SOUTH AFRICA MAINSTREAM RENEWABLE POWER DEVELOPMENTS PTY (LTD)

Proposed Construction of the !Xha Boom Wind Farm near Loeriesfontein, Northern Cape Province

Surface Water Assessment – Scoping Report

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DETAILS OF SPECIALIST AND DECLARATION OF INTEREST

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Application for authorisation in terms of the National Environmental Management Act, 1998 (Act No. 107 of 1998), as amended and the Environmental Impact Assessment Regulations, 2014

PROJECT TITLE

Proposed Construction of the !Xha Boom Wind Farm near Loeriesfontein, Northern Cape Province – Surface Water Assessment: Scoping Report

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The specialist appointed in terms of the Regulations

I, **Shaun Taylor**, declare that --

General declaration:

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

Signature of the specialist

SiVEST Environmental

Name of company (if applicable)

23 January 2017

Date

MAINSTREAM RENEWABLE POWER DEVELOPMENTS (PTY) LTD

PROPOSED CONSTRUCTION OF THE !XHA BOOM WIND FARM NEAR LOERIESFONTEIN, NORTHERN CAPE PROVINCE

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SURFACE WATER ASSESSMENT – SCOPING REPORT

1 INTRODUCTION

Mainstream Renewable Power Developments (Pty) Ltd (hereafter referred to as “Mainstream”) are proposing to construct a wind farm near Loeriesfontein in the Northern Cape Province. The proposed development will consist of up to a 235MW export capacity wind farm referred to as the !Xha Boom Wind Farm (hereafter referred to the, “the proposed development”).

The !Xha Boom Wind Farm will have an associated and a 132kV Power Line, which will evacuate the electricity generated by the wind farm. The power line component will however form part of a separate Basic Assessment (BA) process. Additionally, it must be noted that the proposed development however forms part of four separate, but adjacent wind farms in total (including Grasskoppies Wind Farm). The other three remaining wind farm developments include Ithemba Wind Farm, Hartebeest Leegte Wind Farm and Grasskoppies Wind Farm. Each of these three proposed wind farms will be undertaken as separate EIA processes, and are therefore not included in this assessment.

In terms of the Environmental Impact Assessment (EIA) Regulations (08 December 2014) promulgated under Sections 24 and 24D of the National Environmental Management Act, 1998 (Act No. 107 of 1998) (NEMA), various aspects of the proposed development are considered to fall within the ambit of listed activities which may have an impact on the environment, and therefore require environmental authorization (EA) from the National Department of Environmental Affairs (DEA) prior to the commencement of such activities. It has therefore been identified that an EIA process is to be followed which will require scoping and impact phase assessments for the proposed !Xha Boom Wind Farm.

SiVEST Environmental Division have subsequently been appointed as the independent surface water specialist consultant to undertake the surface water impact assessment for the proposed development. The scoping phase surface water report will provide information obtained at a desktop level. This report will furthermore provide details on the project type (technology considered, output capacity, layout alternatives etc.), the anticipated legislative implications and requirements, scope the potential environmental impacts that could be associated with the proposed development and other surrounding developments, propose mitigation measures to minimize the potential impacts identified and finally, include specialist recommendations.

1.1 Legislative Context

1.1.1 National Water Act, 1998 (Act No. 36 of 1998)

The National Water Act, 1998 (Act No. 36 of 1998) (NWA) was created in order to ensure the protection and sustainable use of water resources (including wetlands) in South Africa. The NWA recognises that the ultimate aim of water resource management is to achieve the sustainable use of water for the benefit of all users. Bearing these principles in mind, there are a number of stipulations within the NWA that are relevant to the potential impacts on watercourses and wetlands that may be associated with the proposed development. These stipulations are explored below and are discussed in the context of the proposed development.

Firstly, it is important to discuss the type of water resources protected under the NWA. Under the NWA, a 'water resource' includes a watercourse, surface water, estuary, or aquifer. Specifically, a watercourse is defined as (*inter alia*):

- A river or spring;
- A natural channel in which water flows regularly or intermittently; and
- A wetland, lake or dam into which, or from which, water flows.

In this context, it is important to note that reference to a watercourse includes, where relevant, its bed and banks. Furthermore, it is important to note that water resources, including wetlands, are protected under the NWA. 'Protection' of a water resource, as defined in the NWA entails the:

- Maintenance of the quality and the quantity of the water resource to the extent that the water use may be used in a sustainable way;
- Prevention of degradation of the water resource; and
- Rehabilitation of the water resource.

In the context of the proposed development and implications towards surface water resources potentially occurring on the study site, the definition of pollution and pollution prevention contained within the NWA is relevant. 'Pollution', as described by the NWA, is the direct or indirect alteration of the physical, chemical or biological properties of a water resource, so as to make it (*inter alia*):

- Less fit for any beneficial purpose for which it may reasonably be expected to be used; or
- Harmful or potentially harmful to the welfare or human beings, to any aquatic or non-aquatic organisms, or to the resource quality.

The inclusion of physical properties of a water resource within the definition of pollution entails that any physical alterations to a water body (for example, the excavation of a wetland or changes to the morphology of a water body) can be considered to be pollution. Activities which cause alteration of the biological properties of a watercourse, i.e. the fauna and flora contained within that watercourse are also considered pollution.

In terms of **Section 19** of the NWA, owners / managers / people occupying land on which any activity or process undertaken which causes, or is likely to cause pollution of a water resource must take all reasonable measures to prevent any such pollution from occurring, continuing or recurring. These measures may include measures to (*inter alia*):

- Cease, modify, or control any act or process causing the pollution;
- Comply with any prescribed waste standard or management practice;
- Contain or prevent the movement of pollutants;
- Remedy the effects of the pollution; and
- Remedy the effects of any disturbance to the bed and banks of a watercourse.

1.1.2 National Environmental Management Act, 1998 (Act No. 107 of 1998)

The National Environmental Management, 1998 (Act No. 107 of 1998) (NEMA) was created essentially to establish:

- Principles for decision-making on matters affecting the environment;
- Institutions that will promote co-operative governance; and
- Procedures for co-ordinating environmental functions exercised by organs of the state to provide for the prohibition, restriction or control of activities which are likely to have a detrimental effect on the environment.

It is stipulated in NEMA *inter alia* that everyone has the right to an environment that is not harmful to his or her health or well-being. Moreover, everyone has the right to have the environment protected, for the benefit of present and future generations, through reasonable legislative and other measures that prevent pollution and ecological degradation, promote conservation and secure ecologically sustainable development and use of natural resources while promoting justifiable economic and social development.

Accordingly, several of the principles of NEMA contained in **Chapter 1 Section 2**, as applicable to wetlands, stipulate that:

- Development must be socially, environmentally and economically sustainable;
- Sustainable development requires the consideration of all relevant factors including the following:
    - That the disturbance of ecosystems and loss of biological diversity are avoided, or, where they cannot be altogether avoided, are minimised and remedied.
    - That pollution and degradation of the environment are avoided, or, where they cannot be altogether avoided, are minimised and remedied.
    - That negative impacts on the environment and on people's environmental rights be anticipated and prevented, and where they cannot be altogether prevented, are minimised and remedied.
- The costs of remedying pollution, environmental degradation and consequent adverse health effects and of preventing, controlling or minimising further pollution, environmental damage or adverse health effects must be paid for by those responsible for harming the environment.

- Sensitive, vulnerable, highly dynamic or stressed ecosystems, such as coastal shores, estuaries, wetlands, and similar systems require specific attention in management and planning procedures, especially where they are subject to significant human resource usage and development pressure.

In line with the above, **Chapter 7** further elaborates on the application of appropriate environmental management tools in order to ensure the integrated environmental management of activities. In other words, this chapter of NEMA addresses the tools that must be utilised for effective environmental management and practice. Under these auspices, the EIA Regulations (2006, 2010 and 2014 as amended) were promulgated in order to give effect to the objectives set out in NEMA. Subsequently, activities were defined in a series of listing notices for various development activities. Should any of these activities be triggered, an application for Environmental Authorisation subject to a Basic Assessment (BA) or EIA process is to be applied for. Fundamentally, applications are to be applied for so that any potential impacts on the environment in terms of the listed activities are considered, investigated, assessed and reported on to the competent authority charged with granting the relevant environmental authorisation.

The above stipulations of the NWA and NEMA have implications for the proposed development in the context of surface water resources. Accordingly, potential impacts / issues as a result of the proposed development on surface water resources are addressed later in this report (**Section 7 & 8**).

1.2 Definition of Surface Water Resources as Assessed in this Study

Using the definition of a surface water resource under the NWA, this study will include a river, a spring, a natural channel in which water flows regularly or intermittently, a wetland, lake or dam into which, or from which, water flows.

1.2.1 Wetlands

The lawfully accepted definition of a wetland in South Africa is that within the NWA. Accordingly, the NWA defines a wetland 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".

Moreover, wetlands are accepted as land on which the period of soil saturation is sufficient to allow for the development of hydric soils, which in normal circumstances would support hydrophytic vegetation (i.e. vegetation adapted to grow in saturated and anaerobic conditions).

Inland wetlands can be categorised into hydrogeomorphic units (HGM units). **Ollis *et al*. (2013)** have described a number of different wetland hydrogeomorphic forms which include the following:

- Channel (river, including the banks): a linear landform with clearly discernable bed and banks, which permanently or periodically carries a concentrated flow of water. A river is taken to include both the active channel and the riparian zone as a unit.
- Channelled valley-bottom wetland: a valley-bottom wetland with a river channel running through it. Channelled valley-bottom wetlands must be considered as wetland ecosystems that are distinct from, but sometimes associated with, the adjacent river channel itself, which must be classified as a “river”.
- Unchannelled valley-bottom wetland: a valley-bottom wetland without a river channel running through it.
- Floodplain wetland: a wetland area on the mostly flat or gently-sloping land adjacent to and formed by an alluvial river channel, under its present climate and sediment load, which is subject to periodic inundation by over-topping of the channel bank. Floodplain wetlands must be considered as wetland ecosystems that are distinct from but associated with the adjacent river channel itself, which must be classified as a “river”.
- Depression: a wetland or aquatic ecosystem with closed (or near-closed) elevation contours, which increases in depth from the perimeter to a central area of greatest depth and within which water typically accumulates.
- Flat: a Level or near-level wetland area that is not fed by water from a river channel, and which is typically situated on a plain or a bench, closed elevation contours are not evident around the edge of a wetland flat.
- Hillslope seep: a wetland area located on gently to steeply sloping land and dominated by colluvial (i.e. gravity-driven), unidirectional movement of water and material down-slope.

1.2.2 Riparian Habitat

Riparian habitats may potentially occur in the study area. Riparian habitats (also known as riparian areas or zones) include plant communities usually adjacent to or along natural channels that are affected by surface and subsurface flows (**DWAF, 2005**). Riparian habitats can be found on the edges of lakes, or drainage lines but are more commonly associated with channelled flowing systems like streams and rivers. Riparian habitats can also be associated with wetlands that are similarly associated with streams and rivers. These are defined as riparian wetlands.

1.2.3 Watercourses

According to the NWA, a watercourse falls within the ambit of a ‘water resource’. For watercourses however, the following is relevant:

- A river or spring; and
- A natural channel in which water flows regularly or intermittently.

Watercourses may be perennial or non-perennial in nature. Moreover, non-perennial watercourses can encompass seasonal or ephemeral watercourses (including drainage lines) depending on the climate and other environmental constraints.

Any of the above mentioned wetland forms, riparian habitats or watercourses may occur within the study area. The types of surface water resources identified are addressed later in the report (**Section 6**).

1.3 Assumptions and Limitations

This short term once-off surface water assessment has only focused on the identification and delineation of surface water resources within the proposed development area. Identification and delineation of surface water resources in the wider area outside of the proposed development area have not been undertaken.

Given the short term once-off nature of the assessment, the assessment should not be undertaken to be a fully comprehensive study on wetland and riparian vegetation species occurrence within the surface water resources.

Use of database information for the desktop assessment included the National Freshwater Ecosystem Priority Areas (**NFEPA, 2011**) database. This database is a national level database and some smaller surface water resources may not be contained in the database. Additionally, mainly wetlands with permanent inundation are included in the database. Therefore, wetlands with seasonal and temporary saturation cycles may not be included. Google Earth™ was therefore used to identify wetlands from a desktop level that may not be contained in the consulted databases.

Surface water resources were initially identified and delineated at a desktop level. These will then only be groundtruthed and verified in the field work (impact) phase. The initial delineations undertaken at a desktop level will then be refined following findings made in the field work phase.

Aquatic studies of fish, invertebrates, amphibians etc. have not been included in this report. Nor have water quality, hydrological or groundwater studies been included.

Application of the **DWAF (2005)** delineation guidelines are limited for the delineation of drainage lines and pan wetlands in arid and semi-arid regions due to the intermittent nature of flow which is poorly accommodated in the methodology, and application thereof.

As a separate independent avifaunal assessment has been undertaken for the proposed development. The assessment of potential impacts as related to avi-fauna have not been included in this assessment. It is therefore assumed that all avi-faunal impacts (including that related to waterfowl associated with wetlands and other surface water resources) will have been adequately covered in the avi-faunal impact assessment.

2 PROJECT NEED AND DESIRABILITY

The negative environmental impacts of using fossil fuels are well documented. In addition to depleting fossil fuels, the processes often result in large pollution risks. The Government of South Africa has committed to contributing to the global effort to mitigate greenhouse emissions.

