Wetland Delineation and Assessment for the Proposed Humansrus Solar Thermal Energy Plant near Postmasburg, Northern Cape

For:

Worley Parsons
Leanna Rautenbach
Leanna.rautenbach@worleyparsons.com

By:

Wetland Consulting Services (Pty) Ltd

Wetland Consulting Services (Pty.) Ltd.
PO Box 72295
Lynnwood Ridge
Pretoria
0040

Tel: 012 349 2699
Fax: 012 349 2993
Email: info@wetcs.co.za

Wetland Consulting Services (Pty.) Ltd.

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CLIENT:	**Worley Parsons**
CONTACT DETAILS:	**Leanna Rautenbach** Leanna.rautenbach@worleyparsons.com
CONSULTANT:	**Wetland Consulting Services, (Pty) Ltd.**
CONTACT DETAILS:	**Allan Batchelor** **PO Box 72295** **Lynnwood Ridge** **0040** **Telephone number: (012) 349 2699** **Fax number: (012) 349 2993** **E-mail:** allanb@wetcs.co.za

TABLE OF CONTENTS

TABLE OF FIGURES

TABLE OF TABLES

INDEMNITY AND CONDITIONS RELATING TO THIS REPORT

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1. BACKGROUND INFORMATION

Wetland Consulting Services (Pty) Ltd was appointed by SSI to undertake the specialist wetland delineation and assessment as part of the EIA process currently being undertaken by SSI for the proposed Humansrus Solar Thermal Energy Plant near Postmasburg in the Northern Cape. The need for the wetland delineation was identified based on the vegetation study undertaken for the site which identified a non-perennial drainage line and associated floodplain on site.

The requirement to establish the existence and/or extent of wetlands and riparian areas on the property is based on the legal requirements contained in both NEMA as well as the Water Act. Given the stringent legislation regarding developments within or near wetland areas, it is important that these areas are identified and developments planned sensitively around them to minimize any potential impacts.

The purpose of this document is to describe the wetlands and riparian habitat within the study area, to identify expected impacts on the wetland and riparian habitats due to the proposed developments and to provide recommendations regarding appropriate mitigation and/or management measures to be implemented should the proposed activities be authorised.

2. SCOPE OF WORK

The following task formed part of the agreed upon scope of work for this initial baseline report:

- **Baseline Wetland Assessment:**
  - ⇒ Conduct a desktop and field investigation of the wetlands and riparian habitats within the study area;
  - ⇒ Assess, classify, delineate and map the identified wetlands and riparian habitats;
  - ⇒ Identify and describe the functions of the wetlands and riparian habitats;
  - ⇒ Determine the Present Ecological State (PES) and Ecological Importance and Sensitivity (EIS); and
  - ⇒ Provide a report, including maps of the wetland and riparian habitats, detailing all the information.

Following on from this initial report, a detailed impact assessment will be undertaken to assess the impacts of the proposed developments on the identified wetlands and riparian habitats

3. LIMITATIONS

The study area was visited from the 1-3 July 2011 during the middle of winter and outside of the growing season. Due to significant frosting back of vegetation and heavy grazing in places, only limited use could be made of vegetation indicators and species. Difficulty in identifying plants to species level at this time of the year are reflected in the species list.

Due to the scale of the remote imagery used (1:10 000 orthophotos and Google Earth Imagery), as well as the accuracy of the handheld GPS unit used to delineate wetlands in the field, the delineated wetland boundaries cannot be guaranteed beyond an accuracy of about 20m on the ground. Should greater mapping accuracy be required, the wetlands would need to be pegged in the field and surveyed using conventional survey techniques.

4. STUDY AREA

4.1 Location

The study area is located on the Farm Humansrus 469 approximately 30km east of Postmasburg along the R 385 road to Barkly West; the tar road forms the northern boundary of the study area. A railway line traverses the study area within the south western reaches of the site. The study area is approximately 1 250ha.

The upper reaches of the Groenwater Spruit flow across the south western reaches of the study area.

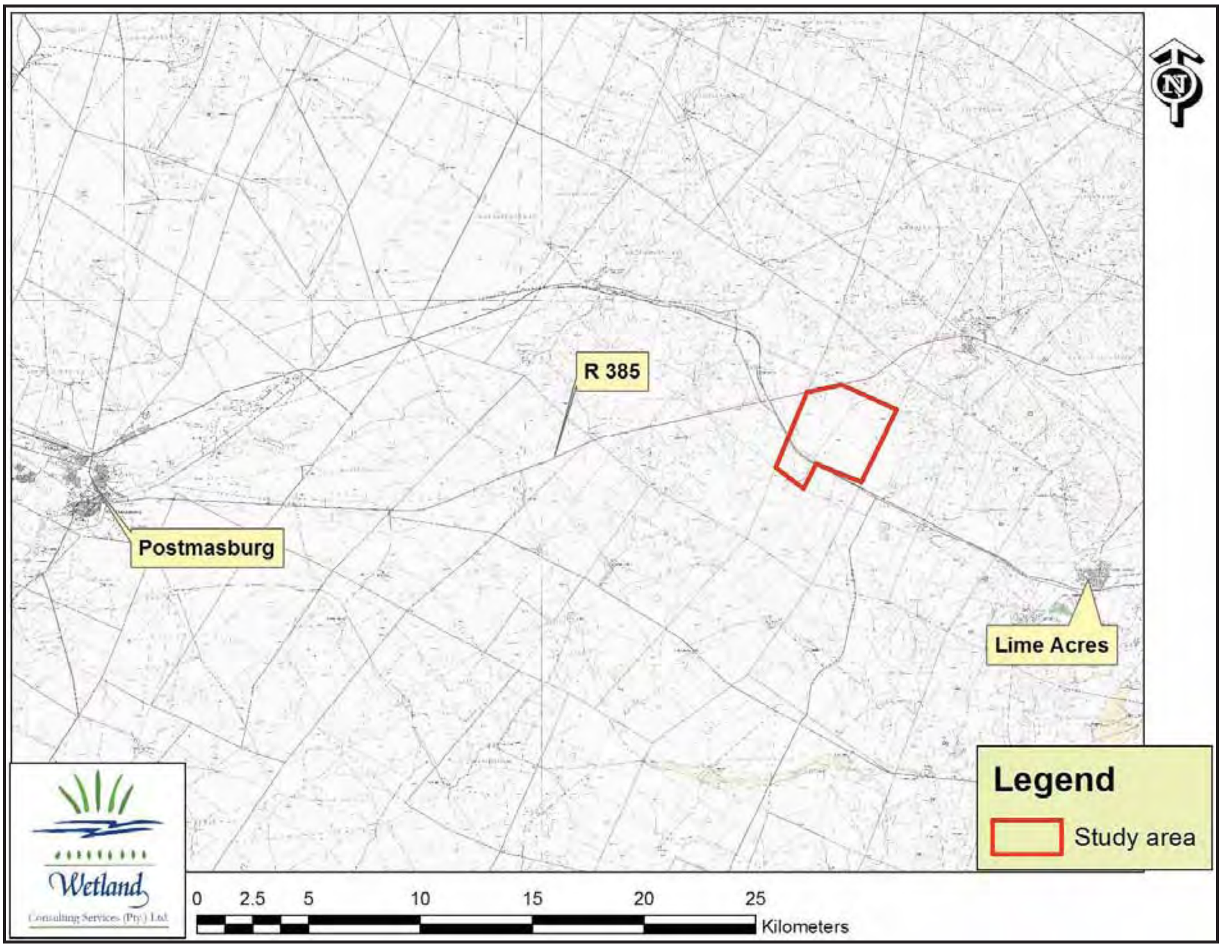

Figure 1. Map showing the location of the study area.

4.2 Catchments

The study area is located within Primary Catchment D, and more specifically within quaternary catchment D73A. The catchment is drained by the Groenwater Spruit.

