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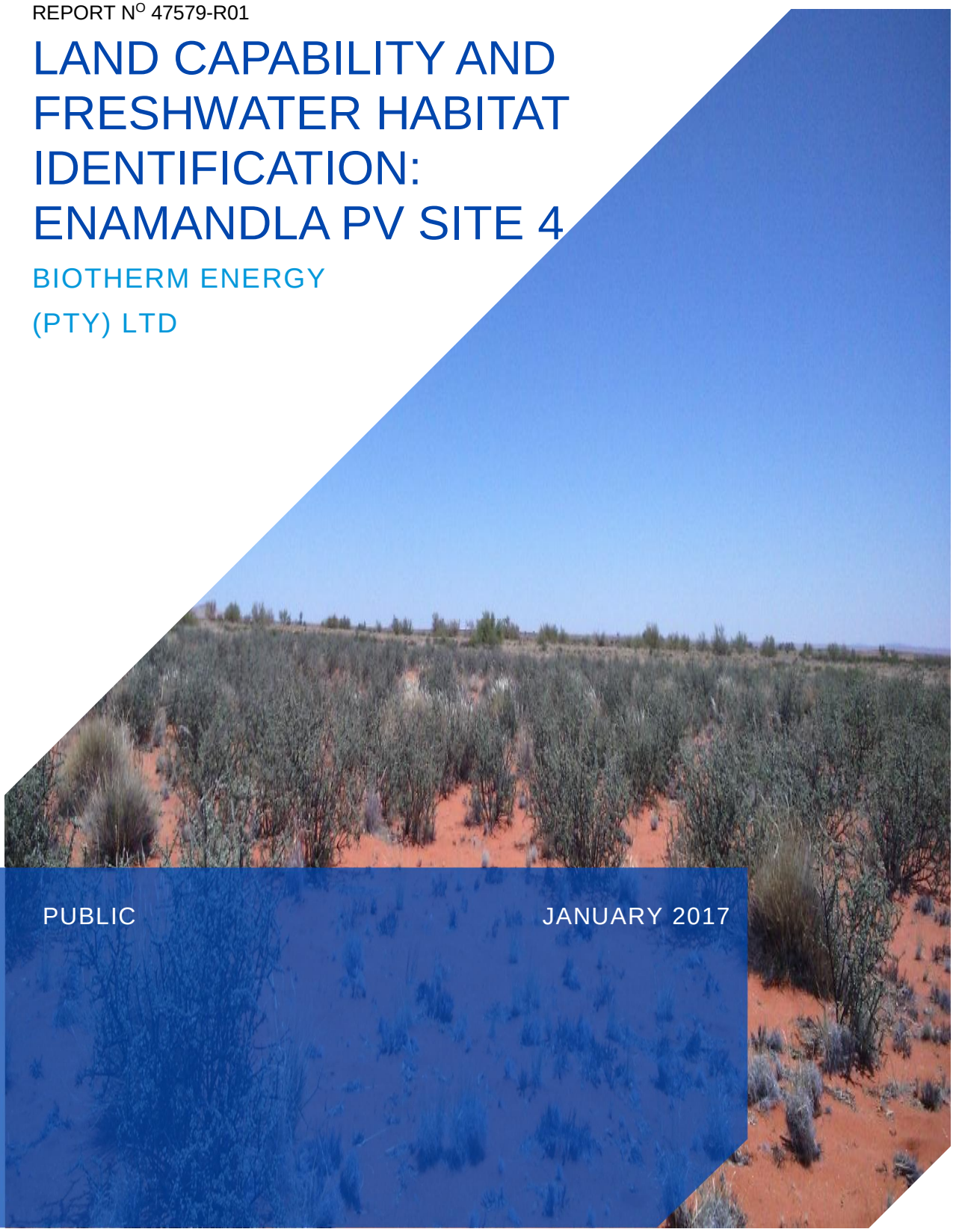
LAND CAPABILITY AND FRESHWATER HABITAT IDENTIFICATION: ENAMANDLA PV SITE 4

BIOTHERM ENERGY (PTY) LTD



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WSP | PARSONS BRINCKERHOFF

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1 INTRODUCTION

BioTherm Energy (Pty) Ltd (BioTherm) have proposed the development for a renewable energy complex Enamandla PV Site 4 in the Northern Cape province. As part of the application process for Environmental Authorisation, WSP Environmental (Pty) Ltd (WSP | Parsons Brinckerhoff) was appointed by BioTherm to undertake a Social and Environmental Impact Assessment (SEIA).

The SEIA is divided into two phases, the Scoping Phase and the Environmental Impact Assessment (EIA) Phase. This report will follow from the scoping phase, addressing the land capability and freshwater habitat systems (i.e. wetlands and watercourses) located within the project footprint, and providing a high level assessment of the potential environmental impacts associated with the proposed development.

1.1 OBJECTIVES OF THE REPORT

The objective associated with the assessments include the following:

- Describe the background of the project and contextualise it in the natural environment. This will include defining the land capability and appraisal and identification of freshwater habitat systems located within the project footprint;
- List and assess the potential environmental impacts associated with the proposed project to the environs identified; and
- Conclude the finding of the report, highlighting any significant impacts and their corresponding mitigation and management measures which should be considered as conditions in the authorisation.

1.2 STUDY APPROACH AND METHODOLOGY

The scope of work covered within this report, which entails a land capability assessment and freshwater habitat identification, forms part of the process required for BioTherm to apply as a Preferred Bidder to the Department of Environmental Affairs (DEA). The study therefore focuses on the identification and assessment of sensitive environments that may be impacted on by the proposed project.

The purpose of this report was to conduct a high level study that defined the land capability and identified freshwater habitat systems in the area of the proposed Enamandla PV Site 4. The potential impacts to the land and freshwater habitat systems were defined at a generic and high level. This entailed a desktop review and site visit from which an initial the scoping report was developed. The desktop review utilised available information at the time, including the following spatial information resources:

- Google Earth Pro;
- Agricultural Geo-Referenced Information System (AGIS);
- National Freshwater Ecosystem Priority Areas (NFEPA);
- The U.S. Geological Survey (USGS);
- The Soil Maps of Africa: European Digital Archive of Soil Maps (EuDASM);
- Hydrological features including rivers and, catchments and water management areas, and

- Existing maps and detailed project information provided by BioTherm which were available at the onset of the project.

Preliminary maps and figures were developed to use during the site visit to verify the information collected during the desktop review, through a ground-truthing exercise.

The site investigation comprised of a three-day site visit conducted between the 9th and 11th of February 2016. The site assessments entailed a drive through of the property on which the proposed Enamandla PV Site 4 is located. The area covered during the site visit was the operational footprint of the proposed project as well as a 500m boundary buffer. The following tasks were undertaken as part of the site investigation:

- Verification of desktop review information;
- Wetland and riparian zone identification and delineation;
- Soil profile characterisation and sample collection, including:
  - Soil depth and profile description (i.e. subjective moisture estimation, effective rooting depth, presence of mottling, gleying, pedocretes and soil structure);
  - Classification of soil form and family based on the Taxonomic Soil Classification System for South Africa (Macvicar, 1991);
  - Permeability based on in-situ estimation and texture properties;
- Underlying lithology; and
- Soil sample collection for laboratory analyses of pH, electrical conductivity, exchangeable sodium and soil texture.

A handheld Global Positioning System (GPS) and camera were used in conjunction with the maps produced in the desktop review, to conduct the ground-truthing exercise. The GPS was used to delineate areas as well as verify and mark all relevant points with exact co-ordinates. Representative soil samples were collected using a hand-operated auger, where holes were drilled until the parent material/refusal was reached. The representative soil samples were sent for analyses to the SGS Soil Laboratory situated in Somerset West in the Western Cape, to determine the pH, electrical conductivity, exchangeable sodium and texture.

LAND CAPABILITY

The land capability for the proposed Enamandla PV Site 4 project footprint was assessed according to the Land Capability Classification described in the Chamber of Mines Guidelines (Chamber of Mines of South Africa/Coaltech, 2007). The physical and chemical data from the soils laboratory analyses, in conjunction with the climatic, topographical, vegetation and land use information, was used to classify the Land Capability of the farm property into 4 broad categories:

- Class 1 Wetland - It is made up of vleis, swamps, marshes, peat-bogs and the like. There is usually a water table present at shallow depth in the soil with the result that it is difficult or impossible to recover soil material for later use because heavy machinery becomes bogged down, unless the soils are drained;
  - Wetland, has one of the following characteristics:
  - a diagnostic organic (O) horizon at the surface;
  - horizon that is gleyed throughout more than 50 percent of its volume and is significantly thick, occurring within 75 cm of the surface;
- Class 2 Arable land - Land which conforms to all of the following requirements: Does not qualify as a wetland;

- has soil that is readily permeable to the roots of common cultivated plants throughout a depth of 0.75 m from the surface;
- has a soil pH value between 4,0 and 8,4. Has electrical conductivity of the saturation extract less than 400mS/m at 25°C, and an exchangeable sodium percentage less than 15 through the upper 0,75 m of soil;
- has a permeability of at least 1,5 mm per hour in the upper 0.5 m of soil;
- has less than 10 percent by volume of rocks or pedocrete fragments larger than 100 mm in diameter in the upper 0,75 m of soil;
- the product of the slope (in percent) and erodibility factor (K) is less than 2.0;
- occurs under a climate regime which permits, from soils of similar texture and adequate effective depth (0,75 m), the economic attainment of yields of adapted agronomic or horticultural crops that are at least equal to the current national average for those crops. Or is either currently being irrigated successfully or has been scheduled for irrigation by the Department of Water Affairs;

- Class 3 Grazing Land - Grazing land conforms to all of the following requirements;
  - does not qualify as wetland or as arable land;
  - has soil or soil-like material, permeable to the roots of native plants, that is more than 0.25 m thick and contains less than 50 % by volume of rocks or pedocrete fragments larger than 100 mm diameter;
  - supports or is capable of supporting a stand of native or introduced grass species or other forage plants utilisable by domesticated livestock or game animals on a commercial basis;
- Class 4 Wilderness land - This is land which has little or no agricultural capability by virtue of being too arid, too saline, too steep or too stony to support plants of economic value. Its uses lie in the fields of recreation and wildlife conservation. It does, however, also include watercourses, submerged land, built-up land and excavations. Wilderness land is defined by exclusion, namely land which does not qualify as wetland, arable land or grazing land.

In addition to the above four classes, the land capability was also defined by the eight land capability classes based on the original USDA work and adapted for SA conditions by ARC. This was done at a desktop level, based on the GIS information provided on the Department of Agriculture, Forestry, and Fisheries (DAFF) Agricultural Geo-Referenced Information System website (AGIS, 2007).

FRESHWATER HABITAT IDENTIFICATION

The freshwater habitat identification for the proposed Enamandla PV Site 4 project entailed the following tasks described below:

- Desktop review to establish the baseline environmental conditions and location of wetlands marked in the National Land Cover GIS database for South Africa (SANBI – BGIS) and the National Freshwater Ecosystem Priority Areas (NFEPA);
- Identification of wetlands, based on the Department of Water Affairs and Forestry (DWAF) publication *Updated Manual for the Identification and Delineation of Wetlands and Riparian Areas* (DWAF, 2008); and
- High level description of the potential impacts on the identified freshwater habitats located within a 500m radius of the proposed Enamandla PV Site 4 project footprint.

IMPACT METHODOLOGICAL FRAMEWORK

The impact valuation uses a methodological framework used by WSP | Parsons Brinckerhoff to meet the combined requirements of international best practice and NEMA, Environmental Impact

Assessment Regulations, 2014 (GN No. 982) (the "EIA Regulations"). As required by the EIA Regulations (2014), the determination and assessment of impacts will be based on the following criteria:

- Nature of the Impact;
- Significance of the Impact;
- Consequence of the Impact;
- Extent of the impact;
- Duration of the Impact;
- Probability if the impact;
- Degree to which the impact:
  - can be reversed;
  - may cause irreplaceable loss of resources; and
  - can be avoided, managed or mitigated.

Following international best practice, additional criteria have been included to determine the significant effects. These include the consideration of the following:

- **Magnitude** to what extent environmental resources are going to be affected;
- **Sensitivity** of the resource or receptor (rated as high, medium and low) by considering the importance of the receiving environment (international, national, regional, district and local), rarity of the receiving environment, benefits or services provided by the environmental resources and perception of the resource or receptor); and
- **Severity** of the impact, measured by the importance of the consequences of change (high, medium, low, negligible) by considering inter alia magnitude, duration, intensity, likelihood, frequency and reversibility of the change.

It should be noted that the definitions given are for guidance only, and not all the definitions will apply to all of the environmental receptors and resources being assessed. Impact significance was assessed with and without mitigation measures in place.

Impacts are assessed in terms of the following criteria:

- The nature, a description of what causes the effect, what will be affected and how it will be affected (**Table 1**);
- The physical extent, wherein it is indicated whether (**Table 2**);
- The duration, wherein it is indicated whether the lifetime of the impact will be (**Table 3**);
- The magnitude of impact on ecological processes, quantified on a scale from 0-10, where a score is assigned (**Table 4)**; and
- The probability of occurrence, which describes the likelihood of the impact actually occurring. Probability is estimated on a scale where (**Table 5**):

Table 1: Nature or Type of Impact

NATURE OR TYPE OF IMPACT	DEFINITION
Beneficial / Positive	An impact that is considered to represent an improvement on the baseline or introduces a positive change.
Adverse / Negative	An impact that is considered to represent an adverse change from the baseline, or introduces a new undesirable factor.