According to the White Paper on the Promotion of Renewable Energy and Clean Energy Development (2002), the Government has committed to develop the framework within which the renewable energy industry can operate, grow, and contribute positively to the South African economy and to the global environment.

Government's long-term goal is the establishment of a renewable energy industry producing modern energy carriers that will offer in future years a sustainable, fully non-subsidised alternative to fossil fuels.

In response to this goal, Mainstream are proposing to establish Wind Farms near Loeriesfontein in the Northern Cape Province.

The overall objective of the project is to generate electricity to feed into Eskom's national electricity grid by means of renewable energy technologies.

3 PROJECT TECHNICAL DESCRIPTION

3.1 Project Location

The proposed wind farm is located approximately 70km north of Loeriesfontein in the Northern Cape Province and straddles the boundary between the Hantam and Khai-Ma Local Municipalities (**Figure 1**). The application site as shown on the locality map below (**Figure 2**) comprises Portion 2 of the Farm Georgs Vley No 217, and is approximately 3800ha in extent. The buildable area of the site will however be significantly smaller than this and will be determined by sensitive areas identified during the EIA.

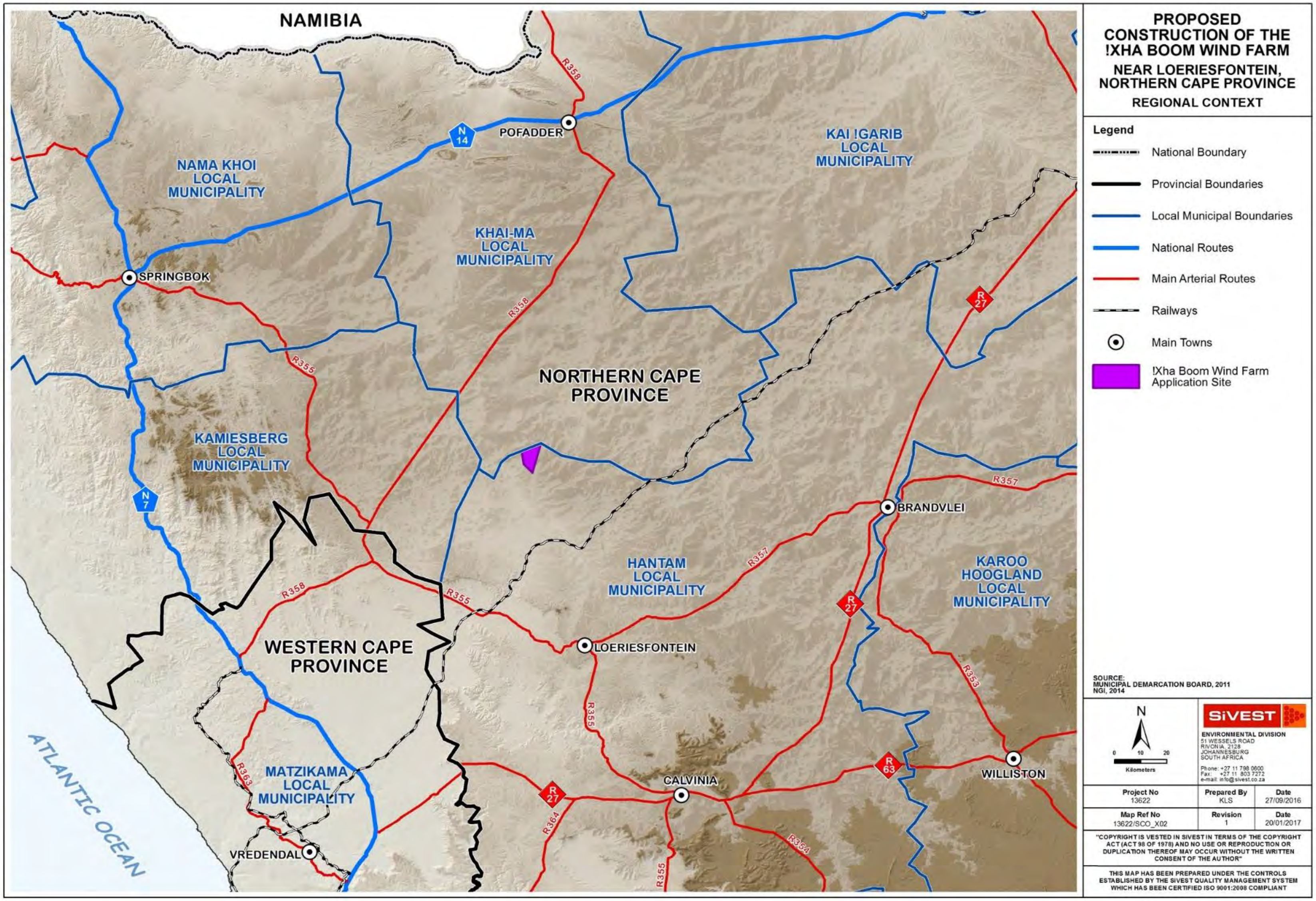

Figure 1: Regional Context Map

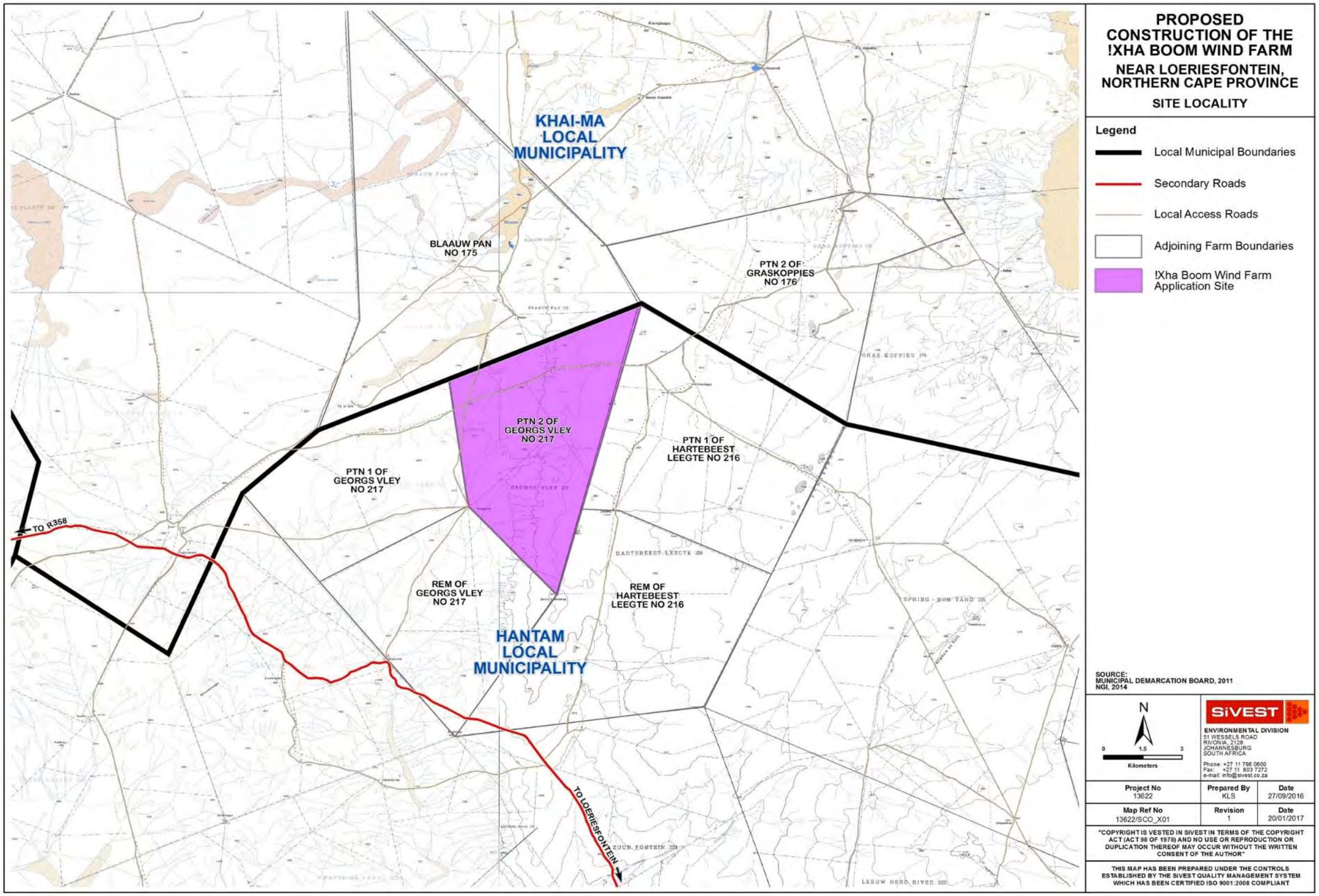

Figure 2: Locality Map

3.2 Wind Farm Technical Details

At this stage it is proposed that the wind farm, comprising wind turbines and associated infrastructure will have a total generation capacity of up to 235MW. The generated electricity will be fed into the national grid at the Helios Substation via a 132kV power line. The key components of the project are detailed below.

3.2.1 Turbines

The size of the wind turbines will depend on the developable area and the total generation capacity that can be produced as a result. The wind turbines will therefore have a hub height of up to 160m and a rotor diameter of up to 160m (**Figure 3**). The blade rotation direction will depend on wind measurement information received later in the process. The electrical generation capacity for each turbine will range from 3 to 5MW depending on the final wind turbine selected for the proposed development.

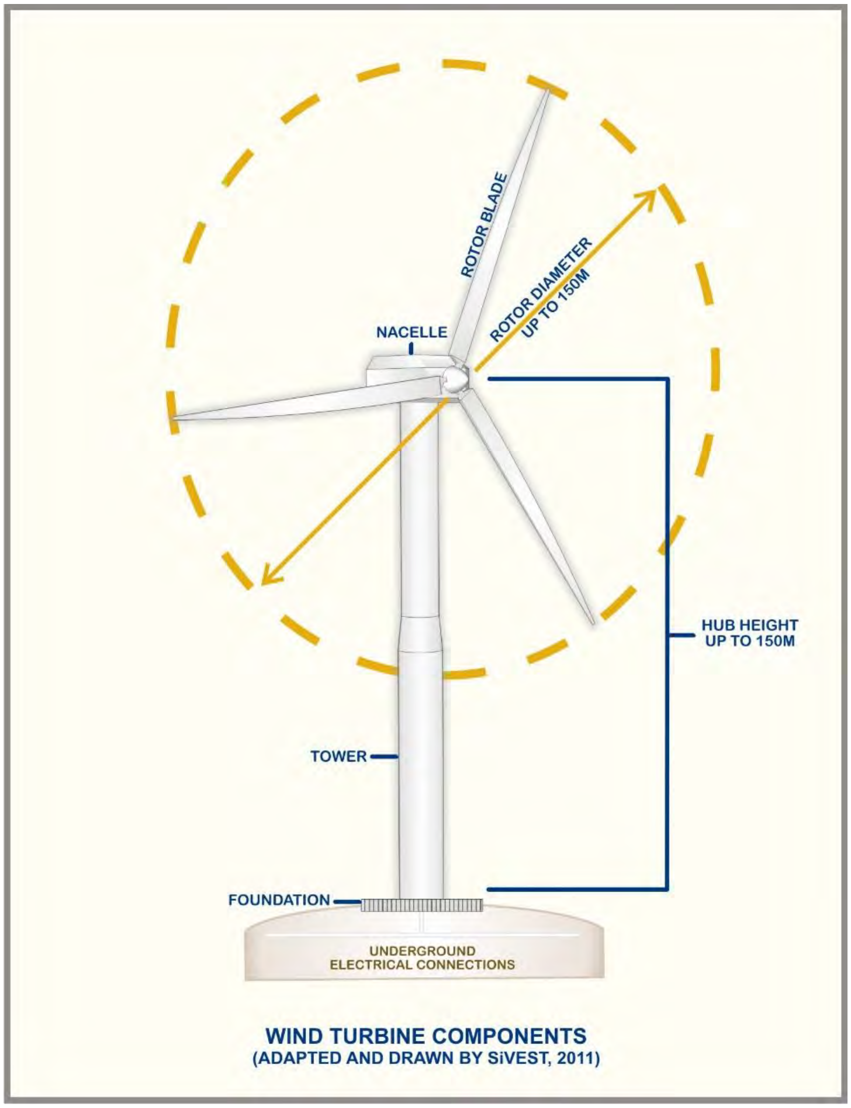

Figure 3: Typical Components of a Wind Turbine

3.2.2 Wind Farm Electrical Infrastructure

The wind turbines will be connected to the substation using buried (up to a depth of 1,5m) medium voltage cables (**Figure 4**) except where a technical assessment of the proposed design suggests that overhead lines are appropriate, such as over rivers and gullies. Where overhead power lines are to be constructed, monopole tower structures will be used in combination with the steel lattice towers at bend points. The dimensions of the monopole structures will depend on grid safety requirements and the grid operator. The exact location of the towers and the final design will depend on Eskom's requirements. As mentioned, the proposed wind farm will connect to the national grid at Helios substation via a 132kV power line with a length of up to 48km. A separate BA process however will be undertaken for this proposed power line. This 132kV power line associated with the proposed wind farm will however require a separate Environmental Authorisation, and is being conducted as a part of a separate Basic Assessment (BA) process. The 132kV power line has been mentioned for background information purposes, but will be authorised under a separate BA to allow for handover to Eskom.