Information regarding catchment size, mean annual rainfall and runoff for the quaternary catchment is provided in the table below (Middleton, B.J., Midgley, D.C and Pitman, W.V., 1990). Figure 2 indicates the position of study area in relation to the affected quarternary catchment. Note the low mean annul precipitation, which indicates that the study area is located within an arid environment.

Table 1. Table showing the mean annual precipitation, run-off and potential evaporation per quaternary catchment (Middleton, B.J., Midgley, D.C and Pitman, W.V., 1990).

Quaternary Catchment	Catchment Surface Area (ha)	Mean Annual Rainfall (MAP) in mm	Mean Annual Run-off (MAR) in mm	MAR as a % of MAP
D73A	297 781	322.66	14.6	4.5 %

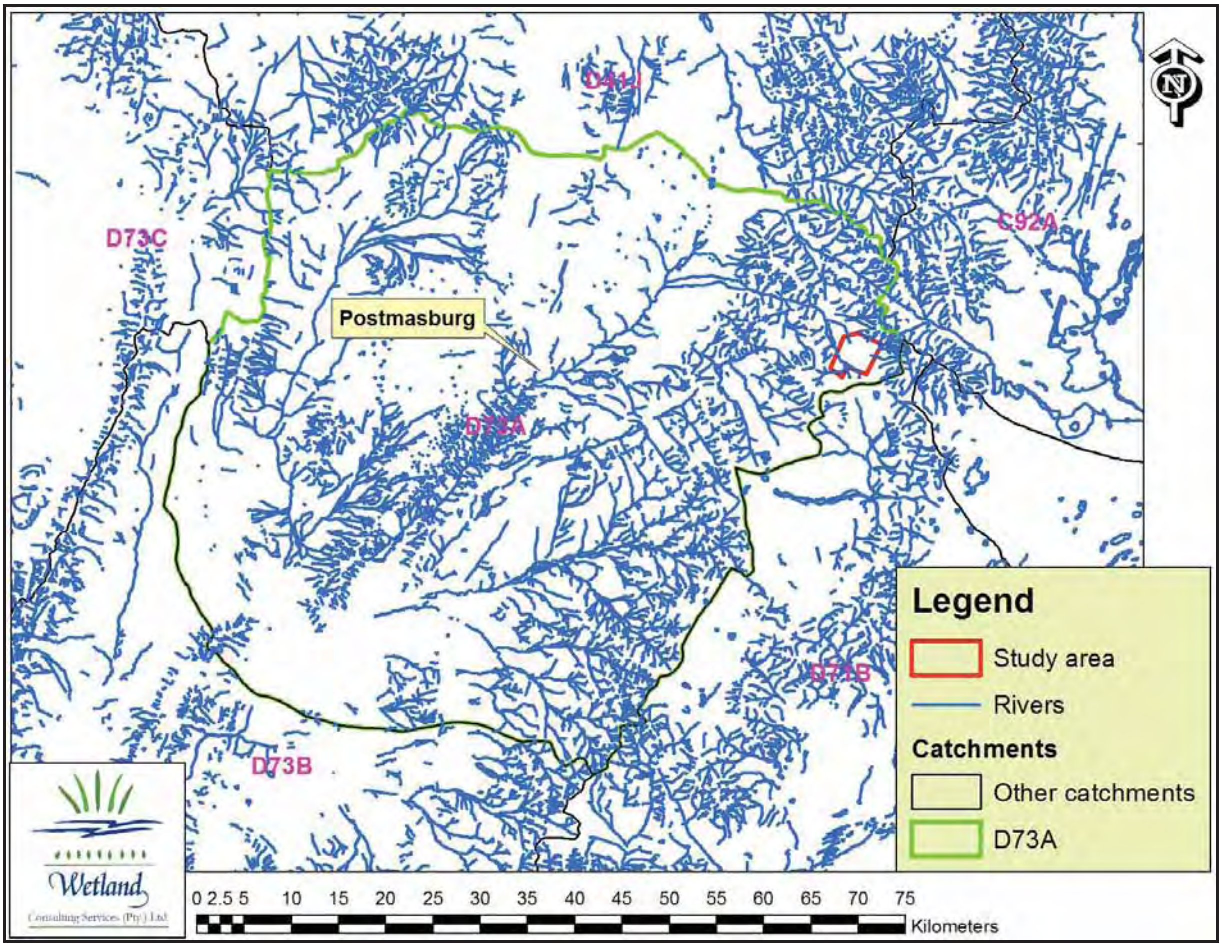

Figure 2. Map showing the study area in relation to the quaternary catchment.

4.3 Geology and Soils

No information regarding the underlying geology was available at the time of writing this report.

The soils on site were generally of a sandy nature within the valley bottom areas and on the flatter areas. The hilly sections of the site were dominated by very rocky terrain with extensive areas of exposed rocks and stones and generally shallow soils. The shallow, rocky soils encourage the surface run-off of water, while the sandy soils allow infiltration of the water into the soil. Rainfall within the area is limited (322mm per annum) and is expected to occur in high intensity storm events that result in large volumes of high velocity runoff from the rocky areas on site following these events. This is supported by the incised drainage line on site.

Within the sandy soil areas, rainfall infiltrates the sandy soil profile and is then either lost to deeper infiltration to groundwater or to evapo-transpiration, or moves through the soil as sub-surface seepage.

4.4 Vegetation

An extract of the latest vegetation mapping of South Africa, undertaken by Mucina and Rutherford (2006), is reproduced in Figure 3 below.

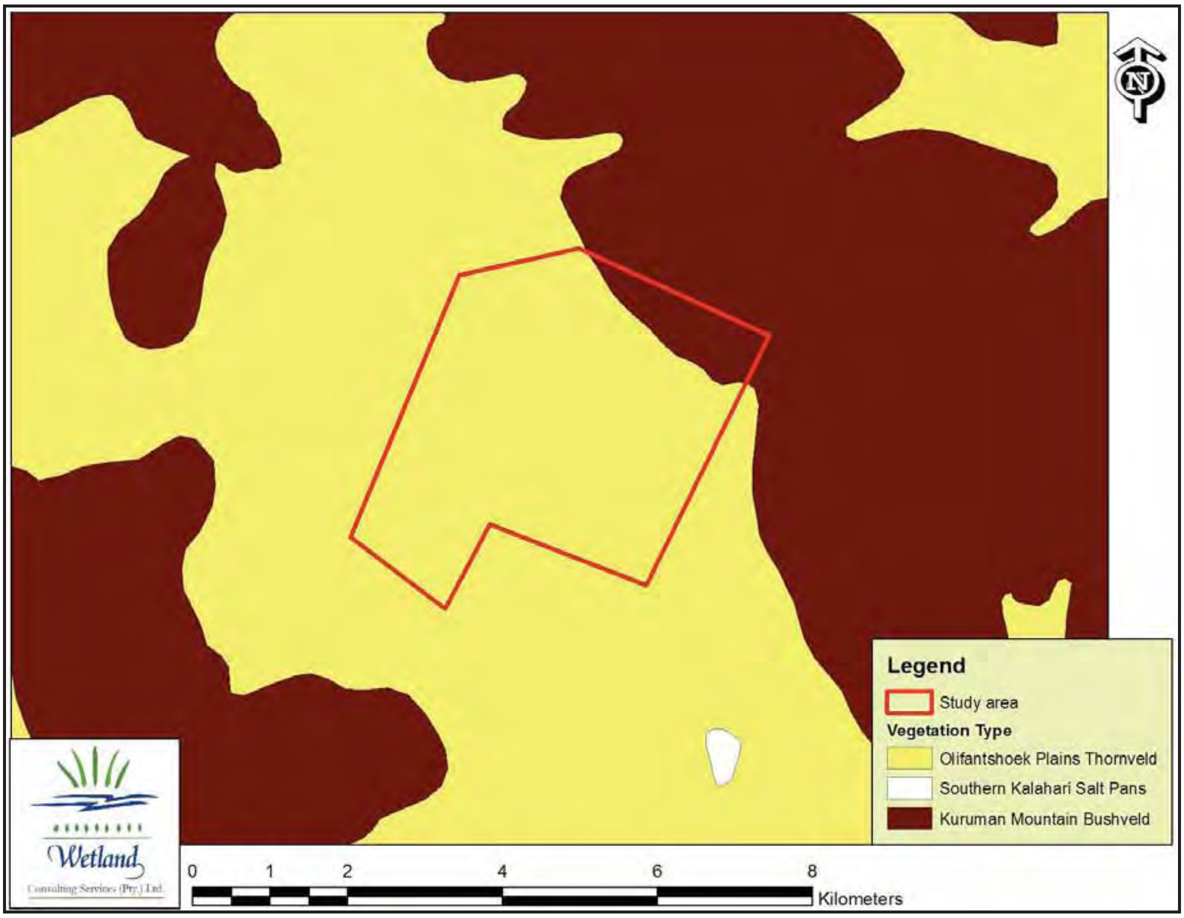

Figure 3. Vegetation types of the study area (Mucina & Rutherford, 2006).