Direct	Impacts that arise directly from activities that form an integral part of the Project (e.g. new infrastructure).
Indirect	Impacts that arise indirectly from activities not explicitly forming part of the Project (e.g. noise changes due to changes in road or rail traffic resulting from the operation of Project).
Secondary	Secondary or induced impacts caused by a change in the Project environment (e.g. employment opportunities created by the supply chain requirements).
Cumulative	Impacts are those impacts arising from the combination of multiple impacts from existing projects, the Project and/or future projects.

Table 2: Physical Extent of Impact

SCORE	DESCRIPTION
1	The impact will be limited to the site.
2	The impact will be limited to the local area.
3	The impact will be limited to the region.
4	The impact will be national.
5	The impact will be international.

Table 3: Duration of Impact

SCORE	DESCRIPTION
1	A very short duration (0 to 1 years).
2	A short duration (2 to 5 years).
3	A medium term (5–15 years).
4	A long term (> 15 years).
5	Permanent.

Table 4: Magnitude of Impact on Ecological Processes

SCORE	DESCRIPTION
0	Small and will have no effect on the environment.
2	Minor and will not result in an impact on processes.
4	Low and will cause a slight impact on processes.
6	Moderate and will result in processes continuing but in a modified way.
8	High (processes are altered to the extent that they temporarily cease).
10	Very high and results in complete destruction of patterns and permanent cessation of processes.

Table 5: Impact Probability of Occurrence

SCORE	DESCRIPTION
1	very improbable (probably will not happen.
2	improbable (some possibility, but low likelihood).
3	probable (distinct possibility).
4	highly probable (most likely).
5	definite (impact will occur regardless of any prevention measures).

- The significance, which is determined through a synthesis of the characteristics described above (refer formula below) and can be assessed as low, medium or high;
- The status, which is described as either positive, negative or neutral;
- The degree to which the impact can be reversed;
- The degree to which the impact may cause irreplaceable loss of resources; and

- The degree to which the impact can be mitigated.

The significance is determined by combining the criteria in the following formula:

$$S = (E + D + M) \times P$$

S = Significance weighting;

E = Extent;

D = Duration;

M = Magnitude, and

P = Probability.

The significance weightings for each potential impact are as follows (**Table 6**):

Table 6: Significance Weightings for Each Impact

Overall Score	Significance Rating	Description
< 30 points	Low	where this impact would not have a direct influence on the decision to develop in the area
31-60 points	Medium	where the impact could influence the decision to develop in the area unless it is effectively mitigated
> 60 points	High	where the impact must have an influence on the decision process to develop in the area

The impact significance without mitigation measures will be assessed with the design controls in place. Impacts without mitigation measures in place are not representative of the Project's actual extent of impact, and are included to facilitate understanding of how and why mitigation measures were identified. The residual impact is what remains following the application of mitigation and management measures, and is thus the final level of impact associated with the development of the Project. Residual impacts also serve as the focus of management and monitoring activities during Project implementation to verify that actual impacts are the same as those predicted in this EIA Report.

1.3 ASSUMPTIONS AND LIMITATIONS

The following assumptions and limitations were identified as part of the assessment:

- The various published data sources (i.e. aerial imagery, mapping and previous reports) have been assumed to be accurate at the time of use.
- At the time of the site investigation, the final layout routes of the pipelines, powerlines and substations was not made available, and as such could not be investigated as part of the site assessment.
- Identification of freshwater habitats in the region of the proposed Enamandla PV Site 4 project, was limited to a high level desktop exercise.
- Owing to the extent of the site and accessibility constraints, groundtruthing was only possible in certain areas of the site. Conditions of freshwater habitat in inaccessible areas were therefore inferred based on site observations of accessible habitats.
- The site visit was limited to a 500m radius around the farm property Hartebeestvlei RE86 within which the proposed Enamandla PV Site 4 project sites are located. As such, only the freshwater habitats identified within the 500m buffer of the farm property that were accessible by vehicle at the time of the site visit, were investigated.
- The site visit was conducted during the dry season for the region, making it difficult to identify and distinguish any freshwater habitats in the area due to arid nature of the region.

1.4 DECLARATION OF INDEPENDENCE

Bruce Wickham is a Hydrologist with an MSc from the University of KwaZulu-Natal in 2015. He joined WSP | Parsons Brinckerhoff in 2015 and has worked on various soil and wetland related projects. He is registered as a Candidate Natural Scientist – Water Resources Science with the South African Council for Natural Scientific Professions (SACNASP).

Colin is a Senior Environmental Consultant at WSP | Parsons Brinckerhoff with an MSc in Applied Environmental Science. He has also completed wetland management courses with the University of Free State. He has completed and managed numerous projects relating to wetland and riparian delineations, Present Ecological State and Ecological Importance and Sensitivity assessments, and the compilation of IWWMPs. He is registered with the South African Council for Scientific Professions – Professional Natural Scientist (Environmental Scientist) and is a SETA accredited Carbon Footprint Analyst.

Greg Matthews has 17 years of professional experience and is registered with the South African Council for Scientific Professions – Professional Natural Scientist (Environmental Scientist and Hydrological Scientist). He has been involved in numerous projects associated with the assessment of activities on both soil and water resources.

WSP | Parsons Brinckerhoff has no financial or other interest in the proposed development and will derive no benefits other than fair remuneration for consulting services provided.

I, Greg Matthews, declare that –

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

Name: Greg Matthews Sign:  **Date:** 11/10/2016

2 DESCRIPTION OF THE PROJECT

The proposed Solar BioTherm development, is located on the remaining extent farm portion Hartebeestvlei RE86 in the Northern Cape province (**Figure 1**). The project entails two renewable solar power technologies viz. Concentrated Solar Power (CSP) and Photovoltaics (PV), differentiated by Letsoai (CSP) and Enamandla (PV) site names (**Figure 2**). Furthermore, there are two alternative site layouts for the Enamandla PV sites 2 – 5, of which the second layout (i.e. 'Alternatives 2") is the preferred option (**Figure 2**).

This report is primarily focused towards potential activities and impacts associated with the Enamandla PV Site 4, however there are also proposed infrastructure options associated with the development (i.e. substations, power transmission lines and pipelines). The associated infrastructure has been assessed in a separate report.

The Enamandla PV Site 4 will produce 75 MW of electrical power which will be fed into the national grid. Photovoltaic (PV) solar power converts light directly into electricity. This technology uses photovoltaic cells which convert light into electric current through the 'photovoltaic effect'. The PV system produces direct current power which fluctuates with the sunlight's intensity. Multiple photovoltaic cells are connected to form a module, and in turn the modules are wired together to form an array. The arrays are connected to a transformer, with the output voltage being stepped up from medium voltage to high voltage in the transformer. The medium voltage cables will be run underground in the facility (except where a technical assessment suggest that overhead lines are applicable) to an onsite substation before being evacuated by 132kV powerlines to the common substation.

The Enamandla PV Site 4 occupies an area of 43.8 km^2 (3.4km^2 for alternative 2), in the northern portion of the farm property, which has a total area of 132 km^2. The closest town is Aggeneys, which is 15km north of the sites (**Figure 1**). The main town of Upington is situated approximately 250km north east of the site. The Orange River is located 55km north of the site (**Figure 1)**. The site is located within the Namakwa District and the Khâi-Ma Local Municipalities (LM). The main economic sectors are agriculture, tourism, community, social and personal services (The Local Government Handbook, accessed 2016). The main road of the N14 runs from Upington to Springbok and serves as the primary access route to Aggeneys and neighbouring towns (**Figure 1**).

In addition to the proposed Enamandla PV Site 4 project, there are additional potential solar/wind power developments planned in the area around the proposed BioTherm solar sites (**Figure 3**). This area falls within the Springbok Wind Renewable Energy Development Zone (REDZ). Which were identified throughout South Africa in a Strategic Environmental Assessment (SEA), as part of the Department of Environmental Affairs Strategic Integrated Project National Infrastructure Plan.

In a separate SEA - Electrical Grid Infrastructure (EGI), national power corridors were delineated for the efficient and effective expansion of the transmission infrastructure throughout South Africa. The location of the BioTherm sites, as well as the proposed neighbouring renewable energy developments, are strategically placed to overlap with the REDZs and EGI demarcated zones (**Figure 3**). The neighbouring potential solar/wind power developments will be factored into the EIA as part of the cumulative impact assessment. These renewable energy developer entities include:

- à Orlight SA (Pty) Ltd – Photovoltaic Power Plant
- à Sato Energy Holdings – Photovoltaics (1 site);
- à Solar Capital (Pty) Ltd – Concentrate Solar Power (1 site);
- à Mainstream Renewable Power SA – Solar (2 sites); and
- à JUWI Renewable Energies (Pty) Ltd – Wind Turbines (2 sites).

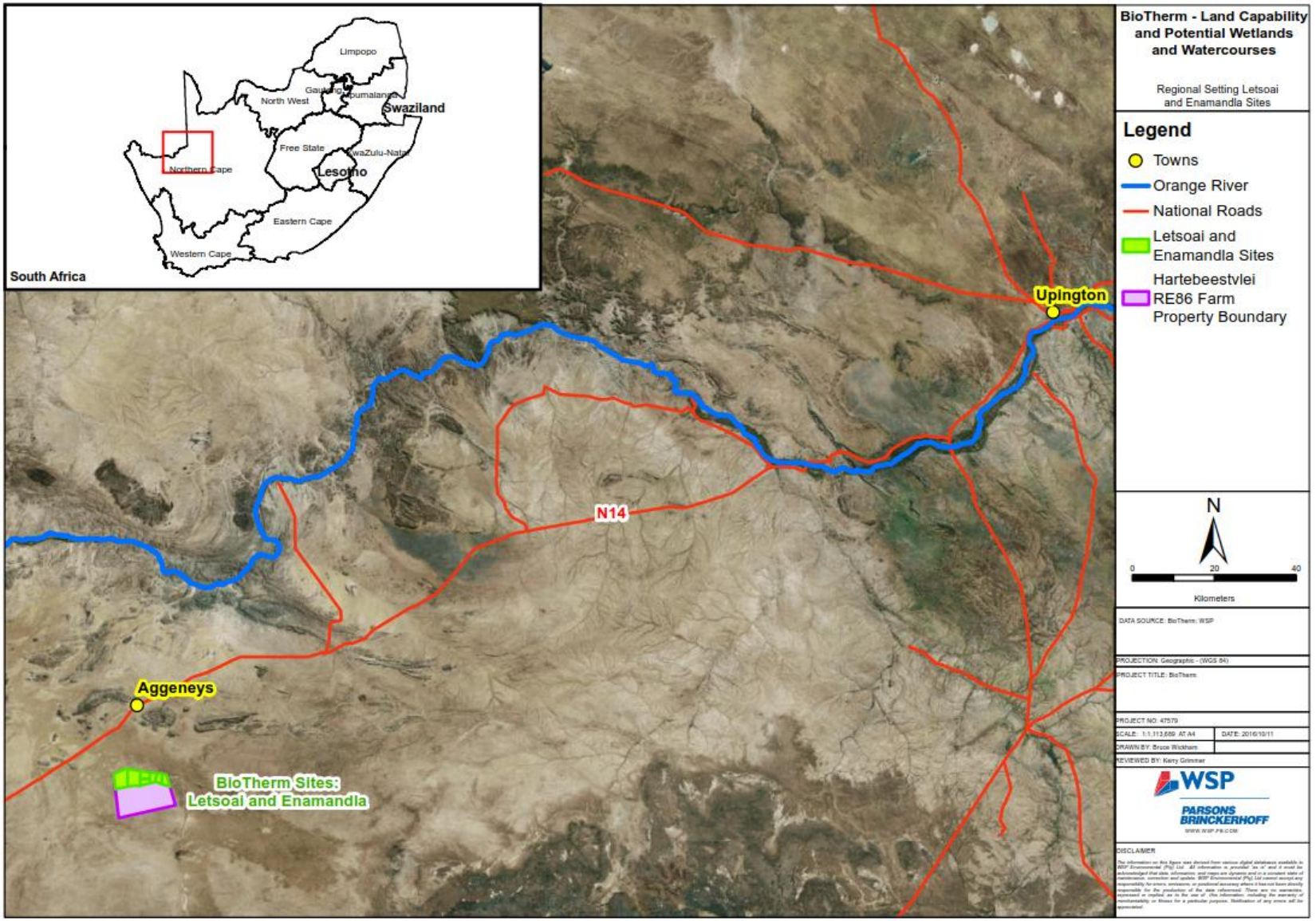

Figure 1: Regional Setting of Enamandla PV Site 4 in relation to the entire BioTherm Project and the town of Upington

