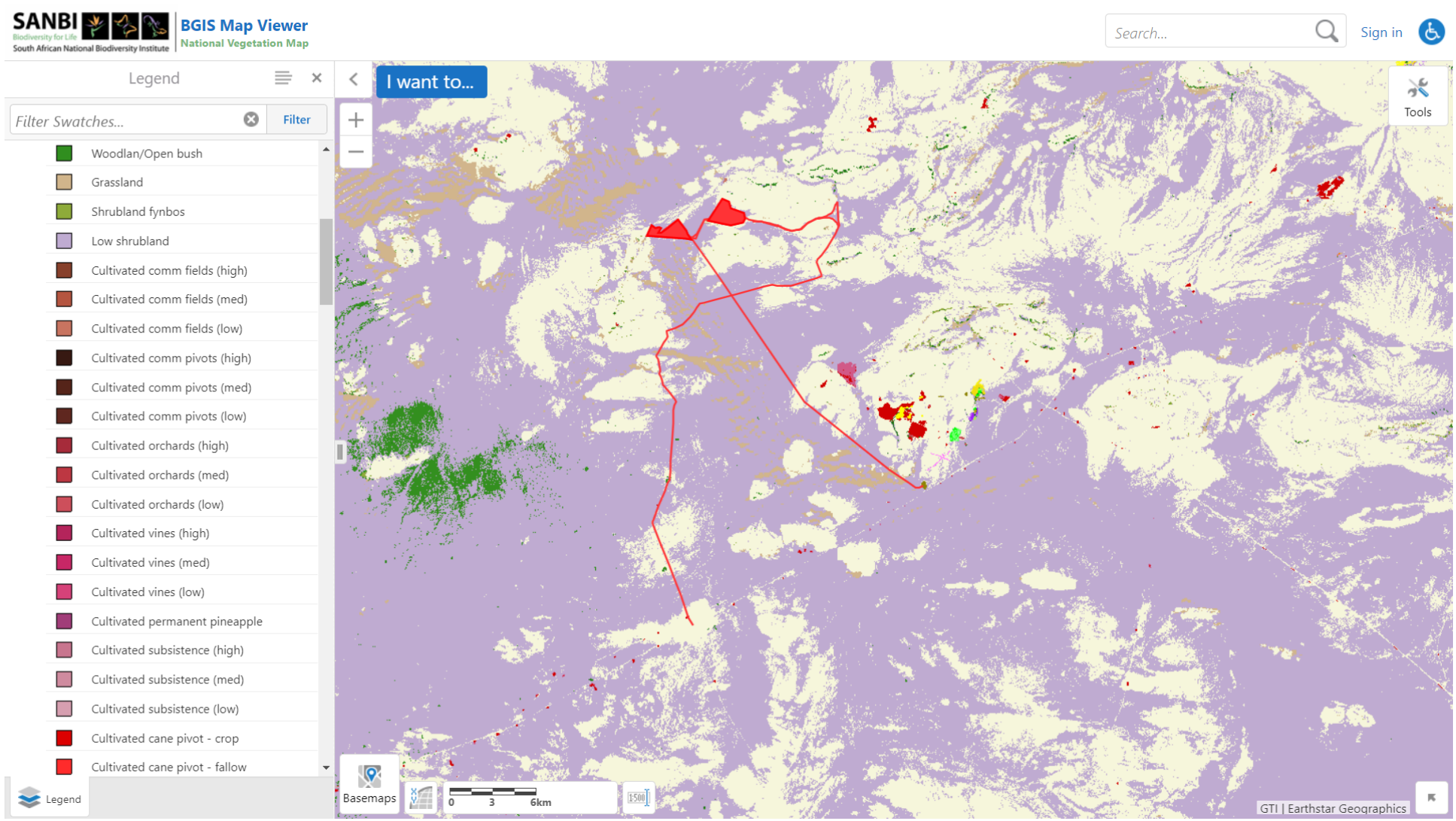


Figure 11. Land cover map for the area (CapeFarmMapper, 2019)

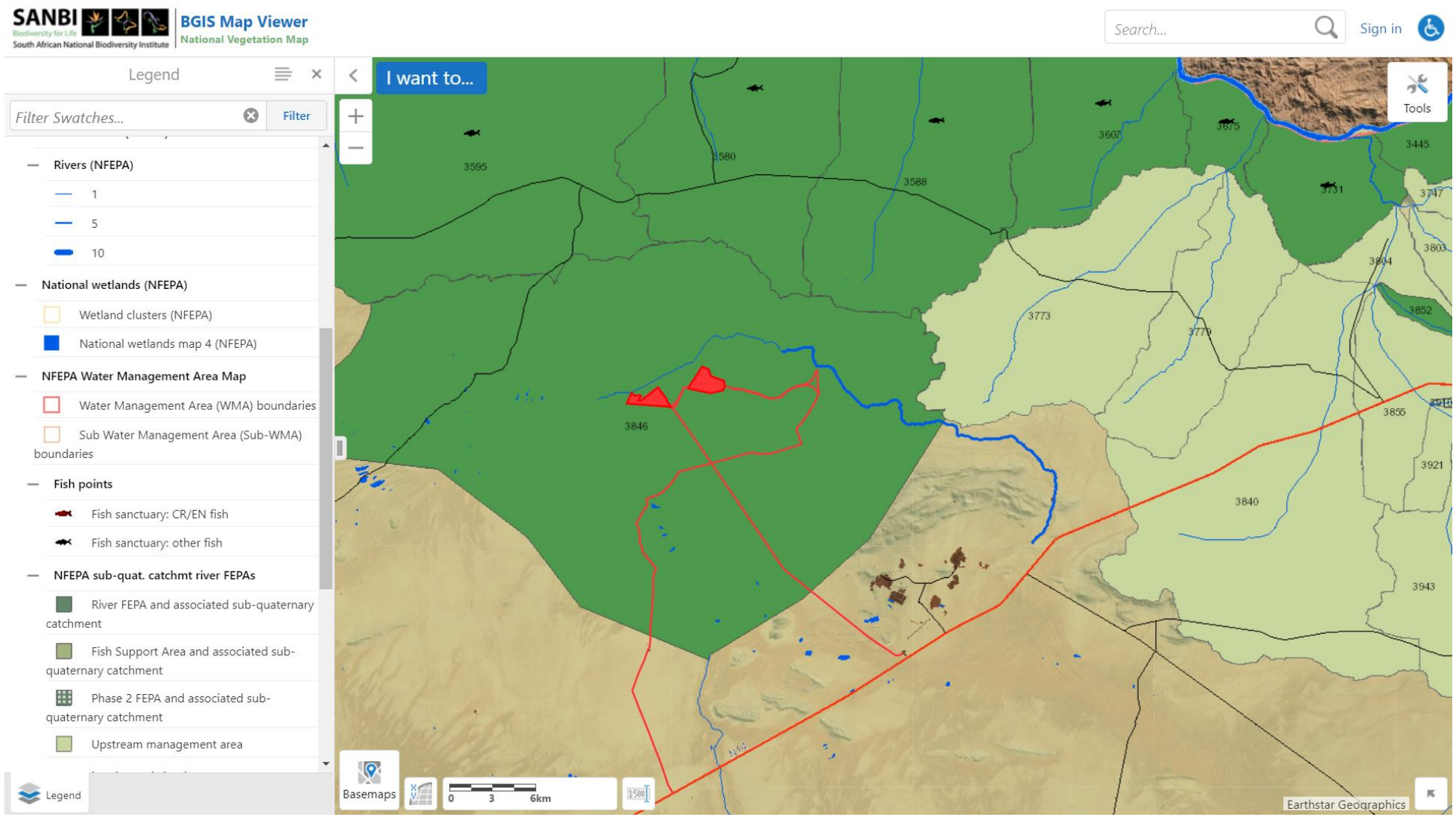


Figure 12. Freshwater Ecosystem Priority Areas for the study area (SANBI Biodiversity GIS, 2019)