The study area falls within the Savanna Biome and the Eastern Kalahari Bushveld Bioregion. Two vegetation types occur on site, namely Kuruman Mountain Bushveld associated with the hills in the north east of the site and Olifantshoek Plains Thornveld across the remainder of the site. Both these vegetation types are considered *Least Threatened*.

5. APPROACH

5.1 Wetland Delineation and Classification

Use was made of 1:50 000 topographical maps, 1:10 000 orthophotos and Google Earth Imagery to create digital base maps of the study area onto which the wetland and riparian habitat boundaries could be delineated using ArcMap 9.0. A desktop delineation of suspected wetland and riparian areas was undertaken by identifying rivers and wetness signatures on the digital base maps. All identified areas suspected to be wetlands or riparian areas were then further investigated in the field.

Wetlands and riparian habitats were identified and delineated according to the delineation procedure as set out by the "*A Practical Field Procedure for the Identification and Delineation of Wetlands and Riparian Areas*" document, as described by DWAF (2005) and Kotze and Marneweck (1999). Using this procedure, wetlands were identified and delineated using the Terrain Unit Indicator, the Soil Form Indicator, the Soil Wetness Indicator and the Vegetation Indicator. Riparian areas are identified and delineated based mostly on vegetation indicators as well as the presence of alluvial soils

For the purposes of delineating the actual wetland boundaries use is made of indirect indicators of prolonged saturation, namely wetland plants (hydrophytes) and wetland soils (hydromorphic soils), with particular emphasis on hydromorphic soils. It is important to note that under normal conditions hydromorphic soils must display signs of wetness (mottling and gleying) within 50cm of the soil surface for an area to be classified as a wetland (*A practical field procedure for identification and delineation of wetlands and riparian areas*, DWAF).

The delineated wetlands were then classified using a hydro-geomorphic classification system based on the system proposed by Brinson (1993), and modified for use in South African conditions by Marneweck and Batchelor (2002).

5.2 Present Ecological State and Ecological Importance & Sensitivity

A present ecological state (PES) and ecological importance and sensitivity (EIS) assessment was conducted for every hydro-geomorphic wetland unit and riparian zone identified and delineated within the study area. This was done in order to establish a baseline of the current state of the wetlands and to provide an indication of the conservation value and sensitivity of the wetlands in the study area.

6. FINDINGS

6.1 Wetland and Riparian Delineation and Classification

The National Water Act, Act 36 of 1998 (the Act), defines wetlands as follows:

> *"Land which is transitional between terrestrial and aquatic systems where the water table is usually at or near the surface, or the land is periodically covered with shallow water, and which land in normal circumstances supports or would support vegetation typically adapted to life in saturated soil."*

Riparian habitat in turn is defined by the Act as:

> *"Riparian habitat includes the physical structure and associated vegetation of the areas associated with a watercourse which are commonly characterised by alluvial soils, and which are inundated or flooded to an extent and with a frequency sufficient to support vegetation of species with a composition and physical structure distinct from those of adjacent land areas."*

The 1:50 000 topographical map of the area (2823AD) indicates a number of non-perennial drainage lines within the study area. Numerous small drainage lines are shown draining onto the site from the mountains to the north and east of the site before petering out on the flat central region of the study area. In the south western portions of the site the upper reaches of the Groenwater Spruit are shown as draining across the study area in a roughly northerly direction.

The field work undertaken during July 2011 revealed that only the Groenwater Spruit and its tributary have associated riparian habitat. The remaining drainage lines indicated on the 1:50 000 topographical maps represent low points within the landscape along which water is expected to flow only occasionally following heavy storm events, but which do not differ in vegetation structure or composition from the adjacent vegetation, and do not have a defined channel. The soils within these areas also showed no hydromorphic features and were typical reddish brown terrestrial soils, presumably of the Hutton soil form. These "drainage lines" were thus not classed as either wetlands or riparian zones. A map of these drainage lines entering the site, as well as some photographs of these areas, are reproduced in Figures 4 and 5 below.

Following heavy rain, surface runoff from the rocky hills to the north and east of the study area is expected to accumulate within these low points where the sandy soil allows easy infiltration of surface water into the soil. Water is thus not retained within the upper reaches of the soil profile for an extended period that would allow the formation of wetland or riparian habitat. Rainfall that has infiltrated the soil is expected to be mostly lost to evapo-transpiration or deeper infiltration into groundwater, though some lateral seepage at depth through the soil profile is possible. To the north of the Farm Humansrus a spring is located on the Farm Groenwater (as indicated by the local farmer) at the northern end of the plain that extends into the central portions of the study area. It is possible that water infiltrating the sandy soil on site plays a role in supporting this spring. This is however mere speculation and will need to be confirmed by the groundwater and geo-technical studies of the site.

