# DYASONS KLIP 5:
# PROPOSED 100 MW SOLAR PHOTOVOLTAIC FACILITY ON THE REMAINDER OF FARM DYASON'S KLIP 454, NORTHERN CAPE

## FRESHWATER ECOLOGY SPECIALIST STUDY

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# EXECUTIVE SUMMARY

The proposed power plant, Dyasons Klip 5 (DK5), is located within Renewable Energy Development Zone (REDZ) 7 in the Upington zone of the Northern Cape. The proposed photovoltaic (PV) solar power plant will produce 100 MW power and is located on the Remainder of Farm Dyason's Klip 454, located about 20km west of Upington along the N14. The development footprint of approximately 267ha includes the photovoltaic (PV) panels/structures, which will be either fixed-tilt-tracking, single- or dual-axis-tracking mounting structures. Panels will be mounted a maximum of 3.5m from ground level.

The main aquatic feature in the area is the perennial Orange River, which is well to the south of the proposed development site, and unlikely to be affected by the development in any way. The main drainage feature on site is the ephemeral drainage line which runs north-south alongside the DK5 property, i.e. Helbrandkloofspruit (D73F-03051). Clearly defined drainage channels are not present on large parts of the DK5 site, but patches of woody biomass indicative of occasional higher moisture presence in the soil, can be seen.

Hirst (2020) confirmed that the natural slope of the ground is flat, with a low probability of wetlands and pans developing. There was very little evidence of moisture, and no standing water on site during the survey in early March 2020. Although the fan of drainage lines traversing the area can be clearly seen on Google Earth, it is difficult to identify and distinguish between drainage lines and washes at a desktop mapping level, and often difficult to see in the landscape. Ephemeral systems and washes are also not well understood, and their sensitivity is often overlooked and underestimated. Washes are essentially a dryland end-type of floodout. Floodouts may start as a defined channel, which terminate in a network characterized by a down-slope decrease in channel depth that culminates in a depositional floodout feature.

The buffers considered for this study area are the 32m buffers most often applied to rivers, streams and drainage lines for development purposes, and the 100m buffer which can be applied to lowland rivers with less confined riparian zones and higher sensitivity. Due to the difficulties in identifying and mapping drainage lines and floodouts which traverse the <u>entire</u> development area, the final decision in consultation with the Environmental Assessment Practitioner (EAP) was to apply a 100m buffer to Helbrandkloofspruit and 32m to all other drainage lines and floodouts identifiable in the landscape.

Note that potential construction and operational impacts are related to all project-related activities, i.e. PV panels, underground cables, powerlines, access roads etc.. It should be noted that it is not possible to identify preferable options in terms of access roads or substations, as all options traverse drainage lines and floodouts. In terms of power line options and grid corridors, that with lowest potential impact over the two main drainage lines (Helbrandkloofspruit and Helbrandleegte) will be preferred, but all options will require water use licensing.

It is expected that all potential impacts can be reduced to Low significance with the application of the recommended mitigation measures. A summary of impacts is shown below.

| Impact | Significance (no mitigation) | Significance (with mitigation) | Probability |
|---|---|---|---|
| **Construction Phase: Direct Impacts** | | | |
| Changes to the hydrological regime of streams and drainage features on DK5. | Medium (-) | Low (-) | Probable |
| Loss of riparian vegetation and instream continuity of streams and drainage features on DK5. | Medium (-) | Low (-) | Probable |
| Use of drainage channels as dumping grounds | Medium (-) | Low (-) | Probable |
| **Construction Phase: Indirect Impacts - None** | | | |
| **Construction Phase: Cumulative Impacts - None** | | | |
| **Operational Phase: Direct Impacts** | | | |
| Changes to the hydrological regime of streams and drainage features on DK5. | Medium (-) | Low (-) | Probable |
| Chemical pollution of aquatic resources (streams, groundwater) on DK5. | Medium (-) | Low (-) | Improbable |
| **Operational Phase: Indirect Impacts - None** | | | |
| **Operational Phase: Cumulative Impacts** | | | |
| Any cumulative impacts in the area would be related to the large number of solar power plants in an area where little is known of the ephemeral systems and sensitive floodout features. | | | |

Due to the dearth of data regarding the aquatic systems in the area, it is critical that any development be undertaken on a precautionary basis with as little disturbance of the natural environment as possible. As so little is known of the area regarding aquatic features, e.g. temporary wetlands that may develop after rainfall events, it is suggested that the Environmental Control Officer (ECO) and other project staff take additional records of any aquatic features that appear on site, and that this data be forwarded to the South African National Biodiversity Institute (SANBI) on an annual basis for data curation and interpretation. This point is in particular reference to the appearance or development of any wetlands on site. Wetland delineation according to DWA (2008) should be conducted, and information forwarded to SANBI for updating National Wetland Map 5 (NWM5). The National Biodiversity Assessment of 2018 identified a Knowledge Gap in terms of inland aquatic ecosystems in arid regions, and suggested an investment in improved representation and verification of these systems through a combination of citizen science, expert mapping, integration in Geographical Information Systems (GIS) and remote sensing methods. This project is in a unique position where aquatic indicators and long-term trends can be monitored. In terms of river systems, recording the following parameters for the Helbrandkloofspruit at times of flow, and forwarding the information to the Department of Water and Sanitation (DWS) and SANBI, would be recommended:

- Fixed point photograph
- GPS coordinate
- Discharge (requiring a flow meter)
- Basic *in situ* water quality indicators to be taken at a fixed place and time of day per sampling round, i.e. pH, electrical conductivity, oxygen, temperature, suspended solids/turbidity
- Any other requirements listed in the water use license

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# ACRONYMS AND ABBREVIATIONS

| | |
|---|---|
| BA | Basic Assessment |
| CARA | Conservation of Agricultural Resources Act |
| CD: NGI | Chief Directorate: National Geo-Spatial Information |
| DEA | Department of Environmental Affairs |
| DEAT | Department of Environmental Affairs and Tourism |
| DK | Dyasons Klip |
| DK SEF 1 | Dyasonsklip Solar Energy Facility 1 |
| DWA | Department of Water Affairs |
| DWAF | Department of Water Affairs and Forestry |
| DWS | Department of Water and Sanitation |
| EAP | Environmental Assessment Practitioner |
| EC | Ecological Category |
| ECO | Environmental Compliance Officer |
| EIA | Environmental Impact Assessment |
| EIS | Ecological Importance and Sensitivity |
| EMF | Environmental Management Framework |
| EPL | Ecosystem Protection Level |
| ETS | Ecosystem Threat Status |
| GIS | Geographical Information System |
| MTS | Main Transmission Substation |
| NBA | National Biodiversity Assessment 2018 |
| NEM(A) | National Environmental Management (Act) |
| (N)FEPA | (National) Freshwater Ecosystem Priority Area |
| NWA | National Water Act |
| NWM5 | National Wetland Map version 5 |
| PES | Present Ecological State |
| PES/EI/ES | Present Ecological State / Ecological Importance / Ecological Sensitivity |
| PV | photovoltaic |
| REDZ | Renewable Energy Development Zone |
| SANBI | South African National Biodiversity Institute |
| SDGs | Sustainable Development Goals |
| SEA | Strategic Environmental Assessment |
| SPL | Species Protection Level |
| SQR | Sub-quaternary reach |
| STS | Species Threat Status |
| UNDP | United Nations Development Programme |
| WMA | Water Management Area |

# 1 INTRODUCTION AND CONTEXT

## 1.1 BACKGROUND

The proposed power plant, Dyasons Klip 5 (DK5), is located within Renewable Energy Development Zone (REDZ) 7 in the Upington zone of the Northern Cape, with a number of renewable energy developments on the same and surrounding properties. The proposed photovoltaic (PV) solar power plant will produce 100 MW power and is located on the Remainder of Farm Dyason's Klip 454, located about 20km west of Upington along the N14 and within the Siyanda District Municipality. Access on to the property is from an existing access point on the N14.

A range of specialist studies have been conducted as part of the Basic Assessment (BA), including terrestrial, avifaunal and vegetation specialist studies. The identification of the defined 267ha area for the DK5 PV development on the 5 725ha farm was through an iterative process, where avifaunal and terrestrial ecologist studies first identified a 327ha Scoping Area on the farm. This area was then evaluated in more detail by the freshwater ecologist, to select an optimal area for development in terms of freshwater ecology. Scherman Environmental cc. was contracted to undertake the freshwater ecology specialist study.

A Freshwater Ecology Report is submitted according to the requirements stipulated in the *"Procedures to be followed for the assessment and minimum criteria for reporting of identified environmental themes in terms of section 24(5)(a) and (h) of the National Environmental Management Act, 1998, when applying for Environmental Authorisation"*, (GNR R648, 10 May 2019 draft regulation). Section 3(b): Protocol for the assessment and reporting of Environmental impacts on aquatic biodiversity, were followed and indicated that the Aquatic Biodiversity Theme for the Proposed Development Area is of Low sensitivity, although the Helbrandkloofspruit, Helbrandleegte and Orange River is of Very High sensitivity for the Grid Connection Infrastructure.

## 1.2 THE PROPOSED SOLAR POWER DEVELOPMENT

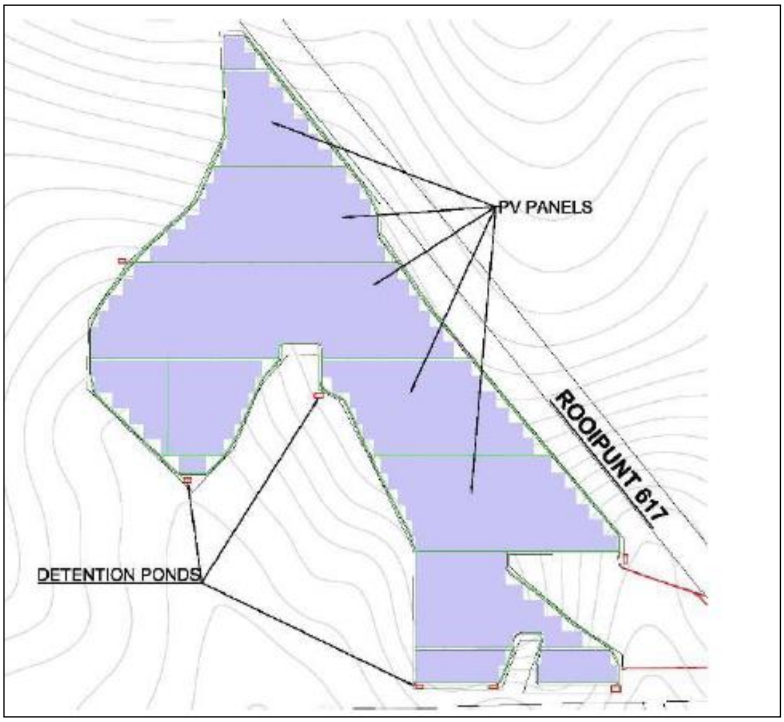
Scherman Environmental was provided with the following information by Cape EAPrac regarding the development:

- The development footprint of approximately 267ha includes the PV panels/structures (maximum of 250ha), auxiliary buildings (1ha: at least a gatehouse, ablutions, workshops, storage and warehousing area, site office with canteen and visitors centre, and control centre), temporary laydown area of 3-5ha (the 1ha permanent laydown area will be contained within the footprint of the temporary laydown area), onsite substation (up to 1ha), inverter stations and containerized battery storage areas (up to 4ha), and internal roads (about 6.5ha and 15km in length; up to 5m in width; main access roads up to 8m in width).
- The existing road crossing the Helbrandkloofspruit in the south will need upgrading to a more formalized crossing.
- A Site Development Plan has been drafted and submitted to specialists.
- The solar technology to be used will be either fixed-tilt-tracking, single- or dual-axis-tracking mounting structures. Panels will be mounted a maximum of 3.5m from ground level.
- Structure orientation will be north-facing at a defined angle of tilt for fixed-tilt-tracking structures and tracking from east to west for single- or dual-axis-tracking mounted in a north-south orientation.