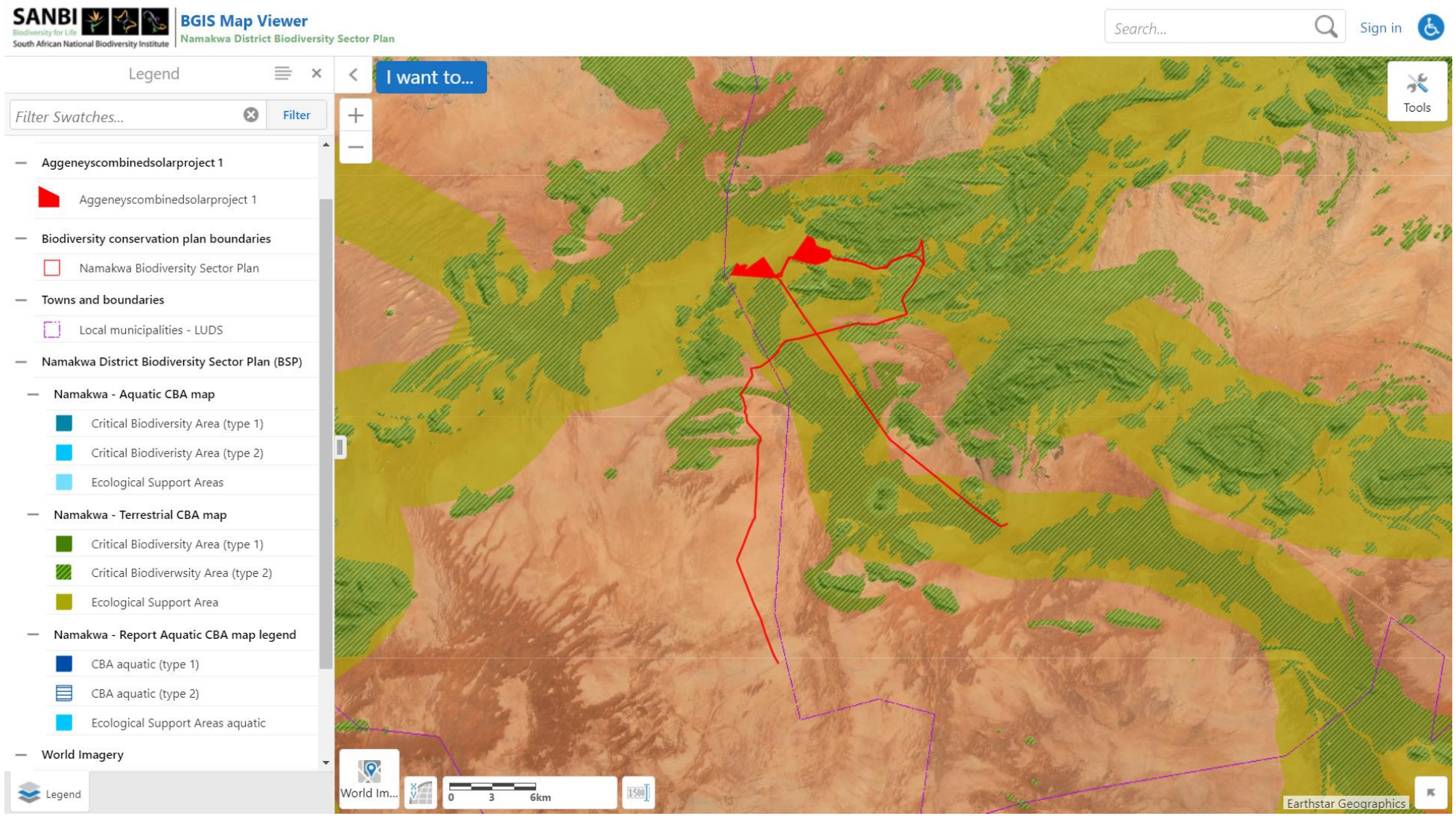


Figure 13. Namakwa Critical Biodiversity Areas map for the study area (SANBI Biodiversity GIS, 2019)

7. FRESHWATER ASSESSMENT OF THE STUDY AREA

The Index for Habitat Integrity (IHI) and a Site Characterisation were used to provide information on the ecological condition of the river systems within the study area.

7.1. RIVER CLASSIFICATION

In order to assess the condition and ecological importance and sensitivity of the rivers in the study area, it is necessary to understand how the rivers might have appeared under unimpacted conditions. This is achieved through classifying rivers according to their ecological characteristics, in order that it can be compared to ecologically similar rivers.

River typing or classification involves the hierarchical grouping of rivers into ecologically similar units so that inter- and intra-river variation in factors that influence water chemistry, channel type, substratum composition and hydrology are best accounted for. Any comparative assessment of river condition should only be done between rivers that share similar physical and biological characteristics under natural conditions. Thus, the classification of rivers provides the basis for assessing river condition to allow comparison between similar river types. The primary classification of rivers is a division into Ecoregions. Rivers within an ecoregion are further divided into sub-regions.

Ecoregions are groups of rivers within South Africa, which share similar physiography, climate, geology, soils and potential natural vegetation. For the purposes of this study, the ecoregional classification presented in Department of Water Affairs and Forestry in 1999, which divides the country's rivers into ecoregions, was used. The river assessed lies within the Nama Karoo Ecoregion, with the characteristics as described in Table 2.

Sub-regions (or geomorphological zones) are groups of rivers, or segments of rivers, within an ecoregion, which share similar geomorphological features, of which gradient is the most important. The use of geomorphological features is based on the assumption that these are a major factor in the determination of the distribution of the biota. Table 3provides the geomorphological features of the streams assessed.

Table 2. Characteristics of the Nama Karoo Ecoregion (Dominant Types In Bold)

Main Attributes	Description
Terrain Morphology: Broad division	Plains; Low Relief; Plains Moderate Relief; Lowlands; Hills and Mountains; Moderate and High Relief; Open Hills, Lowlands; Mountains; Moderate to High Relief; Closed Hills; Mountains; Moderate and High Relief
Vegetation types	Eastern Mixed Nama Karoo; Upper Nama Karoo; **Bushmanland Nama Karoo**; Orange River Nama Karoo
Altitude	300-1700 (m a.m.s.l)
MAP	0 to 500 (mm)
Rainfall seasonality	Late to very late summer to Winter
Mean annual temp.	12 to 20 (°C)
Median annual simulated runoff	<5 to 60 (mm) for quaternary catchment

7.2. RIVER/SITE CHARACTERISATION

All of the streams within the study area are ephemeral (only flowing for short periods of time following rainfall events) or endorheic (no outflow) and consist of shallow or poorly-defined channels with a gravel substrate. The smaller streams draining the inselberg do not have distinct riparian vegetation. As the streams flow out onto the plains the channels become wide and braided within deep alluvial sands. Tall bushman-grass and desert broom tend to

dominate within the river channel. Shepherd's trees often frequent the riparian zones. The perennial Orange River has distinct aquatic habitat with common reeds instream of a mix of trees and shrubs such as sweet-thorn, tamarisk and white karee dominating the riparian zone. From the Site Characterisation assessments, the geomorphological and physical characteristics of the tributaries can be classified as shown in Table 3.

Table 3. Geomorphological and Physical features

River	Smaller tributaries on the inselberg	Wider streams on the plains	Orange River
Geomorphological Zone	Lower foothill	Floodplain streams	Lowland river
Lateral mobility	Semi-confined to confined	Unconfined	Largely confined
Channel form	Simple to Complex	Complex	Complex
Channel pattern	Single & multiple thread: low sinuosity	Multiple thread: low sinuosity	Multiple thread: low sinuosity
Channel type	Alluvium with gravel/pebbles	Alluvium	Bedrock alluvium
Channel modification	Moderate to low modification (some grazing and instream impoundments)		Moderate modification
Hydrological type	Ephemeral		Perennial
Ecoregion	Nama Karoo		
DWA catchment	D82A and D82B (Orange River system)		
Vegetation type	Bushman Inselberg Shrubland and Bushmanland Arid Grassland	Bushman Arid and Sandy Grassland	Eastern Gariep Plains and Rocky Desert
Rainfall region	Late summer/early autumn		

7.3. INDEX OF HABITAT INTEGRITY

The evaluation of Index of Habitat Integrity (IHI) provides a measure of the degree to which a river has been modified from its natural state. This assessment was undertaken for the Orange River and its tributaries within the study area (Table 4 and 5). The methodology (DWAF, 1999) involves a qualitative assessment of the number and severity of anthropogenic perturbations on a river and the damage they potentially inflict upon the system. These disturbances include both abiotic and biotic factors, which are regarded as the primary causes of degradation of a river. The severity of each impact is ranked using a six-point scale with 0 (no impact) to 25 (critical impact).

The IHI assessment is based on an evaluation of the impacts of two components of the rivers, the riparian zone and the instream habitat. The total scores for the instream and riparian zone components are then used to place the habitat integrity of both in a specific habitat category.

Table 4. Index of Habitat Integrity Assessment for ephemeral tributaries of the Orange River

Instream Criteria	Weight	Score	Riparian Zone Criteria	Weight	Score
Water abstraction	14	4	Water abstraction	13	4
Flow modification	13	3	Inundations	11	4
Bed modification	13	6	Flow modification	12	3
Channel modification	13	4	Water quality	13	5
Water quality	14	5	Indigenous vegetation removal	13	6
Inundation	10	4	Exotic vegetation encroachment	12	5
Exotic macrophytes	9	0	Bank erosion	14	5
Exotic fauna	8	0	Channel modification	12	4
Solid waste disposal	6	2			
Category		B	Category		B/C

Table 5. Index of Habitat Integrity Assessment for the Orange River

Instream Criteria	Weight	Score	Riparian Zone Criteria	Weight	Score
Water abstraction	14	8	Water abstraction	13	8
Flow modification	13	8	Inundations	11	4
Bed modification	13	4	Flow modification	12	8
Channel modification	13	3	Water quality	13	6
Water quality	14	6	Indigenous vegetation removal	13	6
Inundation	10	4	Exotic vegetation encroachment	12	5
Exotic macrophytes	9	3	Bank erosion	14	4
Exotic fauna	8	5	Channel modification	12	3
Solid waste disposal	6	3			
Category		B/C	Category		B/C

The ephemeral streams within the study area are still in a largely natural ecological condition, with a modification of the habitat occurring as a result of the surrounding farming activities (livestock grazing) and direct habitat disturbance as a result of roads and other infrastructure development. The Orange River within the study area is in a largely natural to moderately modified condition largely due to upstream impacts on flow and water quality.

7.4. ECOLOGICAL IMPORTANCE AND SENSITIVITY (EIS)

EIS considers a number of biotic and habitat determinants surmised to indicate either importance or sensitivity. The determinants are rated according to a four-point scale (Table 6). The median of the resultant score is calculated to derive the EIS category (Table 9).

Table 6. Scale used to assess biotic and habitat determinants presumed to indicate either importance or sensitivity

Scale	Definition
1	One species/taxon judged as rare or endangered at a local scale.
2	More than one species/taxon judged to be rare or endangered on a local scale.
3	One or more species/taxon judged to be rare or endangered on a Provincial/regional scale.
4	One or more species/taxon judged as rare or endangered on a National scale (i.e. SA Red Data Books)

Table 7. Ecological importance and sensitivity categories (DWAF, 1999)

EISC	General description	Range of median
Very high	Quaternaries/delineations that are considered to be unique on a national and international level based on unique biodiversity (habitat & species diversity, unique species, rare and endangered species). These rivers (in terms of biota and habitat) are usually very sensitive to flow modifications and have no or only a small capacity for use.	>3-4
High	Quaternaries/delineations that are considered to be unique on a national scale based on their biodiversity (habitat diversity, species diversity, unique species, rare and endangered species). These rivers (in terms of biota and habitat) may be sensitive to flow modifications but in some cases may have substantial capacity for use.	>2-≤3
Moderate	Quaternaries/delineations that are considered to be unique on a provincial or local scale due to biodiversity (habitat diversity, species diversity, unique species, rare and endangered species). These rivers (in terms of biota and habitat) are not usually very sensitive to flow modifications and often have substantial capacity for use.	>1-≤2
Low/ marginal	Quaternaries/delineations that are not unique on any scale. These rivers (in terms of biota and habitat) are generally not very sensitive to flow modifications and usually have substantial capacity for use.	≤1

Table 8. Results of the EIS assessment

Biotic Determinants	Ephemeral tributaries of the Orange River	Orange River
Rare and endangered biota	1	3
Unique biota	2	2
Intolerant biota	2	1
Species/taxon richness	1	3
Aquatic Habitat Determinants		
Diversity of aquatic habitat types or features	1	3
Refuge value of habitat type	1.5	3
Sensitivity of habitat to flow changes	2	1.5
Sensitivity of flow related water quality changes	2	1
Migration route/corridor for instream and riparian biota	1.5	3
National parks, wilderness areas, Nature Reserves, Natural Heritage sites, Natural areas, PNEs	2	2
RATINGS	1.6	2.3
EIS CATEGORY	Moderate	High

The ecological importance and sensitivity of the ephemeral streams are considered to be moderate while the Orange River within the study area is considered of a high ecological importance and sensitivity. This is due to the fact that the river provides a 'green' corridor within an arid environment and provides important aquatic habitat. Endemic fish that occur in lower Orange River include river sardine (*Mesobola brevianalis*); largemouth yellowfish (*Labeobarbus kimberlyensis*) and Orange River mudfish (*Labeo capensis*). Amphibians recorded in the study area are Cape Sand Frog (*Tomopterna delalandii*), Paradise Toad *(Vandijkophrynus robonsoni*) and Marble Rubber Frog (*Phynomantis annectens*).