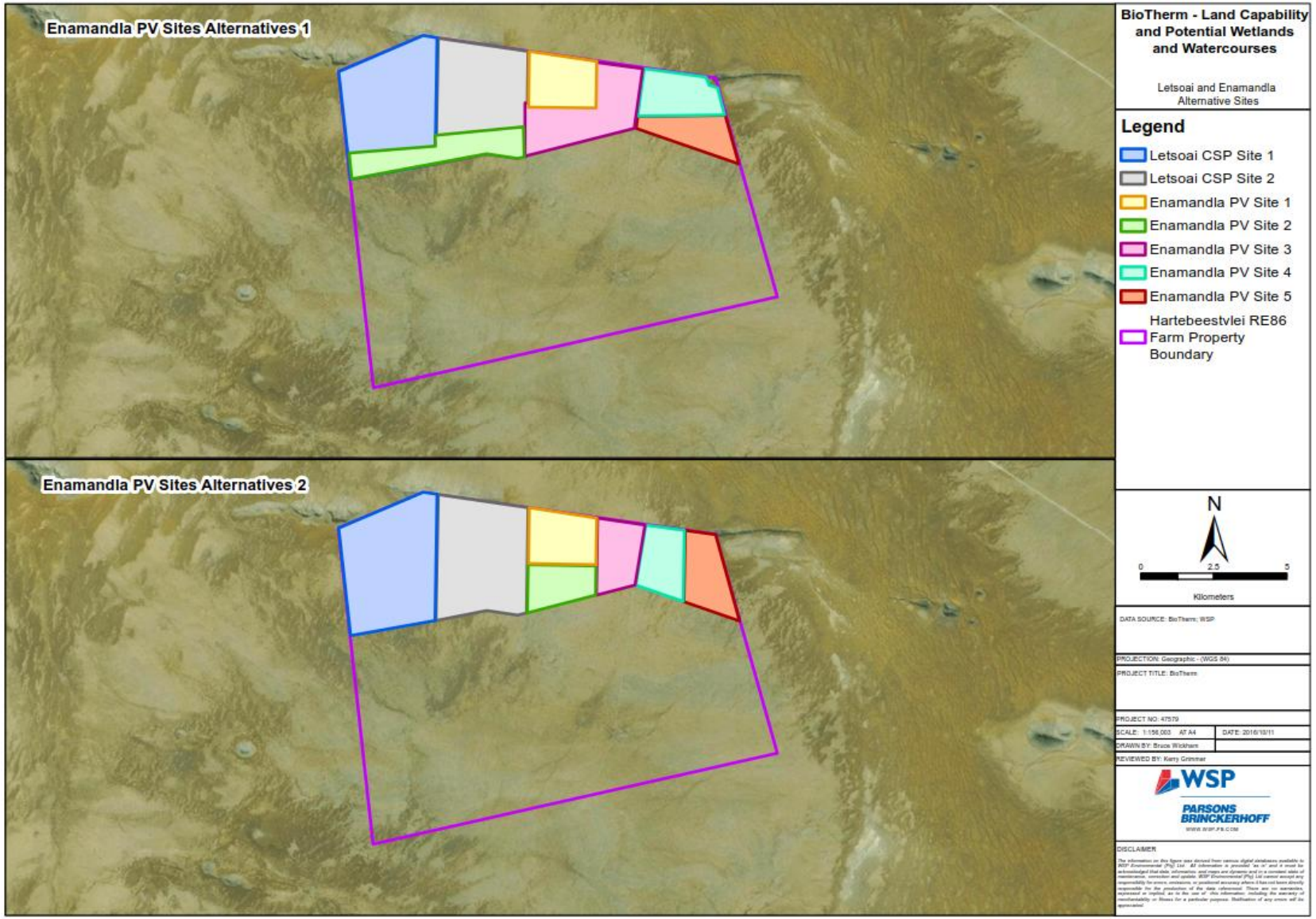

Figure 2: Letsoai CSP and Enamandla PV Alternative Sites

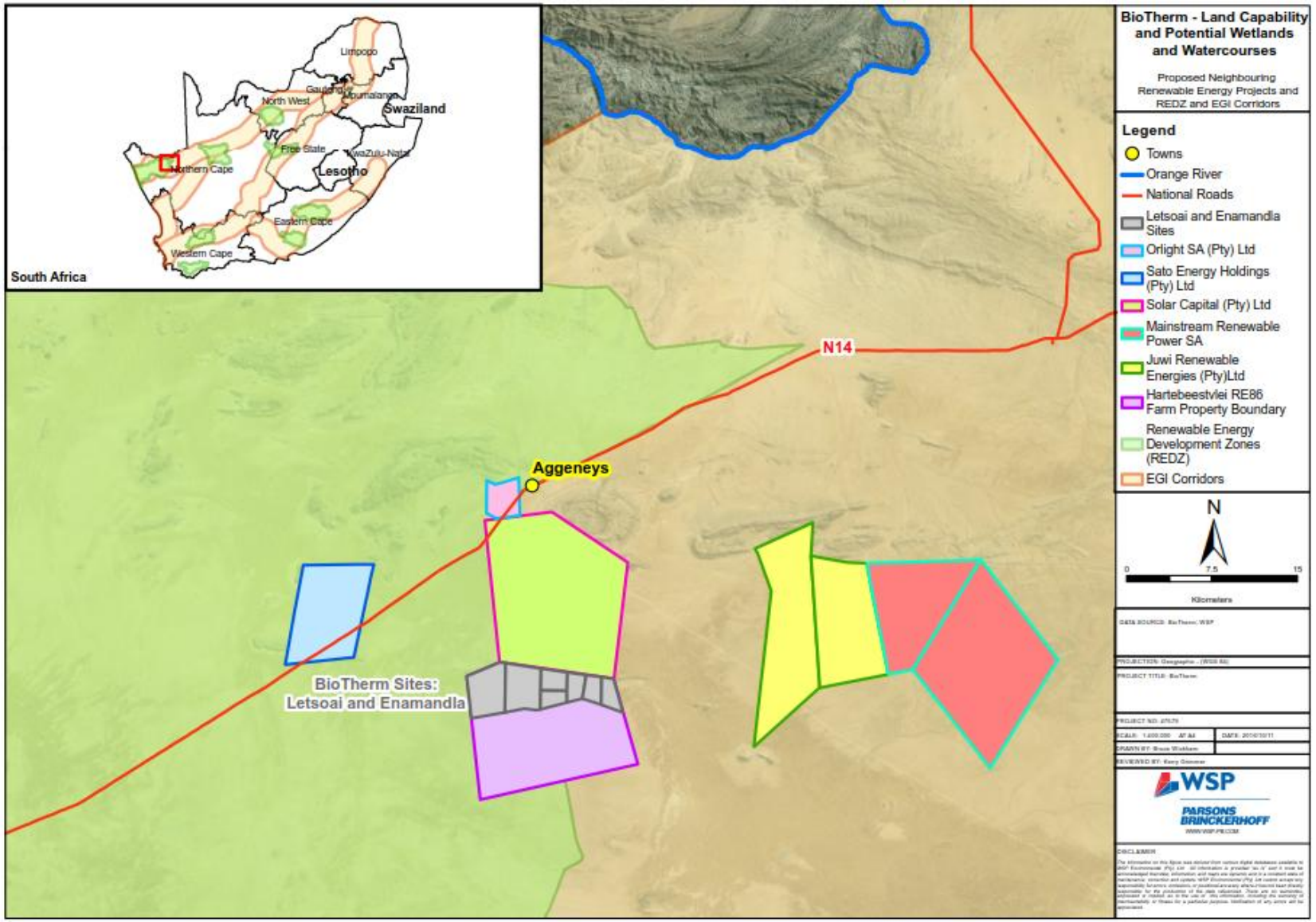

Figure 3: Proposed Neighbouring Renewable Energy Projects, REDZ and EGI

3 DESCRIPTION OF THE AFFECTED ENVIRONMENT

The local natural environment within which the proposed Enamandla PV Site 4 project is located is summarised in the following section. This will include the local hydrology, natural vegetation and land use, soil type and characterisation, and a simple geological description with a basic groundwater assessment. This will serve as basic description of the present natural conditions in the area of the proposed Enamandla PV Site 4 project.

3.1 HYDROLOGY

South Africa is divided into nine Water Management Areas (WMAs), where the proposed BioTherm solar power sites are situated in the Orange WMA 6 (**Figure 4**). The site is located in the downstream portion of the Orange River Basin, which starts in the Lesotho Highlands headwaters of the Senqu River. The Upper region of the Orange WMA, as well as the Upper, Middle and Lower Vaal WMA's all contribute to the Orange River Basin as a whole.

The Enamandla PV Site 4 lies within tertiary catchment D82 and quaternary catchment D82B (**Figure 5**). The hydrological characteristics are summarised in **Table 7**, including catchment area, Mean Annual Precipitation (MAP), Mean Annual Evaporation (MAE) and Mean Annual Runoff (MAR). The MAE largely exceeds the MAP, resulting in very low runoff and reinforcing the arid conditions of the region. The Quaternary catchment, is 100% endoreic (WRC/DWA, 2012). An endoreic area does not contribute to runoff, and thus rainfall on this area is lost through either evaporation or percolation to the underlying groundwater environment, and as such does not contribute to surface water runoff. For a complete assessment of the water component of the Study, the reader is referred to the *Water Assessment report for the Solar Power Generation in the Northern Cape Province* Report (WSP, 2016).

Table 7: Tertiary D82 Hydrological Characteristics

QUATERNARY	CATCHMENT AREA (km^2)	MAP (mm)	MAE (mm)	MAR (million m^3/a)
D82B	4 877	80	2 650	0

Upon the site visit, there were no watercourses identified within the proposed Enamandla PV Site 4. The nearest evidence of a watercourse was the Kao River (and associated tributaries) which is located north (outside) of the project site (**Figure 5**). During the site visit there was no water present in the Kao River. Given the low MAP, predominantly flat topography (i.e. average slope of 3.1% from north to south) and sandy soils (i.e. high transmissivity), justifies the dominant endoreic characteristic for the region. As such the rivers in this region (excluding the Orange) are ephemeral and are likely to only convey water during infrequent high rainfall events.

Figure 4: Location of BioTherm Sites In Relation to New WMA

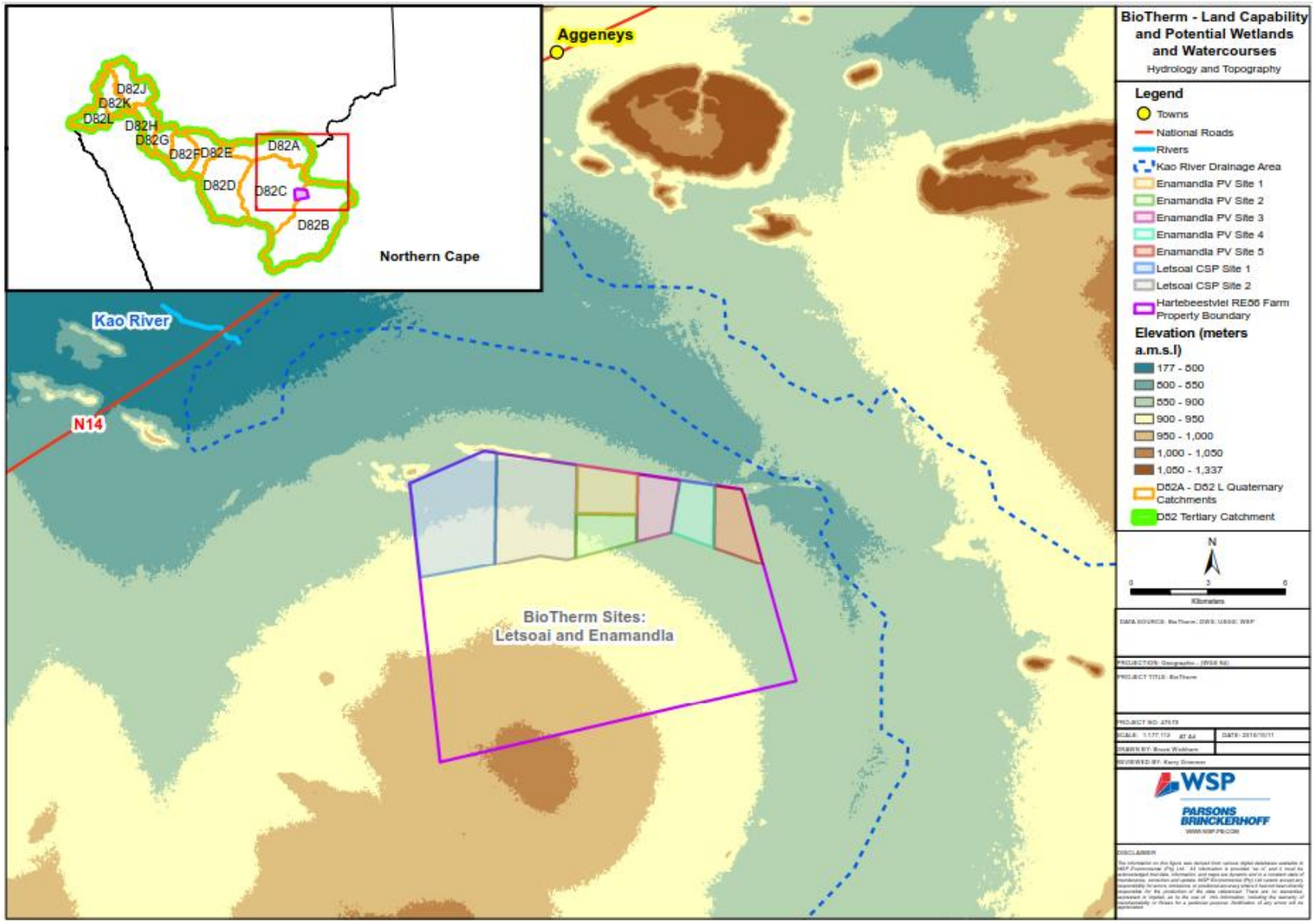

Figure 5: Local Hydrology and Topography

3.2 VEGETATION AND LAND USE

Based on the Mucina and Rutherford (2006) natural vegetation classification map, the area of proposed BioTherm solar power project is mostly Bushmanland Arid Grassland (**Figure 6**). There are minor portions of Bushmanland Inselberg Shrubland situated on the small hills along the northern edge of the Hartebeestvlei RE8 farm property boundary (**Figure 6**). The Department of Agriculture, Forestry and Fisheries (DAFF) define the land use within the Hartebeestvlei RE86 farm property, as predominantly Shrubland and Low Fynbos, with smaller pockets of unimproved (natural) Grassland, and minor areas of Woodlands (DAFF, 2012) (**Figure 7**). As shown in **Figure 7**, there are three potential wetlands located approximately 3.4km ,5.2km and 1.7km south (outside) of the proposed BioTherm sites.