- There are two substation alternatives, each 100m x 100m in size.
  - **Alternative 1 (preferred)** is located near the north-eastern corner of the DK5 development footprint.
  - **Alternative 2** is located at the south-eastern corner of the development footprint which borders Dyasonsklip Solar Energy Facility 1 (DK SEF 1), or otherwise referred to as DK4.

- The 132 kV overhead power line options each has a 200m buffer either side of the proposed lines routes (i.e. the 400m wide corridors will be the focus areas), therefore referred to as *grid corridor alternatives* and named according to the associated substation. The main difference between the corridors is the small section deviating to substation 1 or 2.
  - **Alternatives 1.1, 1.2 and 1.3** runs past (switches into) the DK SEF 1 substation, along the north and then western boundary of DK3 into DK1/2 Switching Station, and then parallel to the existing 132kV line all the way back to Upington Main Transmission Substation (MTS).
  - **Alternatives 2.1, 2.2 and 2.3** runs past (switches into) the DK SEF 1 substation, runs down the eastern boundary, and then parallel to the existing 132kV line all the way back to the MTS.
  - Note that alternatives 1.2 and 2.2 are preferred based on cost, due to their proximity to the MTS.

- Internal electrical reticulation will be in the form of underground cabling.
- A Stormwater Management Report has been prepared for DK5 by Richard Hirst of SiVEST SA (Pty) Ltd. (referred to as Hirst, 2020). As runoff is mostly toward Helbrandkloofspruit, the main drainage line on site, three detention ponds have been recommended to manage ponding due to stormwater flows.




Note that stormwater management presented by SiVEST at this stage does not cater for overland major storm occurrences, i.e. Q50 and Q100 durations (Hirst, 2020).

- Floodlines have not been delineated due to the ephemeral nature of drainage lines in the area, which only flow for a few days at times of high rainfall.
- Note that water use for construction will be supplied by the Dawid Kruiper (Upington) Municipality and trucked onto site. Rainwater tanks will be set up on site for use during operations.
- Treatment of domestic effluent will be via conservancy tanks.

## 1.3 THE STUDY AREA AND AQUATIC ENVIRONMENT

Dyasons Klip 5 (DK5) is located in quaternary catchment D73F outside Upington in the Northern Cape province of South Africa, in the Lower Orange Water Management Area (WMA). The climate of the area is designated as arid with an average annual rainfall of approximately 190mm falling between October and May. Highest rainfall is generally in March and the lowest in July (Hirst, 2020).

The main aquatic feature in the area is the perennial Orange River, which is well to the south of the proposed development site, and unlikely to be affected by the development in any way. The river is significantly impacted by intensive irrigation along its bank and ranges from a Present Ecological State (PES) of a C to D as it flows from east to west along its length south of DK5. The PES refers to the EcoStatus of designated reaches of a river. The EcoStatus can be defined as the totality of the features and characteristics of the river and its riparian areas (so physical drivers such as hydrology, geomorphology and water quality, and riparian vegetation) that bear upon its ability to support an appropriate natural flora and fauna (or biotic responses such as fish and macroinvertebrates). This ability relates directly to the capacity of the system to provide a variety of goods and services and describes a change from natural or unmodified state. The Ecological Category (EC) describes this integrated state according to the A-F rating system shown in **Table 1.1**.

**Table 1.1 Description of A – F ecological categories based on Kleynhans et al. (2005)**

| Ecological Category | Ecological description | Management perspective |
|---|---|---|
| A | Unmodified, natural. | Protected systems; relatively untouched by human hands; no discharges or impoundments allowed |
| B | Largely natural with few modifications. A small change in natural habitats and biota may have taken place but the ecosystem functions are essentially unchanged. | Some human-related disturbance, but mostly of low impact potential |
| C | Moderately modified. Loss and change of natural habitat and biota have occurred, but the basic ecosystem functions are still predominantly unchanged. | Multiple disturbances associated with need for socio-economic development, e.g. impoundment, habitat modification and water quality degradation |
| D | Largely modified. A large loss of natural habitat, biota and basic ecosystem functions has occurred. | |
| E | Seriously modified. The loss of natural habitat, biota and basic ecosystem functions is extensive. | Often characterised by high human densities or extensive resource exploitation. |

| Ecological Category | Ecological description | Management perspective |
|---|---|---|
| F | Critically / Extremely modified. Modifications have reached a critical level and the system has been modified completely with an almost complete loss of natural habitat and biota. In the worst instances the basic ecosystem functions have been destroyed and the changes are irreversible. | Management intervention is needed to improve health, e.g. to restore flow patterns, river habitats or water quality |

In the absence of detailed studies to assess ecological state, and to aid decision-making, PES and EC data are available on a desktop basis through a study funded jointly by the Department of Water and Sanitation (DWS) and the Water Research Commission, i.e. the PES/EI/ES study, completed for all WMAs of South Africa in 2014. Input data were received from DWS in 2011 and then updated to include all known and recent data, so as to produce the final present state and recommended ecological categories per sub-quaternary reach (SQR). Each SQR was assessed thoroughly by a team of specialists using Google Earth, to “groundtruth” assessed rivers, and assign a present state per reach according to the following six metrics that represents a very broad qualitative assessment of both the instream and riparian components of a river.

- Potential instream habitat continuity modification
- Potential riparian/wetland habitat continuity modification
- Potential instream habitat modification activities
- Potential riparian/wetland zone modifications
- Potential flow modification
- Potential physico-chemical modification activities

**Figure 1.1** shows the main ephemeral drainage line which runs north-south alongside the DK5 property, i.e. Helbrandkloofspruit (D73F-03051), with a number of washes flowing into the main drainage line. Note that ephemeral systems were not scored during the PES/EI/ES project, meaning that although Helbrandkloofspruit was digitized it was not assigned an EC.

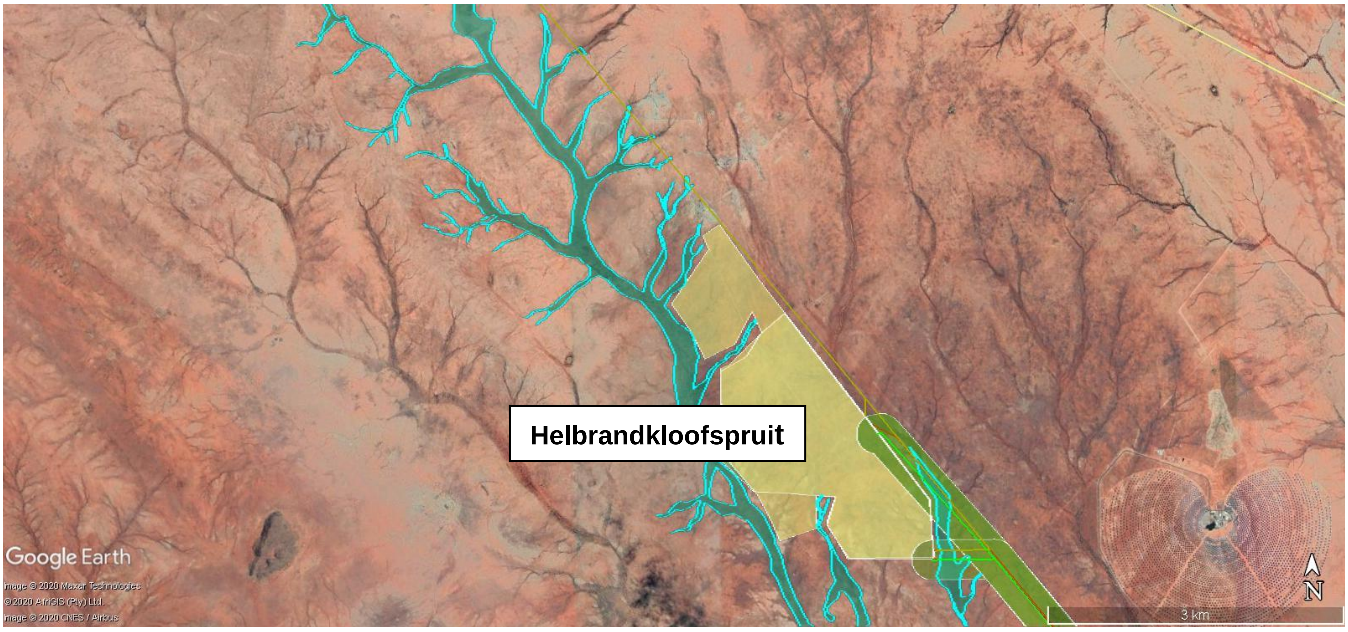



**Figure 1.1 Helbrandkloofspruit running north-south alongside the DK5 Scoping Area.**

Other than the Orange River, all other streams in the area are ephemeral, and have therefore not been assigned an EcoStatus.

Note there is significant under-mapping of isolated wetlands, such as ephemeral depressions, seeps and flats, in REDZ 7 (DEA, 2015). Although the fan of drainage lines traversing the area can be clearly seen on Google Earth, it is difficult to identify and distinguish between drainage lines and washes at a desktop mapping level, and often difficult to see in the landscape. **Figure 1.2** is an example of an established ephemeral stream in the broader area (part of the Helbrandkloofspruit system, but not on the proposed footprint or layout of the development).