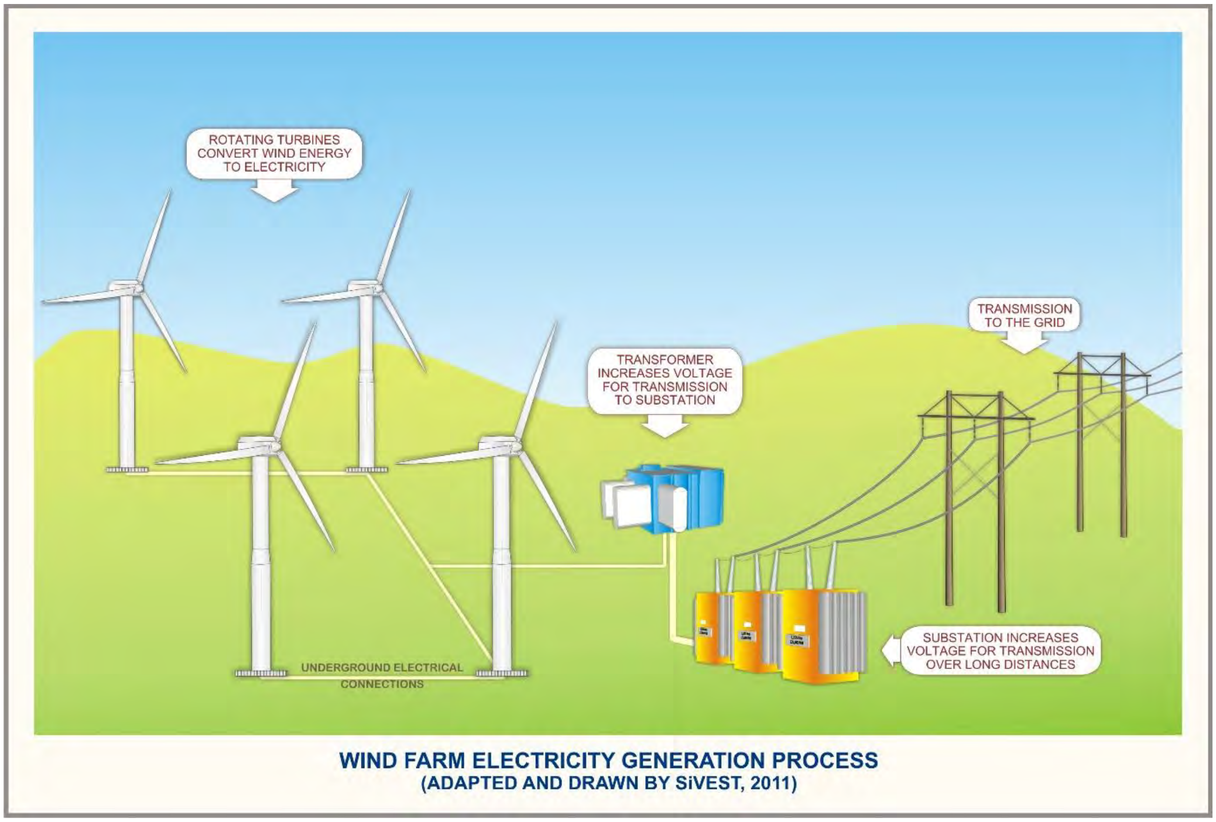

Figure 4: Conceptual Wind Farm Electricity Generation Process

A new substation and associated transformers will be developed which will supply the generated electricity to the national grid. The connection from the substation to the national grid line will be an overhead power line as mentioned above.

3.2.3 Roads

Internal Access roads with a maximum width of 13.5m are initially being proposed for the construction phase. This is however only temporary as the width of proposed internal access roads will be reduced to approximately 6m for maintenance purposes during the operational phase.

3.2.4 Construction Lay Down Area

A temporary lay down area will be constructed for the proposed development and will include an access road and a contractor's site office.

3.2.5 Other Infrastructure

Other infrastructure includes the following:

- Operation and maintenance (O&M) buildings; and
- Fencing.

3.3 Alternatives

In terms of the NEMA and the EIA Regulations, feasible alternatives are required to be considered during the EIA Process. All identified, feasible alternatives are required to be evaluated in terms of social, biophysical, economic and technical factors. The following alternatives will be considered and investigated as part of this Scoping Phase Report:

- Two (2) alternative site locations for the proposed on-site 132kV !Xha Boom substation; and
- The “No-go” Alternative.

3.3.1 No-go Alternative

The ‘no-go’ alternative is the option of not establishing the proposed wind energy facility. South Africa is currently under immense pressure to generate electricity to accommodate for the additional demand which has been identified. With the current global focus on climate change, the government is exploring alternative energy sources in addition to coal fired power stations. Although wind power is not the only solution to solving the energy crisis in South Africa, not establishing the proposed wind energy facility would be detrimental to the mandate that the government has set to promote the implementation of renewable power. It is a suitable sustainable solution to the energy crisis and this project would contribute to this solution. This project will aid in achieving South Africa’s goals in terms of sustainability, energy security, mitigating energy cost risks, local economic development and national job creation.

4 METHODOLOGY

4.1 Database Assessment

The first step in the scoping level surface water assessment was to identify any potential surface water resources using various database information sources. This was undertaken using Geographic Information System (GIS) software. The software ArcView developed by ESRI was used. The collection of data source information encompassed (but is not limited to) 1:50 000 topographical maps, the **Namakwa District Biodiversity Sector Plan (2008)**, the National Freshwater Ecosystem Priority Areas **(NFEPA, 2011)** database, the Northern Cape and National Environmental Potential Atlas **(ENPAT, 2000)** database, the

South African National Biodiversity Institute (SANBI): C.A.P.E. Fine-Scale Biodiversity Plan **(SANBI, 2007)** database and the SANBI Vegetation Map (**SANBI, 2006**).

4.2 Desktop Assessment

The use of Google Earth™ imagery supplemented the above-mentioned data sources. Desktop delineations of identified surface water resources from the databases were undertaken. The supplementary use of satellite imagery (**Google Earth™**) also allowed for other potentially overlooked surface water resources, not contained within the databases, to be identified and earmarked for ground-truthing in the field work component of the EIA phase, where required.

Utilising these resources, wetlands and any other surface water resources identified were mapped and highlighted for the next (in-field detailed) phase of the assessment.

4.3 Surface Water Buffer Zones

A wetland buffer zone is typically an area of vegetated, un-developed land surrounding a wetland that is maintained to protect, support and screen wetland flora and fauna from the disturbances associated with neighbouring land uses. As wetlands and aquatic habitats are regarded as inherently ecologically sensitive habitat units, the designation of conservation buffers allows for the protection of this habitat unit that could potentially emanate from terrestrial-based activities. Ultimately, buffer zones are typically required to protect and minimise the edge impacts to wetlands.

Although buffers are considered vitally important to the functioning of wetland systems through the provision of the abovementioned services, the determination of the minimum buffer widths to effectively protect and sustain different wetland processes and functions has proven difficult. The minimum wetland buffer width required to maintain the integrity of a wetland is the product of a number of factors:

- the sensitivity of the wetland flora and fauna to edge effects (noise, light, alien plants and direct human disturbances), sediment pollution, water pollution and/or increased surface water inputs;
- the specific lifecycle and habitat requirements of the wetland flora and fauna present within the wetland;
- the disturbance intensity of the proposed neighbouring land use in terms of noise, light, alien plants and/or direct human disturbances;
- the disturbance intensity and risk of sediment and/or water pollution associated with the proposed neighbouring/adjacent land use;
- the ability of the proposed buffer to capture sediment and/or remove and filter pollutants before reaching the wetland; and
- the ability of the proposed buffer to dissipate and infiltrate the surface runoff before reaching the wetland.

Depending on the type of land use or development proposed, an appropriate buffer zone to protect wetlands **(DWAF, 2005)** and other surface water resources should be applied to delineations. As such, consideration of the above factors (including the flow drivers, water quality, geomorphology, habitat and biota of the surface water resources) in relation to potential impacts as a result from the proposed development were taken into account in determination of an appropriate buffer zone.

4.4 Impact Assessment Method

Current and potential impacts will be identified based on the proposed development and potential impacts that may result for the construction, operation and decommissioning of the proposed development. The identified potential impacts will be evaluated using an impact rating method (**Appendix A**). This is addressed in **Section 9**.

5 GENERAL STUDY AREA

The !Xha Boom Wind Farm is generally accessible via a dirt off Granaatboskolk which can be accessed via the R357 which leads to Loeriesfontein. Land cover in the area is mainly vacant land used for grazing purposes but also includes salt mining, railways and various renewable energy developments (both solar and wind). A map indicating the land cover classes of the general area for the proposed development are provided in **Figure 5** below.

According to **Mucina and Rutherford (2006)**, the proposed development site falls within the Nama-Karoo Biome. Within a biome, smaller groupings referred to as bioregions can be found which provide more specific but general details as to the biophysical characteristics of smaller areas. The development site can be found within the Bushmanland bioregion. Going into even finer detail, vegetation units are classified which contain a set of general but more local biophysical characteristics as opposed to the entire bioregion. The proposed development can therefore be found within the Bushmanland Basin Shrubland and Western Bushmanland Klipveld vegetation units (**Figure 6**). The description of Vegetation and Landscape Features, Geology and Soils, Climate and Conservation as contained in **Mucina and Rutherford (2006)** are provided below for this vegetation unit.