Upon the site visit, the vegetation was identified as mostly shrub-like arid grassland, which is primarily used for sheep grazing (**Plates 1 – 3**). Cattle grazing activities and herd of indigenous antelope (Springbok) were also present within Hartebeestvlei RE86 farm property. Windmill driven boreholes located throughout the farm property supply water to small reservoirs for the sheep and cattle (**Plate 4**).

Beyond the Hartebeestvlei RE86 farm property boundary, additional land use activities identified during the site walkover included, sheep farming, the Eskom Aggeneis Sub-station, Aggeneys mining village, the Black Mountain Mine and the Gamsberg Mine.

3.3 SOILS AND GEOLOGY

Based on the information included in the land type maps of South Africa (AGIS, 2007) the soils in the area of the Hartebeestvlei RE86 farm are identified mostly as "*Red-yellow apedal, freely drained soils, red, high base status, < 300 mm deep*". There are smaller areas comprised of "*Miscellaneous land classes, very rocky with little or no soils*" on the inselbergs (small hills) located on the northern boundary of the farm property (**Figure 8**). The landscape is mostly shaped by wind erosion, and there is a low to moderate water erosion hazard (AGIS, 2007).

The general geology description of the area is based on the 1:1 000 000 geological map for Northern Cape Province, published by the Trigonometrical Survey Office in 1970 (Schifano *et.al.*, 1970). The farm property is located on the Namaqualand and Natal belt of metamorphism and granitization where the rock type comprises of *Migmatite, gneiss and ultrametamorphic rocks* (**Figure 9**). Upon the site walkover, gneiss rock types were present below the soil profile (**Plate 5**)

The ranges of hills, mountains and inselbergs in the area display some of the most diverse and complex geology in Southern Africa including some of the richest known concentrations of copper, lead and zinc (Mining Technology, accessed 2016). The Aggeneys deposits occur in the Precambrian metavolcanic metasedimentary Bushmanland Group which forms part of the Namaqualand Metamorphic Complex. The Bushmanland Group is located within the Namaqualand-Natal Mobile Belt, with an area of approximately 18 000km^2.

Due to the high minerals in the area, mining activities have been active for many years, and projected to continue for decades to come (i.e. the Black Mountain Mine and Gamsberg Mine). The Black Mountain Mine is an underground base-metal operation mining zinc, lead, copper and silver, and is located 14 km north of Hartebeestvlei farm RE86.

The large flat plains dominated by the fine red sand sediment, is underlain by granitic gneisses, while the protruding inselbergs and ranges of hills are characterised by metavolcanic-metasedimentary units of the Bushmanland Group (Bailie *et al.*, 2007). The orebody at the proposed Gamsberg mine nearby is hosted by iron sulphide-rich pelitic rocks and iron formation, and the economic mineralisation comprises sphalerite (zinc) and minor galena (lead). As of November 2014, the Gamsberg mine was estimated to contain mineral resources of 194Mt.

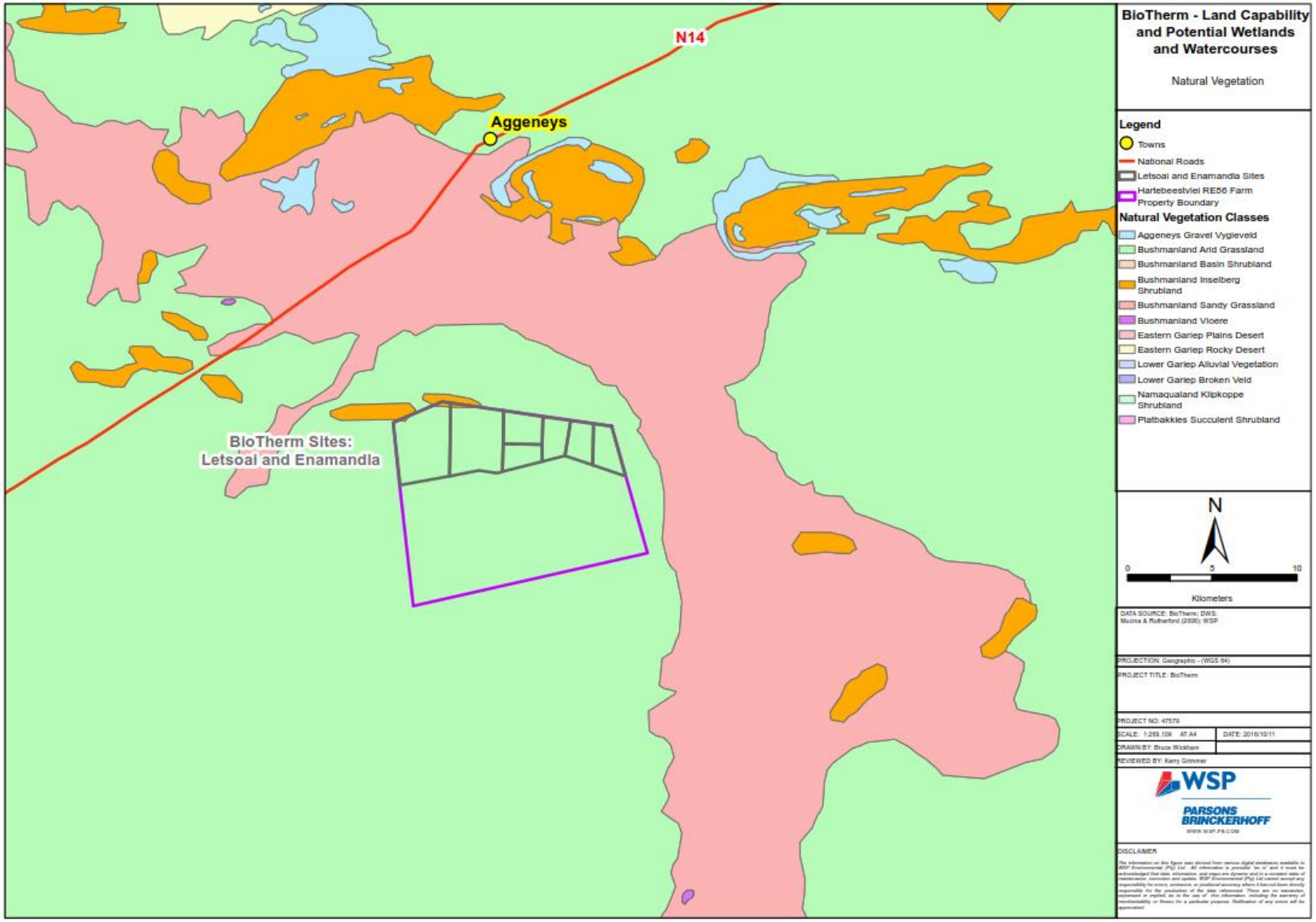

Figure 6: Local Natural Vegetation

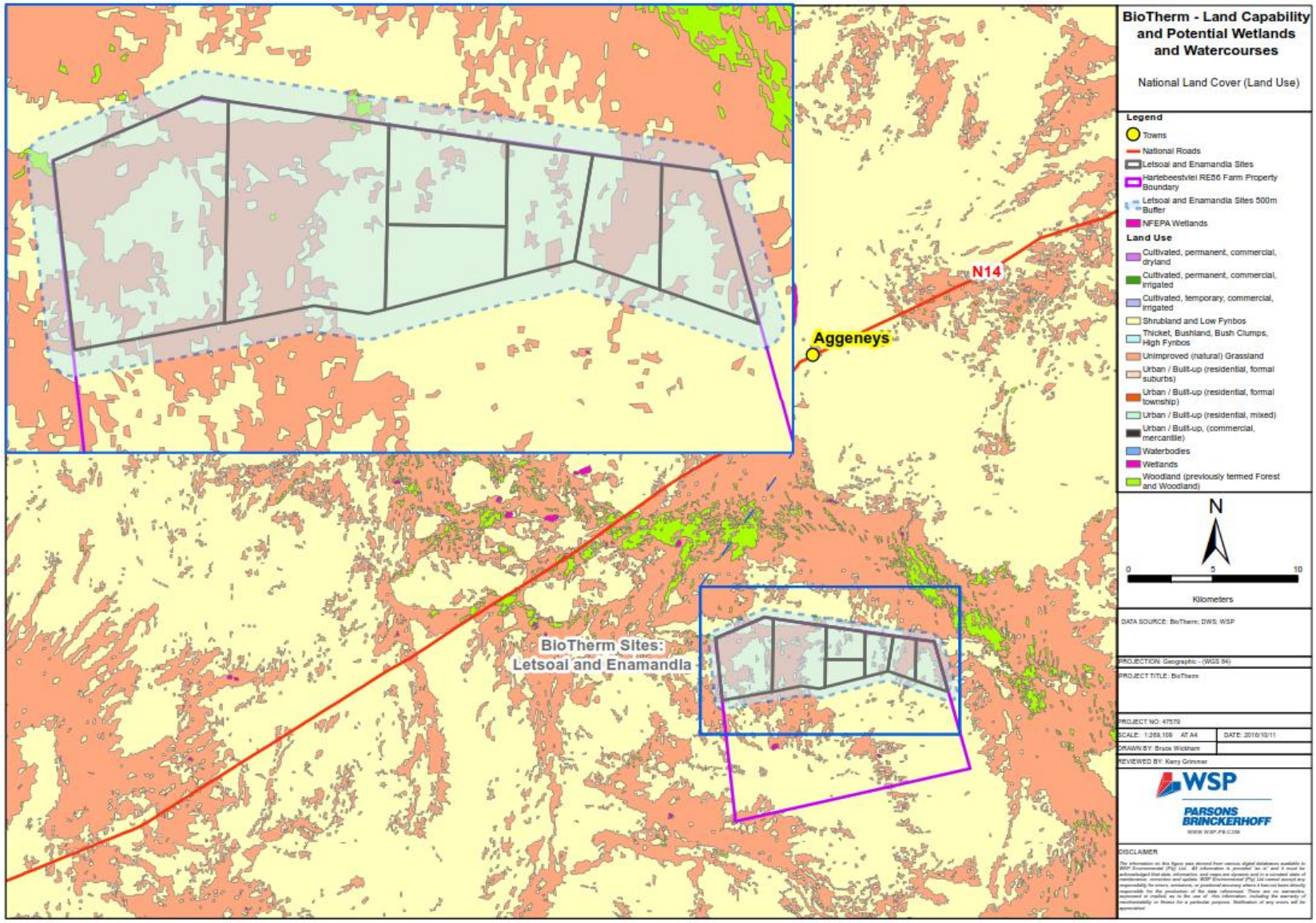

Figure 7: Local Land Cover (Land Use)