**Figure 1.2 An ephemeral stream on the DK5 site.**

Ephemeral systems and washes are also not well understood, and their sensitivity is often overlooked and underestimated. Washes are essentially a dryland end-type of floodout. Floodouts may start as a defined channel, which terminate or split into a distributive or multi-thread distributive channel network characterized by a down-slope decrease in channel depth that culminates in a depositional floodout feature (see **Figure 1.3**). The active dispersal path can change over time in response to sediment movement and deposition, but this movement is difficult to determine due to the associated climatic (arid) conditions. Floodouts can therefore be a response to the supply of sediment relative to discharge. When sediment supply exceeds the transport capacity of the channel, floodouts may form (Grenfell et al., 2014). They are important features ecologically because they are transitional systems in space and time; at times being dry alluvial deposits and after episodic rainfall temporary wetlands or sites of biocrust formation (Michael Grenfell, pers. comm., April 2020). Biological soil crusts are communities of living organisms on the soil surface in arid and semi-arid ecosystems. They are found throughout the world with varying species composition and cover depending on topography, soil characteristics, climate, plant community, microhabitats, and disturbance regimes. They may be composed of any configuration of soil surface-dwelling cyanobacteria, eukaryotic algae, lichens, mosses or liverworts, and support assemblages of decomposers and a faunal food web. The community of autotrophs and heterotrophs that make up biocrusts therefore have a number of functions such as stabilizing soils in arid and desert landscapes, dictate soil carbon and nutrient cycling, and help determine the fate of precipitation (Bowker et al., 2018).

Clearly defined drainage channels are not present on large parts of the DK5 site, but patches of woody biomass (see Terrestrial ecology report) indicative of occasional higher moisture presence in the soil, can be seen.

Hirst (2020) confirmed that the natural slope of the ground is flat, with a low probability of wetlands and pans developing. There was little evidence of moisture, and no standing water on site during the survey in early March 2020, despite good and above average rainfall in February preceding the survey. Soil is semi- to impermeable, with grasslands and shrubs making up the majority of the vegetation on site (Hirst, 2020).

**Figure 1.3 A depositional floodout feature on DK5.**

## 1.4 RELEVANT LEGISLATION AND POLICY

Locally the South African Constitution, numerous Acts and international treaties allow for the protection of rivers and water courses. These systems are therefore protected by the following pieces of legislation and policies:

- Section 24 of The Constitution of the Republic of South Africa (Act No. 108 of 1996)
- Agenda 21 – Action plan for sustainable development of the Department of Environmental Affairs and Tourism (DEAT) 1998
- National Environmental Management (NEM) Act (referred to as NEMA), 1998 (Act No. 107 of 1998) inclusive of all amendments e.g. Government Gazette No. 38282 of December 2014), as well as the NEM: Biodiversity Act, 2004 (Act No. 10 of 2004) and 2009 (Act No. 291 of 2009), NEM: Protected Areas Act, 2003 (Act No. 57 of 2003) and NEM: Waste Act (Act No. 59 of 2008).
- National Biodiversity Strategy and Action Plan (2015)
- National Water Act (NWA) of 1998 (Act No. 36 of 1998)
- National Water Services Act of 1997 (Act No. 108 of 1997)
- Environment Conservation Act of 1989 (Act No. 73 of 1989)
- Conservation of Agricultural Resources Act (CARA) of 1983 (Act No. 43 of 1983)
- Minerals and Petroleum Resources Development Act of 2002 (Act No. 28 of 2002)
- Nature and Environmental Conservation Ordinance (Act No. 19 of 1974)
- National Forest Act (Act No. 84 of 1998)
- Environmental Impact Assessment (EIA) regulations of 2017, and Government Notice (GNR) 320 or March 2020.
- Sustainable Development Goals (SDGs)[1]

Specific legislation pertaining to wetlands are also available as follows:

- NEMA 1998 (Act No. 107 of 1998). Definitions pertaining to wetland ecosystems are contained in the 7 April 2017 revision (GN R324-7).
- NWA 1998 (Act No. 36 of 1998)
- CARA 1983 (Act No. 43 of 1983)
- RAMSAR Convention on Wetlands of International Importance (signed in 1971)
- World Heritage Convention Act (Act No. 49 of 1999)

Note that it is expected that water use licensing will be triggered as development (e.g. internal roads) will be within the buffer zones delineated around the network of drainage lines traversing the site.

### 1.4.1 Planning tools

A number of planning tools are available for use.

**Strategic Environmental Assessment (SEA) for wind and solar photovoltaic energy in South Africa, 2015**

The mission of this SEA was to identify Renewable Energy Development Zones that are of strategic importance for large scale wind and solar photovoltaic development in terms of Strategic

[1] The United National Development Programme's (UNDP) Sustainable Development Goals (SDGs) came into effect in 2016 and guide UNDP policy and funding until 2030; they include goals focused on water, climate action, life below water and life on land.

Integrated Project 8, and in which significant negative impacts on the natural environment are limited and socio-economic benefits to the country are enhanced (DEA, 2015). This process also allows DEA to utilise provisions in NEMA to streamline the environmental authorisation process in pre-assessed geographical areas, thereby allowing authorisation to be via the Basic Assessment process. The identification of REDZ and process for authorization was legislated by Government Notice No. R114 in Gazette No. 41445 of 16 February 2018.

**National Freshwater Ecosystem Priority Areas (NFEPA), 2011**

NFEPA (Nel et al., 2011) provides guidance on which rivers, wetlands and estuaries should remain in a natural or near-natural condition. It supports the implementation of the NWA, the Biodiversity Act and the Protected Areas Act. The NFEPA project's aims were to:

- identify FEPAs to meet national biodiversity goals for freshwater ecosystems; and
- develop a basis for enabling effective implementation of measures to protect FEPAs, including free-flowing rivers.

**PES/EI/ES (Present Ecological State / Ecological Importance / Ecological Sensitivity) assessment, 2014**

As discussed in **Section 1.3**, the PES/EI/ES study was launched in the absence of detailed studies to assess ecological state of rivers, and to aid decision-making using available information on a desktop basis.

**National Biodiversity Assessment (NBA), 2018**

The NBA was a collaborative effort to synthesise the best available science on South Africa's biodiversity to inform policy and decision-making in a range of sectors and contribute to national development priorities. The NBA uses the Ecosystem Threat Status (ETS) and Ecosystem Protection Level (EPL) as headline indicators for ecosystems and headline indicators for ecosystems, and the Species Threat Status (STS) and Species Protection Levels (SPL) for species. The ETS and STS inform us on the threat status of ecosystem types and species whereas the EPL and SPL indicate how protected the ecosystem types and species are. Both indicators are dependent on spatial datasets of ecosystem types and condition, as well as species records of occurrence and breeding sites (van Deventer et al., 2019). The risk of extinction (species) or collapse (ecosystems) is evaluated across all realms and for taxonomic groups for which sufficient data exists. The protection level indicators reflect how well our species and ecosystem types are represented in the protected area network (SANBI, 2019).

One of the main improvements since the 2011 NBA is the mapping of wetlands, resulting in the production of National Wetland Map version 5 (NWM5), used as a mapping tool for this aquatic assessment, together with NFEPA wetland maps.

**Siyanda District Municipality Environmental Management Framework (EMF), 2008**, which discusses the suitability and importance of the area for solar energy generation.

# 2 AQUATIC ASSESSMENT

## 2.1 SCOPE OF WORK

The Scope of Work included the following tasks:

- Literature review, information gathering and an overview of the study area, including aquatic water resources, prior to any fieldwork. This step also includes mapping of drainage lines, streams and potential wetlands in the study area using latest available overlays, imagery and available planning documents, e.g. National Wetland Map 5. A sensitivity map of the area will be prepared. The desktop PES/EI/ES (Present Ecological State/Ecological Importance/Ecological Sensitivity) database of the Department of Water and Sanitation (DWS, 2014) will be reviewed for information on the current state of rivers and streams, prior to a site survey.
- Undertake one site assessment or survey to ground-truth the desktop assessment. The primary purpose of the field survey was to identify water resources potentially impacted by the new development, and assess the current structure and status of any wetland or riparian systems found within the site, or within the licensing zone of the development.
- Identify and rate potential environmental impacts.
- Identify mitigations for negative and positive impacts. Include any riparian buffers zones, with information on riparian vegetation provided by the terrestrial ecologist.
- Prepare a Risk Assessment Matrix as part of reporting, if required.
- Make recommendations to be incorporated into the Environmental Management Programme Report and Stormwater Management Plan.
- Identify sensitive riparian aquatic species requiring protection, based on data provided by the terrestrial ecologist, and propose rehabilitation measures as required.
- Prepare a specialist report.

## 2.2 APPROACH AND METHODOLOGY

The approach followed for this assessment was as follows:

- Conduct a desktop mapping exercise and extensive literature review. The following datasets were reviewed:
  - FEPAs (Freshwater Ecosystem Priority Areas) rivers 2010
  - FEPA 2011 wetlands and wetland clusters
  - NBA (National Biodiversity Assessment) Artificial Wetlands 2018
  - NBA NWM5 (National Wetland Map 5)
  - NBA 2018 Rivers PES2017[2]
  - Topo Rivers Line from the CD: NGI (Chief Directorate: National Geo-Spatial Information) dataset 2006
- Conduct a field survey.
- Analyse the data accessed and collected for the study area and proposed activity, and prepare the specialist report.

[2] Rivers data used for the NBA of 2018 was from the Present Ecological State (PES) assessment as at 2017

## 2.3 SITE VISIT

In preparation for visiting the DK5 site on 5 March 2020, a map of the area was prepared. **Figure 2.1** shows the proposed development area - the 1:50 000 2821CA topo-cadastral map serves as background.