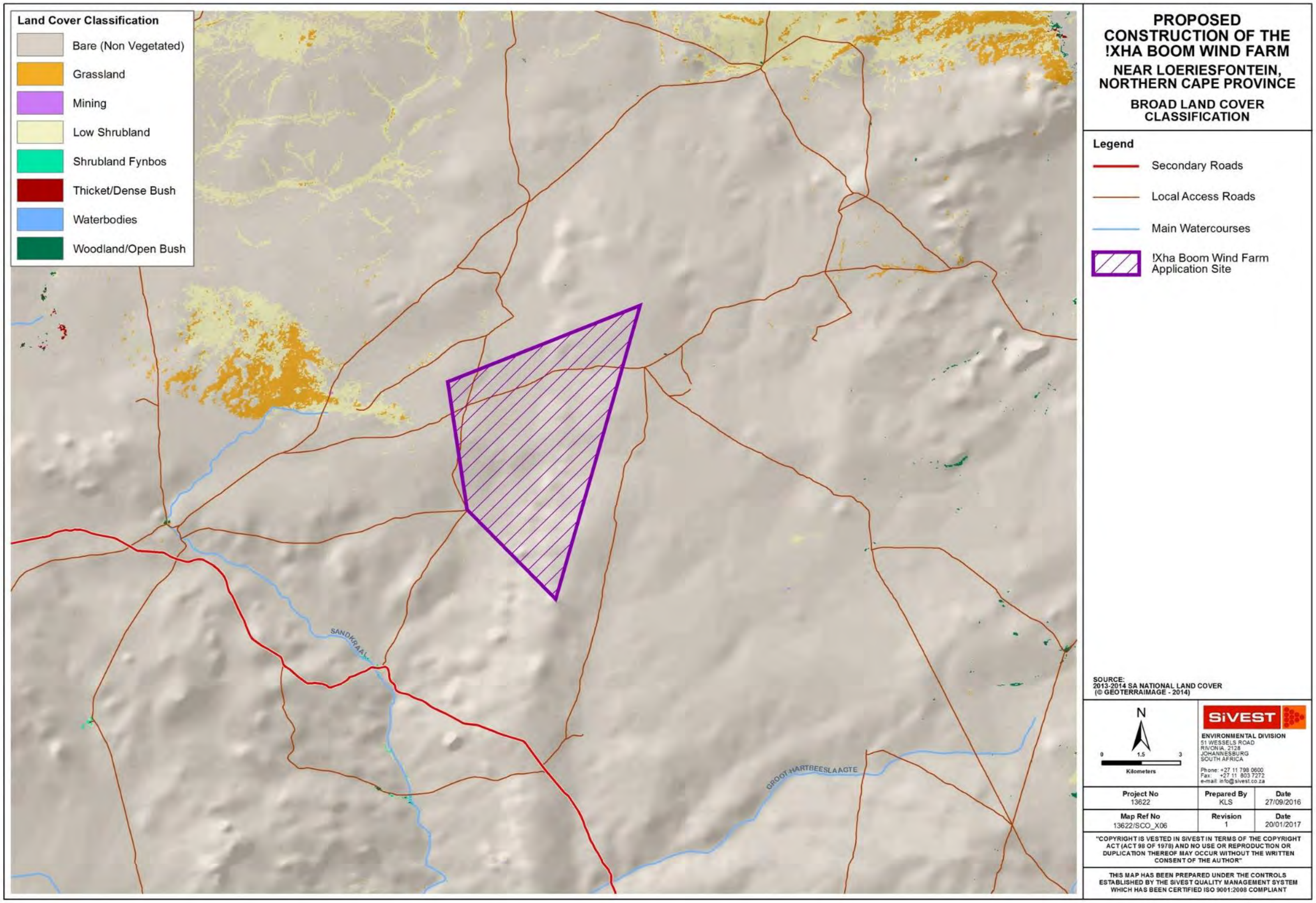

Figure 5: Land Cover Map

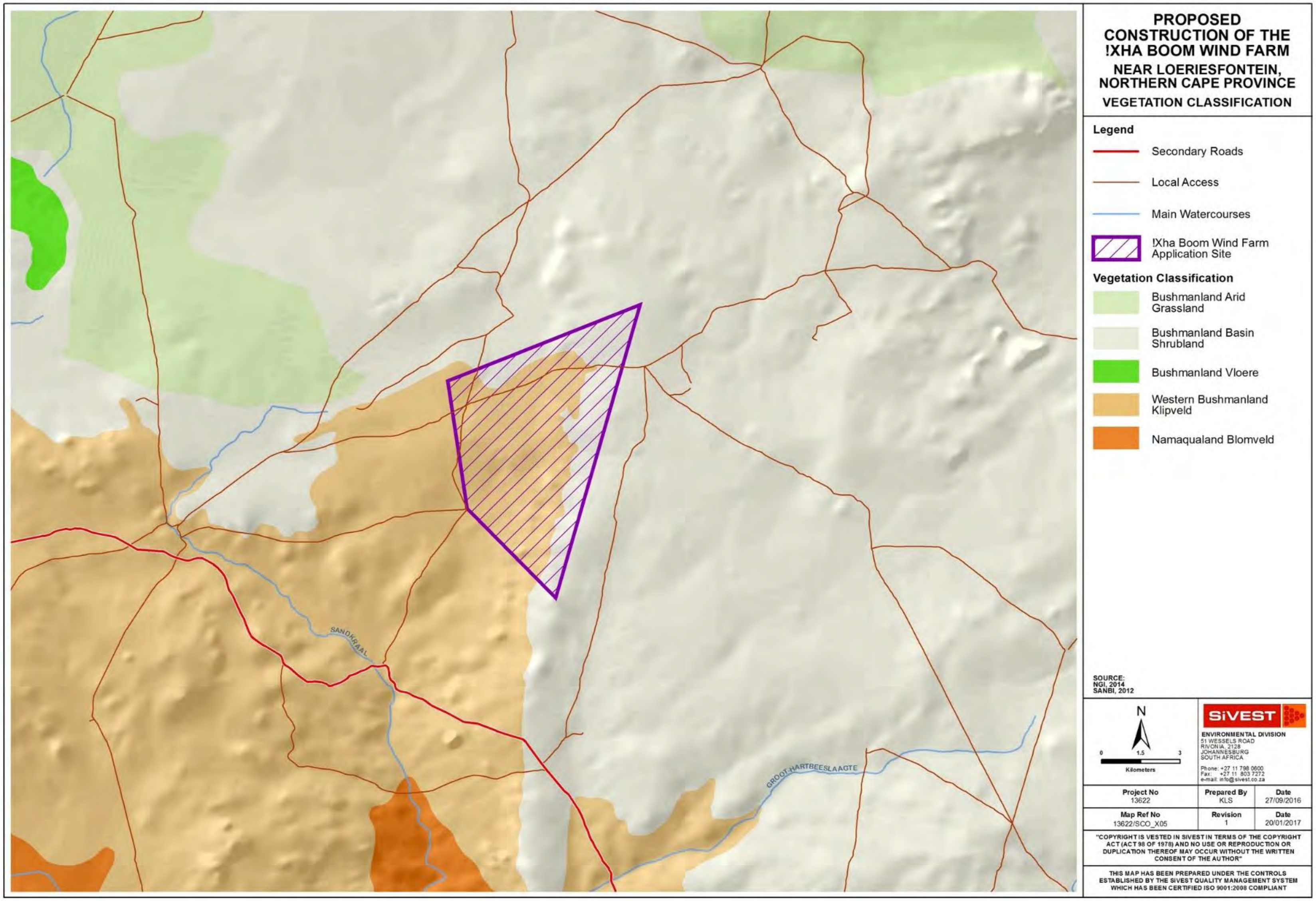

Figure 6: Vegetation Unit Map

5.1 Bushmanland Basin Shrubland Vegetation Unit

The vegetation and landscape features of the Bushmanland Basin Shrubland are characterised by slightly irregular plains with dwarf shrubland dominated by a mixture of low sturdy and spiny (and sometimes also succulent) shrubs (*Rhigozum, Salsola, Pentzia, Eriocephalus*), “white” grasses (*Stipagrostis*) and in years of high rainfall also by abundant annuals such as species of *Gazania* and *Leysera*.

The geology and soils comprise of mudstones and shales of Ecca Group (Prince Albert and Volksrust Formations) and Dwyka tillites, both of early Karoo age, dominate. About 20% of rock outcrop is formed by Jurassic intrusive dolerite sheets and dykes. Soils are shallow Glenrosa and Mispah forms, with lime generally present in the entire landscape (Fc land type) and, to a lesser extent, red-yellow apedal, freely drained soils with a high base status and usually <15% clay (Ah and Ai land types) are also found. The salt content in these soils is very high.

Rainfall occurs in late summer and early autumn. Mean Annual Precipitation (MAP) ranges from about 100-200m. Mean maximum and minimum monthly temperatures in Brandvlei are 39.6^{o}C and -2.2^{o}C for January and July, respectively. Corresponding values for Van Wyksvlei are 39.5^{o}C and -4.6^{o}C.

The conservation status of the vegetation unit is described as least threatened (Target 21%). None of the unit is conserved in statutory conservation areas. No signs of serious transformation is present, but scattered individuals of *Prosopis* sp. occur in some areas (e.g. in the vicinity of the Sak River drainage system), and some localised dense infestation form closed “woodlands” along the eastern border of the unit with Northern Upper Karoo (east of Van Wyksvlei). Erosion is moderate (56%) and low (34%).

5.2 Western Bushmanland Klipveld

The vegetation and landscape features are characterised by very sparsely populated plains with a desert appearance (rocky pavements built of rounded, dark-coloured rocks and boulders) supporting succulent dwarf shrubs (*Aridaria*, *Drosanthemum Eberlanzia*, *Phyllobolus*, *Psilocaulon*, *Rushcia*), with microphyllous non-succulent shrubs (*Aptosium*, *Pentzia*) and drought-tolerant grasses.

The geology and soils consist of Hutton and Mispah soils over Karoo Sequence sediments (mostly Dwyka diamictite and Ecca shale). The rocky pavements of rounded boudlers, which characterise this area, are palaeo-river terraces of the palaeo-Orange River, which is presumed to have flowed south through this area (approximately 22 million years ago). Fc (Glenrosa and Mispah soil forms) land type covers the entire region.

The climate of the vegetation unit is identified as a very dry region with a Mean Annual Precipitation (MAP) of only 90mm (range 70-100mm) and erratic (almost desert-like) rainfall. Slight peak in precipitation in winter, hardly any in December and January, consistent with the classification of this unit in winter-rainfall Succulent Karoo Biome. Potential evaporation exceeds 2660mm. Overall Mean Annual Temperature (MAT) 16-17º C, with clear maxima in December to January. Mean maximum and minimum monthly temperatures in Kliprand are 36º C and -2º C for January and July, respectively. Incidence of frost is relatively high (25 days, range 20-40 days) due to its land-locked position and high altitude generating effect of thermal continentality.

The conservation status of the vegetation unit is described as least threatened (Target 18%). None conserved in statutory conservation areas. No signs of large scale transformation or invasion of alien plants. Erosion is high (70%) and moderate (12%).

6 FINDINGS OF ASSESSMENT

6.1 Surface Water Database Information

In terms of the **National ENPAT (2002)** database, the proposed wind farm study site is completely within the Olifants / Doorn Water Management Area (WMA) (**Figure 7**). Moreover, the proposed development is therefore also within the Olifants – Cape Primary Catchment (Olifants / Doorn WMA). At a finer level of detail, the !Xha Boom Wind Farm site traverses two (2) quaternary catchments including E31A and E31C.

In terms of the **NFEPA (2011)** database, there is only one (1) natural depression wetland. This wetland is not considered to be a Wetland Freshwater Ecosystem Priority Area (WETFEPA). A WETFEPA is a wetland that is earmarked to stay in good condition in order to conserve freshwater ecosystems and protect water resources for human use. These are classified according to a number of criteria some of which include existing protected areas and focus areas for protected area expansion identified in the National Protected Expansion Strategy.

Two (2) non-perennial watercourses were identified in the **Northern Cape ENPAT (2000)** database. No other watercourses were identified from the **NFEPA (2011)** database.

No other surface water resources were identified from the available databases.

6.2 Surface Water Desktop Delineation Information

A delineation exercise was undertaken using satellite imagery (Google Earth™) to demarcate the outer boundaries of any surface water resources identified at a desktop level. The results for the Grasskoppies Wind Farm study site are as follows:

- Two (2) Depression Wetlands;
- Three (3) Major Drainage Line (drainage lines with channel width >5m);
- Two hundred and thirty, six (236) Drainage Lines (drainage lines with a channel width <5m).

The result are shown in **Figure 8** below.

Between the database information in **Section 6.1** and the desktop delineation information in **Section 6.2**, the features identified will be earmarked for groundtruthing in the fieldwork phase. A refinement of the surface water resources will be undertaken in the impact phase pending the fieldwork findings.