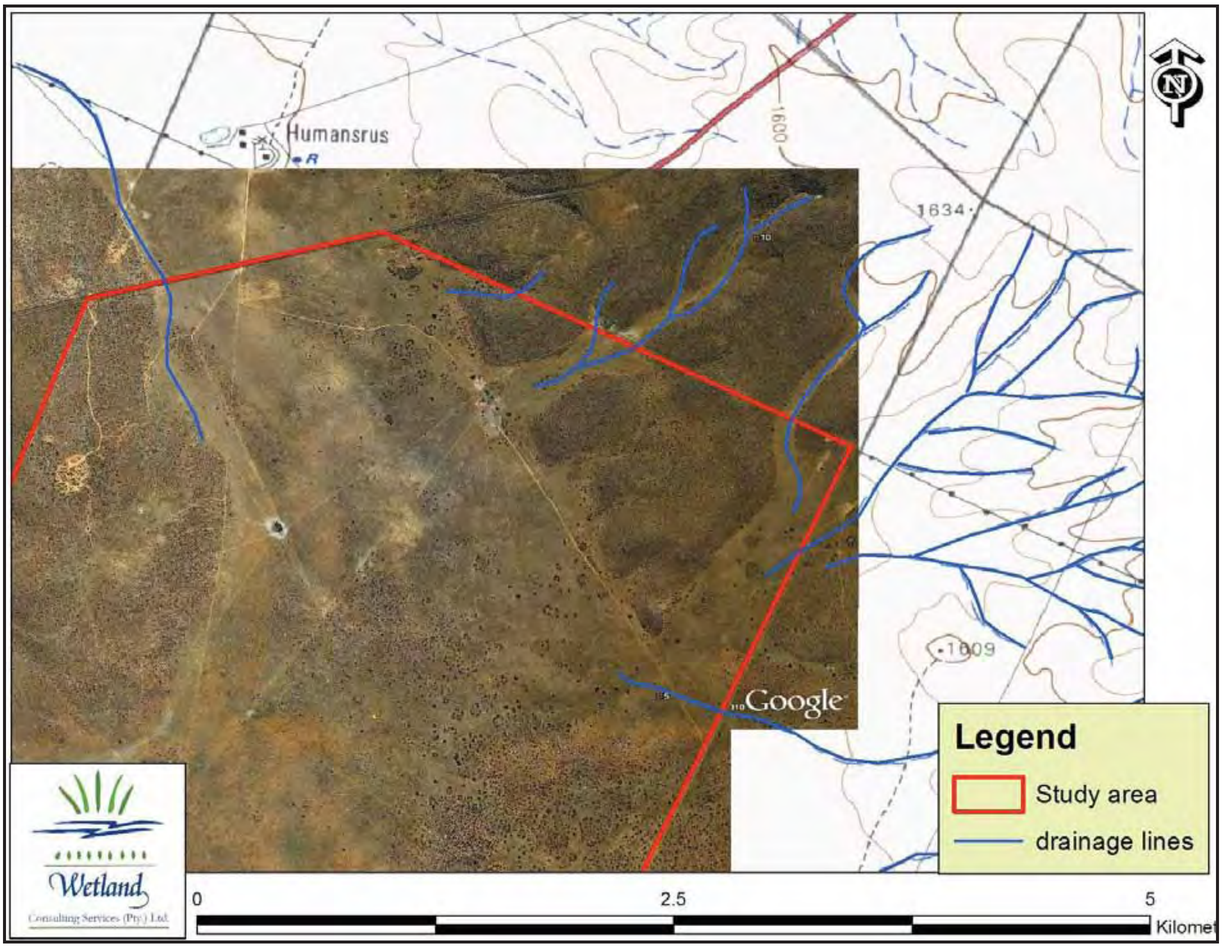

Figure 4. Map of the northern reaches of the study area indicating the drainage lines indicated on the 1:50 000 topographical maps of the area.

Figure 5. Photographs of the ephemeral "drainage lines" indicated in Figure 4. Drainage lines are indicated by a blue line.

The riparian habitat delineated along the Groenwater Spruit and its tributary is illustrated in Figure 6 below, with photographs in Figure 7.

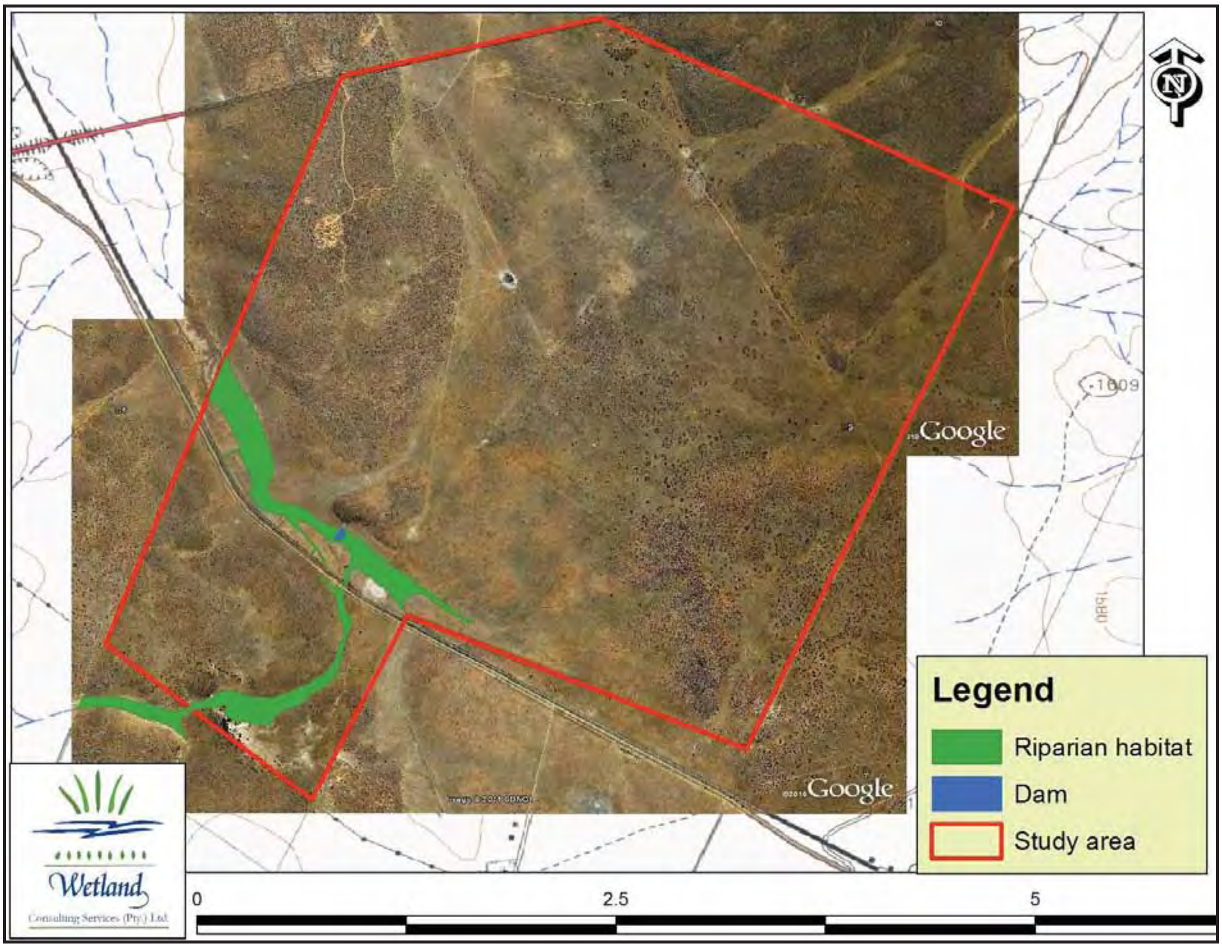

Figure 6. Map of the delineated riparian habitat associated with the Groenwater Spruit.

The delineated riparian habitat covers approximately 31.7ha, which makes up only 2.5 % of the study site by area. In addition to the riparian habitat, a small farm dam constructed along the Groenwater Spruit was also identified.

The reach of the Groenwater Spruit located upslope of the railway line and gravel road is characterised by a clearly defined, incised channel characterised by a rocky substrate. Adjacent side slopes were also generally rocky. Isolated pools of water were observed in this area. Along this section of the riparian habitat a number of tree and shrub species were observed, including *Olea europea, Rhus lancea* and *Acacia tortilis*. Grass species included *Themeda triandra, Aristida congesta, Aristida spp., Eragrostis chloromelas* and *Juncus rigidus*. Though classified as a riparian zone, isolated patches along the water course did display some wetland characteristics and sub-surface water seepage, most notably a small spring located upslope and outside of the study area in close proximity to the site boundary, as well as the area located immediately below the old farm house.

Figure 7. Photographs of the riparian habitat associated with the Groenwater Spruit (clockwise from top left): immediately upstream of the study area; directly below the old farm house; lower reaches of Groenwater Spruit on site looking upstream from northern boundary fence; and upper shallow impoundment.

To the north of the railway line upstream and immediately downstream of the small dam, the Groenwater Spruit and its tributary flow along a poorly defined channel. This section of the riparian habitat is completely devoid of trees and is dominated by various grass species. The timing of the study precluded accurate identification of many of the grass species due to the significant frosting back of vegetation that had already taken place, as well as heavy grazing by livestock. Typical species however included various *Aristida* spp., *Themeda triandra*, *Juncus rigidus*, *Eragrostis* spp, *Melinis repens*, *Sporobolus* spp. and *Cynodon dactylon*.

The lower reaches of the Groenwater Spruit on site are again characterised by a clearly defined, incised channel, the channel being broad and fairly shallow. Once again the riparian habitat is tree-less and dominated by grass species. Soils along this section of the riparian zone were typical of terrestrial soils with no signs of seepage into the stream channel. The channel was also completely dry downslope of the railway crossing.

6.2 Water Quality

At the time of the site visit in July 2011 the Groenwater Spruit on site was mostly dry with surface water restricted to small isolated pools of standing water within the stream channel. No flowing water was observed. Areas of standing water were heavily utilised and trampled by livestock.

These conditions are not ideal for the sampling of water quality and diatoms, with especially diatoms best sampled in flowing water to allow for the utilisation of the diatom pollution indices.