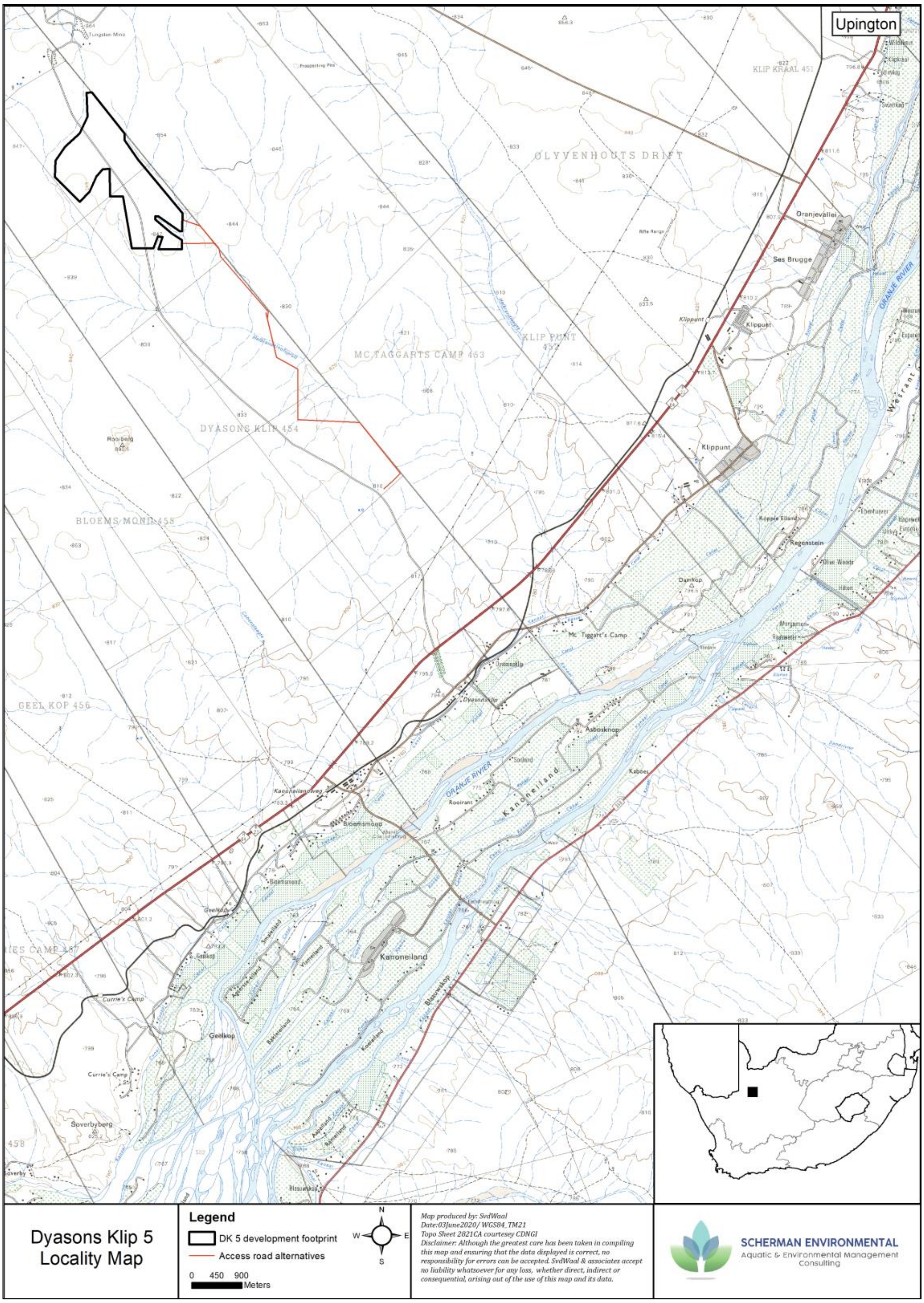



**Figure 2.1 Topographical map of the DK5 development site.**

Note that both NFEPA and NWM5 datasets were consulted during the mapping phase **(Figure 2.2)**. Mapping showed no wetlands within 500m of the proposed development site from either dataset — which was consistent with the ground-truthing exercise conducted. Wetlands found in the study area appear to be either depression wetlands or floodplain wetlands, mostly associated with the Orange River. Note some wetlands associated with the main drainage lines in the area, i.e. D73F-02996: Helbrandleegte, and D73F-03051: Helbrandkloofspruit, were mapped.

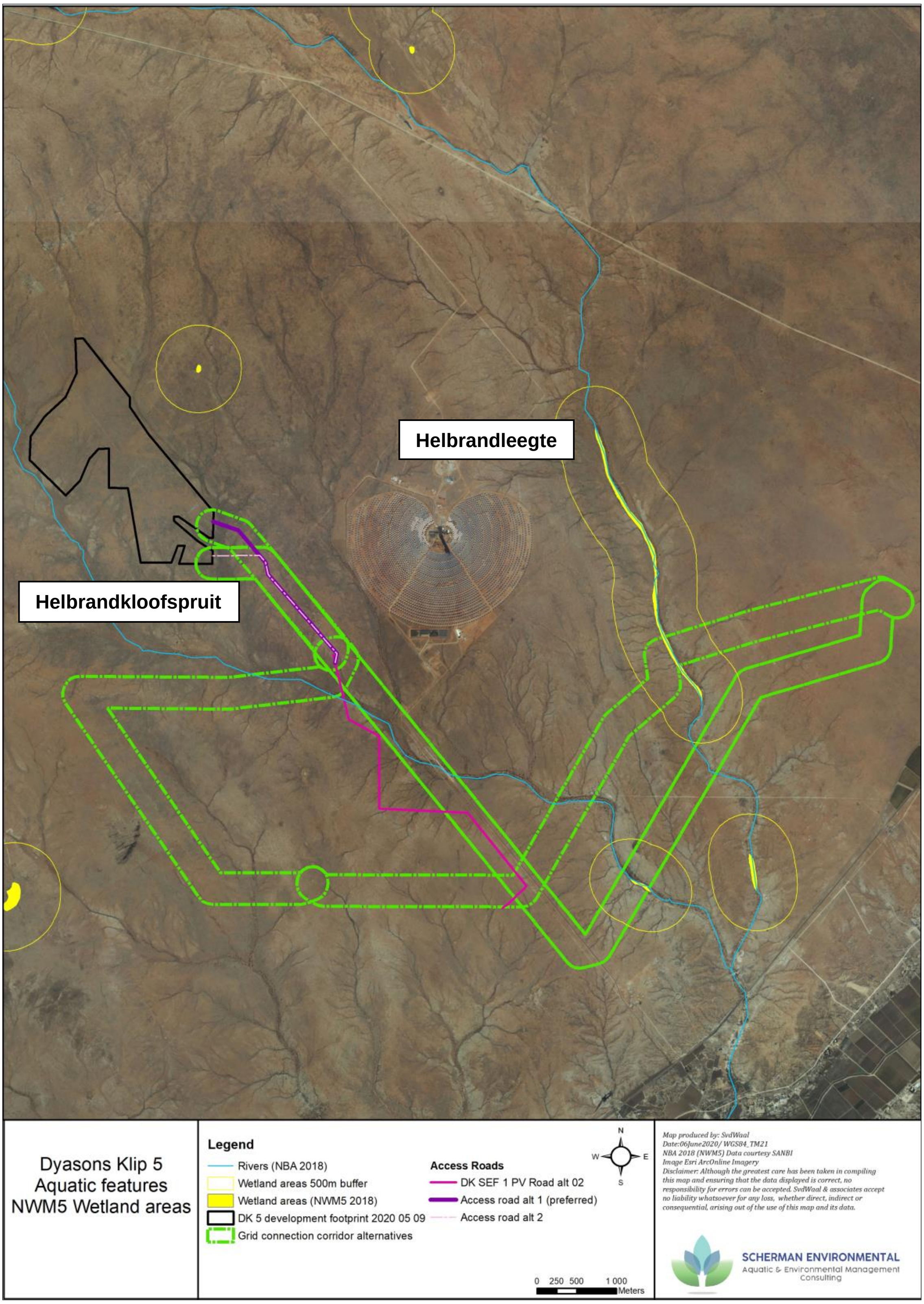



**Figure 2.2 NWM5 wetlands in the broader study area with their 500m licensing zones.**

As the area was dry and drainage lines are ephemeral, instream biota (fish and macroinvertebrates) could not be sampled. Little moisture was seen on site, with no flowing water visible despite vegetation showing evidence of good recent rainfall. A number of points on and outside the DK5 site were evaluated during the early March 2020 field survey, as indicated on **Figure 2.3**. Most floodout or drainage line points seen on site had been mapped, with a few added as part of ground-truthing. No wetland areas were identified on site by mapping or through ground-truthing.

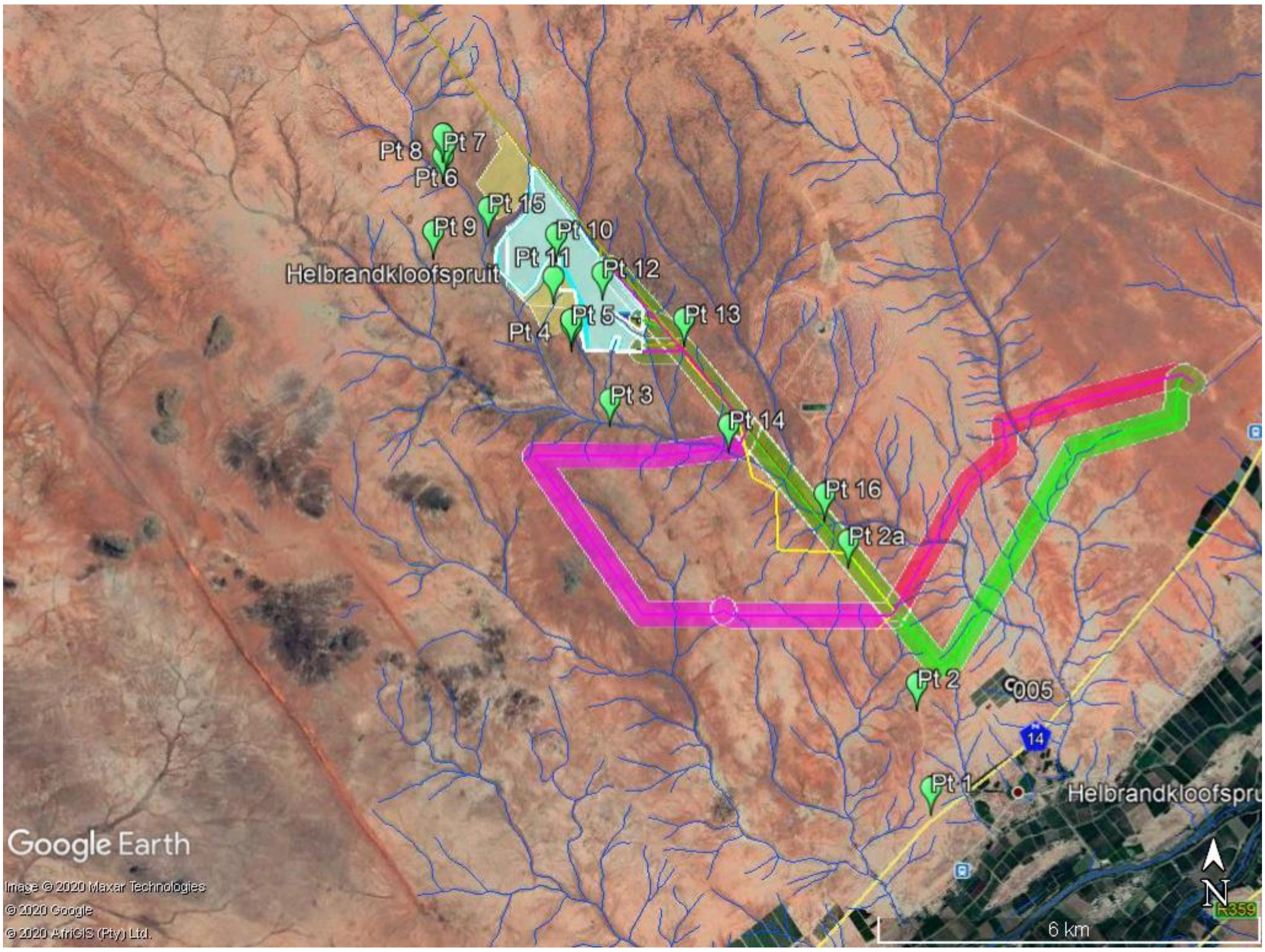



**Figure 2.3 Points assessed during the site survey of March 2020.**

## 2.3 RESULTS

### 2.3.1 National Biodiversity Assessment results

Results from the 2018 NBA which are directly pertinent to this study area are as follows (van Deventer et al., 2019):

- 90% of the length of river ecosystem types have been assessed for present ecological state using expert ratings.
- **10% of the extent of river ecosystem types are poorly understood (ephemeric or episodic systems in arid regions).**
- River ecosystems are declining in ecological condition. Of the 222 river ecosystem types assessed, 64% were found to be threatened (43% Critically Endangered, 19% Endangered and 2% Vulnerable).