8. DESCRIPTION AND EVALUATION OF THE PROPOSED ACTIVITIES AND THEIR ALTERNATIVES

8.1. DESCRIPTION OF PROJECT ALTERNATIVES

The proposed Namakwa (Veld) Solar Facility will consist of two 75 MW PV facilities on the farm Haramoep (Remainder of Farm 53). The two PV facilities will also have their own substation that would connect onto an existing Eskom powerline. The PV facility will have numerous arrays of solar panels, internal access roads, an operations and maintenance building, an on-site substation (including switching yard), internal cabling laid underground when feasible, a loop-in loop-out line would be built between the facility and an existing Eskom transmission line to the east (approximately 150 m in length) and site access will mostly be via existing roads (widened to 6 m). In addition, it is proposed to construct a transmission line from the facility adjacent to the 220kV line to an existing substation in the south.

The alternatives being considered consist of the following:

Technology: PV technology alternatives consist of fixed or tracking PVs.

Alternative sites: No alternatives are being considered as part of this assessment as alternatives have already been discarded.

Layouts: The layouts being considered are indicated in Figure 14. These have been refined based on specialist input.

Transmission and Access routes: The possible routes are shown in Figure 15.

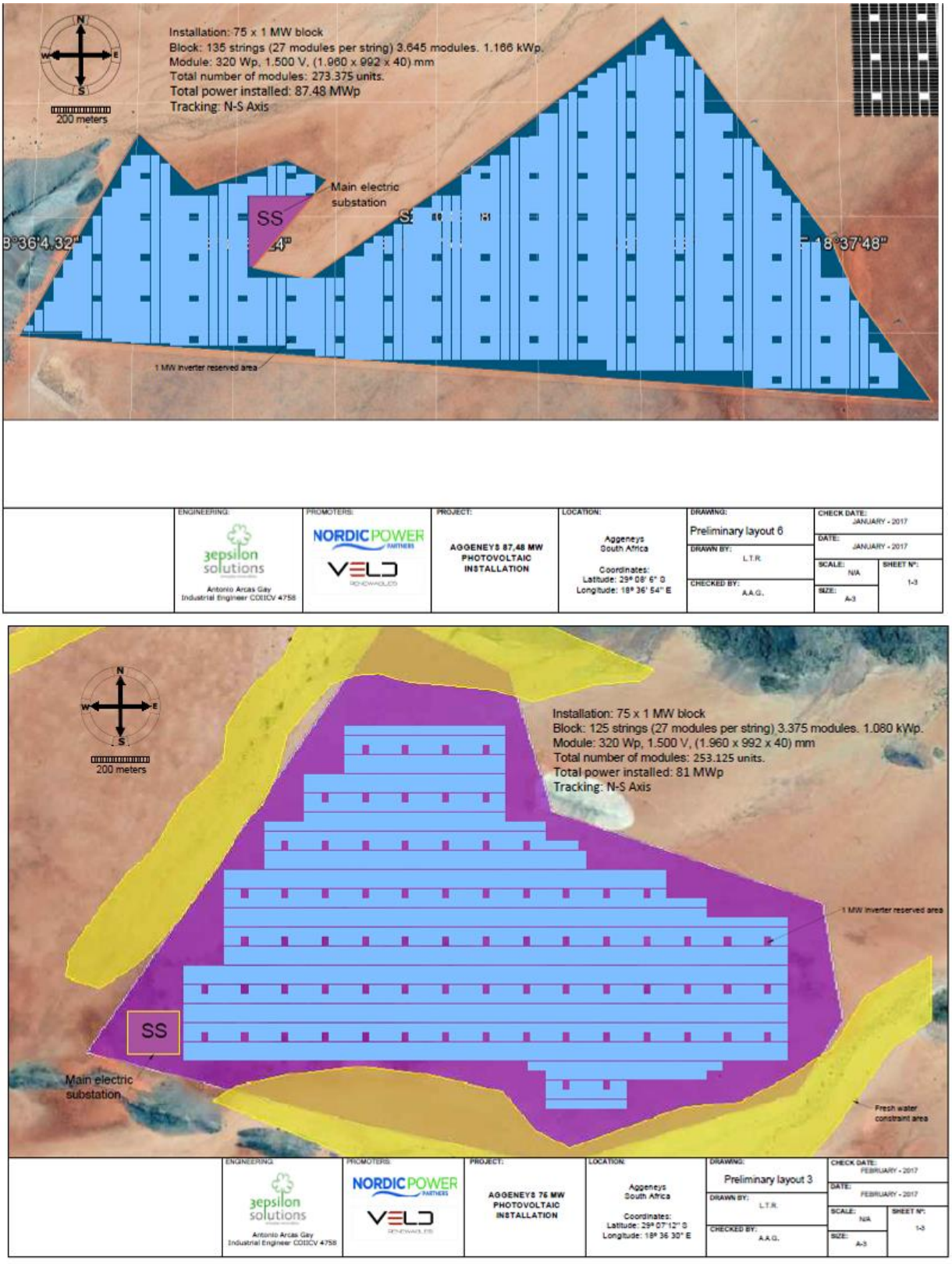


Figure 14. Proposed layouts for the PV North (top) and PV South (bottom) sites

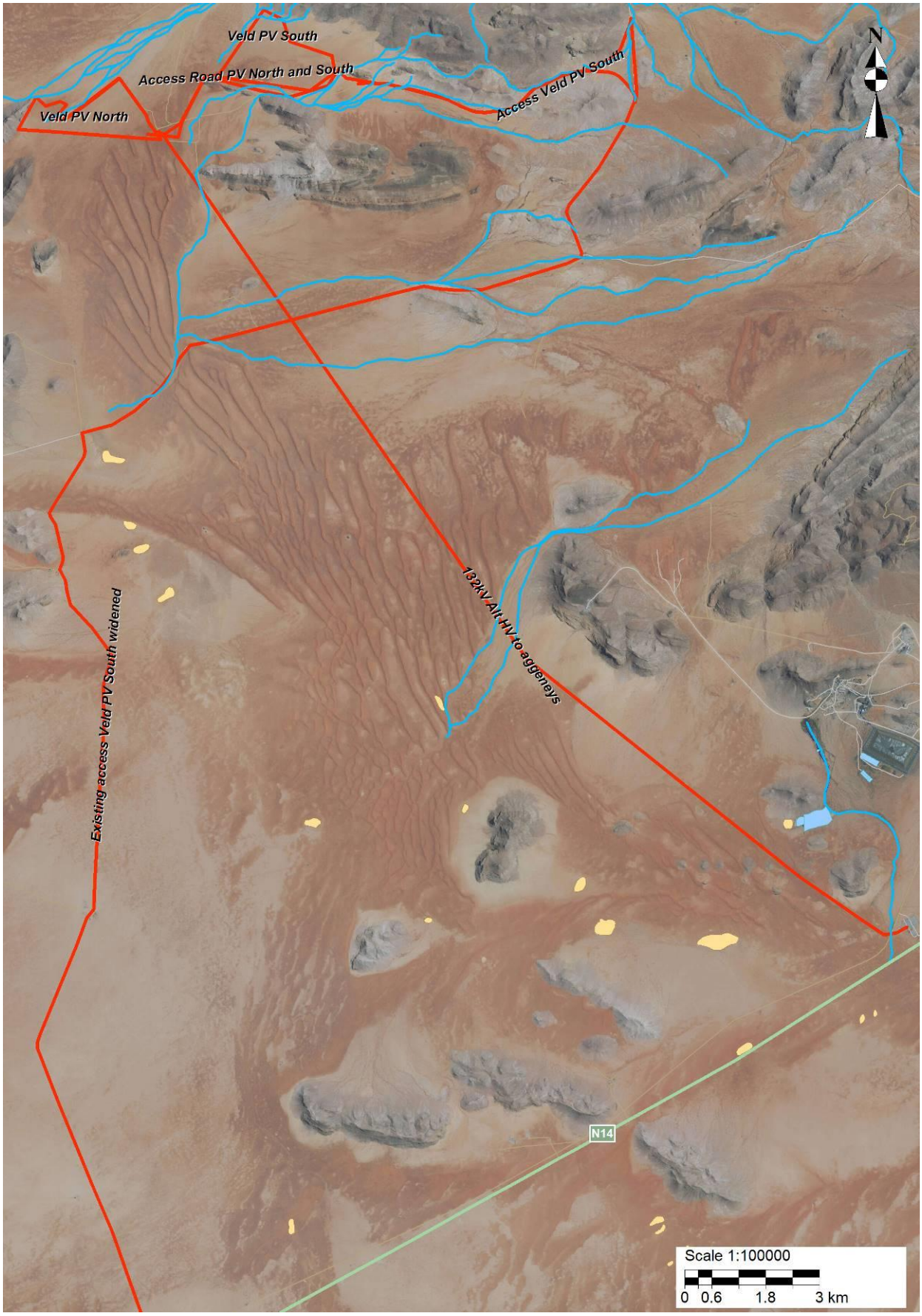


Figure 15. Proposed project components and the alternatives

8.2. FRESHWATER CONSTRAINTS

The proposed sites that were assessed are discussed in the following table per proposed activity and its alternatives:

Table 9. Assessment of Proposed Activities

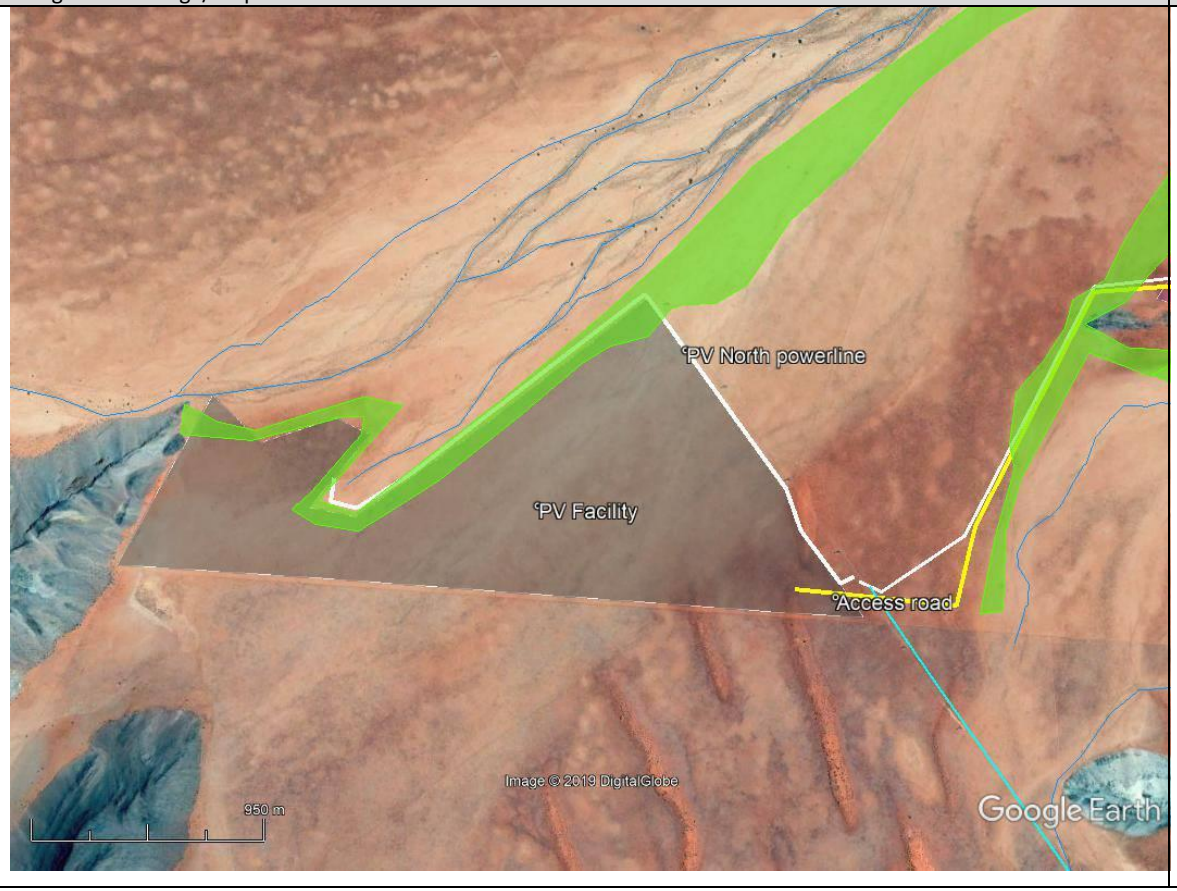
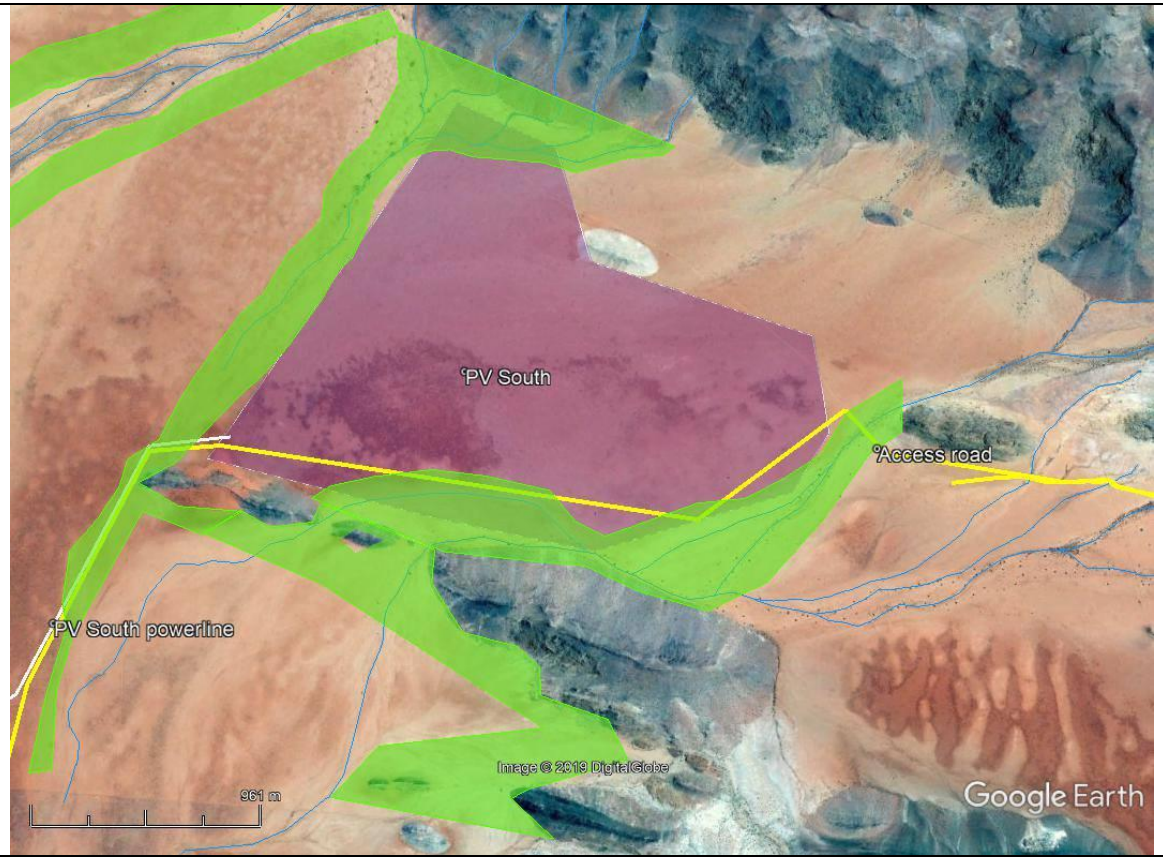
Activity	Google Earth image/Map	Comment
PV North Facility and associated infrastructure		Due to the wide and unconfined nature of the stream to the north of the site, it is recommended that a buffer of approximately 175m from top of bank of the stream, (narrowing down to about 100m in the downstream extent at the site where the watercourse becomes less significant) be allowed for as a development setback (green polygons). This riparian buffer zone of the stream contains a number of Shepherd trees, particularly on the stream's northern bank, that should also preferably remain. Some modules may need to be moved slightly to accommodate the recommended buffer. The smaller stream to the east of the PV site is much smaller in extent and a buffer of approximately 100m is recommended from the stream. The proposed access road and the powerline for PV North occur within this buffer and should be slightly realigned. Provided the PV facility is located outside of the freshwater features and recommended buffers, the technology alternatives would have limited potential freshwater impact. It is recommended that 1 in 50 year and 1 in 100 floodlines be determined for the site to ensure that the proposed infrastructure is located outside of these flood risk areas. The potential freshwater impacts of the PV facility area likely to be low with mitigation. Key mitigation measurements would be on-site stormwater management; limiting disturbance within freshwater features and buffers; and control of alien vegetation of the potential for erosion.

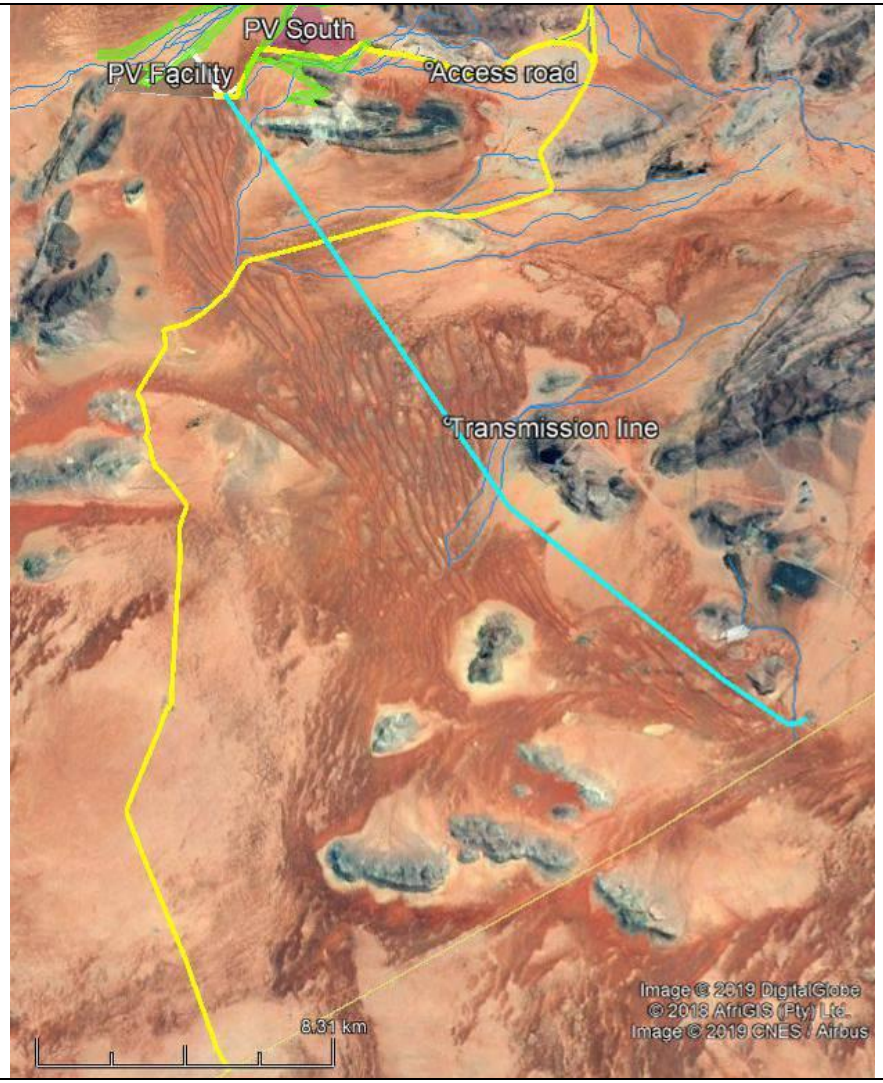
Table 10 *cont*. Assessment of Proposed Activities