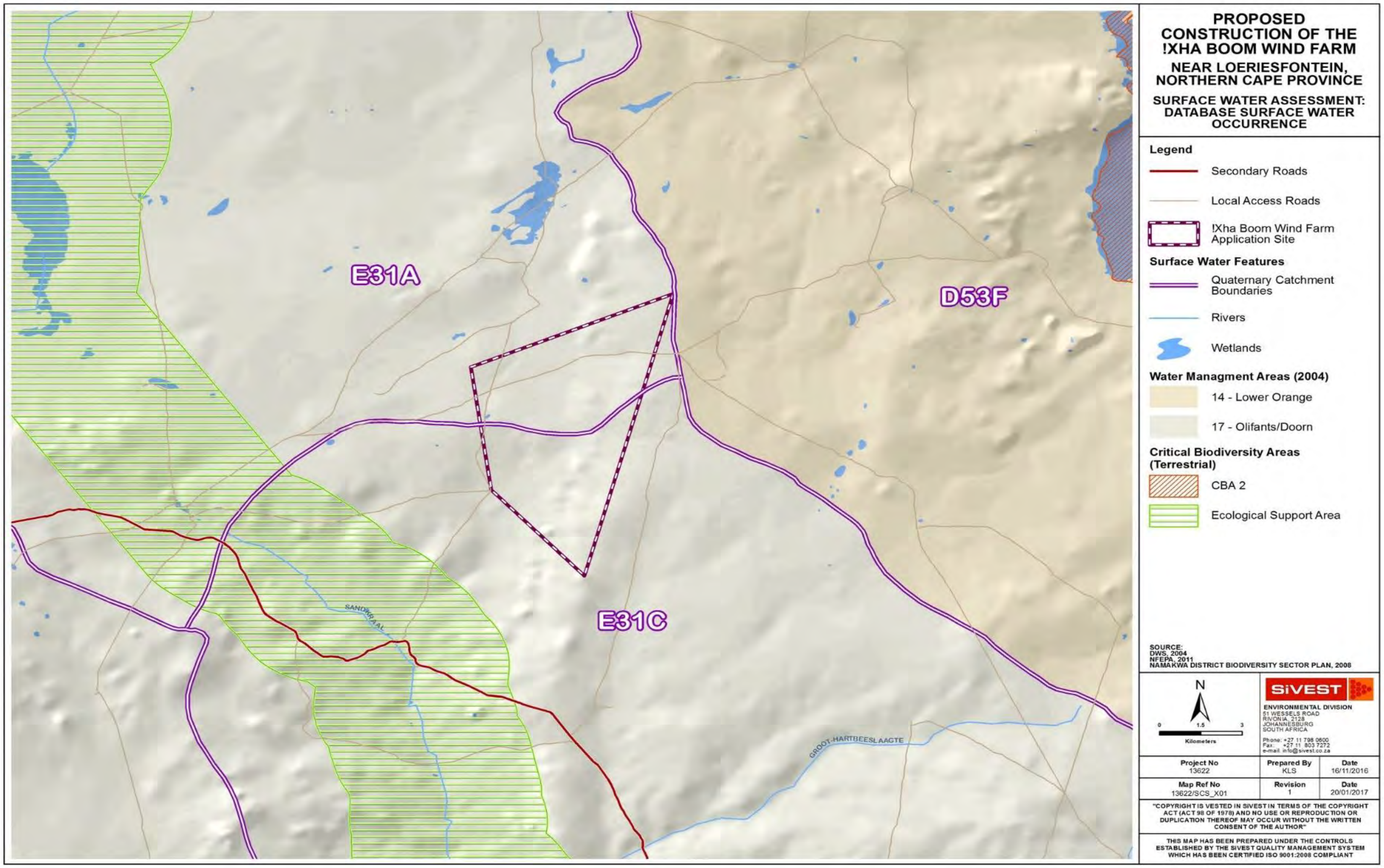

Figure 7: Database Surface Water Occurrence Map

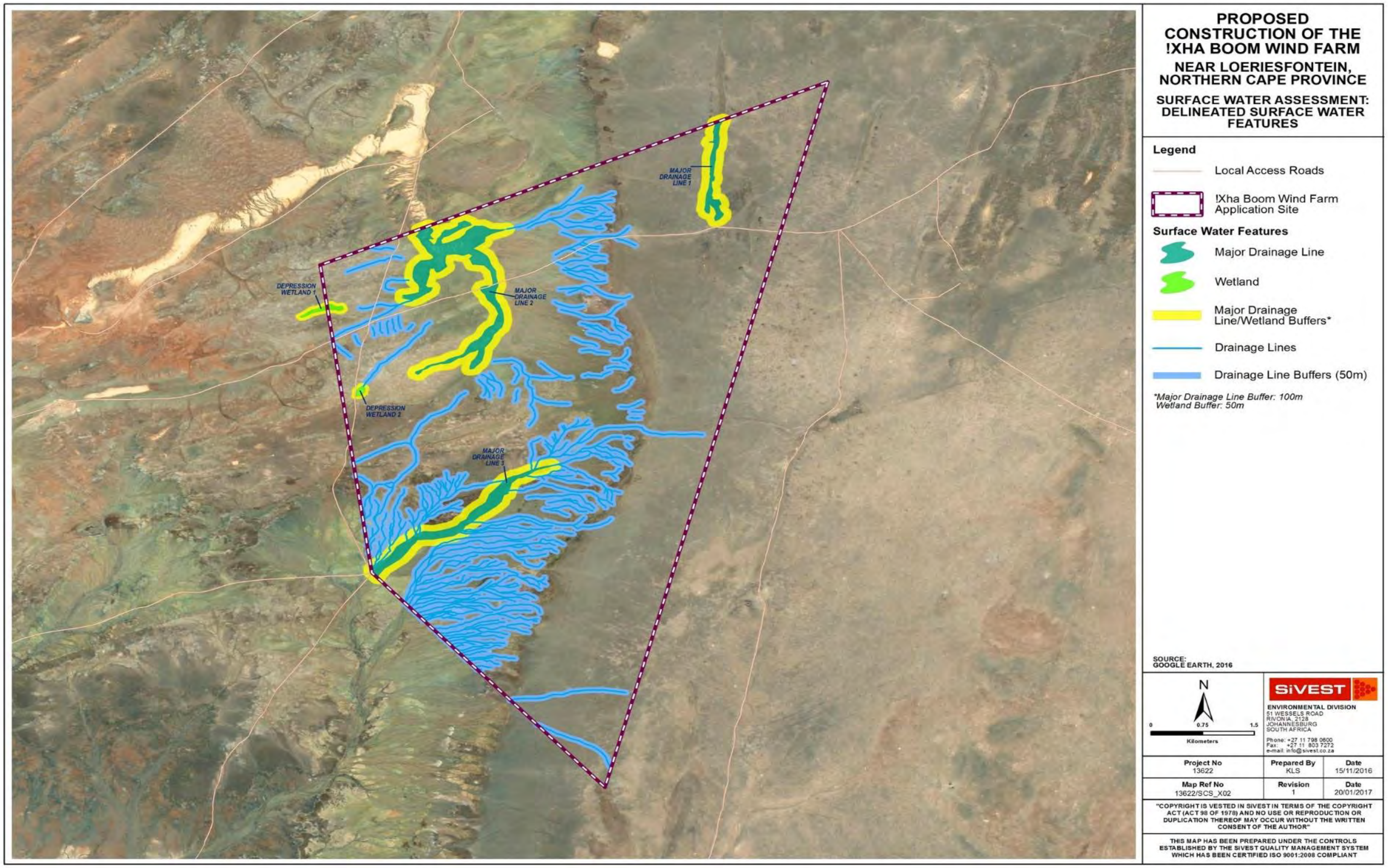

Figure 8: Desktop Delineation Map

6.3 Surface Water Buffer Zones

A provisional buffer zone of 50m has been implemented at this stage for all surface water resources. Pending the results of the in-field groundtruthing and verification exercise, the buffer may be increased or decreased depending on the assessment findings.

7 COMPARATIVE ASSESSMENT

As previously mentioned, two (2) onsite substation alternative site locations have been investigated for the proposed wind energy facility development. These alternatives have been comparatively assessed in order to determine the preferred alternative from a surface water perspective.

The following factors were taken into account when comparatively evaluating the proposed alternatives:

- Size and number of potentially impacted surface water resource(s) in the proposed alternative;
- Proximity to the nearest surface water resource(s);
- The location of any surface water resources present and the ability of the proposed development to be constructed out of, around or away from any nearby surface water resources;
- Number of sub-catchments affected; and
- Existing impact factors (such as existing infrastructure, roads and impacted land).

In terms of the first criteria, the size and number of surface water resources within an alternative area was relevant. The more surface water resources that are present and the greater the area each occupies, it is likely that the impact of the proposed development will be greater.

The second criteria to consider is proximity of the proposed development positioning to any nearby surface water resources. The type of surface water resource and the distance of the proposed development to it will have a bearing on whether there may be direct or indirect impacts that could affect it.

The third criteria focuses on whether the proposed development may be able to be constructed with surface water resources present. It may be possible for the proposed development to be constructed if there are few surface water resources present and the facility component or infrastructure is repositioned to avoid the surface water feature. In this instance, manoeuvrability of the site layout may only also be possible should any surface water resources be located on the boundary of the proposed development area under consideration.

The fourth criteria includes sub-catchment areas that will be affected by the proposed development. The sub-catchments include the wetland specific catchment areas for the endorheic systems as well as the general catchment areas containing several wetland features. Where more sub-catchment areas are affected (both directly / indirectly), more potential contamination pathways can be present thereby influencing the extent and severity of impact.

The final criteria of significance, when selecting the most suitable alternative, is existing infrastructure (power lines, roads, railway etc.) and impacted land (agricultural fields, urban areas etc.). Disturbance to an existing impacted area will be less than if undisturbed, or where less impacted land is affected.

The preference ratings for the onsite substation site alternatives are provided in **Table 1** below. The alternatives are rated as being either preferred (the alternative will result in a low surface water impact / reduce the surface water impact), not-preferred (the alternative will result in relatively high surface water impact / increase the surface water impact), favourable (the surface water impact will be relatively insignificant) or no preference (the alternative will result in equal impacts). This is shown in the key below.

Key

PREFERRED	The alternative will result in a low impact / reduce the impact
FAVOURABLE	The impact will be relatively insignificant
NOT PREFERRED	The alternative will result in a high impact / increase the impact
NO PREFERENCE	The alternative will result in equal impacts

Table 1: Surface Water Comparative Assessment Table

Alternative	**Preference**	**Reasons (incl. potential issues)**
SUBSTATION ALTERNATIVES		
On-site Substation Option 1	Preferred	No surface water resources are found within this alternative site. The nearest surface water resource is a major drainage line which is located approximately 600m to the west, and separated by a low ridge acting as a watershed. The potential for indirect impacts is minimal considering the distance and barrier to the drainage line. This option is therefore preferred.
On-site Substation Option 2	Not Preferred	There are two minor drainage lines that can be found within this substation alternative. There will

Alternative	Preference	Reasons (incl. potential issues)
		therefore be direct potential impacts to these surface water resources. Additionally, there are several other minor drainage lines in close proximity (<120m). Indirect potential impacts such as increased run-off, and consequent sedimentation and erosion are therefore, likely. This option is therefore considered not preferred.

Based on the above assessment, the **preferred alternative site for the proposed substation is Substation Option 1**.

8 LEGISLATIVE IMPLICATIONS

8.1 National Environmental Management Act, 1998 (Act No. 108 of 1998) and Environmental Impact Assessment Regulations (2014)

In the context of NEMA (1998) and the EIA Regulations (2014), as no specific layout is available at this time, it is provisionally identified that Activities 12 and 19 of Government Notice 983 Listing Notice 1 are identified that may be triggered thereby requiring Environmental Authorization. The aforementioned potentially applicable activities are elaborated on in more detail below. Importantly, the applicability of these triggered activities can however only be confirmed once a more detailed layout is available.

8.1.1 Environmental Impact Assessment Regulations 2014, Listing Notice 1, GN. 983, Activity 12:

The development of-

(xii) *infrastructure or structures with a physical footprint of 100 m^2 or more;*

where such development occurs-

(a) within a watercourse;
(c) if no development setback exists, within 32 m of a watercourse, measured from the edge of a watercourse; -

8.1.2 Environmental Impact Assessment Regulations 2014, Listing Notice 1, GN. 983, Activity 19:

The infilling or depositing of any material of more than 5 m³ into, or the dredging, excavation, removal or moving of soil, sand, shells, shell grit, pebbles or rock of more than 5 m³ from-

(i) a watercourse;

8.2 National Water Act, 1998 (Act No. 36 of 1998)

In the context of the NWA (1998) and the proposed development, a “water use” is required where construction activities will impact on a water resource. In this light, “water use” is defined *inter alia* as follows:

a) Taking water from a water resource;
b) Storing water;
c) Impeding or diverting the flow of water in a watercourse;
d) Engaging in stream flow reduction activity contemplated in Section 36 of the NWA;
e) Engaging in a controlled activity identified as such in Section 37 (1) or declared under Section 38 (1) of the NWA;
f) Discharging waste or water containing waste into a water resource through a pipe, canal, sewer, sea outfall or other conduit;
g) Disposing of waste in a manner which may detrimentally impact on a water resource;
h) Disposing of waste in a manner of water which contains waste from, or which has been heated in any industrial or power generation process;
i) Altering the bed, banks, course or characteristics of a watercourse;
j) Removing, discharging or disposing of water found underground if it is necessary for efficient continuation of an activity or for the safety of people; and
k) Using water for recreational purposes.

In this context, a water use license will be required where any of the above water uses are required for a development. As such, for the proposed development, it has been identified that there are a number of surface water resources which may be affected and it is therefore possible that water uses (c) and (i) may be applicable thereby requiring a water use license. The applicability of these water uses can however only be confirmed once a more detailed layout is available.

9 NATURE OF THE POTENTIAL IMPACTS ASSOCIATED WITH THE PROPOSED !XHA BOOM WIND FARM

This section will identify and contextualise each of the potential impacts on the identified surface water resources within the context of the proposed development. A worst case scenario approach will be adopted in the absence of a detailed layout. This section will rate these potential impacts according to an impact rating system (see **Appendix A** for a full methodology and description of the impact rating system), determine the effect of the environmental impact and provide recommendations towards mitigating the anticipated impact. The identification and rating of impacts will be undertaken for the pre-construction, construction, operation and de-commissioning phase of the proposed development.

9.1 Pre-Construction Phase Potential Impacts

9.1.1 Impacts associated with the Construction Lay-down Area

A construction lay-down area is likely to be required for the proposed development. The location of the construction lay-down area will be important as placing this area in a wetland or any other surface water resource is likely to result in direct negative physical impacts. Direct negative impacts can include vegetation clearing and degradation, and soil compaction impacts due to temporary structures and vehicle movement. Impacts related to worker ingress and the degradation of wetlands or any other surface water resource may similarly result. Potential contamination and pollution impacts from stored oils, fuels, and other hazardous substances or materials are also a possibility. Where site clearing may be required in the wetland or any other surface water resource in order for the lay-down area to be established, this will result in the clearance/removal of vegetation at the surface leaving the exposed soils of the wetland(s) or surface water resource vulnerable to erosion and sedimentation impacts. Indirect impacts can also be anticipated in the form of sedimentation and increased run-off which can induce erosion, should the location of the construction lay-down area be within close proximity (32m) to the wetlands and / or watercourses.

A summary of the predicted impacts and cumulative effects is provided in **Table 2** below.

Table 2: Impacts associated with the Construction Lay-down Area directly in or in close proximity to Surface Water Resources

IMPACT TABLE		
Environmental Parameter	Depression wetlands and drainage lines	
Issue/Impact/Environmental Effect/Nature	Impacts associated with the construction lay-down area directly in or within close proximity to surface water resources	
Extent	*Site*	
Probability	*Probable*	
Reversibility	*Partly reversible*	
Irreplaceable loss of resources	*Marginal loss of resources*	
Duration	*Medium term*	
Cumulative effect	*Low cumulative Impact*	
Intensity/magnitude	*High*	
Significance Rating	*Pre-mitigation significance rating is medium and negative. With appropriate mitigation measures, the potential impact can be reduced greatly.*	
	Pre-mitigation impact rating	Post mitigation impact rating
Extent	1	1
Probability	3	1
Reversibility	2	1
Irreplaceable loss	2	1
Duration	2	1
Cumulative effect	2	1
Intensity/magnitude	3	1
Significance rating	- 36 (medium negative)	- 6 (low negative)
Mitigation measures	**Location of the Lay-down Area** – The location of the lay-down area must not be within 50m of any of the identified surface water resources. Therefore, the location of the construction lay-down area must not be within any of the associated buffer zones by implication. Additionally, the storage of materials and machinery must also not be within 50m of any of the identified surface water resources.	

9.2 Construction Phase Potential Impacts

9.2.1 Vehicle and Machinery Degradation Impacts

Construction vehicles (heavy and light) are likely to require access to the proposed development. Potential negative impacts can include the need to travel into or through surface water resources, thereby resulting in physical degradation. Moreover, leaks or spills of oils, fluids and/or fuels from vehicles and machinery in general, or during re-fuelling, or servicing in the surface water resources, are a possibility. Should any leakage or spillage occur in and / or near the surface water resources, potential soil / water contamination can result. Fuels and oils also pose a fire risk not only to the surface water resources, but also neighbouring areas.

Assessment of the above potential negative impacts and mitigation measures thereto are provided in **Table 3** below.