- NWM5 has significantly improved the representation of inland wetland ecosystem types. The representation of the extent of inland wetlands has improved by 123%, whereas the incorrect representation of terrestrial ecosystems as wetlands has been reduced.
- **In spite of the improvements (of NWM5), nearly 70% of the extent of South Africa(n wetlands) is still at a low confidence level, and NWM5 is still considered an underrepresentation of inland wetlands.**
- About 73% of inland wetlands are threatened and unprotected (Not Protected or Poorly Protected). **The shortfall to the biodiversity target is largest for Bushmanland Depression (> 65 000ha) and Mesic Highveld Grassland Valley-bottom (nearly 40 000ha wetlands.** These systems should be prioritised for in-field integrity assessment following by consideration in an expansion strategy for protection.
- Pressures in the arid regions, such as overgrazing and invasive plant species, are not represented in the base layers used for modelling ecological condition of inland wetlands. As a result, most of the systems in arid inland vegetation bioregions therefore appear as natural or near-natural (PES = A/B), owing to a lack of representation of pressures in these regions (Kotze et al., 2019; cited in van Deventer et al., 2019).

- Identified Knowledge gaps and Priority actions related to this area are shown below:
  - Knowledge Gap: Representation of river and inland wetland extent and ecosystem types show spatial inaccuracies and inland wetlands are particularly underrepresented in the National Wetland Maps. **In particular, inland aquatic ecosystems in arid regions needs better indicators for defining and identifying and characterising these systems**.
  - Priority Action: Invest in **improved representation and verification of these systems** through a combination of citizen science, expert mapping, integration in GIS and remote sensing methods. In particular, river ecosystem types need to be refined to include riparian vegetation because these not represented and could potentially be highly threatened. Develop indices for the identification of inland aquatic ecosystems in arid regions.

- An identified Research gap directly relevant to this area: **Criteria for the identification and characterisation of inland aquatic ecosystems in arid regions.** This research gap is based on the fact that inland aquatic ecosystems in the arid regions are poorly understood. The PES/EI/ES study indicated these rivers as 'Data Deficient' and they were subsequently not assessed.
- Illegal sand mining is becoming an Emerging Pressure in the in the semi-arid and arid rivers (e.g. the middle and lower Orange River reaches) of the Northern Province (Ben Benade, *pers. comm.*, 10 October 2018). These river ecosystems are seasonal and ephemeral in nature, and changes to the amount of sand prohibit infiltration into the aquifer, placing more pressure on arid and semi-arid regions which are already prone to drought.

### 2.3.2 Buffers

Buffer zones are used in land-use planning to protect natural resources and limit the impact of one land use on another. An example of buffers routinely used in the Eastern Cape are shown in **Table 2.1** below (Berliner & Desmet, 2007), and was used as a template for buffers around drainage lines and floodouts on the DK5 site.

**Table 2.1 Recommended buffers for rivers (Berliner & Desmet, 2007).**

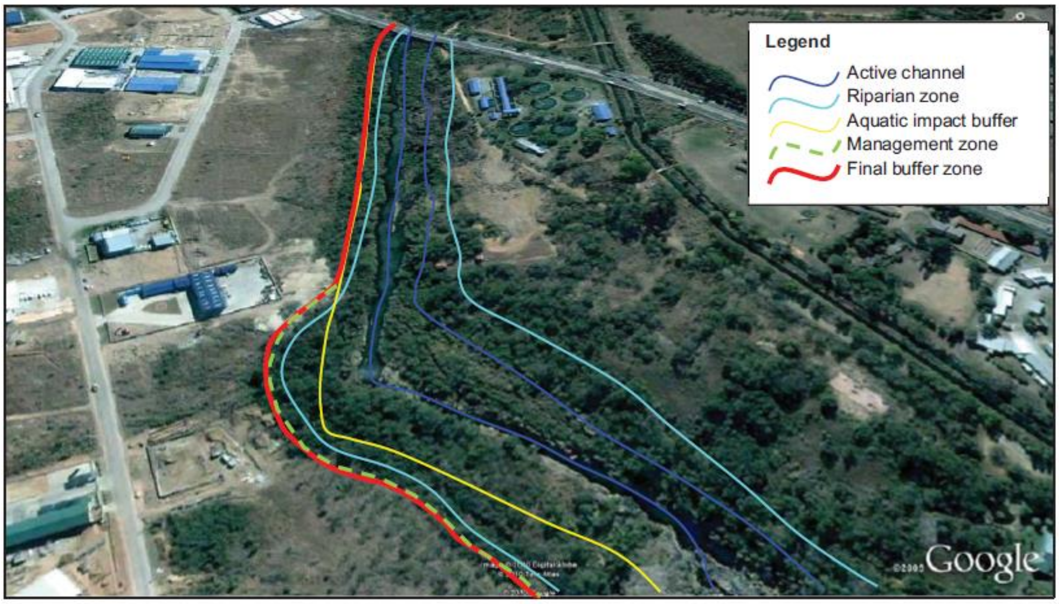
| River criterion used | Buffer width (m) | Rationale |
|---|---|---|
| Mountain streams and upper foothills of all 1:500 000 rivers | 50 | These longitudinal zones generally have more confined riparian zones than lower foothills and lowland rivers and are generally less threatened by agricultural practices. |
| Lower foothills and lowland rivers of all 1:500 000 rivers | 100 | These longitudinal zones generally have less confined riparian zones than mountain streams and upper foothills and are generally more threatened by development practices. |
| All remaining 1:500 000 streams | 32 | Generally smaller upland streams corresponding to mountain streams and upper foothills, smaller than those designated in the 1:500 000 rivers layer. They are assigned the riparian buffer required under South African legislation. |

In addition to the 2007 guidelines on buffers, the Water Research Commission undertook the development of a preliminary guideline in 2015 for the determination of buffer zones for rivers, wetlands and estuaries to reduce impacts on water resources, i.e. *Testing the preliminary guidelines for the determination of buffer zones for rivers, wetlands and estuaries.* One of the outcomes of this study was a Technical Manual for buffer zone determination prepared by Macfarlane and Bredin (2017).

According to Macfarlane and Bredin (2017), determining appropriate management measures for aquatic impact buffer zones is largely dependent on the threats associated with the proposed activity adjacent to the water resource. These threats include:

- Increases in sedimentation and turbidity.
- Increased nutrient inputs.
- Increased inputs of toxic organic and heavy metal contaminants.
- Pathogen inputs.

Mapping buffer zones is an iterative process, with the final buffer zone requirements for water resource protection effectively determined by the maximum distance of the water resource boundary (including riparian habitat), or the aquatic impact buffer zone required to protect the water resource – see the figure below as an example of buffer zones for a proposed residential development planned alongside a river system (Macfarlane and Bredin (2017).



Once a buffer zone has been determined, management measures need to be documented to ensure activities and functions such as buffer zone vegetation and soil attributes are maintained during construction and operational activities. Note that stormwater management features should be located outside of buffer zones, with buffer zones therefore providing a post-attenuation treatment function.

The decision regarding buffers around drainage lines and floodouts for the DK5 development footprint was problematic due to the following factors:

- The area is traversed by numerous undefined and ephemeral drainage lines and floodouts, with mapping and Google Earth being the primary tools by which these could be identified.
- Floodlines were not determined due to the ephemeral nature of the area.
- Due to the lack of data for arid zones and ephemeral systems, a precautionary approach needs to be taken to ecological management, and therefore buffer zone delineation.
- The installation of panels (top of panel a maximum of 3.5m above ground level at full tilt) are not considered a highly impacting activity, with the focus therefore being on the impact of service infrastructure such as roads[3] (jeep tracks for construction and maintenance), gates (where the corridor crosses a cadastral fence), underground power cables, substations and battery storage areas, powerline pylons (generally 200m – 300m apart), and auxiliary buildings including ablution facilities.

The buffers considered for this study area are the 32m buffers most often applied to rivers, streams and drainage lines for development purposes, and the 100m buffer which can be applied to lowland rivers with less confined riparian zones and higher sensitivity. Consultation with a fluvial geomorphologist specializing in floodouts suggested a 100m buffer zone should be applied to these sensitive zones, but due to the difficulty in identifying and mapping drainage lines and floodouts which traverse the entire development area, the final decision in consultation with the Environmental Assessment Practitioner (EAP) was to apply a 100m buffer to Helbrandkloofspruit and 32m to all other drainage lines and floodouts identifiable in the landscape. These buffer zones were forwarded to the layout team. **Figures 2.4 and 2.5** show the implications of both 32m and 100m buffers respectively, around identified drainage lines and floodout areas.

Minimum buffer zones recommended by Macfarlane and Bredin (2017) for above- and below-ground electricity infrastructure (10m), unpaved roads, parking lots and offices (15m), and cement/concrete works and electricity generation works (20m), are all within the recommended 32m buffers to be implemented around drainage lines and floodouts. The wider buffer zone around Helbrandkloofspruit will serve additional protection for the only well-defined ephemeral drainage in the development area which would flow down into the Orange River at times of high flow.

[3] The main access road will serve multiple purposes, so may be tarred in future.