PV South Facility and associated infrastructure		Smaller streams occur to the west and south-east of the proposed PV area. It is recommended that a buffer of approximately 100m (yellow polygons) from these streams be allowed for. There are not likely to be any constraints associated with the stream and its buffer to the west of the PV area. However, the stream to the south-east is wide and unconfined. It is recommended at the modules in this area be placed further away from the stream. As for PV North, the proposed access road and the powerline for PV South occur within this buffer and should be slightly realigned. Provided the PV facility is located outside of the freshwater features and recommended buffers, the technology alternatives would have limited potential freshwater impact. It is recommended that 1 in 50 year and 1 in 100 floodlines be determined for the site to ensure that the proposed infrastructure is located outside of these flood risk areas. The potential freshwater impacts of the PV facility area likely to be low with mitigation. Key mitigation measurements would be on-site stormwater management; limiting disturbance within freshwater features and buffers; and control of alien vegetation of the potential for erosion.

General comment for PV North and PV South:

The substation associated with the PV South facility is located outside of the freshwater features and recommended buffers however the substation for PV North should be moved slightly to outside of the recommended buffer. Provided the PV facilities and substations are located outside of the freshwater features and recommended buffers, the technology alternatives would have a very similar potential freshwater impact. The potential freshwater impacts of the PV facility area likely to be low, if properly mitigated. Key mitigation measurements would be on-site stormwater management; limiting disturbance within freshwater features and buffers; and control of alien vegetation of the potential for erosion.

Table 10 *cont.* Assessment of Proposed Activities

Access routes, transmission lines and pipelines:		**Access roads**: All of the roads are existing roads – either internal farm roads or larger public gravel roads. The potential freshwater impacts associated with the use of these roads for the proposed development is considered to be very low, provided the impacts are adequately mitigated. **Transmission lines**: The transmission line will need to cross a number of small ephemeral drainage lines however the potential impacts can be easily mitigated. No poles should be placed within any of the mapped aquatic features or 30m adjacent to the watercourses.

9. ASSESSMENT OF IMPACTS

This section provides an assessment of the overall potential impacts to freshwater ecosystems that are likely to be associated with the proposed activities. The assessment methodology as outlined in Appendix 3 was utilised to evaluate the identified potential impacts. The impact assessment and recommended mitigation measures are grouped according to the various proposed activities, that is, the proposed PV facilities, as well as the transmission lines and access routes.

9.1. DESCRIPTION AND ASSESSMENT OF IMPACTS OF PROPOSED ACTIVITIES

PV FACILITIES (NORTH AND SOUTH)

CONSTRUCTION PHASE ACTIVITIES

Nature of Impact: The proposed PV facilities will have a combined footprint of approximately 277 ha. Activities during the construction phase of the project could thus be expected to result from the clearing of natural vegetation cover and construction activities adjacent to the ephemeral streams and drainage lines.

Significance of impacts without mitigation: A localized shorter term impact of moderate intensity (depending on the extent of the activities and the distance between the construction activities and the freshwater features) that is expected to have a moderate to low overall significance in terms of its impact on the identified aquatic ecosystems in the area.

Proposed mitigation: Key mitigation measurements would be:

- On-site stormwater management to minimise the potential impact of modified stormwater runoff on the adjacent freshwater features;
- Limiting disturbance within freshwater features and buffers: The PV facilities should be moved to ensure that they are located outside of the freshwater features and recommended buffers. Construction activities should as far as possible be limited to the footprint of the proposed solar energy facilities. The proposed buffers adjacent to the delineated freshwater features as indicated in the previous section should be adhered to.
- Rehabilitation of the cleared areas and control of alien vegetation growth within the site
- All materials on the construction sites should be properly stored and contained. Disposal of waste from the sites should also be properly managed. Construction workers should be given ablution facilities at the construction sites that are located at least 100m away from the drainage lines/ephemeral streams and regularly serviced. These measures should be addressed, implemented and monitored in terms of the EMP for the construction phase.

Significance of impacts after mitigation: A localized, short-term impact will still occur during the construction phase; however, the overall significance of the impact on the aquatic ecosystems is expected to be low to very low.

OPERATION PHASE ACTIVITIES

Nature of Impact: The facilities are designed to operate continuously, largely unattended and with low maintenance requirements over the medium to long term. There would be basic operation and maintenance activities on site. The site should be decommissioned and cleared once the life-span of the technology is exceeded.

Significance of impacts without mitigation: A localized longer term impact of low to very low intensity that is expected to have a low to very low overall significance in terms of its impact on the identified aquatic ecosystems in the area.

Proposed mitigation: Operational activities should as far as possible be limited to the delineated site for the proposed development and the identified access routes. Invasive alien plant growth should be monitored on an ongoing basis to ensure that these disturbed areas do not become infested with invasive alien plants. Should any erosion features develop, they should be stabilised as soon as possible.

Significance of impacts after mitigation: A localized, long-term impact will still occur during the operational phase; however, the overall significance of the impact on the aquatic ecosystems is expected to be very low.

PV technology	Alternative A1		Alternative A2	
Short description	Fixed axis PV		Single axis tracking PV	
Description of alternative specific attributes	Modified surface runoff characteristics		Modified surface runoff characteristics	
List of negative impacts	Potential disturbance of aquatic habitat	Stormwater Runoff modification as a result of: Reduced surface roughness and increased hardening of surface	Potential disturbance of aquatic habitat	Stormwater Runoff modification as a result of: Reduced surface roughness and increased hardening of surface
List of positive impacts		Potential for minimising agricultural impacts on the streams and riparian zones		Potential for minimising agricultural impacts on the streams and riparian zones
List of potential mitigations	The solar facilities should be moved slightly to outside of the freshwater features and recommended buffers. Key mitigation measurements would be on-site stormwater management; limiting disturbance within freshwater features and buffers; and control of alien vegetation of the potential for erosion.		The solar facilities should be moved slightly to outside of the freshwater features and recommended buffers. Key mitigation measurements would be on-site stormwater management; limiting disturbance within freshwater features and buffers; and control of alien vegetation of the potential for erosion.	
Assessment				
Nature	Positive	Negative	Positive	Negative
Duration		Long term		Long term
Extent		Small		Small
Magnitude		Low		Low
Probability		Medium		Medium
Confidence		High		High
Reversibility		Reversible		Reversible
Resource irreplaceability		Low		Low
Mitigatability		High		High
Significance		Low		Low
Conclusion		Low negative impact		Low negative impact
Ranked preference (from 1-4)		1		1
Motivation for preferred alternative	Provided the PV facilities and substations are located outside of the freshwater features and recommended buffers, the technology alternatives would have a very similar potential freshwater impact.			

IMPACT OF THE TRANSMISSION LINES:

CONSTRUCTION PHASE ACTIVITIES

Nature of Impact: The proposed PV South and PV North powerline routes are located within the buffer areas adjacent to watercourses and should be realigned to remain outside of the buffers. The transmission line to Aggenys will need to cross a number of small drainage lines. It is however relatively easy to place the pylons of the line such that there is very limited disturbance of aquatic habitat.

Significance of impacts without mitigation: Limited freshwater impact that is of a very low significance.

Proposed mitigation: As stated above, PV South and PV North powerline routes should be realigned to remain outside of the buffers. The pylons for the Aggenys transmission line should be placed at least 30m outside of the delineated stream channels. Where the access route for transmission lines needs to be constructed through the drainage channels, disturbance of the channels should be limited. These areas should be rehabilitated after construction is complete and the areas monitored for growth of invasive alien plants.

Significance of impacts after mitigation: A localized, short-term impact will occur during the construction phase; however, the overall significance of the impact on the aquatic ecosystems is expected to be a very low impact.

OPERATION PHASE ACTIVITIES

Nature of Impact: An impact of very limited significance is expected on the ephemeral streams after the construction phase

Significance of impacts without mitigation: A localized longer term impact of low intensity that is expected to have a very low overall significance in terms of its impact on the identified aquatic ecosystems in the area.

Proposed mitigation: All crossings over drainage channels or stream beds after the construction phase should be rehabilitated and maintained such that the flow within the drainage channel is not impeded. Maintenance of transmission lines should only take place via the designated access routes. Invasive alien plant growth should be controlled within the site.

Significance of impacts after mitigation: A localized, long-term impact will still occur during the construction phase; however, the overall significance of the impact on the aquatic ecosystems is expected to be a very low impact.

Power lines	North PV Power line		South PV Power Line		Transmission line to Aggenys	
Short description	North site powerline along access road		South site powerline along access road		transmission line from the facility adjacent to the 220kV line to an existing substation in the south	
Description of alternative specific attributes	Within aquatic buffer		Within aquatic buffer		Crosses small drainage lines	
List of negative impacts	Potential disturbance of aquatic habitat		Potential disturbance of aquatic habitat		Potential disturbance of aquatic habitat	
List of positive impacts	None		None		None	
List of potential mitigations	The pylons for the transmission lines should be placed at least 30m outside of the delineated stream channels or outside buffers. Where the access route for transmission lines needs to be constructed through the drainage channels, disturbance of the channels should be limited. These areas should be rehabilitated after construction is complete and the areas monitored for growth of invasive alien plants.					
Assessment						
Nature	Positive	Negative	Positive	Negative	Positive	Negative
Duration		Long term		Long term		Long term
Extent		Small		Small		Small
Magnitude		Low		Low		Low

Probability		Low		Low		Low
Confidence		High		High		High
Reversibility		Reversible		Reversible		Reversible
Resource irreplaceability		Low		Low		Low
Mitigatability		High		High		High
Significance		Very low		Very low		Very low
Conclusion		Very low negative to negligible		Very low negative to negligible		Very low negative to negligible
Ranked preference (from 1-4)	Not applicable					
Motivation for preferred alternative		No alternative		No alternative		No alternative

IMPACT OF THE ACCESS ROUTES:

CONSTRUCTION PHASE ACTIVITIES

Nature of Impact: All the proposed access routes are established gravel roads or farm roads. The major impacts associated with the access roads relate to some potential loss of habitat within the streams or drainage lines and the potential invasive alien plant growth as well as the potential for flow and water quality impacts and the direct impacts on the soil (erosion of drainage channels). Due to the fact that the habitat and riparian vegetation associated with the ephemeral streams is negligible, as well as the frequency of flow in the stream, the impact can be expected to be minimal.