Table 3: Impact Rating for Construction Vehicle and Machinery Degradation Impacts to Surface Water Resources

IMPACT TABLE		
Environmental Parameter	Depression wetlands and drainage lines	
Issue/Impact/Environmental Effect/Nature	Vehicle and machinery degradation to surface water resources	
Extent	*Site*	
Probability	*Probable*	
Reversibility	*Partly reversible*	
Irreplaceable loss of resources	*Marginal loss of resources*	
Duration	*Medium term*	
Cumulative effect	*Medium cumulative Impact*	
Intensity/magnitude	*High*	
Significance Rating	*Pre-mitigation significance rating is medium and negative. With appropriate mitigation measures, the impact can be reduced slightly.*	
	Pre-mitigation impact rating	Post mitigation impact rating
Extent	1	1
Probability	3	3
Reversibility	2	2
Irreplaceable loss	2	2

Duration	2	2
Cumulative effect	3	2
Intensity/magnitude	3	3
Significance rating	- 39 (medium negative)	- 36 (medium negative)
Mitigation measures	**Preventing Physical Degradation of Surface Water Resources** – Surface water resources are to be designated as "highly sensitive areas". Vehicle access is not to be allowed in the highly sensitive areas. Internal access roads are not to be routed in any surface water resources. Should this be required, environmental authorisation and a water use license will be required before construction takes place and all mitigation measures are to be implemented accordingly. **Limiting Damage to Surface Water Resources** – Ideally, to minimise any impact to surface water resources, the proposed development (including buildings, wind turbines and all associated infrastructure) should seek to avoid all surface water resources as far as possible. Where this is not possible a single access route or "Right of Way" (RoW) is to be established through or in the desired construction area in the surface water resource(s). The environmentally authorized and license permitted construction area is to be demarcated and made visible. The establishment of the RoW likewise must be demarcated and made visible. The width of the RoW must be limited to the width of the vehicles required to enter the surface water resource (no more than a 3m width). An area around the locations of the proposed development buildings, wind turbines and any other associated infrastructure will be required in order for construction vehicles and machinery to operate/maneuver, only where required. This too must be limited to the smallest possible area and made visible by means of demarcation.	

	Where crossings are required, only vehicle tracks should be made through the surface water resources. No crossings however are to be made through the natural depression wetlands. RoW areas through surface water resources should not be completely cleared of vegetation, only the tracks should be cleared. Vegetation should otherwise be trimmed appropriately such that vehicles can move through RoW areas adequately. No structures will need to be placed in the RoW crossing areas through surface water resources since these systems are ephemeral. No bog mats or gravel running tracks would therefore be required. No surface water resources are to be crossed during or directly after a rainfall event. Construction workers are only allowed in the designated construction areas of the proposed development and not into the surrounding surface water resources. Highly sensitive areas are to be clearly demarcated prior to the commencement of construction and no access beyond these areas is to be allowed unless in RoW areas. **Preventing Soil Contamination** – No vehicles are to be allowed in the highly sensitive areas unless authorised. Should vehicles be authorized in highly sensitive areas, all vehicles and machinery are to be checked for oil, fuel or any other fluid leaks before entering the required construction areas. Should there be any oil, fuel or any other fluid leaks, vehicles are not to be allowed into surface water resources. All vehicles and machinery must be regularly serviced and maintained before being allowed to enter the construction areas. No fuelling, re-fuelling, vehicle and machinery servicing or maintenance is to take place in the highly sensitive areas. Sufficient spill contingency measures must be available throughout the construction process. These include, but are not limited to, oil spill kits to be

	available, fire extinguishers, fuel, oil or hazardous substances storage areas must be bunded to prevent oil or fuel contamination of the ground and/or nearby surface water resources.

9.2.2 Human Degradation of Flora and Fauna associated with Surface Water Resources

The possibility of human degradation to the surface water resources is likely to occur during the construction phase, since construction activities may take place in close proximity to surface water resources. Human degradation can take the form of physical / direct degradation such as lighting fires (purposefully or accidentally) in or near to surface water resources. Usage of the surface water resources for sanitation purposes may take place resulting in pollution of the surface water resources. The surface water resources may also be utilised as a source of water for domestic use, building and general cleaning purposes.

Fauna and avi-fauna associated with surface water resources are often hunted, trapped, killed or eaten. This impact must be prevented. Finally, flora associated with surface water resources may need to be cleared or removed for building storage purposes which can result in a loss of resources.

Assessment of the above potential negative impacts and mitigation measures thereto are provided in **Table 4** below.

Table 4: Impact Rating for Human Degradation of Flora and Fauna associated with Surface Water Resources

IMPACT TABLE	
Environmental Parameter	Depression wetlands and drainage lines
Issue/Impact/Environmental Effect/Nature	Human degradation to fauna and flora associated with surface water resources
Extent	*Site*
Probability	*Probable*
Reversibility	*Completely reversible*
Irreplaceable loss of resources	*Marginal loss of resources*
Duration	*Short term*
Cumulative effect	*Low cumulative impact*
Intensity/magnitude	*Medium*
Significance Rating	*Pre-mitigation significance rating is medium and negative. With appropriate mitigation measures, the impact can be reduced to a low impact.*

	Pre-mitigation impact rating	Post mitigation impact rating
Extent	1	1
Probability	3	2
Reversibility	1	1
Irreplaceable loss	2	1
Duration	1	1
Cumulative effect	2	1
Intensity/magnitude	3	2
Significance rating	- 30 (medium negative)	- 14 (low negative)
Mitigation measures	**Minimising Human Physical Degradation of Sensitive Areas** – Construction workers are only allowed in designated construction and RoW areas where the environmental authorisation and the relevant water use license is obtained where and if required. The highly sensitive areas are to be clearly demarcated no access into these areas are to be allowed unless authorised. No animals on the construction site or surrounding areas are to be hunted, captured, trapped, removed, injured, killed or eaten by construction workers or any other project team members. Should any party be found guilty of such an offence, stringent penalties should be imposed. The appointed Environmental Control Officer (ECO) or suitably qualified individual may only remove animals, where such animals (including snakes, scorpions, spiders etc.) are a threat to construction workers. The ECO or appointed individual is therefore to be contacted should removal of any fauna be required during the construction phase. Animals that cause a threat and need to be removed may not be killed. Additionally, these animals are to be relocated outside the RoW, within relative close proximity where they were found. No “long drop” toilets are allowed on the study site. Suitable temporary chemical sanitation facilities are to be provided. Temporary chemical sanitation facilities must be placed at least 100 meters from any surface water resource(s) where required.	

	Temporary chemical sanitation facilities must be checked regularly for maintenance purposes and cleaned often to prevent spills. No water is to be abstracted unless a water use license is granted for specific quantities for a specific water resource. No hazardous or building materials are to be stored or brought into the highly sensitive areas. Should a designated storage area be required, the storage area must be placed at the furthest location from the highly sensitive areas. Appropriate safety measures as stipulated above must be implemented. No cement mixing is to take place in a surface water resource. In general, any cement mixing should take place over a bin lined (impermeable) surface or alternatively in the load bin of a vehicle to prevent the mixing of cement with the ground. Importantly, no mixing of cement directly on the surface is allowed in the highly sensitive areas.

9.2.3 Degradation and Removal of Soils and Vegetation in Surface Water Resources

It is likely that the wind turbines, associated buildings and infrastructure are to be located within the identified surface water resources given the number and distribution of surface water resources. As a result, foundations and hard stand areas will need to be laid for the wind turbines. Additionally, foundations will need to be established for the various buildings, structures and infrastructure. Where the placement of the foundations and hard stand areas extend into the surface water resource areas, the excavation of potential soils are likely to affect the functionality of these hydrological systems. Functionality may be affected in terms of hydrogeomorphic functionality. Moreover, the implementation of the foundations will result in a relatively permanent structure, meaning that the area occupied by the foundation will ultimately result in a degree of permanent habitat and soil loss.

Assessment of the above potential negative impacts and mitigation measures thereto are provided in **Table 5** below.

Table 5: Impact Rating for Degradation and Removal of Vegetation and Soils associated with Surface Water Resources

IMPACT TABLE		
Environmental Parameter	Depression wetlands and drainage lines	
Issue/Impact/Environmental Effect/Nature	Degradation and removal of soils and vegetation associated with surface water resources	
Extent	*Site*	
Probability	*Probable*	
Reversibility	*Barely reversible*	
Irreplaceable loss of resources	*Marginal loss of resources*	
Duration	*Long term*	
Cumulative effect	*Medium cumulative Impact*	
Intensity/magnitude	*Very High*	
Significance Rating	*Pre-mitigation significance rating is high and negative. With appropriate mitigation measures, the impact can be reduced to a medium impact.*	
	Pre-mitigation impact rating	Post mitigation impact rating
Extent	1	1
Probability	3	3
Reversibility	3	3
Irreplaceable loss	2	2
Duration	3	3
Cumulative effect	3	2
Intensity/magnitude	4	3
Significance rating	- 60 (High negative)	- 42 (medium negative)
Mitigation measures	**Strategic Positioning of Wind Turbines, Buildings and other Linear Infrastructure** – Preferably all wind turbines, buildings and infrastructure should be placed at least 50m from any surface water resource as far as practically possible. This will significantly reduce the potential impact on surface water resources. Where this is not possible, more intense mitigation measures will be required as stipulated below. **Obtaining Relevant Authorisations and Licenses** – Before any construction or removal of soils and vegetation in any delineated surface water resources	

	is undertaken, the relevant water use license and environmental authorisation is to be obtained and conditions adhered to. **Limiting Damage to Surface Water Resources** – Construction must be limited to the authorized RoW areas where applicable. **Limiting Removal of Excavated Soils** – Should the necessary authorisations (water use license, environmental authorisation etc.) be obtained for the proposed development to be placed in surface water resources, excavated topsoils should be stockpiled separately from subsoils so that it can be replaced in the correct order for rehabilitation purposes post-construction. Soils removed from surface water resources must only be removed if absolutely required. Furthermore, any removed soils and vegetation that are not required should be taken to a registered landfill site that has sufficient capacity to assimilate the spoil. The topsoil is to be used for rehabilitation purposes and should not be removed unless there is surplus that cannot be utilised. It is important that when the soils are re-instated, the subsoils are to be backfilled first followed by the topsoil. The topsoil contains the natural seedbank from which the affected surface water resources or the associated buffer zone can naturally rehabilitate. Where the soils are excavated from the sensitive areas, it is preferable for them to be stockpiled adjacent to the excavation pit to limit vehicle and any other movement activities around the excavation areas. **Preventing Pollution Impacts** – Any cement mixing should take place over a bin lined (impermeable) surface or alternatively in the load bin of a vehicle to prevent the mixing of cement with the ground of the surface water resource. Importantly, no mixing of cement directly on the surface is allowed in the

	construction and RoW areas in surface water resources. **Protection of Stockpiled Soils** – Stockpiled soils will need to be protected from wind and water erosion. Stockpiled soils are not to exceed a 3m height and are to be bunded by suitable materials. Stacked bricks surrounding the stockpiled soils can be adopted. Alternatively, wooden planks pegged around the stockpiled soils can be used. **Rehabilitation of RoW Areas** – Ideally, the affected RoW zones in the sensitive areas must be re-instated with the soils removed from the surface water resource(s), and the affected areas must be levelled, or appropriately sloped and scarified to loosen the soil and allow seeds contained in the natural seed bank to re-establish. However, given the aridity of the study area, it is likely that vegetation recovery will be slow. Rehabilitation areas will need to be monitored for erosion until vegetation can re-establish where prevalent. If affected areas are dry and no vegetation is present, the soil is to be re-instated and sloped.

9.2.4 Increased Run-off, Erosion and Sedimentation Impacts

Vegetation clearing will need to take place for the construction process. Excessive or complete vegetation clearance in the highly sensitive and nearby surrounding areas is likely to result in exposing the soil, leaving the ground susceptible to wind and water erosion particularly during and after rainfall events. Due to the climate of the study area (generally arid with sudden sporadic rainfall) general soil erosion, as a consequence of the proposed development, is a distinct possibility. A further impact due to erosion and storm water run-off impacts is increased sedimentation to surface water resources. Deposited sediments can smother vegetation and change flow paths and dynamics making affected areas susceptible to alien plant invasion leading to further degradation.

Assessment of the above potential negative impacts and mitigation measures thereto are provided in **Table 6** below.

Table 6: Impact Rating for Increased Storm Water Run-off, Erosion and Sedimentation Impacts

IMPACT TABLE		
Environmental Parameter	Surface water resources	
Issue/Impact/Environmental Effect/Nature	Increased storm water run-off, erosion and increased sedimentation impacting on surface water resources	
Extent	*Site*	
Probability	*Definite*	
Reversibility	*Partly reversible*	
Irreplaceable loss of resources	*Marginal loss of resources*	
Duration	*Medium term*	
Cumulative effect	*Medium cumulative impact*	
Intensity/magnitude	*Very High*	
Significance Rating	*Pre-mitigation significance rating is high and negative. With appropriate mitigation measures, the impact can be reduced to a medium level.*	
	Pre-mitigation impact rating	Post mitigation impact rating
Extent	1	1
Probability	4	3
Reversibility	2	2
Irreplaceable loss	2	2
Duration	2	2
Cumulative effect	3	3
Intensity/magnitude	4	3
Significance rating	- 56 (high negative)	- 39 (medium negative)
Mitigation measures	**Preventing Increased Run-off and Sedimentation Impacts** – Vegetation clearing should take place in a phased manner, only clearing areas that will be constructed on immediately. Vegetation clearing must not take place in areas where construction will only take place in the distant future. An appropriate storm water management plan formulated by a suitably qualified professional must accompany the proposed development to deal with increased run-off in the designated construction areas.	

	In general, adequate structures must be put into place (temporary or permanent where necessary in extreme cases) to deal with increased/accelerated run-off and sediment volumes. The use of silt fencing and potentially sandbags or hessian "sausage" nets can be used to prevent erosion in susceptible construction areas. Grass blocks on the perimeter of the wind turbine hard stand areas and building structure footprints can also be used to reduce run-off and onset of erosion. Where required more permanent structures such as attenuation ponds and gabions can be constructed if needs be, however this is unlikely given the study area. All impacted areas are to be adequately sloped to prevent the onset of erosion.