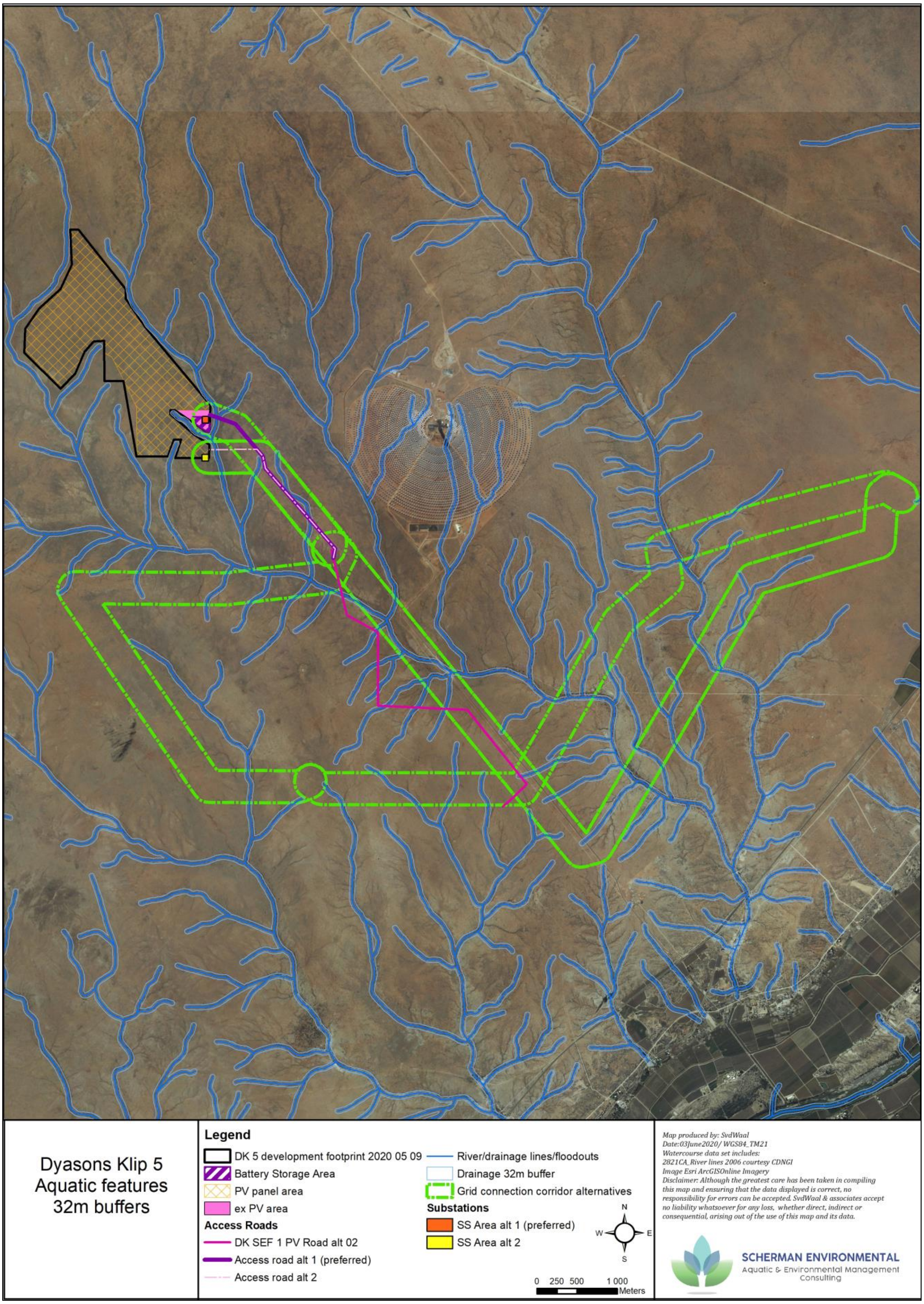



**Figure 2.4 DK5 drainage lines and floodouts, with 32m buffers.**

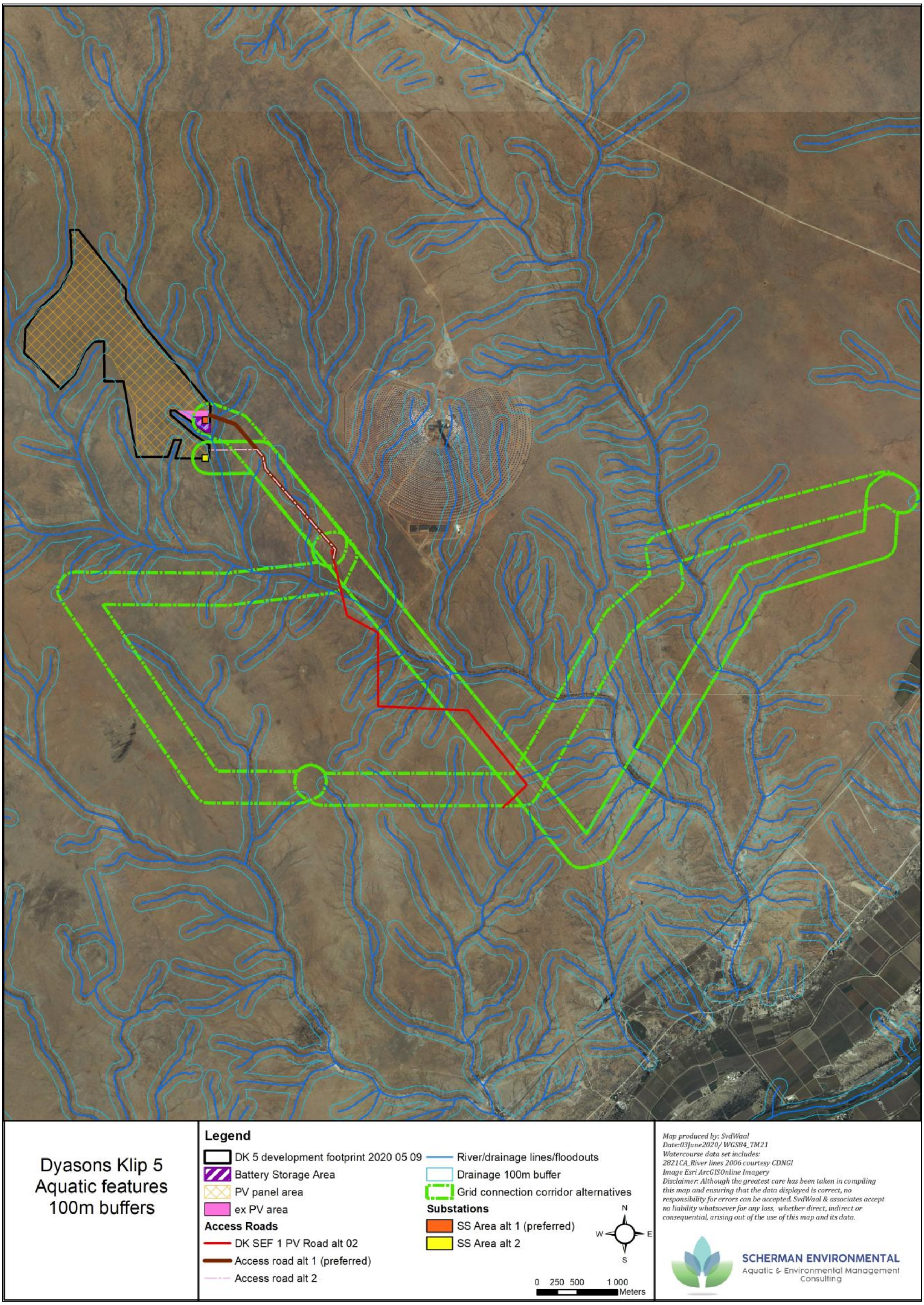



**Figure 2.5 DK5 drainage lines and floodouts, with 100m buffers.**

# 3 IMPACT ASSESSMENT

The impact assessment was conducted according to the methodology provided in **Annexure 1**. Impacts have been rated based on the project actions / impacts, as well as any potential cumulative impacts expected during the construction and operational phases of the project. Note that potential construction and operational impacts are related to all project-related activities, i.e. PV panels, underground cables, access roads, power lines etc..

It should be noted that it is not possible to identify preferable options in terms of access roads or substations, as all options traverse drainage lines and floodouts. In terms of grid corridors, all alternatives cross at least one of the two main drainage lines (Helbrandkloofspruit and Helbrandleegte) at some point. The option will the least potential impact on the drainage lines would be preferable, but all options will require water use licensing.

Potential impacts are listed as follows, with the detail shown per impact on the tables below.

- Changes to the hydrological regimes of streams and drainage features on DK5.
- Loss of riparian vegetation and instream continuity of streams and drainage features on DK5.
- Chemical pollution of aquatic resources (streams, groundwater) on DK5.
- Use of drainage channels as dumping grounds.

## 3.1 CONSTRUCTION PHASE DIRECT IMPACTS

The following section of the report identifies direct impacts that may be associated with the construction phase of the development.

**Changes to the hydrological regime of streams and drainage features on DK5.**

| | |
|---|---|
| **Nature of the Impact** | The assessment of this impact assumes levelling and clearing outside the 32m buffer around streams and drainage, and outside the 100m buffer around Helbrandkloofspruit for all activities, i.e. construction of buildings, roads, underground cables. |
| **Extent** | **Site specific –** It is assumed that construction will take place during the dry season, and therefore not disrupt drainage during stormwater events. |
| **Duration** | **Temporary** |
| **Consequence / Intensity** | **Low** – it is assumed that construction will take place during the dry season. Considering the lack of aquatic indicators, drainage lines are not strongly defined in their natural state and during the dry season. |
| **Probability** | **Probable** |
| **Reversibility** | **Reversible** |
| **Degree of Confidence** | **Medium** |
| **Irreplaceable Loss of Resources** | **Replaceable** |
| **Status and Significance (without mitigation)** | **Medium Negative (-)** |
| **Mitigation** | • Development outside the 32m buffer zones of drainage lines and floodouts and 100m buffer line for the Helbrandkloofspruit.<br>• No activities, e.g. stockpiles, within the drainage lines or floodouts.<br>• Finalize the stormwater management plan for efficient movement of stormwater down drainage lines. |
| **Significance and Status (with mitigation)** | **Low Negative (-)** |

**Loss of riparian vegetation and instream continuity of streams and drainage features on DK5.**

| | |
|---|---|
| **Nature of the Impact** | Riparian and aquatic corridors create longitudinal links between a variety of habitats and refugia and serve as migration corridors. |
| **Extent** | **Site specific –** It is not possible to evaluate the current state of Helbrandkloofspruit or drainage lines across DK5, but it is anticipated that little water flows in them most of the time, considering the dearth of aquatic indicators. There is also little connectivity between the drainage lines, but it is assumed that they provide migration routes across the site. |
| **Duration** | **Temporary** – The impact is considered temporary provided mitigation measures are applied during construction. |
| **Consequence / Intensity** | **Low** – Considering the homogeneity of vegetation along and in drainage lines, and lack of aquatic indicators, drainage lines are not strongly defined in their natural state and during the dry season. |
| **Probability** | **Probable** |
| **Reversibility** | **Reversible** |
| **Degree of Confidence** | **Medium** |
| **Irreplaceable Loss of Resources** | **Replaceable** |
| **Status and Significance (without mitigation)** | **Medium Negative (-)** |
| **Mitigation** | • Development outside the 32m buffer zones of drainage lines and floodouts and 100m buffer line for the Helbrandkloofspruit.<br>• Maintain the network of drainage lines across the site, so as to maintain migration corridors. |
| **Significance and Status (with mitigation)** | **Low Negative (-)** |

**Use of drainage channels as dumping grounds.**

| | |
|---|---|
| **Nature of the Impact** | This impact is linked particularly to the clearing of sites before construction. Proper management of construction activities can reduce this impact. |
| **Extent** | **Site-specific** |
| **Duration** | **Temporary** – The impact is considered temporary provided mitigation measures are applied during construction. |
| **Consequence / Intensity** | **Medium** |
| **Probability** | **Probable** |
| **Reversibility** | **Reversible** |
| **Degree of Confidence** | **Moderate** – Although the use of drainage channels as dumping grounds during clearing is often evident on construction sites, the undefined nature of drainage channels on DK5 will result in a lower potential impact. |
| **Irreplaceable Loss of Resources** | **Replaceable** |
| **Status and Significance (without mitigation)** | **Medium Negative (-)** |
| **Mitigation** | • Development outside the 32m buffer zones of drainage lines and floodouts and 100m buffer line for the Helbrandkloofspruit, and maintenance of riparian buffers where evident.<br>• No dumping within drainage lines, floodouts and no-go areas. |
| **Significance and Status (with mitigation)** | **Low Negative (-)** |

### 3.2 INDIRECT CONSTRUCTION PHASE IMPACTS

None were identified.