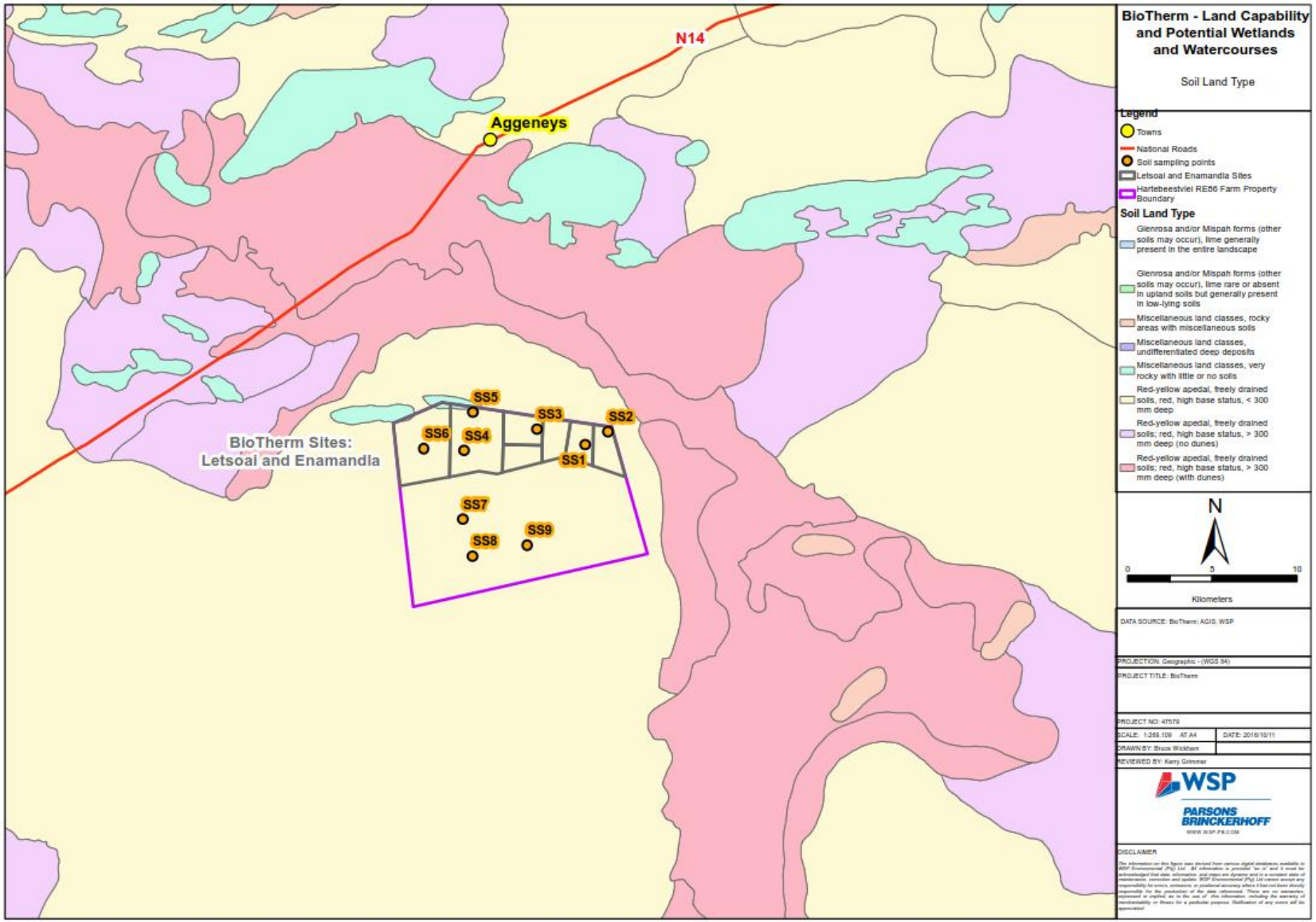

Figure 8: Local Soil land Type and Soil Sampling Locations

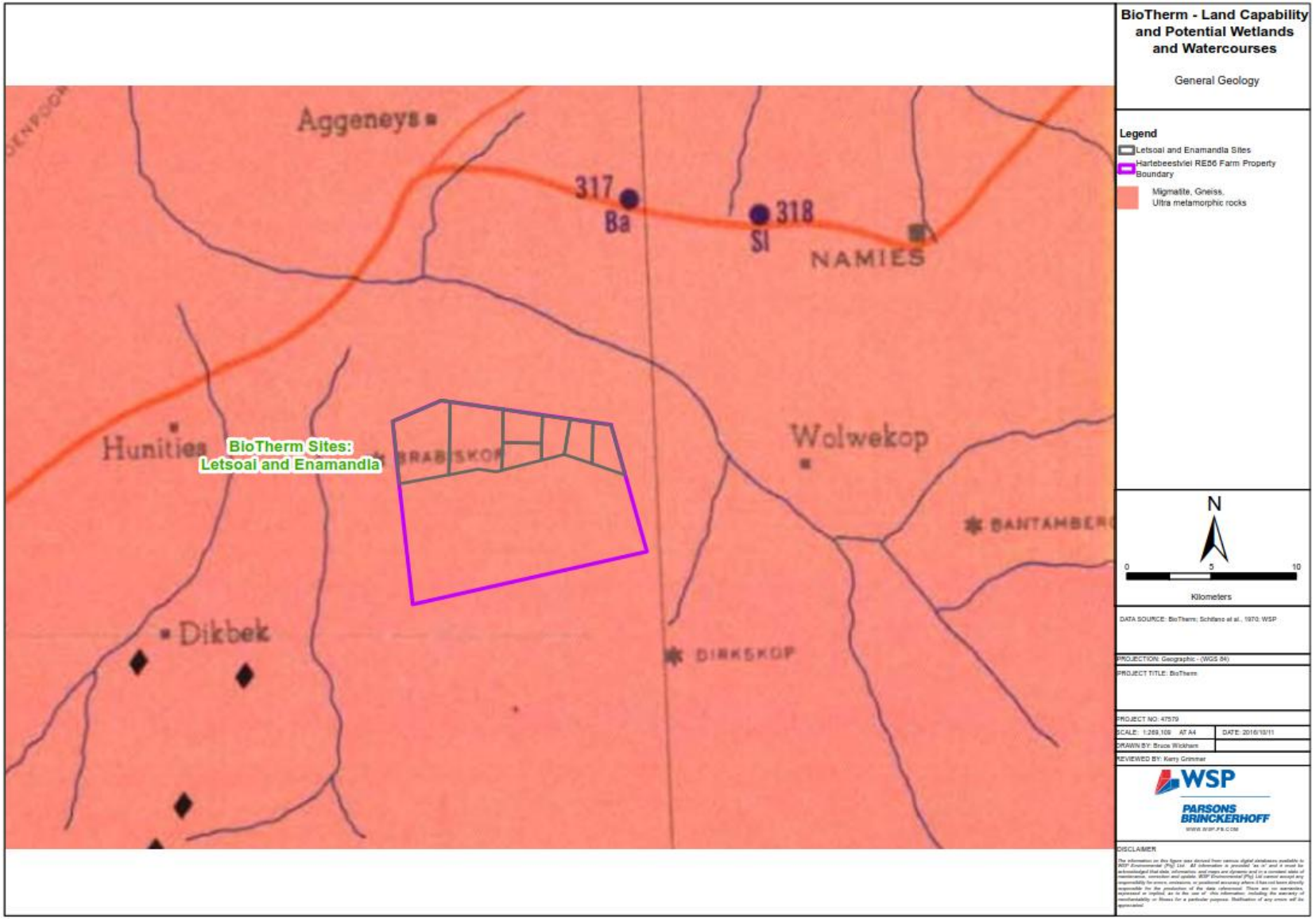

Figure 9: Local General Geology

3.4 GROUNDWATER

The groundwater of the area was assessed through a site walkover conducted by WSP | Parsons Brinckerhoff and VSA Leboa Consulting. Several boreholes over the area were identified with three representative boreholes chosen to be analysed for both yield and chemical constituents.

The groundwater investigation identified the underlying natural geology as a poor aquifer, with a low low-yielding system of poor water quality with a least vulnerability to contamination and the low susceptible to anthropogenic activities. The regional depth to groundwater is 30 to 50m below ground level (bgl). Water level measured from the boreholes ranged between 27.74 m and 79.59m bgl. Owing to mining within the area groundwater level may be induced to drop.

Aquifer testing of two of the boreholes indicated that the average sustainable yield ranged between 0.72 l/s and 1.105 l/s. The groundwater quality analysis revealed a dominance in sodium, potassium, chloride and sulphate ions, with Totals Dissolved Solids ranging from 1000 to 1500 mg/l.

The *Water Assessment report for the Solar Power Generation in the Northern Cape Province* Report (WSP, 2016) summaries the finding of the assessment of hydrogeological conditions associated with the broader site.

4 FINDINGS – ENAMANDLA PV SITE 4

The assessment of the land capability and Freshwater Habitat for the Enamandla PV Site 4 are outlined below.

4.1 LAND CAPABILITY

To ascertain the characteristics of the soils across the site, soil samples were obtained from nine locations (i.e. SS1 – SS9) (**Figure 8**). The location of the soil sampling points was determined from interpreting the soil land type map for the area as well as on-site observation for changes in the topography and land feature which might induce a change in the soil type.

At each location, the soil depth and diagnostics horizons were identified, and a sample was collected for chemical and physical analyses in a suitable soil laboratory (**Appendix A**). For practical reasons, soil samples that were collected (within 0.3m depth) in a similar setting and had the same soil family, were composited to provide representative samples for the area (**Table 8**). The characteristics of the soil samples and profiles are described in **Table 9**. Based on the *Taxonomic Soil Classification System for South Africa* (Macvicar, 1991) all the soil samples were classified as Namib soil form (**Plate 6**).

Table 8: Representative Soil Samples

REPRESENTATIVE SOIL SAMPLE	MIX SOIL SAMPLES
1	SS1 + SS2 + SS3
2	SS4 + SS5 + SS6
3	SS7 + SS8 + SS9

Table 9: Soil Sample Characteristics

CHARACTERISTIC	SS1	SS2	SS3	SS4	SS5	SS6	SS7	SS8	SS9
Soil Form	Namib	Namib	Namib	Namib	Namib	Namib	Namib	Namib	Namib
Profile Depth	0.16	0.95	0.23	1.58	1.13	0.33	0.31	0.34	0.22
Dry Colour*, mottling and gleying	Pale orange	Pale orange	Orange	Orange	Orange	Pale orange	Orange	Orange	Orange
	Hue 5 YR	Hue 5 YR	Hue 2.5 YR	Hue 2.5 YR	Hue 2.5 YR	Hue 5 YR	Hue 5 YR	Hue 7.5 YR	Hue 7.5 YR
	Value 8	Value 8	Value 8	Value 8	Value 8	Value 8	Value 7	Value 7	Value 7
	Chroma 4	Chroma 4	Chroma 8	Chroma 8	Chroma 8	Chroma 4	Chroma 8	Chroma 6	Chroma 6
Subjective moisture	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry
Effective rooting depth-Grasses (m)	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
Effective rooting depth - Shrubs (m)	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Soil structure	Single grained	Single grained	Single grained	Single grained	Single grained	Single grained	Single grained	Single grained	Single grained
Presence of rocks, pedocretes, calcareousness	No	No	No	No	No	No	No	No	No
pH	6.7	6.7	6.7	7.1	7.1	7.1	7.4	7.4	7.4
Electrical conductivity (mS/m)	18.4	18.4	18.4	20.1	20.1	20.1	19.9	19.9	19.9
Exchangeable sodium (%)	1.4	1.4	1.4	2.2	2.2	2.2	1.1	1.1	1.1
Sand (S) Silt (Si) & Clay (C) (%)	96, 2, 2	96, 2, 2	96, 2, 2	96, 2, 2	96, 2, 2	96, 2, 2	96, 2, 2	96, 2, 2	96, 2, 2
Texture**	Fine Sand	Fine Sand	Fine Sand	Fine Sand	Fine Sand	Fine Sand	Fine Sand	Fine Sand	Fine Sand
Estimate permeability (m/d)***	1.6 – 6.0	1.6 – 6.0	1.6 – 6.0	1.6 – 6.0	1.6 – 6.0	1.6 – 6.0	1.6 – 6.0	1.6 – 6.0	1.6 – 6.0
Erodibility K factor #	52	52	52	52	52	52	52	52	52

Sources: ** Colour based on the revised Standard Soil Colour Chart (Fujihara Industry Co.,2001) ;*

*** Texture based upon the United States Department of Agriculture (USDA) Soil texture triangle and grain size*

**** Estimate Permeability based upon soil structure and texture (van der Molen, Beltran, & Ochs, 2007)*

 # Estimated from the soil erodibility nomograph of Wischmeier, Johnson and Cross (1971)

According to DAFF Agricultural Geo-Referenced Information System (AGIS, 2007), the land capability within the Hartebeestvlei RE86 farm property is largely classified as non-arable with a low potential for grazing, while the inselbergs on the northern boundary of the farm property constitute as Wilderness (**Figure 10**). These two groups correlate to Classes VII and VIII from the Eight-Class Land Capability System described in Klingebiel and Montgomery (1961), as follows:

- VII: Severe limitations that make the land unsuited to cultivation and restrict its use largely to grazing, woodland or wildlife. Restrictions are more severe than those for Class VI due to one or more limitations which cannot be corrected, such as very steep slopes, erosion, shallow soil, stones, wet soil, salts or sodicity (amount of sodium held in a soil) and unfavourable climate.
- VIII: Limitation that preclude its use for commercial plant production and restrict its use to recreation, wildlife, water supply, or aesthetic purposes; limitations that cannot be corrected may result from the effects of one or more of erosion or erosion hazard, sever climate, wet soil, stones, low water-holding capacity, salinity or sodicity.

Based on the Land Capability Classification described in the Chamber of Mines Guidelines the land capability within the Enamandla PV Site 4 is classified as *Class 3: Grazing Land*, for the following reasons:

- There were no wetlands confirmed within the site during the desktop and site walkover exercises. Thus by definition of the Chamber of Mines classification, it is not a wetland;
- The soils are predominately shallow (average 0.58m). Thus by definition of the Chamber of Mines classification, it is not an arable land;
- The product of the slope (in percent) and erodibility factor (K) in the site is not less than 2 (the lowest value is 161.2). Thus by definition of the Chamber of Mines Guidelines, it is not arable land;
- The land on the site is not irrigated. Thus by definition of the Chamber of Mines Guidelines, it is not an arable land; and
- It meets all the requirements for class 3: grazing land.

4.2 FRESHWATER HABITAT

A wetland is defined as 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 (National Water Act, Act 36 of 1998).

During the desktop investigation, no freshwater habitats were identified within the Enamandla PV Site 4. This was confirmed, where possible, during infield investigations.

Figure 10: Local Land Capability

5 ASSESSMENT OF IMPACTS

The impacts identified for the Enamandla PV Site 4 are assessed in the section that follows. The methodology for defining the significance of the respective impacts is described in section 1.2 of this report. The impacts will be assessed for the construction, operational and de-commissioning phases of the project.

A cumulative impact assessment will also be performed for the neighbouring BioTherm sites and adjacent renewable energy projects. This section will provide a summary of the findings from the significance rating tables used for each impact. The process for determining the relevant significances of each impact for the various phases of the project is provided in **Appendix B**.

5.1 CONSTRUCTION PHASE

The anticipated impacts for the Enamandla PV Site 4 during the construction phase of the project are summarised in **Table 10**. The impacts are only applicable to the present land capability status of the site, as no wetlands freshwater habitats were confirmed within the site and 500m radius of the site boundary.