9.3 Operation Phase Potential Impacts

9.3.1 Vehicle Damage to Surface Water Resources

Vehicle access may be required to construction areas for the wind turbines, structures, buildings and infrastructure (such as roads, cables and power lines) in and / or through and / or over (spanning) surface water resources. It is therefore important that access routes and service roads to wind turbines, structures, buildings and infrastructure are not planned and constructed within surface water resources as far as practically possible. However, where this is required and the relevant environmental authorization and water use license is obtained, access routes and service roads for vehicles in or through surface water resources may be susceptible to soil compaction and consequent erosion impacts. Regular vehicle movement in surface water resources can compact the soil affecting the hydrology of the surface water resources. Similarly, regular movement from vehicles can flatten the ground surface making it a preferential flow path for storm water and thereby becoming susceptible to accelerated run-off which may result in progressive erosion. Compaction from vehicles can also create incisions which may induce donga erosion over time.

Assessment of the above potential negative impacts and mitigation measures thereto are provided in **Table 7** below.

Table 7: Impact of Vehicle Damage to Surface Water Resources

IMPACT TABLE		
Environmental Parameter	Depression wetlands and drainage lines	
Issue/Impact/Environmental Effect/Nature	Vehicle compaction damage to surface water resources	
Extent	*Local*	
Probability	*Definite*	
Reversibility	*Partly reversible*	
Irreplaceable loss of resources	*Marginal loss of resources*	
Duration	*Long term*	
Cumulative effect	*Medium cumulative impact*	
Intensity/magnitude	*Very High*	
Significance Rating	*Pre-mitigation significance rating is high and negative. With appropriate mitigation measures, the impact can be reduced to a medium negative impact.*	
	Pre-mitigation impact rating	Post mitigation impact rating
Extent	2	2
Probability	4	3
Reversibility	2	2
Irreplaceable loss	2	2
Duration	3	3
Cumulative effect	3	2
Intensity/magnitude	4	3
Significance rating	- 64 (high negative)	- 42 (medium negative)
Mitigation measures	**Minimising Vehicle Damage to the Surface Water Resources** – Potential impacts can be avoided by planning and routing of access / service roads outside of and away from all surface water resources and the associated buffer zones. Where access through surface water resources are unavoidable and are absolutely required, it is recommended that any road plan and associated structures (such as stormwater flow pipes, culverts, culvert bridges etc.) be submitted to the relevant environmental and water departments for approval prior to construction.	

	Internal access and services roads authorised in sensitive areas will have to be regularly monitored and checked for erosion. Monitoring should be conducted once every month. Moreover, after short or long periods of heavy rainfall or after long periods of sustained rainfall the roads will need to be checked for erosion. Rehabilitation measures will need to be employed should erosion be identified. Where erosion begins to take place, this must be dealt with immediately to prevent significant erosion damage to the surface water resources. Should large scale erosion occur, a rehabilitation plan will be required. Input, reporting and recommendations from a suitably qualified wetland / aquatic specialist must be obtained in this respect should this be required.

9.3.2 Stormwater Run-off Impacts to Surface Water Resources

The impact of stormwater run-off is primarily related to the types of structures and surfaces that will need to be established for the proposed development. Hard impermeable surfaces and foundations are to be laid for wind turbines, buildings and associated infrastructure. Additionally, where regular movement from vehicles flatten the ground surface making it a preferential flow path for storm water, sediment transportation from hardened gravel surfaces via run-off for internal access and service roads can result in increased sedimentation. In general, flat and hard surfaces aid with the acceleration and generation of run-off which can impact on nearby surface water resources through the onset of erosion, as well as by means of increased sedimentation.

Assessment of the above potential negative impacts and mitigation measures thereto are provided in **Table 8** below.

Table 8: Storm-water Run-off Impacts to Surface Water Resources

IMPACT TABLE	
Environmental Parameter	Depression wetlands and drainage lines
Issue/Impact/Environmental Effect/Nature	Impermeable and hardened surfaces creating accelerated and increased run-off, consequent erosion and increased sedimentation
Extent	Local
Probability	Definite

Reversibility	Partly reversible	
Irreplaceable loss of resources	Marginal loss of resource	
Duration	Long term	
Cumulative effect	Medium cumulative impact	
Intensity/magnitude	Very High	
Significance Rating	*Pre-mitigation significance rating is high and negative. With appropriate mitigation measures, the impact can be reduced to a moderate level.*	
	Pre-mitigation impact rating	Post mitigation impact rating
Extent	2	2
Probability	4	3
Reversibility	2	2
Irreplaceable loss	2	2
Duration	3	3
Cumulative effect	3	3
Intensity/magnitude	4	3
Significance rating	-64 (high negative)	-45 (moderate negative)
Mitigation measures	Any hardstand area or building within 50m proximity to a surface water resource must have energy dissipating structures in an appropriate location to prevent increased run-off entering adjacent areas or surface water resources. This can be in the form of hard concrete structures or soft engineering structures (such as grass blocks for example). Alternatively, a suitable operational storm water management plan can be compiled and implemented that accounts for the use of appropriate alternative structures or devices that will prevent increased run-off and sediment entering adjacent areas or surface water resources, thereby also preventing erosion. This must be submitted to the relevant environmental and water authority for approval, if undertaken.	

9.4 Decommissioning Phase Potential Impacts

9.4.1 Decommissioning Impacts

Should the proposed development need to be decommissioned, the same impacts as identified for the construction phase of the proposed development can be anticipated. Similar impacts are therefore expected to occur and the stipulated mitigation measures where relevant and appropriate must be employed as appropriate to minimise impacts.

9.5 Cumulative Impacts

Although it is important to assess the potential surface water impacts of the proposed wind farm, it is equally important to assess the cumulative visual impact that could materialise in the area should other renewable energy developments (both wind and solar facilities) be granted authorisation to proceed. Cumulative impacts are the combined impacts from different developments / facilities which, in combination, result in significant impacts that may be larger than sum of all the impacts. These renewable energy facilities and their potential for large scale visual impacts could significantly alter the sense of place and visual character in the study area, if constructed. It must be noted that for the purpose of this study, renewable energy developments within a 55km radius of the !Xha Boom Wind Farm study site were identified and mapped.

The proposed renewable energy developments identified are identified in **Table 9** and shown in **Figure 9** below.

Table 9: Renewable energy developments proposed within a 55km radius of the !Xha Boom Wind Farm application site

Development	Current status of EIA/development	Proponent	Capacity	Farm details
Khobab Wind Farm	Under Construction	Mainstream Renewable Power	140MW	Pt 2 of Farm Sous 226
Loeriesfontein 2 Wind Farm	Under Construction	Mainstream Renewable Power	140MW	Pt 1 & 2 of Farm Aan de Karree Doorn Pan 213
Wind farm	Environmental Authorisation issued	Mainstream Renewable Power	50MW	Pt 1 of Farm Aan de Karree Doorn Pan 213
PV Solar Energy Facility	Environmental Authorisation issued	Mainstream Renewable Power	100MW	Portion 2 of Farm Aan de Karree Doorn Pan 213

Hantam PV Solar Energy Facility	Environmental Authorisation issued / Approved under RE IPPPP	Solar Capital (Pty) Ltd	Up to 525MW	RE of Farm Narosies 228
PV Solar Power Plant	Environmental Authorisation issued	BioTherm Energy	70MW	Pt 5 of Farm Kleine Rooiberg 227
Dwarsrug Wind Farm	Environmental Authorisation issued	Mainstream Renewable Power	140MW	Remainder of Brak Pan 212 Stinkputs 229
Kokerboom 1 Wind Farm	Environmental Impact Assessment (EIA) underway	Business Venture Investments No. 1788 (Pty) Ltd (BVI)	240MW	• Remainder of the Farm Leeuwbergrivier No. 1163 • Remainder of the Farm Kleine Rooiberg No. 227
Kokerboom 2 Wind Farm	Environmental Impact Assessment (EIA) underway	Business Venture Investments No. 1788 (Pty) Ltd (BVI)	240MW	• Remainder of the Farm Springbok Pan No. 1164 • Remainder of the Farm Springbok Tand No. 215

The main potential cumulative surface water impacts from a catchment perspective in the local area include both potential direct and indirect impacts. Direct impacts include cumulative loss of as well as further degradation of surface water resources due to the footprints of developments encroaching or destroying surface water resources in the greater catchment. The indirect impacts relate mainly to increased run-off, sedimentation and erosion for linear and endorheic hydrological systems. The indirect impacts to hydrological systems (i.e. drainage lines) which are connected across several farm boundaries have a greater risk for potential cumulative impacts from developments upstream.

From a direct cumulative potential impact perspective, where there is no direct impact to surface water resources on the proposed project site, there will be no direct cumulative impact to surface water resources from a project site specific level.

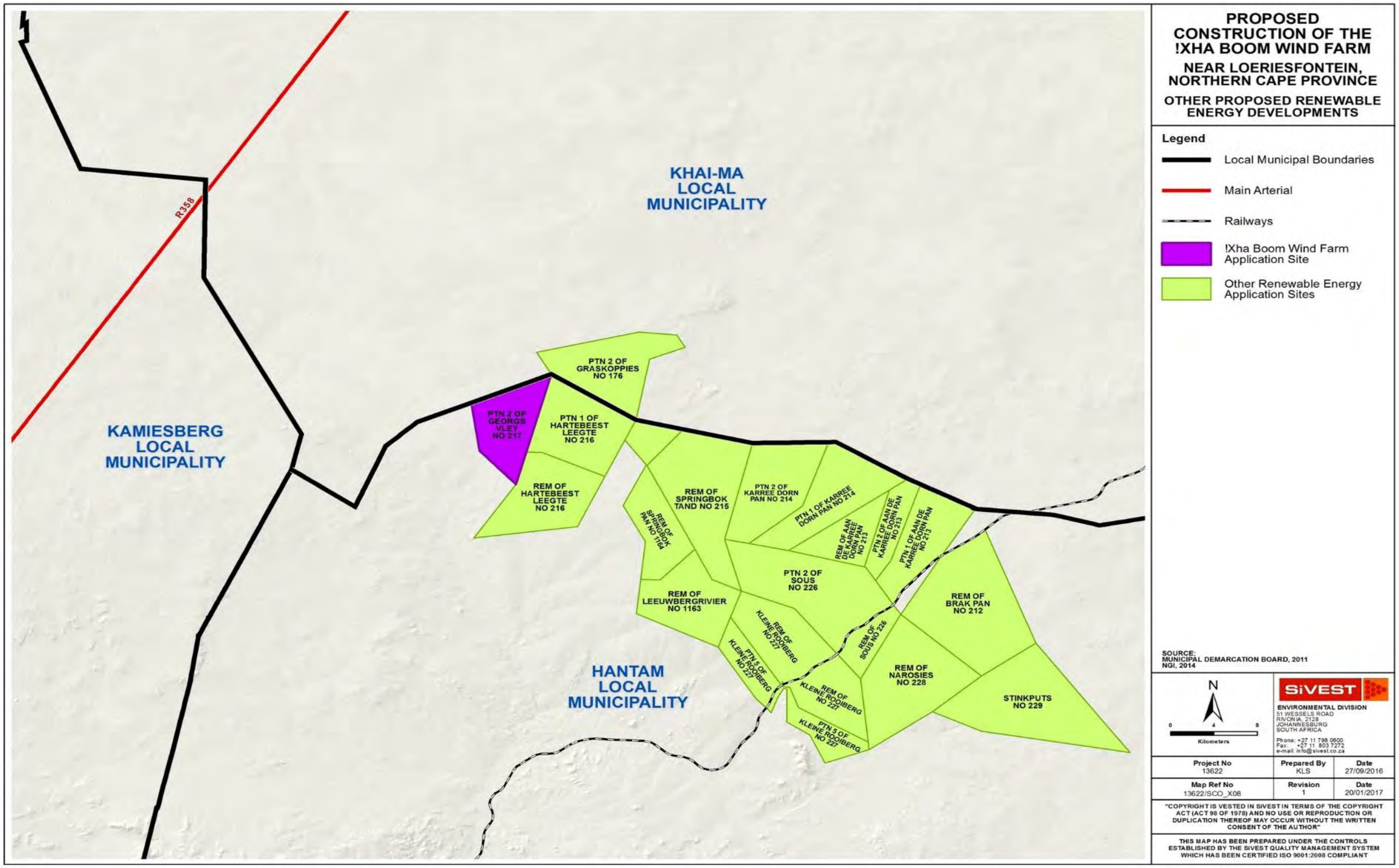

Figure 9: Renewable energy facilities proposed within a 55km radius of the !Xha Boom Wind Farm application site

The nearest surrounding development that could potentially be impacted as a result of the proposed development from an indirect perspective is the Kokerboom 2 Wind Farm. This wind farm is located approximately 9km from the proposed development site. Therefore, there is a considerable distance between the proposed development and the nearest surrounding development. The two sites are also separated by two low ridges that act as watersheds and occupy separate local catchments. Drainage from the proposed development is in a western direction, whilst drainage for the Kokerbook 2 Wind Farm is in a south eastern direction. As a result, it is therefore highly unlikely that the proposed development will affect the Kokerboom 2 Wind Farm should this development proceed to construction. Indirect impacts such as increased run-off, consequent sedimentation and erosion are highly unlikely.

Over and above the negligible potential cumulative impact to Kokerboom 2 Wind Farm, the potential cumulative impact on the remaining surrounding renewable energy developments is negligible for the same reasons, as stated above. The negligible cumulative impact is compounded by the fact that there is an increased distance to the remaining surrounding proposed renewable energy developments.