Significance of impacts without mitigation: A localized shorter term impact of low intensity that is expected to have a low to very low overall significance in terms of its impact on the identified aquatic ecosystems in the area.

Proposed mitigation: Existing road infrastructure should be utilized as far as possible to minimize the overall disturbance created by the proposed project. Where crossings associated with the access routes need to be constructed through ephemeral streams, disturbance of the channel should be limited. All crossings over drainage channels or stream beds should be such that the flow within the drainage channel is not impeded. Road infrastructure and transmission lines should coincide as much as possible to minimize the road network and impact of these activities. Any disturbed areas should be rehabilitated to ensure that these areas do not become subject to erosion or invasive alien plant growth.

Significance of impacts after mitigation: The overall significance of the impact on the aquatic ecosystems is expected to be a very low impact.

OPERATION PHASE ACTIVITIES

Nature of Impact: An impact of very low significance is expected. The major impacts associated with the access roads during the operation phase relate to disturbance to the instream and riparian habitat of the freshwater ecosystems along the designated routes.

Significance of impacts without mitigation: For the Concordia-Pella and N14 access roads, the potential impact is very low to negligible in terms of the significance impact on the identified aquatic ecosystems in the area. A more significant impact can be expected for the internal farm roads and in particular the road from the Northern Site.

Proposed mitigation: Maintenance of infrastructure related to the project should only take place via the designated access routes. Disturbed areas along the access routes should be monitored to ensure that these areas do not become subject to erosion or invasive alien plant growth.

Significance of impacts after mitigation: A localized, longer-term impact will occur during the operation phase; however, the overall significance of the impact on the aquatic ecosystems is expected to be a negligible.

Access routes	Widening of access to site		Construction of on-site access	
Short description	Existing access road from the N14 to be widened		Existing farm road to be upgraded and extended to PV North and South	
Description of alternative specific attributes (environmental / socioeconomic / Technical and financial)	Existing gravel road that crosses a number of small streams and drainage lines		Existing gravel road that crosses a number of small streams and drainage lines	
List of negative impacts	Potential disturbance of aquatic habitat and flow modification		Potential disturbance of aquatic habitat and flow modification	
List of positive impacts	No significant new disturbance		No significant new disturbance	
List of potential mitigations	Existing road infrastructure should be utilized as far as possible to minimize the overall disturbance created by the proposed project. Where crossings associated with the access routes need to be constructed through ephemeral streams, disturbance of the channel should be limited. All crossings over drainage channels or stream beds should be such that the flow within the drainage channel is not impeded. Road infrastructure and transmission lines should coincide as much as possible to minimize the road network and impact of these activities. Any disturbed areas should be rehabilitated to ensure that these areas do not become subject to erosion or invasive alien plant growth.			
Assessment				
Nature	Positive	Negative	Positive	Negative
Duration		Long term		Long term
Extent		Small		Small
Magnitude		Low		Low
Probability		Low		Low
Confidence		High		High
Reversibility		Reversible		Reversible
Resource irreplaceability		Low		Low
Mitigatability		Low		Low
Significance				
Conclusion		Very low negative to negligible		Very low negative to negligible
Ranked preference (from 1-4)	Not applicable			
Motivation for preferred alternative	No alternative			

9.2. CUMULATIVE IMPACT OF THE ACTIVITIES ON FRESHWATER ECOSYSTEMS:

Land use in the study area currently consists of primarily of livestock (sheep) farming with natural areas. Due to the arid nature of the area, the carrying capacity of the land is low and livestock numbers in general are low. The land and climate are also not conducive to the cultivation of crops and pastures. Current land and water use impacts on the

ephemeral streams are low. Due to the ephemeral character of these surface water systems, they are also slow to recover from any impacts.

The nature of the power projects allows them to have minimal impact on the surface water features with the correct mitigation measures (as are recommended in this report). Erosion and sedimentation from the project activities, together with the potential for invasive alien plant growth and the possible modification of surface water runoff and water quality may lead to additional impacts on the freshwater habitats within the study area. It is recommended that the proposed activities for this project are placed outside of the identified freshwater features. Provided the construction and operation activities of the projects remain contained within the allocated areas and any disturbed areas within the freshwater features rehabilitated, the overall impact should be limited and of a low significance.

9.3. "NO GO" ALTERNATIVE:

The site is likely to remain available to the farmers as rangeland or retained as wilderness area. These activities are all largely at a small scale and have a low impact on the freshwater features in the study area. The tributaries of the Orange River within the study area can therefore be expected to remain in their current state of largely natural under the existing land use activities. There are however patches of relatively dense invasive alien mesquite growth that should be monitored and managed. the No-Go Alternative will be of very low significance to being insignificant.

10. RISK ASSESSMENT

A preliminary risk assessment was carried out for the proposed activities (summary in Table 10) to inform the water use authorisation process. The full risk assessment matrix can be seen in Appendix 5.

Table 10. Risk assessment for the proposed project activities

Phases	Activity	Aspect	Impact	Significance	Risk Rating	Adjusted Risk Rating
Construction	Construction PV North	Construction adjacent to a watercourse to north-west	Disturbance/loss of aquatic habitat, flow and water quality modification, facilitating erosion and spread of alien vegetation	57	M/L	L
	Construction PV South	Construction adjacent to watercourses to west and east		57	M/L	L
	Construction access road from N14	Widen existing road at drainage feature crossings		42	L	L
	Construction PV North and South Access	Upgrade and extend existing farm road with watercourse crossings		68.25	M/L	L
	Construction PV North and South powerlines	Construction adjacent to watercourses		35.75	L	L
	Construction of transmission line to south	Transmission line will need to cross drainage features		35.75	L	L
Operation	Maintenance of infrastructure	Disturbance related to infrastructure maintenance		42	L	L

The risk rating, (where Low (L) risk has a significance score of 1-55 and Moderate risk (M) has a score of 56-169) of the proposed activities is considered to be moderate to low. The risks are of such a nature that if the proposed activities

are properly mitigated and managed as recommended in this report, a low risk of impacting on the aquatic features is deemed likely. The proposed activity with mitigation, would thus meet with the General Authorisations for Section 21 (c) and (i) water uses.

11. CONCLUSIONS AND RECOMMENDATIONS

The main freshwater features within the study area consist of the following:

- a network of ephemeral streams that drain the inselbergs to form larger tributaries that drain northwards into the Orange River; and
- wide wash-like systems that drain the plains

The ephemeral streams within the study area are still in a largely natural ecological condition, with a modification of the habitat occurring as a result of the surrounding farming activities (livestock grazing) and direct habitat disturbance as a result of roads and other infrastructure development. The Orange River within the study area is in a largely natural to moderately modified condition largely due to upstream impacts on flow and water quality. Current land and water use impacts on the ephemeral streams are low. Due to the ephemeral character of these surface water systems, they are also slow to recover from any impacts.

The ecological importance and sensitivity of the ephemeral streams are considered to be moderate while the Orange River within the study area is considered of a high ecological importance and sensitivity. This is due to the fact that the river provides a 'green' corridor within an arid environment and provides important aquatic habitat.

The Orange River and its tributaries in the north of the study area have been identified as FEPA Rivers while the Orange River is also considered a Fish FEPA. The valley bottom wetlands along the Orange River are also mapped as FEPA wetland areas. The only aquatic feature identified as part of the Namakwa Critical Biodiversity Areas mapping as being of biodiversity conservation importance is the valley bottom wetland areas associated with the Orange River. The ecological corridors that are associated with the smaller tributaries within the unique terrestrial vegetation associated with the inselberg are included in the terrestrial CBAs.

The nature of the power projects allows them to have minimal impact on the surface water features with the correct mitigation measures (as are recommended in this report). Erosion and sedimentation from the project activities, together with the potential for invasive alien plant growth and the possible modification of surface water runoff and water quality may lead to additional impacts on the freshwater habitats within the study area. The proposed activities for this project are recommended to be located outside of the identified freshwater features. Provided the construction and operation activities of the projects remain contained within the allocated areas and any disturbed areas within the freshwater features rehabilitated, the overall impact should be limited and of a low significance.

Due to the wide and unconfined nature of the stream to the north of the PV North site, it is recommended that a buffer of approximately 175m from top of bank of the stream, narrowing to about 100m downstream, be allowed for as a development setback. Some modules may need to be moved slightly to accommodate the recommended buffer. The smaller stream to the east of the PV site is much smaller in extent and a buffer of approximately 100m is recommended from the stream. The proposed access road and the powerline for PV North occur within this buffer and should be slightly realigned.

Smaller streams occur to the west and south-east of the proposed PV South area. It is recommended that a buffer of approximately 100m from these streams be allowed for. In addition, the stream to the south-east of the site is wide and unconfined. It is recommended at the modules in this area be placed further away from the stream. As for PV

North, the proposed access road and the powerline for PV South occur within this buffer and should be slightly realigned.

The potential freshwater impacts of the PV facility area likely to be low with mitigation. Key mitigation measurements would be on-site stormwater management; limiting disturbance within freshwater features and buffers; and control of alien vegetation of the potential for erosion. Provided the PV facilities are located outside of the freshwater features and recommended buffers, the technology alternatives would have limited potential freshwater impact. It is recommended that 1 in 50 year and 1 in 100 floodlines be determined for the PV sites to ensure that the proposed infrastructure is located outside of these flood risk areas.