Table 10: Construction Phase Impacts

ACTIVITY	POTENTIAL IMPACT
Site preparation and construction of solar power facility and associated infrastructure.	Loss of grazing land current utilised for grazing mostly sheep farming, cattle farming and indigenous antelope.
	Loss of aesthetical value of the natural landscape.
	Increased potential of soil erosion due to vegetation clearance, soil disturbance and a high traffic movement on site.
	Potential land contamination from hazardous substances. This includes spillage of concrete onto soil surface, as well as oils, fuel, grease (from construction vehicles) and sewage from temporary on-site ablution facilities.

There are no fatal flaws identified for the construction phase associated with the proposed Enamandla PV Site 4 project. The loss of gazing land is a negative impact and was assigned a medium environmental significance rating score, after mitigation measures. This impact is unavoidable given the fact that during the construction phase the project will physically occupy portions of the land located within the project footprint. The other identified impacts (i.e. soil erosion and spillage of hazardous substances) were classified as negative impacts, but had a low environmental significance rating before and after mitigation measures.

5.2 OPERATIONAL PHASE

The anticipated impacts for the Enamandla PV Site 4 during the operational phase of the project are summarised in **Table 11**. The impacts are only applicable to the present land capability status of the site, as no freshwater habitats were confirmed within the site and 500m radius of the site boundary.

Table 11: Operational Phase Impacts

ACTIVITY	POTENTIAL IMPACT
Day-to-day operational activities during the normal functioning of the solar power facility, including maintenance .	Loss of grazing land current utilised for mostly sheep farming, cattle farming and indigenous antelope.
	Loss of aesthetical value of the natural landscape.
	Increased potential of soil erosion due to vegetation clearance, and more run-off from harden surfaces (i.e. roads and array of heliostats).

	Potential land contamination from hazardous substances. This includes spillage of oils, fuel, grease (from site operational and maintenance vehicles) and permanent onsite sewage systems.

Similar to the construction phase, there were no fatal flaws identified during this phase of the project. The loss of grazing land was assigned a high environmental significance rating, however this negative impact is unavoidable given the fact that associated solar power infrastructure will permanently occupy a portion of the land within the proposed project footprint. With mitigation measures in place, this impact was brought down to a medium environmental significance. The medium rating is under the assumption that farming practices may continue in and around the infrastructure during the operational phase. The other negative impacts of potential soil erosion and spillage of hazardous substances were assigned a low environmental significance before and after mitigation measures.

5.3 DECOMMISSIONING PHASE

The anticipated impacts for the Enamandla PV Site 4 during the de-commissioning phase of the project are summarised in **Table 12**. The impacts are only applicable to the present land capability status of the site, as no freshwater habitats were confirmed within the site and 500m radius of the site boundary.

Table 12: De-commissioning Phase Impacts

ACTIVITY	POTENTIAL IMPACT
De-commissioning of the solar power facility.	Increased potential of soil erosion due to removal of solar power infrastructure (i.e. Heliostats), soil disturbance and a high traffic movement on site.
	Potential land contamination from hazardous substances. This includes spillage of oils, fuel, grease (from construction vehicles) and sewage from on-site systems.

The decommissioning phase exhibited the lowest environmental significance rating scores for the associated impacts of the proposed Enamandla PV Site 4 project. There were no fatal flaws identified during this phase of the project. The potential for soil erosion and spillage of hazardous substances were classified as a low environmental significance rating before and after mitigation measures.

5.4 CUMULATIVE IMPACTS

There are a number of Environmental Authorisations (EA) (either issued or in process) in the area surrounding the Proposed Project site. It must be stressed that the fact that there are several approved EA surrounding the site does not equate to actual 'development'. The surrounding projects, except for the Preferred Bidders, are still subject to the Renewable Energy Independent Power Producer Procurement Programme (REIPPPP) bidding process like the Enamandla project.

In addition to the Enamandla PV Site 4, the proposed BioTherm project includes one additional CSP site and five PV sites (**Figure 2**). Furthermore, there are five proposed renewable energy projects located within a 100 km radius from the centroid of the BioTherm sites (**Figure 3**). A summarised desktop review of the proposed neighbouring projects, (including the BioTherm sites) is summarised in **Table 13**. The renewable energy projects that have received Environmental Authorisation were investigated to determine any identified potential impacts on land capability and freshwater habitats. These individual impacts were tabulated and assigned a significance rating (Low to High) which allowed for the cumulative assessment of these impacts on the landscape. Overall the cumulative impact of the proposed Enamandla PV Site 4 is deemed to be of 'Low' significance (**Appendix C**).

None of the proposed BioTherm sites intersect any identified freshwater habitats, and the anticipated impacts during the construction, operational and de-commissioning phases are expected to be the same as those summarised above for the Enamandla PV Site 4.

Table 13: Neighbouring Renewable Energy Projects Comparison

Energy Entity	Renewable Energy Technology	Footprint (km^2)	No. of Water Courses Intersections	NFEPA Wetlands Intersections	Parent Farm Properties	Towns Intersected
Letsoai CSP Site 1	Concentrated Solar Power	13.0	None	None	Hartebeestvlei RE86	None
Letsoai CSP Site 2	Concentrated Solar Power	11.9	None	None	Hartebeestvlei RE86	None
Enamandla PV Site 1	Photovoltaics	4.0	None	None	Hartebeestvlei RE86	None
Enamandla PV Site 2 (Alternative)	Photovoltaics	4.9 (3.1)	None	None	Hartebeestvlei RE86	None
Enamandla PV Site 3 (Alternative)	Photovoltaics	7.3 (3.4)	None	None	Hartebeestvlei RE86	None
Enamandla PV Site 5 (Alternative)	Photovoltaics	3.2 (3.8)	None	None	Hartebeestvlei RE86	None
Orlight SA (Pty) Ltd	Photovoltaics	1.16	1 x ephemeral watercourse	None	Aroams 57 RD	None
Sato Energy Holdings (Pty) Ltd	Photovoltaics	51.7	1 x ephemeral watercourse	6	Zuurwater62	None
Solar Capital (Pty) Ltd	Concentrated Solar Power	141.5	1 x ephemeral watercourse	5	Bloemhoek 61	None
Mainstream Renewable Energies (Pty) Ltd Site 1	Solar Power	57.8	1 x ephemeral watercourse	None	Namies Suid 212	None
Mainstream Renewable Energies (Pty) Ltd Site 2	Solar Power	116.3	1 x ephemeral watercourse	None	Poortje 209	None
Juwi Renewable Energies (Pty) Ltd WEF 1	Wind Turbines	72.7	1 x ephemeral watercourse	None	Vogelstruis Hoek 88	None
Juwi Renewable Energies (Pty) Ltd WEF 2	Wind Turbines	57.11	1 x ephemeral watercourse	None	Namies Suid 212	None

Similarly, the additional proposed renewable projects adjacent to the BioTherm sites, are expected to have the similar impacts to those identified for the BioTherm sites, however several of these project sites intersect freshwater habitats. The assessment of these potentially affected ecological features within the four neighbouring renewable energy developments is beyond the scope of this study, and will require an individual assessment for the respective projects in their own scoping and EIA studies. It is assumed that the impacts during the construction, operational and de-commissioning phases are expected to be more significant from a freshwater habitat perspective than those summarised above for the Enamandla PV Site 4.

There was no fatal flaw identified in the cumulative impacts for the proposed BioTherm sites and the five proposed renewable energy projects. As in the case of the above mentioned phases, the loss of grazing land is unavoidable. This impact was initially assigned a high environmental significance, which can be reduced to low with the implementation of mitigation measures (i.e. keep the affected area to a minimal during the construction, operational and decommissioning phases). Potential impacts of soil erosion and spillage of hazardous substances were both classified with a low environmental significance, before and after mitigation measures.

5.5 OPTIONS ANALYSIS

There are two configuration alternatives, within the same overall footprint of the Letsoai and Enamandla Projects (**Figure 2**). The operational impacts of these sites are not significantly different from one another in terms of impacts on land capability and the high-level freshwater habitats (assuming that this infrastructure is not positioned within a freshwater habitat). The major impacts will then be associated with the construction and decommissioning phases which will result in physical disturbance of the environment. The options analysis is based on limiting the environmental impact on land capability and freshwater habitat, as the land is majorly homogenous, land capability basically comes down to the size of the area disturbed by each option, where in terms of freshwater habitats, it comes to location in relation to these habitats and the potential hydrological alterations.

As there are no freshwater habitats that have been identified onsite, the area being fairly homogenous and the overall footprint of the combined Letsoai and Enamandla Projects do not alter between the two alternative configurations; there is no one option that is significantly preferred over the other.

6 MITIGATION AND MANAGEMENT MEASURES

The potential impacts identified in Section 5 of this report, have been assessed with and without mitigation and management measures. These mitigation and management measures are summarised in **Table 14**, for the construction, operation and decommissioning phases of the project.

The same mitigation and management measures are proposed for the cumulative impacts identified in the previous section, however the responsible person may differ according to the renewable energy project developer.

In addition, an aquatic specialist should be present onsite before the site preparation phase of construction to conduct an in-depth site walkover prior to any site work to assess the area for any freshwater habitats which may be affected by the actions conducted during the construction phase.

Table 14: Mitigation and Management Measures for Potential Impacts

Activity	Mitigation and Management Measure	Responsible Person	Applicable Development Phase	Include as Condition of Authorisation	Monitoring requirements
Loss of land previously used for sheep, cattle and antelope grazing will be occupied by the solar power facility and associated infrastructure.	Areas of construction should be (where practical) limited to the extent of the project footprint, and activities outside of the site should be kept to a minimum.	Site construction managers (BioTherm contractors)	Construction and Operational	Yes – activity has been assigned a high environmental significance during the operational phase	A site compliance audit should be conducted (1) prior to construction to determine the base line conditions, (2) during construction on a monthly basis and (3) after rehabilitation measures have been implemented.
Increased potential for soil erosion due to vegetation clearance, soil disturbance and high traffic movement on site.	Areas of construction should be (where practical) limited to the extent of the project footprint, and activities outside of the site should be kept to a minimum. Traffic of construction vehicles should be kept to a minimum to reduce soil compaction, and limited to existing or proposed roadways where practical. Soils excavated during construction of the facility should be appropriately stored in stockpiles which are protected from erosion (i.e. through use of vegetation cover in the case of long-term stockpiles- this should form part of the rehabilitation process after the construction phase). Wind erosion is dominant for the region, however the array of heliostats will act as an artificial wind break and reduce the effect in the site footprint. Water erosion action is considered limited, however backfilling with soil and use of gabions or Reno Mattresses should be used where evidence of erosion is present.	Site construction managers (BioTherm contractors)	Construction, Operational and Decommissioning	Yes – activity has been assigned a medium environmental significance during the construction phase	A site compliance audit should be conducted (1) prior to construction to determine the base line conditions, (2) during construction on a monthly basis and (3) after rehabilitation measures have been implemented.
Potential spillage of hazardous substances such as oils, fuel, grease from construction and operational vehicles, and sewage from on-site sanitation systems	The proper handling and storage of hazardous materials, the use of hardstanding in storage areas of hazardous substances and where spillages are possible. The use of bunding around storage of hazardous materials and proper upkeep of machinery and vehicles. A complete spill kit must be onsite at all times.	Site construction managers (BioTherm contractors)	Construction, Operational and Decommissioning	No – activity has been assigned a low environmental significance during the construction, operational and decommissioning phases	A site compliance audit should be conducted (1) prior to construction to determine the base line conditions, (2) during construction on a monthly basis and (3) after rehabilitation measures have been implemented.

7 STAKEHOLDER CONSULTATION

7.1 STAKEHOLDER CONSULTATION PROCESS

Public participation is a requirement of the S&EIR process; it consists of a series of inclusive and culturally appropriate interactions aimed at providing stakeholders with opportunities to express their views, so that these can be considered and incorporated into the S&EIR decision-making process. Effective public participation requires the prior disclosure of relevant and adequate project information to enable stakeholders to understand the risks, impacts, and opportunities of the Proposed Project.

A comprehensive stakeholder consultation process was undertaken during the scoping phase. Stakeholders were identified through existing databases, site notices, newspaper adverts and meetings. All stakeholders identified to date have been registered on the project database. All concerns, comments, viewpoints and questions (collectively referred to as 'issues') received to date have been documented and responded to in a Comment and Response Report.

There will be ongoing communication between WSP | Parsons Brinckerhoff and stakeholders throughout the S&EIR process.

7.2 STAKEHOLDER COMMENTS AND RESPONSE

The stakeholder's queries and comments to the Draft Environmental Scoping Report, relating to land Capability and Freshwater Habitats, have been responded to in **Table 15** below.

Table 15: Stakeholder Comments and Queries and the associated Responses

STAKEHOLDER DETAILS	COMMENT	SPECIALIST RESPONSE
C Schwartz **Department of Water and Sanitation** Northern Cape Region (Lower Orange Water Management Area) 25 October 2016	à The Department takes note of the proposed activity and therefore provides the following comments: à Indicated on page 25 of the above-mentioned report, water will be sourced from Sedibeng Water. Please note that an agreement between the applicant and Sedibeng Water should be submitted to the Department. à Any spillage of any hazardous materials including diesel that may occur during construction and operation must be reported immediately to this Department. à All sewage and grey water, as well as any waste generated during the construction phase of the facilities will be collected, contained and disposed of at the permitted and/or licenced facilities of the Local Authority and this must please be confirmed in writing by the local authority.	à Noted. à Noted. à Noted. Spill response has been addressed within the site-specific EMPr. It is specified that all major spills are reported to the DWS immediately. A representative onsite must be trained in the use of the spill kit stop, contain and remove contamination, to prevent further pollution of the environment. à Waste and water management has been addressed within the site specific EMPr. All waste generated onsite must be disposed of in a safe manner at permitted and/or licenced facility. Safe disposal certificates are required to be onsite for inspection by the ECO and officials. The DWS must be informed of any use of private contractors. The details of this contractor and safe disposal certificates must be made available to the DWS when requested.