However, a grab water sample was collected and submitted to the ARC-ISCW for analysis of standard anions and cations, as well as an MS-ICP scan for metals. The results of the analysis are summarised in the tables below.

The water quality was sampled in the Groenwater Spruit from the largest observed extent of surface water, located below the old farmhouse (-28.320424°S; 23.352987°E). As indicated, no flowing water was present at the time of sampling, and remaining areas of standing water were heavily impacted by livestock reliant on these areas for drinking water. The impact of the livestock on the water is indicated by the elevated nitrate concentration of the water, resulting from cattle droppings in the water. Generally the water quality is however of an acceptable standard. The target water quality guidelines for aquatic ecosystems were exceeded for both Selenium and Zinc, though this is expected to be the natural condition of the stream and is not taken as being indicative of pollution.

Table 2. Results of water quality analysis for standard anions and cations.

Variable	Concentration (mg/l)
pH	8.21
EC	86.00
TDS	490.63
Alkalinity	317.00
Bicarbonate	386.74
Boron	0.07
Calcium	77.05
Carbonate	0.00
Chloride	76.60
Fluoride	0.28
Magnesium	47.60
Nitrate	**5.82**
Nitrite	0.00
Phosphate	0.00
Potassium	4.46
Sodium	30.09
Sodium Bicarbonate	0.00
Sodium Carbonate	0.00
Sulphate	55.66

Table 3. Results of the Ms-ICP scan for metals.

Element	Concentration (ppb)	Guidelines Aquatic Ecosystems
Co	0.272	≤ 0.3 µg/l
Li	0.905	
Se	3.761	≤ 2 µg/l (5 µg/l)[1]
Br	809.4	
As	1.089	≤ 10 µg/l
Zn	6.567	≤ 2 µg/l (3.6 µg/l)[2]
Sr	291.10	
Ni	1.438	
Mo	0.302	
Mn	0.098	180 µg/l
Cr	5.895	≤ 7 µg/l
V	8.789	
Ti	2.684	
B	66.15	
Be	0.00	
Cu	2.405	
Ba	66.65	
Bi	0.00	
Pb	0.00	≤ 0.2 µg/l
Tl	0.017	
Hg	0.00	≤ 0.04 µg/l
Pt	0.051	
Rb	0.825	
La	0.00	
U	3.515	
Cs	0.00	
I	48.3	
Te	0.001	
Sb	0.02	
Sn	1.275	
Cd	0.005	≤ 0.07 µg/l
W	0.023	

6.3 Functional Importance of the riparian habitat

A number of functions and ecosystem services are typically attributed to riparian habitats that are linked to the hydrology, geomorphology and vegetation characteristics of the riparian habitat in question.

The riparian habitat on site is associated with an ephemeral and highly variable stream in terms of flow characteristics, which are reflected in the riparian vegetation which is in many places poorly developed and often resembles the adjacent terrestrial habitat. Nonetheless, the riparian habitat is expected to play a role in various functions, including:

- Erosion control – the riparian vegetation stabilises river banks through the binding action of the plant roots, as well as slowing down flows through the surface roughness provided by the vegetation, further reducing erosion risk. As the riparian habitat on site is dominated by

[1] Concentration in brackets indicates the chronic effect value for Selenium as per the Guidelines for Aquatic Ecosystems.
[2] Concentration in brackets indicates the chronic effect value for Zinc as per the Guidelines for Aquatic Ecosystems.

non-woody species, the surface roughness provided by the riparian vegetation is however somewhat limited;

- Flood attenuation – the main flood attenuation function of the riparian habitat is performed when flows overtop the stream channel and spread out across the riparian habitat. This slows down flood velocities;
- Biodiversity support – the riparian habitat provides habitat differing from the surrounding terrestrial habitat and can thus support species not generally found elsewhere on site. Given the arid environment, riparian habitats within the general area are rather limited, further increasing the importance of this function;
- Water supply – the riparian habitat and associated stream represent the only natural surface water supply within the study area and thus provides important drinking areas for a variety of species, particularly bird species (e.g. Namaqua Sandgrouse were observed utilising the remaining pools of water in the stream);
- Ecological corridors – riparian areas often provide ecological corridors for the movement of fauna along the riparian habitat to other areas of suitable habitat; and
- Direct use benefits – on site, these appear to be limited, though the riparian habitat does provide livestock grazing to cattle, goats and horses.

6.4 Present Ecological Status (PES) Assessment

The present ecological state of the riparian habitat was assessed using the VegRAI Level 3 methodology.

Based on this assessment, the riparian habitat is considered to be in a B/C category, indicating a ***largely natural to moderately modified*** system.

Impacts to the riparian habitat that have resulted in degradation of the habitat can be summarised as follows:

- Livestock grazing – heavy grazing by livestock is expected to have resulted in decreased cover and abundance of especially non-woody vegetation within the riparian habitat. Decreased vegetation cover increases erosion risk within the riparian habitat, while livestock paths that lead towards remaining pools of water within the stream further exacerbate the erosion risk. A change in species composition is also likely to occur as a result of heavy grazing pressure. Areas most affected by heavy grazing include the area immediately below the old farm house, as well as around the watering trough located just to the north of the railway line and upstream of the dam;
- Road crossing – the Groenwater Spruit is crossed by both the public gravel road as well as the railway line via a number of culverts. These culverts have concentrated flows and resulted in incision of the channel downslope of the culverts; and
- Dam – the small farm dam as well as a further shallow impoundment upslope of the dam and a berm downslope of the dam have resulted in changes to the riparian vegetation through extended water retention (inundation) while also leading to further concentration of flows. Concentrated flows increase the erosion risk and have lead to channel incision within the riparian habitat.

As the definition of riparian habitat implies (see above), the primary determinant of the distribution and abundance of riparian plant biota is the hydrological regime, which in turn is defined by the depth, seasonal timing, frequency and duration of flooding (Rogers and van der Zel 1989). The volume and time distribution of run-off from the catchment are the prime determinants of the hydrological regime of a river system (Rogers 1995). The geomorphological form of the channel and riparian zone, on the other hand create the site specific condition of depth, duration, frequency and even timing of both surface and ground water fluctuations (Rogers and van der Zel 1989). The geomorphology is, in turn, a function of the run-off characteristics, the volume, timing and character of sediment delivered to the river and of the geological character and history of the local landscape (Church, 1992). The upper catchment of the Groenwater Spruit is mostly undeveloped and changes to catchment run-off quantity and quality are expected to be minimal, with the supporting hydrology of the system still largely intact. This is reflected in the overall fairly good condition of the riparian habitat on site.

Table 4. Ecological categories used for the VEGRAI scoring system (modified from Kleynhans 1996 & Kleynhans 1999).

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

6.5 Ecological Importance and Sensitivity (EIS)

Ecological Importance and Sensitivity is a concept introduced in the reserve methodology to evaluate a water course in terms of:

- Ecological Importance;
- Hydrological Functions; and
- Direct Human Benefits

The riparian habitat on site is considered to be of ***High*** ecological importance and sensitivity and is placed in an ***ecological management class of B***. This rating is based mostly on the ecological and hydrological importance of the riparian habitat (see functional assessment above) as direct human benefits provided by the system under current conditions are limited.

7. SIGNIFICANCE OF FINDINGS

A single riparian zone associated with the Groenwater Spruit and one of its tributaries was identified on site. The delineated riparian habitat covers approximately 31.7ha, which makes up only 2.5 % of the study site by area. In addition to the riparian habitat, a small farm dam constructed along the Groenwater Spruit was also identified.

The riparian habitat is still in a largely natural to moderately modified condition, having been impacted mostly by livestock grazing as well as the construction of the gravel road and railway line across the stream. The riparian habitat is also expected to be of importance in providing various benefits such as erosion protection and biodiversity support.

It is recommended that a buffer zone around the riparian habitat be excluded from development. As the Northern Cape Province does not have its own buffer guidelines, it is recommended that the Gauteng Department of Agriculture and Rural Development (GDARD) buffer guidelines (Pfab, 2009) for riparian habitats be applied. Based on these guidelines, a 100m buffer zone should be delineated around riparian habitats located outside the urban edge and both the riparian habitat as well as the buffer zone should be excluded from development. A map indicating the delineated riparian habitat with a 100m buffer zone is illustrated below.