### 3.3 CONSTRUCTION PHASE CUMULATIVE IMPACTS

None were identified.

### 3.4 OPERATIONAL PHASE DIRECT IMPACTS

**Changes to the hydrological regime of streams and drainage features on DK5.**

| | |
|---|---|
| **Nature of the Impact** | The assessment of this impact assumes levelling and clearing outside the 32m buffer around streams and drainage, and outside the 100m buffer around Helbrandkloofspruit for all activities, i.e. construction of buildings, access roads, underground cables. It is assumed that stormwater will be diverted into three on-site detention ponds, which could impact on hydrological regimes during storm events. The crossing of the Helbrandkloofspruit in the south by the access road will be upgraded, which will aid downstream flow during storm events. |
| **Extent** | **Regional –** In an arid environment the input of every tributary will be significant. |
| **Duration** | **Permanent** |
| **Consequence / Intensity** | **Medium** – although the operational activities will be long-term and will cause a modification of the hydrological regime of the Helbrandkloospruit, the input of this tributary to a largely modified Orange River is probably of moderate significance. |
| **Probability** | **Probable** |
| **Reversibility** | **Partially Reversible** – it is not known what the contribution of Helbrandkloofspruit is to the Orange River system. |
| **Degree of Confidence** | **Medium** |
| **Irreplaceable Loss of Resources** | **Partially Replaceable** – it is not known what the contribution of Helbrandkloofspruit is to the Orange River system. |
| **Status and Significance (without mitigation)** | **Medium Negative (-)** |
| **Mitigation** | • Development outside the 32m buffer lines and 100m buffer line for the Helbrandkloofspruit.<br>• No activities, e.g. stockpiles, within the drainage lines or floodouts.<br>• Finalize the stormwater management plan for efficient movement of stormwater down drainage lines.<br>• Upgrade the crossing over the Helbrandkloofspruit to aid downstream flow. |
| **Significance and Status (with mitigation)** | **Low Negative (-)** |

**Chemical pollution of aquatic resources (streams, groundwater) on DK5.**

| | |
|---|---|
| **Nature of the Impact** | This impact is linked specifically to any activities which may result in chemical pollution of aquatic resources, e.g. leakage from the battery storage area, ablution facilities etc. |
| **Extent** | **Site-specific** – Due to the ephemeral nature of the streams on site, any polluting events on surface sources are likely to be site-specific. Note that if the groundwater resource were to be contaminated, the impact would be **Regional**, particularly due to the importance of groundwater in arid areas. |
| **Duration** | **Long-term** |
| **Consequence / Intensity** | **Medium** |
| **Probability** | **Improbable** |
| **Reversibility** | Only **Partially Reversible** if groundwater is contaminated. |
| **Degree of Confidence** | **Medium** |
| **Irreplaceable Loss of Resources** | **Replaceable** – It is considered unlikely that contaminants would reach either the groundwater resource or the Orange River. |
| **Status and Significance (without mitigation)** | **Medium Negative (-)** – This impact is considered Medium even without mitigation, due to the ephemeral drainage lines on site, distance to the Orange River and no wetlands on the DK5 site. |
| **Mitigation** | Proper mitigation and management can mitigate the impact, e.g. the proposed containerized battery storage area and use of conservancy tanks for domestic effluent. |
| **Significance and Status (with mitigation)** | **Low Negative (-)** |

## 3.5 INDIRECT OPERATIONAL PHASE IMPACTS

None were identified.

## 3.6 OPERATIONAL PHASE CUMULATIVE IMPACTS

Any cumulative impacts in the area would be related to the large number of solar power plants in an area where little is known of the ephemeral systems and sensitive floodout features. As seen in the NBA 2018 documents, little data are available for the ephemeral systems in these arid areas, suggesting that development should adopt a precautionary approach, e.g. the 100m buffer adopted in the layout around the significant ephemeral stream in the project layout area, the Helbrandkloofspruit.

## 3.7 ENVIRONMENTAL MANAGEMENT RECOMMENDATIONS

A number of management activities can reduce the impact on the ephemeral drainage lines and floodouts of the DK5 site. Some of these are listed below:

- Follow the requirements of the Environmental Authorisation issued by the Department of Environmental Affairs, e.g. an Environmental Control Officer (ECO) must be appointed by the project developer for the duration of construction activities.
- Reduce potential impacts and the ecological footprint of the development on the aquatic environment by only developing outside of dedicated buffer zones, within the dedicated fenced-off area, and once perimeter fencing and upgraded culverts are in place.

- Implement buffer zones as recommended and submitted to the layout designers, i.e. 100m buffer around the main ephemeral drainage line, Helbrandkloofspruit, and 32m buffers around other drainage lines and floodouts.
- Prevent the movement of vehicles or dumping of materials in any drainage lines or floodouts.
- Minimise pollution and contamination of aquatic resources with solutions such as containerized battery units, and maintain ablution and waste removal facilities in good working order. Conservancy tanks should be mounted on concrete slabs. Ensure emergency measures are in place in case of overflow or failure.
- Direct all runoff away from watercourses.
- Where drainage lines have to be crossed e.g. the access road at the southern end of the Helbrandkloofspruit, utilize low impact technology.
- Optimize the Stormwater Management Plan to allow natural stormwater flow down the drainage lines, particularly the Helbrandkloofspruit, to the Orange River.
- Natural groundwater recharge must be encouraged so as to maintain the natural hydrological regime as far as possible.
- Erosion control should be practised throughout construction and operations, particularly in terms of managing sediment movement and deposition in drainage lines.

To aid in information gathering for the arid systems of SA, the following is recommended:

- Wetlands: monitor for the development of wetlands, and delineate and determine PES and EIS once recorded in the landscape according to DWA (2008).
- Record the following parameters for the Helbrandkloofspruit at times of flow and at selected points (upstream and downstream of the development), and forward the information to the DWS:
  - Fixed point photograph
  - GPS coordinate
  - Discharge (requiring a flow meter)
  - Basic *in situ* water quality indicators to be taken at a fixed place and time of day per sampling round, i.e. pH, electrical conductivity, oxygen, temperature, suspended solids/turbidity
  - Any other requirements listed in the water use license

Note that the Conditions of the water use license issued for the development will specify management and/or monitoring requirements. These conditions may include groundwater monitoring.

## 3.8 CONCLUSIONS AND RECOMMENDATIONS

### 3.8.1 Impact Statement (Summary of Impacts)

It is expected that all potential impacts can be reduced to Low significance with the application of the recommended mitigation measures. A summary of impacts is shown below.

| Impact | Significance (no mitigation) | Significance (with mitigation) | Probability |
|---|---|---|---|
| **Construction Phase: Direct Impacts** | | | |
| Changes to the hydrological regime of streams and drainage features on DK5. | Medium (-) | Low (-) | Probable |
| Loss of riparian vegetation and instream continuity of streams and drainage features on DK5. | Medium (-) | Low (-) | Probable |
| Use of drainage channels as dumping grounds | Medium (-) | Low (-) | Probable |
| **Construction Phase: Indirect Impacts - None** | | | |
| **Construction Phase: Cumulative Impacts - None** | | | |
| **Operational Phase: Direct Impacts** | | | |
| Changes to the hydrological regime of streams and drainage features on DK5. | Medium (-) | Low (-) | Probable |
| Chemical pollution of aquatic resources (streams, groundwater) on DK5. | Medium (-) | Low (-) | Improbable |
| **Operational Phase: Indirect Impacts - None** | | | |
| **Operational Phase: Cumulative Impacts** | | | |
| Any cumulative impacts in the area would be related to the large number of solar power plants in an area where little is known of the ephemeral systems and sensitive floodout features. | | | |

# 4 CONCLUSION AND RECOMMENDATIONS

It is expected that all potential impacts can be reduced to Low significance with the application of the recommended mitigation measures. Due to the dearth of data regarding the aquatic systems in the area, it is critical that any development be undertaken on a precautionary basis with as little disturbance of the natural environment as possible. As so little is known of the area regarding aquatic features, e.g. temporary wetlands that may develop after rainfall events, it is suggested that the ECO or other on-site staff take additional records of any features that appear on site, and that this data be forwarded to the SANBI on an annual basis for data curation and interpretation. This point is in particular reference to the appearance or development of any wetlands on site. Wetland delineation according to DWA (2008) should be conducted, PES and EIS determined and information forwarded to SANBI for updating National Wetland Map 5 (NWM5).

The NBA of 2018 identified a Knowledge Gap in terms of inland aquatic ecosystems in arid regions, and suggested an investment in improved representation and verification of these systems through a combination of citizen science, expert mapping, integration in GIS and remote sensing methods. This project is in the unique position where aquatic indicators and long-term trends can be monitored.

In terms of river systems, recording the following parameters for the Helbrandkloofspruit at times of flow, and forwarding the information to the DWS and SANBI, would be recommended:

- Fixed point photograph
- GPS coordinate
- Discharge (requiring a flow meter)
- Basic *in situ* water quality indicators to be taken at a fixed place and time of day per sampling round, i.e. pH, electrical conductivity, oxygen, temperature, suspended solids/turbidity
- Any other requirements listed in the water use license

# 5 REFERENCES

Berliner D., and Desmet P. 2007. Eastern Cape Biodiversity Conservation Plan: Technical Report. Department of Water Affairs and Forestry (DWAF). Project No. 2005-012. Pretoria. 1 August 2007.

Bowker M., Reed S.C., Maestre F.T., and Eldridge D.J. 2018. Biocrusts: the living skin of the earth. *Plant and Soil* 429:1-7.

Department of Environmental Affairs (DEA). 2015. Strategic Environmental Assessment for wind and solar photovoltaic energy in South Africa. CSIR Report Number: CSIR/CAS/EMS/ER/2015/0001/B. Stellenbosch.

Department of Water Affairs (DWA). 2008. Updated Manual for the Identification and Delineation of Wetlands and Riparian Areas, prepared by M. Rountree, A. L. Batchelor, J. MacKenzie and D. Hoare. Stream Flow Reduction Activities, Department of Water Affairs and Forestry, Pretoria, South Africa.

Department of Water and Sanitation (DWS). 2014. A Desktop Assessment of the Present Ecological State, Ecological Importance and Ecological Sensitivity per Sub-Quaternary Reaches for Secondary Catchments in South Africa. Secondary: R4. Compiled by RQIS-RDM: https://www.dwa.gov.za/iwqs/rhp/eco/peseismodel.aspx. Technical team led by Scherman Colloty & Associates cc.