STAKEHOLDER DETAILS	COMMENT	SPECIALIST RESPONSE
	à Stormwater must be diverted from the construction works and roads and must be managed in such a manner as to disperse runoff and to prevent the concentration of stormwater flow.	à Stormwater management and erosion control have been addressed within this report and the site-specific EMPr. A stormwater management plan must be compiled and approved by DWS.

8 CONCLUSION

The land capability of the proposed Enamandla PV Site 4 is defined as non-arable with a low potential for grazing. Grazing activities (mainly sheep) are the dominant land use for the region and has the largest potential to be impacted by the activities of the proposed BioThem project. Indirect impacts of increased soil erosion are expected at the site given the dry, fragile environment of the region. Furthermore, spillage of hazardous substances onto the land as a result of the activities of the Enamandla PV Site 4 project, is a possibility. However, all these potential impacts on the current land capability for the area were classified with a low environmental significance risk, should the appropriate mitigation measure be followed during the construction, operational and decommissioning phases of the project.

There were no freshwater habitat systems identified within a 500m radius of the proposed Enamandla PV Site 4. As such, no impacts are anticipated for the freshwater habitat systems as a result of the activities of the proposed Enamandla PV Site 4 project.

Consequently, there are no fatal flaws anticipated for the proposed Enamandla PV Site 4 project, from a land capability and freshwater habitat perspective. It is recommended that the mitigation and management measures outlined in this report be followed throughout all phases of the project.

This report provides an initial high-level identification and description of the land capability and freshwater habitat systems within the site boundary. This is due to the extent of the site, accessibility constraints and lack of information relating to the positioning of operational and road infrastructure. Should BioTherm be recognised as a Preferred Bidder, the required application for a Water Use Licence (WUL) in terms of Section 21 of the National Water Act (NWA) (Act 36 of 1998) may commence. This application (WULA) will require detailed functional assessments (i.e. PES, EIS and EcoServices) of freshwater habitats potentially affected. Therefore, it is recommended that a more in-depth and thorough study be conducted by a land capability and aquatic specialist should BioTherm be recognised as a Preferred Bidder.

It is also recommended that an aquatic specialist must conduct an in-depth site walkover prior to the construction phase commencing, after the proposed construction footprint has been confirm and demarcated. This is to assess the footprint for any freshwater habitats, allowing for slight alterations in the footprint, to prevent any impacts on the freshwater habitats due to the actions conducted during the construction phase.

9 PLATES

Plate 1 – Vegetation

Plate 2 – Sheep pen

Plate 3 – Cattle pen

Plate 4 – Windmill-driven boreholes and reservoir

Plate 5 – Namib soil form

Plate 6 – Gneiss rock type below soil profile

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Appendix A

SGS LABORATORY SOIL ANALYSIS REPORT

LABORATORY REPORT FOR SOIL ANALYSIS

REG No. 1949/032643/07 VAT REG No. 4560117428

COMPANY:	**WSP**	**NAME:**	**P BRINKERHOFF**	**Building H1**
ADDRESS:		**FARM:**		**AECI-site**
ADDRESS:		**DISTRICT:**		**De Beers Avenue**
TEL/FAX:		**DATE:**	**3/3/2016**	**Somerset West**
REF:	**229161**	**REP:**		**Tel: (021) 852 7899**

Lab Nr.	Ref.	Camp	Depth	pH	P	K	Ca	Mg	Na	K	Ca	Mg	Na	K	Ca	Mg	Na	KCl (H^+)	Ca:Mg	(Ca+Mg)/K	Mg:K	Acid Sat
				KCl	Bray 1 mg/kg	Amm Acetate mg/kg				%				meq = cmol(+)/kg					Norms			%
																			1.5 - 4.5	10 - 20	3 - 4	
B16-203-43	1	SS 1,2,3		6.7	9	95	350	100	9	8.5	61.4	28.7	1.4	0.24	1.75	0.82	0.04	0.00	2.1	10.6	3.4	0.00
B16-203-44	2	SS 4,5,6		7.1	3	96	377	100	15	8.1	62.5	27.2	2.2	0.25	1.89	0.82	0.07	0.00	2.3	11.0	3.3	0.00
B16-203-45	3	SS 7,8,9		7.4	10	111	571	108	10	7.0	70.2	21.8	1.1	0.28	2.86	0.89	0.04	0.00	3.2	13.2	3.1	0.00

This Laboratory participates in one or more diciplines of AgriLASA's Control Scheme.
A certificate of participation and performance is available at www.agrilasa.co.za

LABORATORY REPORT FOR SOIL ANALYSIS

REG No. 1949/032643/07 VAT REG No. 4560117428

SGS s

COMPANY: WSP
ADDRESS:
ADDRESS:
TEL/FAX:
REF: 229161

Lab Nr.	Ref.	Camp	S-Value cmol(+)/kg	T-Value cmol(+)/kg	Base Sat %	Cu	Zn	Mn	Fe	B	S	Clay	Silt	Sand	Density	EC
						0.1M HCl mg/kg				H_2O mg/kg	Am Ac mg/kg	Hydrometer %			g/cm^3	mS/m
B16-203-43	1	SS 1,2,3	2.9	2.9	100.00	0.55	0.74	12.20	4.00	0.17	4.0	2	2	96	1.730	18.4
B16-203-44	2	SS 4,5,6	3.0	3.0	100.00	0.59	0.49	8.30	0.00	0.15	4.1	2	2	96	1.689	20.1
B16-203-45	3	SS 7,8,9	4.1	4.1	100.00	0.65	0.94	12.70	0.00	0.19	6.8	2	2	96	1.629	19.9

Appendix B

ENVIRONMENTAL SIGNIFICANCE FOR EACH IMPACT

Construction Phase									
Enamandla Site 4									
Potential Impact		Extent (E)	Duration (D)	Magnitude (M)	Probability (P)	Significance (S=(E+D+M)*P)		Status (+ve or -ve)	Confidence
Loss of land previously used for sheep, cattle and antelope grazing will be occupied by the solar power facility and associated infrastructure	Nature of impact:	Direct							
	Without Mitigation	2	2	8	5	60	Medium	-	medium
	degree to which impact can be reversed:	low							
	degree of impact on irreplaceable resources:	low							
	Mitigation Measures	Areas of construction should be (where practical) limited to the extent of the project footprint, and activities outside of the site should be kept to a minimum.							
	With Mitigation	1	2	6	5	45	Medium	-	medium
Construction activities will entail vegetation clearance, soil disturbance and high traffic movement on site, resulting in a	Nature of impact:	Direct and Indirect							
	Without Mitigation	2	2	6	4	40	Medium	-	medium
	degree to which impact can be reversed:	high							

higher potential for soil erosion	degree of impact on irreplaceable resources:	low							
	Mitigation Measures	Areas of construction should be (where practical) limited to the extent of the project footprint, and activities outside of the site should be kept to a minimum. Traffic of construction vehicles should be kept to a minimum to reduce soil compaction, and limited to existing or proposed roadways where practical. Soils excavated during construction of the facility should be appropriately stored in stockpiles which are protected from erosion (i.e. through use of vegetation cover in the case of long-term stockpiles). Wind erosion is dominant for the region, however the array of heliostats will act as an artificial wind break and reduce the effect in the site footprint. Water erosion action is considered limited, however backfilling with soil and use of gabions or Reno Mattresses should be used where evidence of erosion is present.							
	With Mitigation	1	2	4	3	21	Low	-	medium
Potential spillage of hazardous substances such as oils, fuel, grease from construction vehicles, and sewage from on-site sanitation systems	Nature of impact:	Indirect							
	Without Mitigation	2	2	2	2	12	Low	-	medium
	degree to which impact can be reversed:	high							
	degree of impact on irreplaceable resources:	low							
	Mitigation Measures	The proper handling and storage of hazardous materials, the use of hardstanding in storage areas of hazardous substances and where spillages are possible. The use of bunding around storage of hazardous materials and proper upkeep of machinery and vehicles.							

	With Mitigation	1	2	0	1	3	Low	-	medium

Operational Phase									
Enamandla Site 4									
Potential Impact		Extent (E)	Duration (D)	Magnitude (M)	Probability (P)	Significance (S=(E+D+M)*P)		Status (+ve or -ve)	Confidence
Loss of land previously used for sheep, cattle and antelope grazing will be occupied by the solar power facility and associated infrastructure	Nature of impact:	Direct							
	Without Mitigation	2	4	8	5	70	High	-	medium
	degree to which impact can be reversed:	low							
	degree of impact on irreplaceable resources:	low							
	Mitigation Measures	Infrastructure of the solar power facility should be limited to the extent of the project footprint, and activities outside of the site should be kept to a minimum.							
	With Mitigation	1	4	6	5	55	Medium	-	medium
Vegetation clearance for heliostats, soil disturbance and	Nature of impact:	Direct and Indirect							
	Without Mitigation	2	4	4	3	30	Low	-	medium

stockpiles, and increased traffic movement on site, resulting in a higher potential for soil erosion	degree to which impact can be reversed:	high							
	degree of impact on irreplaceable resources:	low							
	Mitigation Measures	Areas of disturbance should be (where practical) limited to the extent of the project footprint, and activities outside of the site should be kept to a minimum. Traffic of maintenance vehicles should be kept to a minimum to reduce soil compaction, and limited to existing roadways where practical. Long term soil stockpiles should be appropriately stored with the use of vegetation cover. Wind erosion is dominant for the region, however the array of heliostats will act as an artificial wind break and reduce the effect in the site footprint. Water erosion action is considered limited, however backfilling with soil and use of gabions or Reno Mattresses should be used where evidence of erosion is present.							
	With Mitigation	1	4	2	2	14	Low	-	medium
Potential spillage of hazardous substances such as oils, fuel, grease from maintenance vehicles, and sewage from on-site sanitation systems	Nature of impact:	Indirect							
	Without Mitigation	2	4	2	2	16	Low	-	medium
	degree to which impact can be reversed:	high							
	degree of impact on irreplaceable resources:	low							
	Mitigation Measures	The proper handling and storage of hazardous materials, the use of hardstanding in storage areas of hazardous substances and where spillages are possible. The use of bunding around storage of hazardous materials and proper upkeep of machinery and vehicles.							

	With Mitigation	1	4	2	1	7	Low	-	medium
Unattended pipeline leakages due to lack of maintenance, negligent operation or management, or unforeseen activity, resulting in soil erosion and establishment of local artificial wetlands.	Nature of impact:	Direct and Indirect							
	Without Mitigation	2	4	6	3	36	Medium	-	medium
	degree to which impact can be reversed:	high							
	degree of impact on irreplaceable resources:	low							
	Mitigation Measures	Regular maintenance and inspection of pipeline by competent individuals. Competent management of the pipeline and pump station system.							
	With Mitigation	1	1	0	1	2	Low	-	medium

Decommissioning Phase								
Enamandla Site 4								
Potential Impact		Extent (E)	Duration (D)	Magnitude (M)	Probability (P)	Significance (S=(E+D+M)*P)	Status (+ve or -ve)	Confidence
Increased potential of soil erosion due to removal of solar power	Nature of impact:	Direct and Indirect						
	Without Mitigation	2	2	4	3	24	Low	-	medium

infrastructure (i.e. Heliostats), soil disturbance and a high traffic movement on site.	degree to which impact can be reversed:	high							
	degree of impact on irreplaceable resources:	low							
	Mitigation Measures	Areas of disturbance should be (where practical) limited to the extent of the project footprint, and activities outside of the site should be kept to a minimum. Traffic of de-construction vehicles should be kept to a minimum to reduce soil compaction, and limited to existing roadways where practical. Long term soil stockpiles should be appropriately redistributed to the site to infill any excavations incurred during the de-commissioning phase. Artificial erosion control measured should be removed to establish natural erosion conditions for the area. Although expected to be nominal in this area, the topsoil removed during the construction period is expected to have a higher fertility than the subsoil horizons. In addition, vegetation seeds are stored in the topsoil. As a result, the topsoil should be kept separate from the subsoils, and should be returned to the impacted land to reinstate the land capability, with topsoil being returned as the top layer. Soil compaction during reinstatement should be minimised to ensure infiltration representative of the regional soils is maintained							
	With Mitigation	1	2	2	2	10	Low	-	medium
Potential spillage of hazardous substances such as oils, fuel, grease from maintenance vehicles, and sewage from on-site sanitation systems	Nature of impact:	Indirect							
	Without Mitigation	2	2	2	2	12	Low		
	degree to which impact can be reversed:	high							

	degree of impact on irreplaceable resources:	low							
	Mitigation Measures	The proper handling and storage of hazardous materials, the use of hardstanding in storage areas of hazardous substances and where spillages are possible. The use of bunding around storage of hazardous materials and proper upkeep of machinery and vehicles.							
	With Mitigation	1	2	0	1	3	Low	-	medium