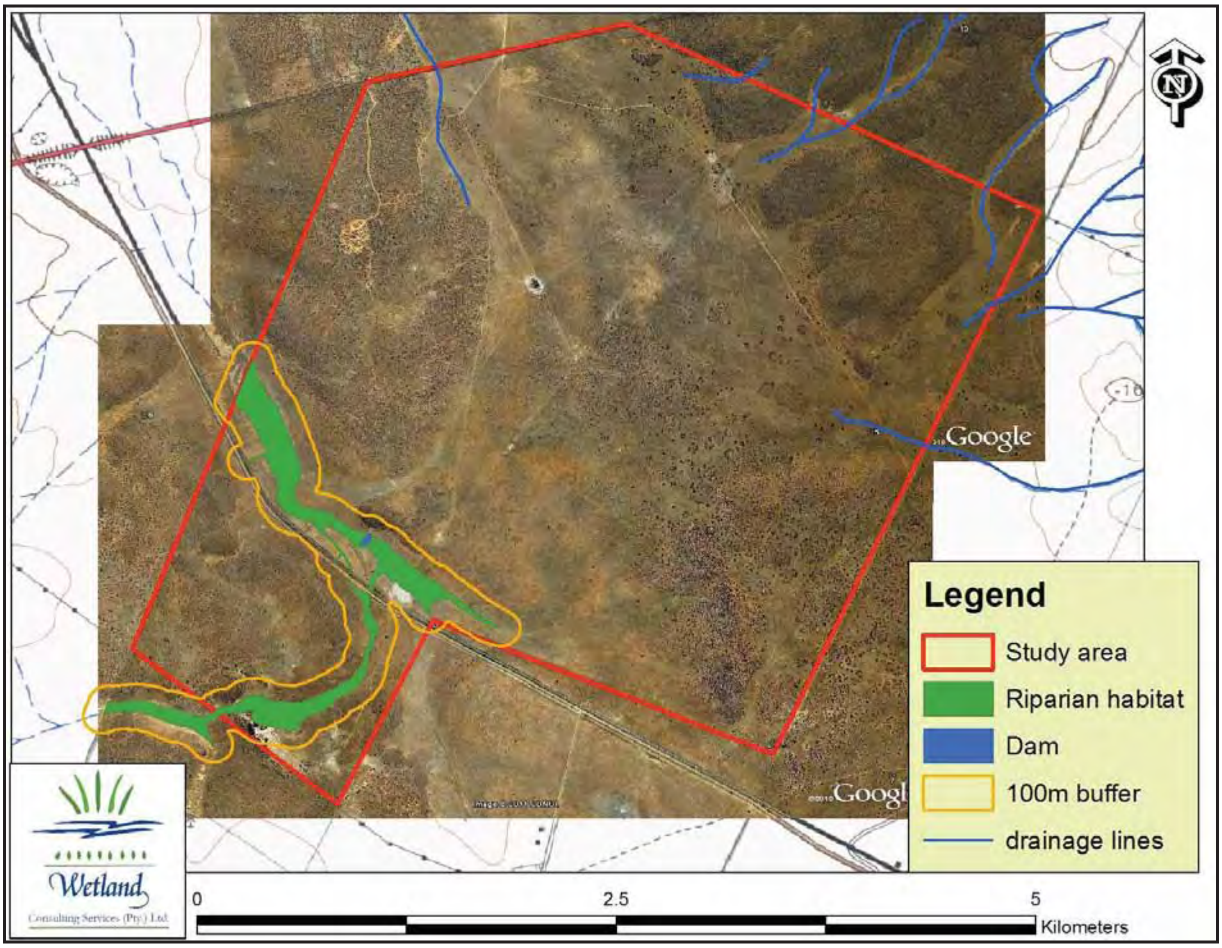

Figure 8. Map of the delineated riparian habitat with a 100m buffer zone as per the GDARD guidelines.

8. IMPACT ASSESSMENT

8.1 Project Description

It is proposed that a 80-100MW Thermal Power Plant be constructed and operated within the Humansrus study area. The power plant will take the form of a Concentrated Solar Power (CSP) Thermal Power Plant that will be connected to the national grid. The CSP Plant and all associated infrastructure will be housed within an 800ha facility located within the Humansrus study area. The following description is taken from the Technical Scope of Work (Worley Parsons, 2011):

> *The CSP Plants are designed as Solar Power Towers, which captures and focuses the sun's thermal energy with thousands of heliostats (tracking mirrors) in an area of 1.1 million m^2. The tower is erected in an inner circle inside the heliostat field. The heliostats focus concentrated sunlight towards the tower where it is absorbed by a receiver which sits on top of the tower. The concentrated sunlight within the receiver, heats the molten salt up to 580ºC, which then flows into a thermal storage tank for storage (maintaining 99% thermal efficiency).*

The molten salt is eventually pumped to a steam generator to generate steam to drive a standard turbine in order to generate electricity. This process, also known as the "Rankin cycle" and is very similar to the operations of a standard coal-fired power plant, except for the fact that it is fuelled by clean, renewable and free solar energy.

In order to reduce the project's water consumption, a dry cooling system has been considered to condense the low pressure (LP) steam exhaust from the turbine.

The proposed facility will be dominated by the large heliostat field which will cover most of the 800ha facility. The heliostats will be mounted on a tubular footing imbedded in a concrete foundation. The tower will be approximately 200m high and have a base diameter of roughly 35m. All ancillary infrastructure will be located adjacent to the tower, with the exception of a new access road and a 132kV loop-in loop-out powerline from the existing powerline crossing the site. The exact location of the access road and the powerlines is not yet known.

The molten salt system will consist of a closed circuit with no discharge. The salt storage tanks will be housed in a bunded area to prevent leaks should failure of the tanks occur. The bunded area will have a capacity of 110% the capacity of the salt storage tanks.

The CSP plant will require substantial amounts of water (117 500m^3 during the 30 month construction period, while up to 44.5m^3/hr will be required for operation during peak consumption), which will need to be imported to the area. Incoming water will pass through a water treatment plant to ensure water of sufficient quality. Several treatment steps will be involved:

- Multimedia filter
- Reverse osmosis
- Electro-deionisation
- Wastewater recovery plant to maximise recovery of water
- Evaporation ponds – for discharge of final waste from treatment plant.

A wastewater purification plant will also be required on site for the treatment and management of 4 sources of waste water that have been identified:

1) Contaminated surface water – this will be capture, re-used as far as possible, and the remainder discharged to the evaporation ponds
2) Sewage effluent – this will be treated via a biological treatment system, with treated water being re-used or discharged to the evaporation ponds
3) Evaporation plant waste water – this will be routed to the water treatment plant, with treated water being reused or discharged to the evaporation ponds
4) Stormwater – clean and dirty stormwater will be separated. Clean stormwater will be captured in a drainage pool and discharged to the environment.

No dirty or treated water will be discharged to the environment.

8.2 Identification and assessment of impacts

A map showing the proposed infrastructure developments in relation to the site and the delineated riparian habitat is provided in Figure 9. A 100m buffer zone has also been delineated around the riparian habitat.

From the image it is clear that none of the proposed infrastructure will intrude into the riparian habitat associated with the Groenwater Spruit. Of the three evaporation pond alternatives indicated in the map below, only alternatives 2 and 3 infringe somewhat on the 100m buffer zone but still fall well outside of the riparian habitat.