Grenfell M.C. Personal communication, April 2020. Senior Lecturer: Environmental & Water Science, Institute for Water Studies / Department of Earth Sciences, University of the Western Cape, South Africa.

Grenfell S.E., Grenfell M.C., Rowntree K.M., and Ellery W.N. 2014. Fluvial connectivity and climate: A comparison of channel pattern and process in two climatically contrasting fluvial sedimentary systems in South Africa. *Geomorphology* 205: 142-154.

Hirst R. 2020. Dyasons Klip Photovoltaic Plant – Stormwater Management Report. Prepared by SiVEST SA (Pty) Ltd. for Dyasons Klip PV 5 (Pty) Ltd.. Revision No. 0, Project o. 16145, 20 May 2020.

Kleynhans C.J., Louw M.D., Thirion C., Rossouw N.J., and Rowntree K. 2005. River Ecoclassification*:* Manual for Ecostatus determination (Version 1). Joint Water Research Commission and Department of Water Affairs and Forestry report. WRC Report No. KV 168/05.

Macfarlane D., and Bredin I. 2017. Buffer Zone Guidelines for Rivers, Wetlands and Estuaries Part 1: Technical Manual. Water Research Commission Report No. TT715-1-17. Produced as part of Project No. K5/2463 entitled *Testing the preliminary guidelines for the determination of buffer zones for rivers, wetlands and estuaries.*

Nel J.L., Murray K.M., Maherry A.M., Petersen C.P., Roux D.J., Driver A., Hill L., van Deventer H., Funke N., Swartz E.R., Smith-Adao L.B., Mbona N., Downsborough L., and Nienaber S. 2011. Technical Report for the National Freshwater Ecosystem Priority Areas Project. WRC Report No. 1801/2/11.

Siyanda District Municipality Environmental Management Framework Report. 2008.

South African National Biodiversity Institute (SANBI). 2019. National Biodiversity Assessment 2018: The status of South Africa's ecosystems and biodiversity. Synthesis Report. South African National Biodiversity Institute, an entity of the Department of Environment, Forestry and Fisheries, Pretoria. 214 pp.

Van Deventer H., Smith-Adao L., Collins N.B., Grenfell M., Grundling A., Grundling P-L., Impson D., Job N., Lötter M., Ollis D., Petersen C., Scherman P., Sieben E., Snaddon K., Tererai F. and Van der Colff D. 2019. South African National Biodiversity Assessment 2018: Technical Report. Volume 2b: Inland Aquatic (Freshwater) Realm. CSIR report number CSIR/NRE/ECOS/IR/2019/0004/A. South African National Biodiversity Institute, Pretoria. http://hdl.handle.net/20.500.12143/6230.

# ANNEXURE 1: IMPACT ASSESSMENT METHODOLOGY

## GENERIC TERMS OF REFERENCE FOR THE ASSESSMENT OF IMPACTS

The following section outlines the assessment methodology and legal context for specialist studies. The identification of potential impacts should include impacts that may occur during the construction and operational phases of the activity. The assessment of impacts is to include direct, indirect, as well as cumulative impacts.

In order to identify potential impacts (both positive and negative) it is important that the nature of the proposed activity is well understood so that the impacts and risks associated with the activity, can be well understood. The process of identification and assessment of impacts and risks will include:

- The determination of the current environmental conditions in sufficient detail so that there is a baseline against which impacts can be identified and measured;
- The determination of future changes to the environment that will occur if the activity does not proceed;
- An understanding of the activity in sufficient detail to understand its consequences; and
- The identification of significant impacts and risks which are likely to occur if the activity is undertaken.

As per GN R 326 Appendix 2, 2. (1) (h) (i), the assessment of impacts must include the alternatives to be assessed within the preferred site, including the option of not proceeding with the activity. Alternatives that will be assessed in the EIA phase of the assessment are outlined in Chapter Five of this report. The impact assessment methodology has been aligned with the requirements for EIA Reports as stipulated in GN R 326 Appendix 3, 3. (1) of the 2014 EIA Regulations (as amended), which states the following:

*"An EIA Report must contain the information that is necessary for the competent authority to consider and come to a decision on the application, and must include - …*

*(j) an assessment of each identified potentially significant impact and risk, including –*
*(i) cumulative impacts;*
*(ii) the nature, significance and consequences of the impact and risk;*
*(iii) the extent and duration of the impact and risk;*
*(iv) the probability of the impact and risk occurring;*
*(v) the degree to which the impact and risk can be reversed;*
*(vi) the degree to which the impact and risk may cause irreplaceable loss of resources; and*
*(vii) the degree to which the impact and risk can be mitigated."*

As per Guideline Document 5: Assessment of Alternatives and Impacts, the following methodology is to be applied to the prediction and assessment of impacts and risks. Potential impacts should be rated in terms of the direct, indirect and cumulative.

- **Direct** impacts are impacts that are caused directly by the activity and generally occur at the same time and at the place of the activity. These impacts are usually associated with the construction, operation or maintenance of an activity and are generally obvious and quantifiable.
- **Indirect** impacts of an activity are indirect or induced changes that may occur as a result of the activity. These types of impacts include all the potential impacts that do not manifest

immediately when the activity is undertaken or which occur at a different place as a result of the activity.

- **Cumulative** impacts are impacts that result from the incremental impact of the proposed activity on a common resource when added to the impacts of other past, present or reasonably foreseeable future activities. Cumulative impacts can occur from the collective impacts of individual minor actions over a period of time and can include both direct and indirect impacts.

- **Spatial extent –** The size of the area that will be affected by the impact/risk
  - Site specific
  - Local (<2 km from site)
  - Regional (within 30 km of site)
  - National

- **Consequence/Intensity –**The anticipated severity of the impact/risk
  - Extreme (extreme alteration of natural systems, patterns or processes, i.e. where environmental functions and processes are altered such that they permanently cease)
  - High (severe alteration of natural systems, patterns or processes i.e. where environmental functions and processes are altered such that they temporarily or permanently cease)
  - Medium (notable alteration of natural systems, patterns or processes i.e. where the environment continues to function but in a modified manner)
  - Low (negligible alteration of natural systems, patterns or processes i.e. where no natural systems/environmental functions, patterns, or processes are affected)

- **Duration –**The timeframe during which the impact/risk will be experienced
  - Temporary (less than 1 year)
  - Short term (1 to 6 years)
  - Medium term (6 to 15 years)
  - Long term (the impact will cease after the operational life of the activity)
  - Permanent (mitigation will not occur in such a way or in such a time span that the impact can be considered transient)

- **Reversibility –** The degree to which the potential impacts/risks can be reversed
  - Reversible
  - Partially Reversible
  - Irreversible

- **Irreplaceable loss of Resources** - The degree to which the impact/risk may cause irreplaceable loss of resources
  - Replaceable
  - Partially Replaceable
  - Irreplaceable

Using the criteria above, the impacts will further be assessed in terms of the following:

- **Probability –**The probability of the impact/risk occurring
  - Improbable (little or no chance of occurring)
  - Probable (<50% chance of occurring)
  - Highly probable (50 – 90% chance of occurring)
  - Definite (>90% chance of occurring)

- **Significance** – Will the impact/ risk cause a notable alteration of the environment?
  - Low to very low (the impact/risk may result in minor alterations of the environment and can be easily avoided by implementing appropriate mitigation measures, and will not have an influence on decision-making)
  - Medium (the impact /risk will result in moderate alteration of the environment and can be reduced or avoided by implementing the appropriate mitigation measures, and will only have an influence on the decision-making if not mitigated).
  - High (the impact/risk will result in major alteration to the environment even with the implementation of the appropriate mitigation measures and will have an influence on decision-making)
  - Very high (the impact/impact will result in very major alteration to the environment even with the implementation on the appropriate mitigation measures and will have an influence on decision-making i.e. the project cannot be authorised unless major changes to the engineering design are carried out to reduce the significance rating).
- **Status** - Whether the impact/risk on the overall environment will be positive, negative or neutral
  - "+" (positive - environment overall will benefit from the impact/risk).
  - "-" (negative - environment overall will be adversely affected by the impact/risk).
  - "o" (neutral - environment overall will not be affected).

- **Confidence** – The degree of confidence in predictions based on available information and specialist knowledge
  - Low
  - Medium
  - High

Impacts, mitigatory measures and the monitoring of impacts will then be collated into the EMPr and these will include the following:

- Quantifiable standards for measuring and monitoring mitigatory measures and enhancements will be set. This will include a programme for monitoring and reviewing the recommendations to ensure their ongoing effectiveness.
- Identifying negative impacts and prescribing mitigation measures to avoid or reduce negative impacts. Where no mitigatory measures are possible this will be stated.
- Positive impacts and mitigation measures will be identified to potentially enhance positive impacts where possible.

Management Actions and Monitoring of the Impacts:

- Where negative impacts are identified, mitigatory measures will be identified to avoid or reduce negative impacts. Where no mitigatory measures are possible this will be stated.
- Where positive impacts are identified, mitigatory measures will be identified to potentially enhance positive impacts.

The table below is to be used by specialists for the rating of impacts:

*Table A1: Rating of impacts.*

| Nature of the Impact | This should include a description of the proposed impact to indicate if the impact is a direct, indirect or a cumulative impact. |
|---|---|
| Extent | Site specific, local, regional or national |
| Duration | Temporary, short term, medium term, long term or permanent |
| Consequence /Intensity | Extreme, High, medium or low |
| Probability | Improbable, probable, highly probable, definite |
| Degree of Confidence | Low, medium or High |
| Reversibility | Reversible, Partially Reversible, Irreversible |
| Irreplaceable Loss of Resources | Replaceable, Partially Replaceable, Irreplaceable |
| Status and Significance (without mitigation) | Low, medium or High indicating whether Positive (+), Negative (-) or Neutral (o) |
| Mitigation | Overview of mitigatory measures to mitigate potentially negative impacts or enhance potential positive impacts indicating how this mitigatory measure impacts on the significance of the impact |
| Status and Significance (after mitigation) | Low, medium or High indicating whether the status of the impact is Positive (+), Negative (-) or Neutral (o) |

Other aspects to be taken into consideration in the assessment of impact significance are:

- Impacts will be evaluated for the construction and operational phases of the project:
  - **NOTE**: No assessment of impacts during the decommissioning phase of the project is proposed. The relevant guidelines and rehabilitation requirements applicable at that time will need to be applied.
- Impacts will be evaluated with and without mitigation in order to determine the effectiveness of mitigation measures on reducing the significance of a particular impact; and
- The impact evaluation will, where possible, take into consideration the cumulative effects associated with this and other facilities/ projects which are either developed or in the process of being developed in the local area.
- The impact assessment will attempt to quantify the magnitude of potential impacts (direct and cumulative effects) and outline the rationale used. Where appropriate, national standards are to be used as a measure of the level of impact.