Cumulative Impacts									
Enamandla Site 4									
Potential Impact		Extent (E)	Duration (D)	Magnitude (M)	Probability (P)	Significance (S=(E+D+M)*P)		Status (+ve or -ve)	Confidence
Loss of land (including wetlands) previously used for sheep, cattle and antelope grazing will be occupied by the solar power facility and associated infrastructure	Nature of impact:	Direct							
	Without Mitigation	2	4	8	5	70	High	-	Low
	degree to which impact can be reversed:	medium							
	degree of impact on irreplaceable resources:	low							

	Mitigation Measures	Infrastructure of the different renewable power facility should be limited to the extent of the respective project footprints, and activities outside of the sites should be kept to a minimum. Special consideration should be given to identified wetlands and watercourses present within 500 m of a proposed site (i.e. ideally no development should occur within 500m of an identied and confirmed wetland and watercourse).							
	With Mitigation	1	4	6	5	55	Medium	-	Low
Vegetation clearance for project infrastructure (i.e. heliostats and tower or PV cells/modules or wind turbines), soil disturbance and stockpiles, and increased traffic movement on site, resulting in a higher potential for soil erosion	Nature of impact:	Direct and Indirect							
	Without Mitigation	2	4	4	3	30	Low	-	Low
	degree to which impact can be reversed:	high							
	degree of impact on irreplaceable resources:	low							
	Mitigation Measures	Areas of disturbance should be (where practical) limited to the extent of the respective project footprint, and activities outside of the site should be kept to a minimum. Traffic of maintenance vehicles should be kept to a minimum to reduce soil compaction, and limited to existing roadways where practical. Long term soil stockpiles should be appropriately stored with the use of vegetation cover. Wind erosion is dominant for the region, however the array of heliostats or PV cells/modules or wind turbines will act as an artificial wind break and reduce the effect in the site footprint. Water erosion action is considered limited, however backfilling with soil and use of gabions or Reno Mattresses should be used where evidence of erosion is present.							
	With Mitigation	1	4	2	2	14	Low	-	Low
Potential spillage of hazardous	Nature of impact:	Indirect							

substances such as oils, fuel, grease from maintenance vehicles, and sewage from on-site sanitation systems	Without Mitigation	2	4	2	2	16	Low	-	Low
	degree to which impact can be reversed:	high							
	degree of impact on irreplaceable resources:	low							
	Mitigation Measures	The proper handling and storage of hazardous materials, the use of hardstanding in storage areas of hazardous substances and where spillages are possible. The use of bunding around storage of hazardous materials and proper upkeep of machinery and vehicles.							
	With Mitigation	1	4	2	1	7	Low	-	Low

Appendix C

CUMULATIVE IMPACT ASSESSMENT

BIOTHERM – CUMULATIVE ASSESSMENT

APPROACH

The Department of Environmental Affairs (DEA) has requested that a detailed cumulative assessment is undertaken for each of the proposed BioTherm projects. The cumulative assessment must take the specialist studies from the surrounding Environmental Authorisations into account.

In order to ensure that a consolidated cumulative assessment can be developed for each project, a template has been produced to ensure that the specialist studies across the disciplines utilise the same approach.

Each specialist discipline will be required to compile the table below and provide a qualitative discussion on the overall cumulative impact of the projects in the study area.

MASTER ASSUMPTIONS

The following assumptions and limitations have been identified in relation to the above approach:

- Due to the number of different significance rating methodologies utilised across the various projects, significance ratings have been simplified to include only Low, Medium and High ratings.
- In the event that specialist studies were unable to be obtained, this has been noted.
- All approved and ongoing environmental authorisations within a 70km radius above been considered

Table 1: Cumulative Impacts – Solar Soil & Land Capability

Proposed Development Name	DEA Reference	Current EA Status	Proponent	Extent	Proposed Capacity	Farms	Impacts																			Proposed Mitigation Measures
							Construction								Operation					Decommissioning						
							Agriculture land	Soil erosion	Agricultural impact	Contamination	Dust	Agric potential	Topsoil loss	Veld degrade	Agriculture land	Soil erosion	Dust	Contamination	Agric potential	Soil erosion	Contamination	Dust	Agric potential			
Construction of the Wind and Photovoltaic (PV) Energy Facilities, including the Construction of the Wind and PV Substations and Gridline Connections, near Springbok, within the Nama-Khoi Local Municipality, Northern Cape Province.	14/12/16/3/3/2/346/AM1	In Process		46 535	75		L	L	L						L											
Construction of the Wind and Photovoltaic (PV) Energy Facilities, including the Construction of the Wind and PV Substations and Gridline Connections, Near Springbok, within the Nama-Khoi Local Municipality, Northern Cape Province.	14/12/16/3/3/2/447	In Process		46 535	1000		L	L	L						L											
The Proposed Boesmanland Solar Farm Portion 6 (A Portion Of Portion 2), Farm 62 Zuurwater, Aggeneys, Northern Cape Province.	12/12/20/2602	Approved		200	75			L								L										
75MW PV plant on the Farm Zuurwater No 62 in the Namakwa District, Northern	14/12/16/3/3/2/473	In Process		222	75			L		L	M	L				M	L	L	L	L	L	M	L		

Proposed Development Name	DEA Reference	Current EA Status	Proponent	Extent	Proposed Capacity	Farms	Impacts																		Proposed Mitigation Measures
							Construction								Operation					Decommissioning					
							Agriculture land	Soil erosion	Agricultural impact	Contamination	Dust	Agric potential	Topsoil loss	Veld degrade	Agriculture land	Soil erosion	Dust	Contamination	Agric potential	Soil erosion	Contamination	Dust	Agric potential		
Cape Province, Phase 4.																									
Proposed Boesmanland Solar Farm Portion 6 (A portion of portion 2) Farm 62 Zuurwater, Aggeneys, Northern Cape.	14/12/16/3/3/2/222	Approved		200	75																				
Proposed Wind Energy Facility and Associated Infrastructure on Namies Wind Farm Pty Ltd, near Aggeneys, Northern Cape Province.	14/12/16/3/3/2/550	In Process		15	220		L		L						L				L						
The Proposed Construction of a Photovoltaic Power Generation Facility within the Black Mountain Mining Area near Aggeneys in the Northern Cape Province.	12/12/20/2151	Approved		19.5	19																				
Proposed 75MW Korana Wind Energy Facility, near Poffader in the Northern Cape.	14/12/16/3/3/2/683	Unknown		3257 (all facilities)	Unknown		M	L					L	L											
Proposed 140MW Khâi-Mai Wind Energy Facility near Pofadder.	14/12/16/3/3/2/680	Unknown		3257 (all facilities)	Unknown		M	L					L	L											
				Total	**Total**																				
				50248.5	1538 MW																				
Significance Totals per impact	Significance Rating						**Total Hectares per impact**																		

Proposed Development Name	DEA Reference	Current EA Status	Proponent	Extent	Proposed Capacity	Farms	Impacts																	Proposed Mitigation Measures
							Construction								Operation					Decommissioning				
							Agriculture land	Soil erosion	Agricultural impact	Contamination	Dust	Agric potential	Topsoil loss	Veld degrade	Agriculture land	Soil erosion	Dust	Contamination	Agric potential	Soil erosion	Contamination	Dust	Agric potential	
	High Significance																							
	Medium Significance						3257				222					222						222		
	Low Significance						46 550	50 214	46 550	222		222	3257	3257	46 550	200	222	222	237	222	222		222	
	Positive Impacts																							

The following EAs surrounding the solar developments have been either withdrawn or have lapsed and are therefore not been considered as part of the cumulative impact assessment:

Proposed Development Name	DEA Reference	Current EA Status	Proponent	Extent	Proposed Capacity	Farms
Proposed Sato Energy Holdings Photovoltaic Project, Khai Ma Local Municipality, Northern Cape.	12/12/20/2334/7	Withdrawn / Lapsed			75	
Proposed Sato Energy Holdings Photovoltaic Project, Khai Ma Local Municipality, Northern Cape.	12/12/20/2334/6	Withdrawn / Lapsed			75	
Proposed Sato Energy Holdings Photovoltaic Project, Khai Ma Local municipality, Northern Cape.	12/12/20/2334/7	Withdrawn / Lapsed			75	
Proposed Gamsberg Solar Energy Project on Portion 1 of Farm 57 Aroams near Upington, Khâi-Ma Municipality, Northern Cape.	12/12/20/2605	Withdrawn / Lapsed			Unknown	

BIOTHERM – CUMULATIVE ASSESSMENT

APPROACH

The Department of Environmental Affairs (DEA) has requested that a detailed cumulative assessment is undertaken for each of the proposed BioTherm projects. The cumulative assessment must take the specialist studies from the surrounding Environmental Authorisations into account.

In order to ensure that a consolidated cumulative assessment can be developed for each project, a template has been produced to ensure that the specialist studies across the disciplines utilise the same approach.

Each specialist discipline will be required to compile the table below and provide a qualitative discussion on the overall cumulative impact of the projects in the study area.

MASTER ASSUMPTIONS

The following assumptions and limitations have been identified in relation to the above approach:

- Due to the number of different significance rating methodologies utilised across the various projects, significance ratings have been simplified to include only Low, Medium and High ratings.
- In the event that specialist studies were unable to be obtained, this has been noted.
- All approved and ongoing environmental authorisations within a 70km radius above been considered

Table 1: Cumulative Impacts – Solar Surface Water

Proposed Development Name	DEA Reference	Current EA Status	Proponent	Extent	Proposed Capacity	Farms	Impacts																Proposed Mitigation Measures
							Construction					Operation						Decommissioning					
							Watercourse sedimentation	Fresh water and habitat loss	Turbines	Power lines	Access route	Fresh water	Watercourse sedimentation	Recharge patterns of pans	Turbines	Power lines	Access route	Watercourse sedimentation	Turbines	Power lines	Access route	
Construction of the Wind and Photovoltaic (PV) Energy Facilities, including the Construction of the Wind and PV Substations and Gridline Connections, near Springbok, within the Nama-Khoi Local Municipality, Northern Cape Province.	14/12/16/3/3/2/346/AM1	In Process		46 535	75		L					L										
Construction of the Wind and Photovoltaic (PV) Energy Facilities, including the Construction of the Wind and PV Substations and Gridline Connections, Near Springbok, within the Nama-Khoi Local Municipality, Northern Cape Province.	14/12/16/3/3/2/447	In Process		46 535	1000		L					L										
The Proposed Boesmanland Solar Farm Portion 6 (A Portion Of Portion 2), Farm 62 Zuurwater, Aggeneys, Northern Cape Province.	12/12/20/2602	Approved		200	75		L						L									
75MW PV plant on the Farm Zuurwater No 62 in the Namakwa District, Northern Cape Province, Phase 4.	14/12/16/3/3/2/473	In Process		222	75		L						M	L				L				
Proposed Boesmanland Solar	14/12/16/3/3/2/222	Approved		200	75																	

Proposed Development Name	DEA Reference	Current EA Status	Proponent	Extent	Proposed Capacity	Farms	Impacts																Proposed Mitigation Measures
							Construction					Operation						Decommissioning					
							Watercourse sedimentation	Fresh water and habitat loss	Turbines	Power lines	Access route	Fresh water	Watercourse sedimentation	Recharge patterns of pans	Turbines	Power lines	Access route	Watercourse sedimentation	Turbines	Power lines	Access route		
Farm Portion 6 (A portion of portion 2) Farm 62 Zuurwater, Aggeneys, Northern Cape.																							
Proposed Wind Energy Facility and Associated Infrastructure on Namies Wind Farm Pty Ltd, near Aggeneys, Northern Cape Province.	14/12/16/3/3/2/550	In Process		15	220				L	L	L				L	L	L		L	L	L		
The Proposed Construction of a Photovoltaic Power Generation Facility within the Black Mountain Mining Area near Aggeneys in the Northern Cape Province.	12/12/20/2151	Approved		19.5	19																		
Proposed 75MW Korana Wind Energy Facility, near Poffader in the Northern Cape.	14/12/16/3/3/2/683	Unknown		3257 (all facilities)	Unknown		L	L				L											
Proposed 140MW Khâi-Mai Wind Energy Facility near Pofadder.	14/12/16/3/3/2/680	Unknown		3257 (all facilities)	Unknown		L	L				L											
				Total	**Total**																		
				50248.5	1538 MW																		

Significance Totals per impact	Significance Rating				**Total Hectares per impact**															
	High Significance																			
	Medium Significance										222									
	Low Significance				50 214	3 257	15	15	15	49 792	200	222	15	15	15	222	15	15	15	
	Positive Impacts																			

The following EAs surrounding the solar developments have been either withdrawn or have lapsed and are therefore not been considered as part of the cumulative impact assessment:

Proposed Development Name	DEA Reference	Current EA Status	Proponent	Extent	Proposed Capacity	Farms
Proposed Sato Energy Holdings Photovoltaic Project, Khai Ma Local Municipality, Northern Cape.	12/12/20/2334/7	Withdrawn / Lapsed			75	
Proposed Sato Energy Holdings Photovoltaic Project, Khai Ma Local Municipality, Northern Cape.	12/12/20/2334/6	Withdrawn / Lapsed			75	
Proposed Sato Energy Holdings Photovoltaic Project, Khai Ma Local municipality, Northern Cape.	12/12/20/2334/7	Withdrawn / Lapsed			75	
Proposed Gamsberg Solar Energy Project on Portion 1 of Farm 57 Aroams near Upington, Khâi-Ma Municipality, Northern Cape.	12/12/20/2605	Withdrawn / Lapsed			Unknown	