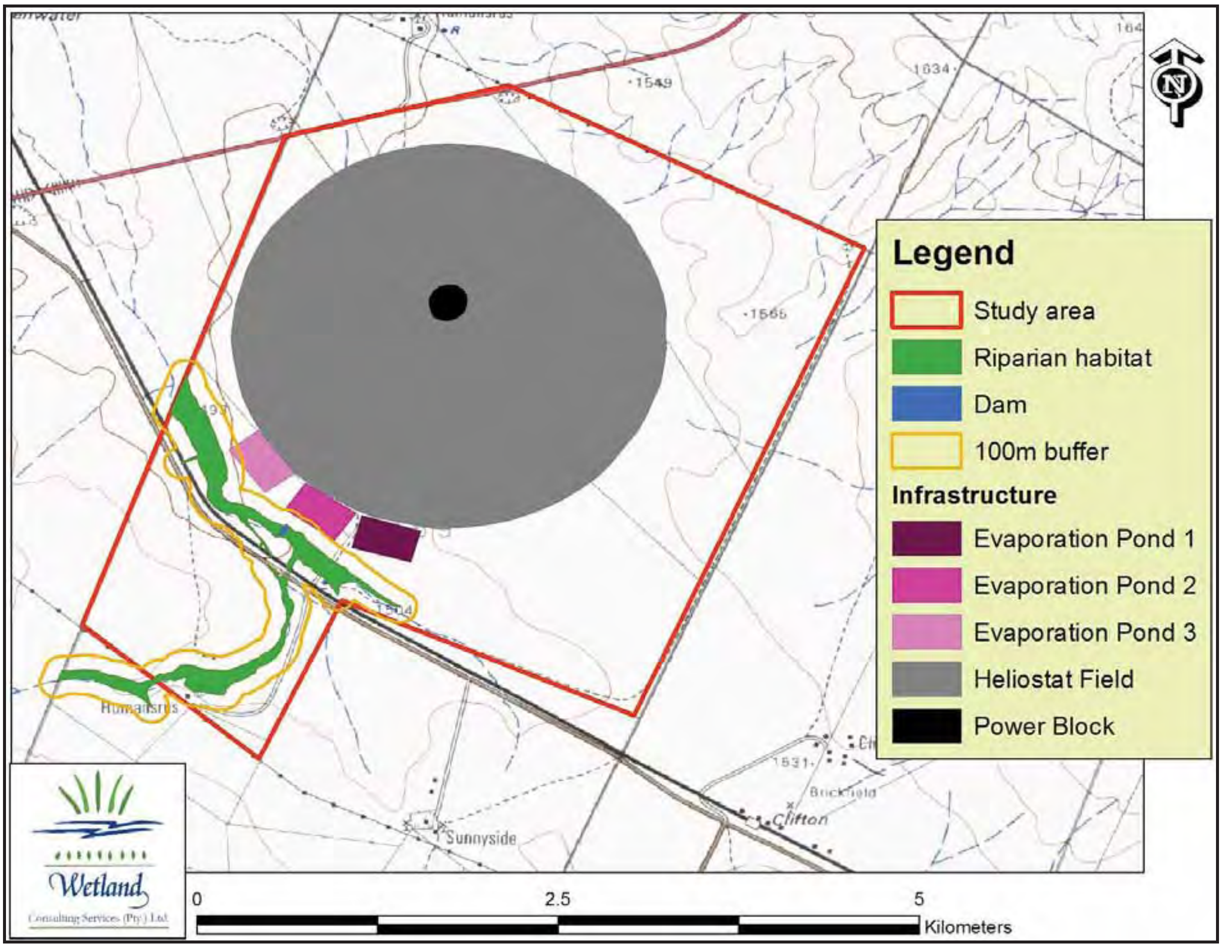

Figure 9. Map showing the proposed infrastructure in relation to the delineated riparian habitat on site.

As no infrastructure will be located within the delineated riparian habitat and associated water course and no construction activities will take place within these areas, no direct impacts to the riparian habitat are expected. Several indirect impacts due to the developments on site are however expected. Expected impacts are related mostly to increased sedimentation due to the earthworks that will be required on site, increased flow within the water course due to the import of large volumes of water, and the deterioration of water quality from leaks and spills of hazardous substances or dirty water.

All of the expected impacts have been grouped into the stage of the project in which they are expected to occur, though some of the impacts are likely to occur across several stages.

Construction Phase:

- Increased sediment movement into the riparian habitat and associated water course
- Water quality deterioration
- Increased flows within the water course

Operational Phase:

- Water quality deterioration
- Increased flows within the water course
- Stormwater discharge

8.2.1 Construction Phase – Increased sedimentation

During the construction phase it is expected that most of the 800ha footprint of the proposed CSP Plant will be cleared of vegetation and extensive earthworks will take place on site. These activities will expose the disturbed, bare soil to erosion by wind and water. As the construction phase is expected to run over 30 months, this will include at least 2 rainfall seasons. High intensity rainfall events which result in surface runoff could result in significant volumes of sediment being transported off the construction site and into downslope water courses. However, most of the proposed developments (i.e. the entire heliostat field) fall outside the direct catchment of the riparian habitat delineated on site. Though the heliostat field does fall within the Groenwater Spruit catchment, the distance between the heliostat field and the channel of the Groenwater Spruit is such that little sediment is likely to be washed into the Spruit, as most of the sediment would be expected to be trapped and deposited within the grassland downslope of the construction site. Only the proposed evaporation pond falls within the direct catchment of the riparian habitat delineated on site.

This impact is expected to be of ***Low significance***.

Description		Spatial scale		Temporal scale		Probability		Severity		Significance	
Negative	-	Low	1	Low	1	Probable	2	Minor	1	Low	-5

Mitigation

The following mitigation measures should be implemented:

- Major vegetation clearing activities and earthworks should be undertaken during the dry season as far as practically possible.
- The footprint of vegetation clearing should be limited to the direct footprint of the proposed developments. The construction servitude should be fenced off prior to the commencement of construction activities and all construction activities should be limited to this servitude.
- Access roads and construction roads should include regular low levels humps to slow down stormwater flow and direct stormwater off the road surfaces and into adjacent grassland at regular intervals to minimise erosive energy of stormwater runoff.

- Stormwater infrastructure should include sediment traps.

8.2.2 Construction Phase – Water quality deterioration

Numerous hazardous substances will be used and stored on site during the construction phase of the project. These substances will include: diesel, oil, cement, salt mixture for the CSP Plant etc. Spillages or leaks of these substances could enter downslope water courses via surface run-off during high intensity storm events, leading to water quality deterioration within the receiving water courses and making the water less fit for use by downstream water users as well as being deleterious to aquatic biodiversity. Communication with the local farmers indicated the presence of a spring within the Groenwater Spruit further downstream of the site which plays an important role in providing drinking water to livestock as it seldom, if ever, dries up. Water quality deterioration could thus have significant consequences to downstream water users. The distance between the construction site and the Groenwater Spruit will however again ensure that pollutants do not directly enter the water course.

This impact is expected to be of ***Medium significance***.

Description		Spatial scale		Temporal scale		Probability		Severity		Significance	
Negative	-	Local	2	Medium	3	Probable	2	Average	2	Medium	-9

Mitigation

The following mitigation measures should be implemented:

- All potentially polluting and hazardous substances used and stored on site should be stored in clearly demarcated areas.
- Storage areas for diesel, oil and other polluting substances must have adequate spillage containment measures to contain any spills within the direct area of the spill. Ideally, all potentially polluting substances should be stored in bunded areas of sufficient capacity to contain the full volume plus 10% of the storage containers.
- All re-fuelling areas and workshops should make use of drip trays to capture fuel and oil spills during re-fuelling or during vehicle maintenance and repairs.
- Stormwater should be diverted around the storage areas of polluting substances to prevent contamination of clean stormwater.
- Sufficient quantities of spill clean-up materials (e.g. Drizit or Spillsorb) should always be available on site. Once used, absorbent material and contaminated soil should be disposed of at a registered hazardous waste disposal site.
- The following guidelines apply to the use of polluting substances on site, and specifically to the use of cement and concrete:
  - ➢ Carefully control all on-site operations that involve the use of cement and concrete.
  - ➢ Limit cement and concrete mixing to single sites where possible.
  - ➢ Use plastic trays or liners when mixing cement and concrete: Do not mix cement and concrete directly on the ground.
  - ➢ Dispose of all visible remains of excess cement and concrete after the completion of tasks. Dispose of in the approved manner (solid waste concrete may be treated as

inert construction rubble, but wet cement and liquid slurry, as well as cement powder must be treated as hazardous waste)

8.2.3 Increased flows within the watercourse

Significant volumes of water will be imported to the study area during the construction of the CSP Plant - 117 500m^3 during the 30 month construction period. This water will be used mostly for dust suppression, heliostat cleaning and compaction purposes, as well as other uses. Large volumes of the water are thus likely to infiltrate into the sandy soil of the area. This could lead to increased surface run-off during rainfall events as the soil becomes saturated more easily, as well as increased seepage of water through the deeper soil profile, water which might be discharged into the Groenwater Spruit further downstream. Increased flows within the Groenwater Spruit could be considered a positive impact by downstream farmers who might have more water available for livestock watering, though increased flows will also lead to changes in the biodiversity supported by the Groenwater Spruit and should thus be seen as a negative impact. The dry climate of the area and high evaporation rates of the area will limit the significance of this impact considerably, as much of the imported water used on site will probably be lost to evaporation before it enters the Groenwater Spruit.