All of the proposed access roads are associated with existing roads – either internal farm roads or larger public gravel roads. The potential freshwater impacts associated with the use of these roads for the proposed development is considered to be very low, provided the impacts are adequately mitigated.

The proposed transmission line to the south will need to cross a number of small ephemeral drainage lines however the potential impacts can be easily mitigated. No poles should be placed within any of the mapped aquatic features or 30m adjacent to the watercourses.

The risk rating for the proposed activities is considered to be moderate to low. The risks are of such a nature that if the proposed activities are properly mitigated and managed as recommended in this report, a low risk of impacting on the aquatic features is deemed likely. The proposed activity with mitigation, would thus meet with the General Authorisations for Section 21 (c) and (i) water uses.

Recommended mitigation measures are as follows:

PV Facilities: The solar facilities should be moved slightly to outside of the freshwater features and recommended buffers. Key mitigation measurements would be on-site stormwater management; limiting disturbance within freshwater features and buffers; and control of alien vegetation of the potential for erosion.

Access roads: Existing road infrastructure should be utilized as far as possible to minimize the overall disturbance created by the proposed project. Where crossings associated with the access routes need to be constructed through ephemeral streams, disturbance of the channel should be limited. All crossings over drainage channels or stream beds should be such that the flow within the drainage channel is not impeded. Road infrastructure and transmission lines should coincide as much as possible to minimize the road network and impact of these activities. Any disturbed areas should be rehabilitated to ensure that these areas do not become subject to erosion or invasive alien plant growth.

Powerlines: The pylons for the transmission lines should be placed at least 30m outside of the delineated stream channels or outside buffers. Where the access route for transmission lines needs to be constructed through the drainage channels, disturbance of the channels should be limited. These areas should be rehabilitated after construction is complete and the areas monitored for growth of invasive alien plants.

Longer term maintenance and management: Stormwater and good housekeeping measures onsite to prevent flow and quality impacts on adjacent streams. Monitor and manage for invasive alien plant growth and erosion of stream channels. Maintain any culvert structures within watercourses.

From a freshwater perspective, there is no reason why the proposed Veld PV Solar Energy Facility, as well as the associated access roads and transmission lines should not be approved.

12. REFERENCES

Aurecon. 2016. Environmental Impact Assessment for a proposed Combined Solar Technology Facility, consisting of 150 MW of Concentrated Solar Power and 150 MW (2x 75 MW) of Photovoltaic Power within a Renewable Energy Development Zone in the Northern Cape: Specialist Information Pack

Department of Water Affairs and Forestry. (1999). *Resource Directed Measures for Protection of Water Resources. Volume 3: River Ecosystems Version 1.0*. Resource Directed Measures for Protection of Water Resources, Pretoria, South Africa.

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

Department of Water Affairs and Forestry. (2007). *River Ecoclassification: Manual for Ecostatus Determination (Version 2)*. Water Research Commission Report Number KV 168/05. Pretoria.

Driver, A., Nel, J., Snaddon, K. Murray, K., Roux, D., and Hill, L. (2011). *Implementation Manual for Freshwater Ecosystem Priority Areas* Report to the Water Research Commission Draft for NFEPA Steering Committee.

Kleynhans, CJ, Thirion, C and Moolman, J (2005). *A Level I River Ecoregion classification System for South Africa, Lesotho and Swaziland.* Report No. N/0000/00/REQ0104. Resource Quality Services, Department of Water Affairs and Forestry, Pretoria, South Africa.

Kleynhans CJ, Louw MD, Graham M. (2008). *Module G: EcoClassification and EcoStatus determination in River EcoClassification: Index of Habitat Integrity (Section 1, Technical manual)* Joint Water Research Commission and Department of Water Affairs and Forestry report. WRC Report No. TT 377-08

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

SANBI Biodiversity GIS: http://bgis.sanbi.org/

APPENDIX 1: DETAILS OF SPECIALIST AND DECLARATION OF INTEREST

environmental affairs
Department:
Environmental Affairs
REPUBLIC OF SOUTH AFRICA

DETAILS OF SPECIALIST AND DECLARATION OF INTEREST

	(For official use only)
File Reference Number:	
NEAS Reference Number:	DEAT/EIA/
Date Received:	

Application for authorisation in terms of the National Environmental Management Act, 1998 (Act No. 107 of 1998), as amended and the Environmental Impact Assessment Regulations, 2010

PROJECT TITLE

ENVIRONMENTAL IMPACT ASSESSMENT FOR THE PROPOSED VELD PV SOLAR ENERGY FACILITY, NAMAKWA DISTRICT, NORTHERN CAPE			
Specialist:	BlueScience (Pty) Ltd		
Contact person:	Antonia Belcher		
Postal address:	Po Box 455, Somerset Mall		
Postal code:	7137	Cell:	082 883 8055
Telephone:	021 851 0555	Fax:	
E-mail:	toni@bluescience.co.za		
Professional affiliation(s) (if any)	South African council for Natural Scientific Professions (Pr. Nat. Sc. 400040/10 for Environmental and Ecological Science)		

Project Consultant:	Aurecon South Africa Pty (Ltd)		
Contact person:	Simon Clark		
Postal address:	PO Box 494, Cape Town		
Postal code:	8000	Cell:	084 614 7800
Telephone:	021 526 6034	Fax:	086 609 6359
E-mail:	Simon.Clark@aurecongroup.com		

4.2 The specialist appointed in terms of the Regulations

I, Antonia Belcher, declare that --

General declaration:

- I act as the independent specialist in this application
- I will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant
- I declare that there are no circumstances that may compromise my objectivity in performing such work;
- I have expertise in conducting the specialist report relevant to this application, including knowledge of the Act, regulations and any guidelines that have relevance to the proposed activity;
- I will comply with the Act, regulations and all other applicable legislation;
- I have no, and will not engage in, conflicting interests in the undertaking of the activity;
- I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing - any decision to be taken with respect to the application by the competent authority; and - the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority;
- All the particulars furnished by me in this form are true and correct; and
- I realise that a false declaration is an offence in terms of Regulation 71 and is punishable in terms of section 24F of the Act.

Signature of the specialist:

Name of company (if applicable): BlueScience (Pty) Ltd

Date: 15 July 2019

APPENDIX 2: ATTACHED CURRICULUM VITAE:

Contact details: PO Box 455, Somerset Mall, 7137

Name: Ms Antonia Belcher

Profession: Ms Antonia Belcher (Aquatic Scientist *Pr. Sci. Nat.* 400040/10);

Fields of Expertise: Specialist in environmental water requirements, river and wetland monitoring and reporting.

Relevant work experience:

Due to Ms Belcher's involvement in the development and implementation of the River Health Programme as well as the Resource Directed Measures (RDM) directorate of the Department of Water Affairs in the Western Cape, she have been a key part of the team that has undertaken six catchment or area wide 'state-of-river' assessments as well as routine monitoring and specialised assessments of rivers and wetlands in all the major catchments in the Western Cape. Ms Belcher and Mr Grobler have also undertaken the River Health Monitoring for the Free State Region in 2011 and 2012.

Relevant publications:

- Freshwater Assessment for the proposed New 132 kV power lines from the Sekgame Switching Station to the existing Bulkop and Sishen power lines, Northern Cape, 2016
- Freshwater Assessment for the proposed Eskom Kimberley Strengthening Phase 4 Project: Beta to Boundary; Boundary to Ulco; Ulco to Manganore; and Manganore to Ferrum, 2014.
- Desktop Freshwater Assessment: Proposed Garob Wind Energy Facility, Located near Copperton in the Northern Cape Province. 2014.
- Freshwater Review of the Proposed Augrabies Photovoltaic Power Project at Farm Rooipad 15 Portion 9, Augrabies, Northern Cape Province, 2012.
- Freshwater Assessment for the Proposed Mulilo Photovoltaic and Wind Energy Facilities near De Aar. 2012.
- Freshwater Assessment for the Proposed construction of two 132kV transmission lines from the Maanhaarberg and Damfontein Wind Energy Facilities (De Aar 1) near De Aar, Northern Cape, 2012.
- Freshwater Assessment for the Proposed construction of two 132kV transmission lines from the South & North Wind Energy Facilities on the Eastern Plateau (De Aar 2) near De Aar, Northern Cape, 2012.
- Freshwater Review of the Proposed Augrabies Photovoltaic Power Project at Farm Rooipad 15 Portion 9, Augrabies, Northern Cape Province. 2012.
- Freshwater Assessment for the Proposed Wind and Solar Energy Facilities near Springbok. 2012.

APPENDIX 3: METHODOLOGY FOR IMPACT ASSESSMENT

Methodology for determining and ranking potential environmental impacts and risks:

CRITERIA	CATEGORY	DESCRIPTION
Extent or spatial influence of impact	**National**	Beyond a 20km radius of the site
	Regional	Within a 20 km radius of the site
	Local	Within a 2 km radius of the centre of the site
	Site specific	On site or within the boundaries of the property
	None	None
Magnitude of impact (at the indicated spatial scale)	**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
	None	Natural and/ or social functions and/ or processes remain *unaltered*
Duration of impact	**None**	Zero time
	Short Term	Up to 18 months
	Medium Term	0-5 years (after operation)
	Long Term	5- 10 years (after operation)
	Permanent	More than 10 years (after operation)
Probability	**Definite**	Estimated greater than 95 % chance of the impact occurring.
	Very likely	Estimated 50 to 95% chance of the impact occurring
	Fairly likely	Estimated 5 to 50 % chance of the impact occurring.
	Unlikely	Estimated less than 5 % chance of the impact occurring.
	None	Definitely no chance of occurrence
Confidence	**Certain**	Wealth of information on and sound understanding of the environmental factors potentially influencing 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	**Irreversible**	The activity will lead to an impact that is permanent.
	Reversible	The impact is reversible, within a period of 10 years.
Irreplaceability	**Low**	The resource is not damaged irreparably or is not scarce
	Medium	The resource is damaged irreparably but is represented elsewhere
	High	The resource is irreparably damaged and is not represented elsewhere