10 SPECIALIST RECOMMENDATIONS

Specialist recommendations in terms of the proposed development are as follows:

- An impact phase assessment with in-field groundtruthing and verification of surface water resources on the Wind Farm site must be undertaken to inform the layouts proposed in the impact phase;
- All surface water resources and buffer zones must be avoided as far as practically possible in the layouts to be designed in order to minimise and potentially avoid potential impacts as far as possible;
- The following are to be revised (if required) based on in-field findings in the impact phase surface water assessment:
    - Surface water buffer zones;
    - Legislative requirements;
    - Impact assessment (including mitigation measures); and
    - Cumulative Impact Assessment.
- The impact phase surface water assessment must include the following:
    - Surface water environmental baseline findings obtained from the in-field assessment; and
    - Alternatives comparative assessment.

11 CONCLUSION

SiVEST has been appointed by Mainstream to undertake an Environmental Impact Assessment (EIA) and Environmental management Programme (EMPr) for the proposed construction of the !Xha Boom Wind Farm, near Loeriesfontein in the Northern Cape Province. As part of the EIA study, the need to undertake a surface water impact assessment was identified. In this study, a scoping–level surface water assessment is provided to initially identify all potential surface water resources at a database and desktop level.

Findings from the database assessment showed that there is only one (1) natural depression wetland. This wetland is not considered to be a Wetland Freshwater Ecosystem Priority Area (WETFEPA). A WETFEPA is a wetland that is earmarked to stay in good condition in order to conserve freshwater ecosystems and protect water resources for human use. These are classified according to a number of criteria some of which include existing protected areas and focus areas for protected area expansion identified in the National Protected Expansion Strategy. Aside from the wetland, two (2) non-perennial watercourses were identified in the **Northern Cape ENPAT (2000)** database. No other watercourses were identified from the **NFEPA (2011)** database. No other surface water resources were identified from the available databases.

In terms of the desktop delineation exercise, the following surface water resources were identified:

- Two (2) Depression Wetlands;
- Three (3) Major Drainage Line (drainage lines with channel width >5m);
- Two hundred and thirty, six (236) Drainage Lines (drainage lines with a channel width <5m).

Between the database findings and the desktop delineation information, the identified features identified are to be earmarked for groundtruthing in the fieldwork phase. A refinement of the surface water resources will be undertaken in the impact phase pending the fieldwork findings.

A provisional buffer zone of 50m has been implemented at this stage for all surface water resources. Pending the results of the in-field groundtruthing and verification exercise, the buffer zone may be increased or decreased depending on the assessment findings.

A comparative assessment was undertaken to determine the environmentally preferred alternative (from a surface water perspective) for the proposed substation. Based on the comparative assessment, the **preferred alternative site for the proposed substation was Substation Option 1**.

In terms of potential applicable legislation from a surface water perspective, potentially triggered environmental activities and water uses were evaluated. As such, in terms of NEMA (1998) and the EIA Regulations (2014), as no specific layout is available at this time, it is provisionally identified that Activities 12 and 19 of Government Notice 983 Listing Notice 1 are identified that may be triggered thereby requiring Environmental Authorization. In terms of the NWA (1998), it has been identified that there are a number of surface water resources which may be affected and it is therefore possible that water uses (c) and (i) may be applicable, thereby requiring a water use license. The applicability of these environmental activities and water uses can ultimately only be confirmed once a more detailed layout is available.

It was identified that several potential impacts may affect the surface water resources within the proposed development area during the pre-construction, construction, operation and decommissioning phases. The impacts for each phase of the proposed development are summarised as follows:

PRE-CONSTRUCTION PHASE		
	Pre-mitigation Rating	**Post-mitigation Rating**
Construction Lay-down Area	-36 (medium negative)	-6 (low negative)
CONSTRUCTION PHASE		
	Pre-mitigation Rating	**Post-mitigation Rating**
Vehicle and Machinery Degradation Impacts	-39 (medium negative)	-36 (medium negative)
Human Degradation of Flora and Fauna associated with Surface Water Resources	-30 (medium negative)	-14 (low negative)
Degradation and Removal of Soils and Vegetation in Surface Water Resources	-60 (high negative)	-42 (medium negative)
Increased Run-off, Erosion and Sedimentation Impacts	-56 (high negative)	-39 (medium negative)
OPERATION PHASE		
	Pre-mitigation Rating	**Post-mitigation Rating**
Vehicle Damage to Surface Water Resources	-64 (high negative)	-42 (medium negative)
Stormwater Run-off Impacts to Surface Water Resources	-64 (high negative)	-45 (medium negative)

It is not anticipated that the proposed development will need to be decommissioned. Should this need to take place, the same impacts as identified for the construction phase of the proposed development can be anticipated. Hence, the same impacts are expected to occur and the stipulated mitigation measures where relevant must be employed to minimise impacts.

Potential cumulative impacts were assessed given that numerous proposed and currently constructed renewable energy developments can be found in the surrounding area. As such, it was found that from a direct cumulative potential impact perspective, where there is no direct impact to surface water resources on the proposed project site, there will be no direct cumulative impact to surface water resources from a project site specific level. The nearest surrounding development that could potentially be impacted as a result of the proposed development from an indirect perspective is the Kokerboom 2 Wind Farm. The considerable distance (9km) and separation by two watersheds between the proposed development and the Kokerboom 2 Wind Farm mean that it is therefore highly unlikely that the proposed development will affect the Kokerboom 2 Wind Farm. Over and above the negligible potential cumulative impact to Kokerboom 2 Wind Farm, the potential cumulative impact on the remaining surrounding renewable energy developments is negligible for the same reasons as stated above. The negligible cumulative impact is compounded by the fact that there is an increased distance to the remaining surrounding proposed renewable energy developments.

Finally, specialist recommendations include the following:

- An impact phase assessment with in-field groundtruthing and verification of surface water resources on the Wind Farm site must be undertaken to inform the layouts proposed in the impact phase;
- All surface water resources and buffer zones must be avoided as far as practically possible in the layouts to be designed in order to minimise and potentially avoid potential impacts as far as possible;
- The following are to be revised (if required) based on in-field findings in the impact phase surface water assessment:
  - Surface water buffer zones;
  - Legislative requirements;
  - Impact assessment (including mitigation measures); and
  - Cumulative Impact Assessment.
- The impact phase surface water assessment must include the following:
  - Surface water environmental baseline findings obtained from the in-field assessment; and
  - Alternatives comparative assessment.

12 REFERENCES

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Appendix A:

Impact Rating Methodology

The determination of the effect of an environmental impact on an environmental parameter (in this instance, wetlands) is determined through a systematic analysis of the various components of the impact. This is undertaken using information that is available to the environmental practitioner through the process of the environmental impact assessment. The impact evaluation of predicted impacts was undertaken through an assessment of the significance of the impacts.

Determination of Significance of Impacts

Significance is determined through a synthesis of impact characteristics which include context and intensity of an impact. Context refers to the geographical scale (i.e. site, local, national or global) whereas intensity is defined by the severity of the impact (e.g. the magnitude of deviation from background conditions, the size of the area affected, the duration of the impact and the overall probability of occurrence). Significance is calculated as per the example shown in **Table 10**.

Significance is an indication of the importance of the impact in terms of both physical extent and time scale, and therefore indicates the level of mitigation required. The total number of points scored for each impact indicates the level of significance of the impact.

Impact Rating System Methodology

Impact assessments must take account of the nature, scale and duration of effects on the environment whether such effects are positive (beneficial) or negative (detrimental). Each issue / impact is usually assessed according to the project stages:

- planning
- construction
- operation
- decommissioning

In this case, a unique situation is present whereby various scenarios have been posed and evaluated accordingly. A brief discussion of the impact and the rationale behind the assessment of its significance has also been included.

Rating System Used To Classify Impacts

The rating system is applied to the potential impact on the receiving environment and includes an objective evaluation of the mitigation of the impact. Impacts have been consolidated into one rating. In assessing the significance of each issue, the following criteria (including an allocated point system) is used:

Table 10. Example of the significance impact rating table

NATURE		
Includes a brief description of the impact of environmental parameter being assessed in the context of the project. This criterion includes a brief written statement of the environmental aspect being impacted upon by a particular action or activity.		
GEOGRAPHICAL EXTENT		
This is defined as the area over which the impact will be expressed. Typically, the severity and significance of an impact have different scales and as such bracketing ranges are often required. This is often useful during the detailed assessment of a project in terms of further defining the determined.		
1	Site	The impact will only affect the site
2	Local/district	Will affect the local area or district
3	Province/region	Will affect the entire province or region
4	International and National	Will affect the entire country
PROBABILITY		
This describes the chance of occurrence of an impact		
1	Unlikely	The chance of the impact occurring is extremely low (Less than a 25% chance of occurrence).
2	Possible	The impact may occur (Between a 25% to 50% chance of occurrence).
3	Probable	The impact will likely occur (Between a 50% to 75% chance of occurrence).
4	Definite	Impact will certainly occur (Greater than a 75% chance of occurrence).
REVERSIBILITY		

This describes the degree to which an impact on an environmental parameter can be successfully reversed upon completion of the proposed activity.		
1	Completely reversible	The impact is reversible with implementation of minor mitigation measures
2	Partly reversible	The impact is partly reversible but more intense mitigation measures are required.
3	Barely reversible	The impact is unlikely to be reversed even with intense mitigation measures.
4	Irreversible	The impact is irreversible and no mitigation measures exist.
IRREPLACEABLE LOSS OF RESOURCES		
This describes the degree to which resources will be irreplaceably lost as a result of a proposed activity.		
1	No loss of resource.	The impact will not result in the loss of any resources.
2	Marginal loss of resource	The impact will result in marginal loss of resources.
3	Significant loss of resources	The impact will result in significant loss of resources.
4	Complete loss of resources	The impact is result in a complete loss of all resources.
DURATION		
This describes the duration of the impacts on the environmental parameter. Duration indicates the lifetime of the impact as a result of the proposed activity		
1	Short term	The impact and its effects will either disappear with mitigation or will be mitigated through natural process in a span shorter than the construction phase (0 – 1 years), or the impact and its effects will last for the period of a relatively short construction period and a limited recovery time after construction, thereafter it will be entirely negated (0 – 2 years).
2	Medium term	The impact and its effects will continue or last for some time after the construction phase but will be mitigated by direct human action or by natural processes thereafter (2 – 10 years).
3	Long term	The impact and its effects will continue or last for the entire operational life of the development, but will be mitigated by direct human action or by natural processes thereafter (10 – 50 years).
4	Permanent	The only class of impact that will be non-transitory. Mitigation either by man or natural process will not occur in such a way or such a time span that the impact can be considered transient (Indefinite).

CUMULATIVE EFFECT		
This describes the cumulative effect of the impacts on the environmental parameter. A cumulative effect/impact is an effect which in itself may not be significant but may become significant if added to other existing or potential impacts emanating from other similar or diverse activities as a result of the project activity in question.		
1	Negligible Cumulative Impact	The impact would result in negligible to no cumulative effects
2	Low Cumulative Impact	The impact would result in insignificant cumulative effects
3	Medium Cumulative impact	The impact would result in minor cumulative effects
4	High Cumulative Impact	The impact would result in significant cumulative effects
INTENSITY / MAGNITUDE		
Describes the severity of an impact		
1	Low	Impact affects the quality, use and integrity of the system/component in a way that is barely perceptible.
2	Medium	Impact alters the quality, use and integrity of the system/component but system/ component still continues to function in a moderately modified way and maintains general integrity (some impact on integrity).
3	High	Impact affects the continued viability of the system/component and the quality, use, integrity and functionality of the system or component is severely impaired and may temporarily cease. High costs of rehabilitation and remediation.
4	Very high	Impact affects the continued viability of the system/component and the quality, use, integrity and functionality of the system or component permanently ceases and is irreversibly impaired (system collapse). Rehabilitation and remediation often impossible. If possible rehabilitation and remediation often unfeasible due to extremely high costs of rehabilitation and remediation.
SIGNIFICANCE		
Significance is determined through a synthesis of impact characteristics. Significance is an indication of the importance of the impact in terms of both physical extent and time scale, and therefore indicates the level of mitigation required. This describes the significance of the impact on		

the environmental parameter. The calculation of the significance of an impact uses the following formula:

(Extent + probability + reversibility + irreplaceability + duration + cumulative effect) x magnitude/intensity.

The summation of the different criteria will produce a non weighted value. By multiplying this value with the magnitude/intensity, the resultant value acquires a weighted characteristic which can be measured and assigned a significance rating.

Points	Impact Significance Rating	Description
6 to 28	Negative Low impact	The anticipated impact will have negligible negative effects and will require little to no mitigation.
6 to 28	Positive Low impact	The anticipated impact will have minor positive effects.
29 to 50	Negative Medium impact	The anticipated impact will have moderate negative effects and will require moderate mitigation measures.
29 to 50	Positive Medium impact	The anticipated impact will have moderate positive effects.
51 to 73	Negative High impact	The anticipated impact will have significant effects and will require significant mitigation measures to achieve an acceptable level of impact.
51 to 73	Positive High impact	The anticipated impact will have significant positive effects.
74 to 96	Negative Very high impact	The anticipated impact will have highly significant effects and are unlikely to be able to be mitigated adequately. These impacts could be considered "fatal flaws".
74 to 96	Positive Very high impact	The anticipated impact will have highly significant positive effects.

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