This impact is expected to be of ***Medium significance***.

Description		Spatial scale		Temporal scale		Probability		Severity		Significance	
Negative	-	Local	2	Low	2	Probable	2	Average	2	Medium	-8

Mitigation

Water usage on site should be minimised and re-use of water should be maximised. No discharge of dirty water should be allowed.

8.2.4 Operational Phase – Water quality deterioration

A number of activities will pose a potential water quality hazard during the operational phase:

- The molten salt circuit
- Diesel storage on site (38 000 litres)
- Water treatment facilities, specifically the discharge of treated or untreated water
- The evaporation pond

The molten salt circuit is a closed system and no discharge of any salt from the system will take place. Both the heated salt and the cool sat tanks will be located within a bunded area that will have a total capacity of 110% the volume of the tank contents, i.e. the bunded area will be of sufficient capacity to contain the entire molten salt used in the plant should the system fail. The molten salt system should thus not pose a significant threat to water quality in the Groenwater Spruit.

It is understood that no water will be discharged from the facilities on site. All dirty water will be routed to the respective wastewater treatment plants, and all treated water will be either re-used or discharged to the evaporation dams.

The evaporation dams will contain dirty water and waste from the water treatment plants and are likely to be highly saline. Leakage or overflow from these dams will flow down the slope and into the Groenwater Spruit, resulting in water quality deterioration, specifically increased salinity, though other pollutants are also likely to occur.

This impact is expected to be of ***Medium significance***.

Description		Spatial scale		Temporal scale		Probability		Severity		Significance	
Negative	-	High	3	Medium	2	Probable	2	Severe	3	Medium	-10

Mitigation

The diesel storage tanks on site should be housed in a designated area that will allow for easy containment and clean-up of any spills that could occur on site, ideally in a bunded area. Drip trays should be used at all refuelling sites to capture small spills during refuelling. Emergency spill procedures must be clearly defined and all staff should be familiar with these procedures. Sufficient quantities of absorbent material should be easily available on site for containment of small spills.

Of the three proposed evaporation pond sites (see Figure 9 above), alternative 1 is the preferred alternative from a surface water resources perspective as it is located furthest away from the Groenwater Spruit. The evaporation dam should be lined with a suitable plastic liner (or series of liners) to ensure no seepage or leakage of water out of the dam occurs. The dam should be of sufficient capacity to ensure that no overflow of the dam will occur up to and including the 1:100 year storm event. The dam should be regularly inspected and cleaned to ensure that capacity is not decreased due to sedimentation. All sediments/brine cleaned from the dam should be disposed of in a registered hazardous waste facility.

No discharge of any treated or untreated water may take place on site unless authorised by the DWA.

8.2.5 Operational Phase – Increased flow

Significant volumes of water will be used during the operational phase of the project – up to 44.5m^3/hr during peak consumption. Importing such volumes of water into an area characterised by a dry climate such as is found on site could have significant consequences if released into the environment. However, it has been indicated that no water will be discharged from site other than clean stormwater captured in the attenuation facility. All water will be treated and re-used as far as possible, with waste water being discharged into the evaporation dam.

This impact is expected to be of ***Low significance***.

Description		Spatial scale		Temporal scale		Probability		Severity		Significance	
Negative	-	None	0	None	0	Improbable	1	Minor	1	Low	-2

Mitigation

No discharge of any treated or untreated water may take place on site unless authorised by the DWA.

8.2.6 Stormwater discharge

Clean stormwater generated on site will be captured in an attenuation facility and discharged into the environment. The location or size of the attenuation facility is not known, nor the location or design of the discharge point. The discharge of stormwater is however likely to occur as a point source discharge and be of higher velocity and concentration that pre-development flows and thus poses a significant erosion risk at the point of discharge.

This impact is expected to be of ***Medium significance***.

Description		Spatial scale		Temporal scale		Probability		Severity		Significance	
Negative	-	Medium	2	High	3	Highly probable	3	Average	2	Medium	-10

Mitigation

To ensure effective functioning of the stormwater system, the attenuation facility should be designed to successfully attenuate all regular return rainfall events, up to at least the 1:25 year event. Silt traps should be incorporated into the stormwater system upstream of the attenuation facility to prevent sedimentation of the attenuation dam. Silt traps should be regularly cleaned.

Discharge from the attenuation facility should take place via an erosion protected discharge point and should incorporate energy dissipaters to ensure low velocity discharge with low erosive energy. Stormwater should not be discharged directly into the Groenwater Spruit.

Clean and dirty stormwater should at all times be kept separate. No dirty stormwater may be discharged.

8.2.7 Powerlines

As indicated, the exact location of the required powerlines is not yet known, though it is assumed that a crossing of the Groenwater Spruit will be required. The following recommendations should apply:

- The powerline pylons should ideally be located outside the delineated riparian habitat on site.
- No pylons may be located within the channel of the Groenwater Spruit.

- As far as possible, existing farm tracks should be utilised as service roads to the powerline rather than new tracks being created.
- The powerline should cross the Groenwater Spruit via the shortest route possible and perpendicular to the direction of flow.
- No construction camps or temporary stockpiles should be located within the riparian habitat during the construction process of the powerline.
- The construction servitude should be clearly demarcated and all construction activities limited to the servitude.

9. SUMMARY

A single riparian zone associated with the Groenwater Spruit and one of its tributaries was identified on site. The delineated riparian habitat covers approximately 31.7ha, which makes up only 2.5 % of the study site by area. In addition to the riparian habitat, a small farm dam constructed along the Groenwater Spruit was also identified.

The riparian habitat is still in a largely natural to moderately modified condition, having been impacted mostly by livestock grazing as well as the construction of the gravel road and railway line across the stream. The riparian habitat is also expected to be of importance in providing various benefits such as erosion protection and biodiversity support.

It is recommended that a buffer zone around the riparian habitat be excluded from development. As the Northern Cape Province does not have its own buffer guidelines, it is recommended that the Gauteng Department of Agriculture and Rural Development (GDARD) buffer guidelines (Pfab, 2009) for riparian habitats be applied. Based on these guidelines, a 100m buffer zone should be delineated around riparian habitats located outside the urban edge and both the riparian habitat as well as the buffer zone should be excluded from development.

No infrastructure will be located within the delineated riparian habitat and associated water course and no construction activities will take place within these areas, thus no direct impacts to the riparian habitat are expected. Several indirect impacts due to the developments on site are however expected. Expected impacts are related mostly to increased sedimentation due to the earthworks that will be required on site, increased flow within the water course due to the import of large volumes of water, and the deterioration of water quality from leaks and spills of hazardous substances or dirty water. A number of mitigation measures have been proposed to mitigate these impacts.

It is pointed out that any activity that takes place within the delineated riparian habitat on site will require authorisation in terms of a Water Use Licence Application under Section 21 of the National Water Act.

10. REFERENCES

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