APPENDIX 4: PRESENT ECOLOGICAL STATUS AND ECOLOGICAL IMPORTANCE AND SENSITIVITY OF RIVERS

SELECT SQ REACH	SQR NAME	LENGTH km	STREAM ORDER	PES ASSESSED BY XPERTS? (IF TRUE="Y")	REASONS NOT ASSESSED	PES CATEGORY DESCRIPTION	PES CATEGORY BASED ON MEDIAN OF METRICS
D82A-03580	(only Orange)	18.20	7	Y		LARGELY NATURAL	B
MEAN EI CLASS	**MEAN ES CLASS**	**DEFAULT ECOLOGICAL CATEGORY (DEC)**	**RECOMMENDED ECOLOGICAL CATEGORY (REC)**				
HIGH	HIGH	B	0.00				

PRESENT ECOLOGICAL STATE		ECOLOGICAL IMPORTANCE				ECOLOGICAL SENSITIVITY	
INSTREAM HABITAT CONTINUITY MOD	SMALL	FISH SPP/SQ	11.00	INVERT TAXA/SQ	51.00	FISH PHYS-CHEM SENS DESCRIPTION	HIGH
RIP/WETLAND ZONE CONTINUITY MOD	SMALL	FISH: AVERAGE CONFIDENCE	1.00	INVERT AVERAGE CONFIDENCE	2.84	FISH NO-FLOW SENSITIVITY DESCRIPTION	HIGH
POTENTIAL INSTREAM HABITAT MOD	SMALL	FISH REPRESENTIVITY PER SECONDARY: CLASS	HIGH	INVERT REPRESENTIVITY PER SECONDARY,	VERY HIGH	INVERT PHYS-CHEM SENS DESCRIPTION	VERY HIGH
RIPARIAN-WETLAND ZONE MOD	SMALL	FISH REPRESENTIVITY PER SECONDARY: CLASS	HIGH	INVERT RARITY PER SECONDARY: CLASS	LOW	INVERTS VELOCITY SENSITIVITY	VERY HIGH
POTENTIAL FLOW MOD ACT.	SERIOUS	FISH RARITY PER SECONDARY: CLASS	LOW	ECOLOGICAL IMPORTANCE: RIPARIAN-WETLAND-INSTREAM VERTEBRATES (EX FISH) RATING	HIGH	RIPARIAN-WETLAND INSTREAM VERTEBRATES (EX FISH) INTOLERANCE WATER LEVEL/FLOW CHANGES DESCRIPTION	HIGH
POTENTIAL PHYSICO-CHEMICAL MOD ACTIVITIES	MODERATE	ECOLOGICAL IMPORTANCE: RIPARIAN-WETLAND-INSTREAM VERTEBRATES (EX FISH) RATING	HIGH	HABITAT DIVERSITY CLASS		STREAM SIZE SENSITIVITY TO MODIFIED FLOW/WATER LEVEL CHANGES DESCRIPTION	LOW
		RIPARIAN-WETLAND NATURAL VEG RATING BASED ON % NATURAL VEG IN 500m (100%=5)	VERY HIGH	HABITAT SIZE (LENGTH) CLASS	LOW	RIPARIAN-WETLAND VEG INTOLERANCE TO WATER LEVEL CHANGES DESCRIPTION	MODERATE
		RIPARIAN-WETLAND NATURAL VEG IMPORTANCE BASED ON EXPERT RATING	LOW	INSTREAM MIGRATION LINK CLASS	VERY HIGH		
				RIPARIAN-WETLAND ZONE MIGRATION LINK	VERY HIGH		
				RIPARIAN-WETLAND ZONE HABITAT INTEGRITY CLASS	VERY HIGH		
				INSTREAM HABITAT INTEGRITY CLASS	VERY HIGH		

SELECT SQ REACH	SQR NAME	LENGTH km	STREAM ORDER	PES ASSESSED BY XPERTS? (IF TRUE="Y")	REASONS NOT ASSESSED	PES CATEGORY DESCRIPTION	PES CATEGORY BASED ON MEDIAN OF METRICS
D82C-03846	0.00	46.51	1	0.00	Ephemeral		
MEAN EI CLASS	**MEAN ES CLASS**	**DEFAULT ECOLOGICAL CATEGORY (DEC)**	**RECOMMENDED ECOLOGICAL CATEGORY (REC)**				
MODERATE			0.00				

PRESENT ECOLOGICAL STATE		ECOLOGICAL IMPORTANCE				ECOLOGICAL SENSITIVITY	
INSTREAM HABITAT CONTINUITY MOD	NONE	FISH SPP/SQ		INVERT TAXA/SQ		FISH PHYS-CHEM SENS DESCRIPTION	
RIP/WETLAND ZONE CONTINUITY MOD	NONE	FISH: AVERAGE CONFIDENCE		INVERT AVERAGE CONFIDENCE		FISH NO-FLOW SENSITIVITY DESCRIPTION	
POTENTIAL INSTREAM HABITAT MOD	NONE	FISH REPRESENTIVITY PER SECONDARY: CLASS		INVERT REPRESENTIVITY PER SECONDARY,		INVERT PHYS-CHEM SENS DESCRIPTION	
RIPARIAN-WETLAND ZONE MOD	NONE	FISH REPRESENTIVITY PER SECONDARY: CLASS		INVERT RARITY PER SECONDARY: CLASS		INVERTS VELOCITY SENSITIVITY	
POTENTIAL FLOW MOD ACT.	NONE	FISH RARITY PER SECONDARY: CLASS		ECOLOGICAL IMPORTANCE: RIPARIAN-WETLAND-INSTREAM VERTEBRATES (EX FISH) RATING	VERY LOW	RIPARIAN-WETLAND-INSTREAM VERTEBRATES (EX FISH) INTOLERANCE WATER LEVEL/FLOW CHANGES DESCRIPTION	VERY LOW
POTENTIAL PHYSICO-CHEMICAL MOD ACTIVITIES	NONE	ECOLOGICAL IMPORTANCE: RIPARIAN-WETLAND-INSTREAM VERTEBRATES (EX FISH) RATING	VERY LOW	HABITAT DIVERSITY CLASS	MODERATE	STREAM SIZE SENSITIVITY TO MODIFIED FLOW/WATER LEVEL CHANGES DESCRIPTION	
		RIPARIAN-WETLAND NATURAL VEG RATING BASED ON % NATURAL VEG IN 500m (100%=5)	VERY HIGH	HABITAT SIZE (LENGTH) CLASS	MODERATE	RIPARIAN-WETLAND VEG INTOLERANCE TO WATER LEVEL CHANGES DESCRIPTION	VERY LOW
		RIPARIAN-WETLAND NATURAL VEG IMPORTANCE BASED ON EXPERT RATING	LOW	INSTREAM MIGRATION LINK CLASS			
				RIPARIAN-WETLAND ZONE MIGRATION LINK			
				RIPARIAN-WETLAND ZONE HABITAT INTEGRITY CLASS			
				INSTREAM HABITAT INTEGRITY CLASS			

APPENDIX 5: RISK MATRIX

ASPECTS AND IMPACT REGISTER/RISK ASSSESSMENT FOR WATERCOURSES INCLUDING RIVERS, PANS, WETLANDS, SPRINGS,DRAINAGE LINES: PROPOSED VELD PV SOLAR ENERGY FACILITY, NAMAKWA DISTRICT, NORTHERN CAPE
COMPILED BY: Toni Belcher, BlueScience (SACNASP 400040/10)
Date: July 2019

					Severity																	
Nr.	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	Legal Issues	Detection	Likelihood	Significance	Risk Rating	Adjusted Risk Rating	Control Measures	Confidence	Type Watercourse
1	Construction	Construction PV North	Construction adjacent to a watercourse to north-west	Disturbance/loss of aquatic habitat, flow and water quality modification, facilitating erosion and spread of alien vegetation	3	1	2	1	1.75	1	2	**4.75**	1	2	5	4	**12**	**57**	**M/L**	**L**	The solar facilities should be moved slightly to outside of the freshwater features and recommended buffers. Key mitigation measurements would be on-site stormwater management; limiting disturbance within freshwater features and buffers; and control of alien vegetation of the potential for erosion.	High	Ephemeral streams draining towards the Orange River and wide wash-like systems; PES=largely natural; EIS=moderate
2		Construction PV South	Construction adjacent to watercourses to west and east		3	1	2	1	1.75	1	2	**4.75**	1	2	5	4	**12**	**57**	**M/L**	**L**			
3		Construction access road from N14	Widen existing road at draiange feature crossings		2	1	2	1	1.5	1	1	**3.5**	1	3	5	3	**12**	**42**	**L**	**L**	Existing road infrastructure should be utilized as far as possible to minimize the overall disturbance created by the proposed project. Where crossings associated with the access routes need to be constructed through ephemeral streams, disturbance of the channel should be limited. All crossings over drainage channels or stream beds should be such that the flow within the drainage channel is not impeded. Road infrastructure and transmission lines should coincide as much as possible to minimize the road network and impact of these activities. Any disturbed areas should be rehabilitated to ensure that these areas do not become subject to erosion or invasive alien plant growth.		
4		Construction PV North and South Access	Upgrade and extend existing farm road with watercourse crossings		3	1	3	2	2.25	1	2	**5.25**	1	3	5	4	**13**	**68.25**	**M/L**	**L**			
5		Construction PV North and South powerlines	Construction adjacent to watercourses		1	1	2	1	1.25	1	1	**3.25**	1	1	5	4	**11**	**35.75**	**L**	**L**	The pylons for the transmission lines should be placed at least 30m outside of the delineated stream channels or outside buffers. Where the access route for transmission lines needs to be constructed through the drainage channels, disturbance of the channels should be limited. These areas should be rehabilitated after construction is complete and the areas monitored for growth of invasive alien plants.		
6		Construction of transmission line to south	Transmission line will need to cross draiange features		1	1	2	1	1.25	1	1	**3.25**	1	1	5	4	**11**	**35.75**	**L**	**L**			
7	Operation	Maintenance of infrastructure	Disturbance related to infrastructure maintenance		2	1	2	1	1.5	1	1	**3.5**	1	2	5	4	**12**	**42**	**L**	**L**	Stormwater and good housekeeping measures onsite to prevent flow and quality impacts on adjacent streams. Monitor and manage for invasive alien plant growth and erosion of stream channels. Maintain any culvert structures within watercourses.		