WETLAND DELINEATION:

FOR THE PROJECT:

Tshepo Solar Power Plant (Pty.) Ltd. near Hotazel

ON:

THE REMAINING EXTENT OF THE FARM LONDON NO. 275, REGISTRATION DIVISION KURUMAN, NORTHERN CAPE PROVINCE.

March 2016

Report prepared by:

ENVIRONMENT RESEARCH CONSULTING

ERC forms part of **Benah Con cc**

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TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

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Background & expertise:

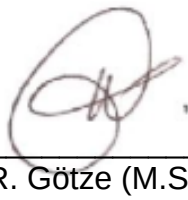
I have been consulting as a professional ecologist, botanist and soil scientist since 2002. I gained valuable experience in the fields of vegetation classification, various restoration disciplines, faunal trapping, soil surveying and wetland surveying during my post graduate studies and later as fieldwork mentor for post graduate ecology students of the Northwest University, Potchefstroom Campus (2008 - 2014), on occasion for game ranch management students of the Tshwane University of Technology. As independent ecological consultant I have experience in various types of scientific floral and faunal studies in the grassland and savannah in Gauteng, North West, Limpopo, Mpumalanga, Free State, Eastern and Northern Cape. I have also on occasion performed vegetation studies in the KwaZulu-Natal savannah and Indian Ocean Coastal Belt, the Eastern Cape thicket, the Western Cape fynbos, Namaqualand, the Karoo and Swaziland. I have 13 years' experience in specialist biodiversity, soil and wetland studies and have performed numerous (at least 95) such studies since 2002. I have authored two and co-authored four scientific papers for various local scientific publications since 2004.

2 PROFESSIONAL DECLARATION

The specialist investigator(s) responsible for conducting this particular specialist assessment declare that:

- We consider ourselves bound to the rules and ethics of the South African Council for Natural Scientific Professions (SACNASP).
- At the time of conducting the study and compiling this report we did not have any interest, hidden or otherwise, in the proposed development that this study has reference to, except for financial compensation for work done in our professional capacity.
- Work performed for this study was done in an objective manner. Even if this study results in views and findings that are not favorable to the client/applicant, we will not be affected in any manner by the outcome of any environmental process of which this report may form a part, other than being members of the general public.

- We declare that there are no circumstances that may compromise our objectivity in performing this specialist investigation. We do not necessarily object to or endorse the proposed development, but aim to present facts, findings and recommendations based on relevant professional experience and scientific data.
- We do not have any influence over decisions made by the governing authorities.
- Should we, at any point, consider ourselves to be in conflict with any of the above declarations, we shall formally submit a Notice of Withdrawal to all relevant parties and formally register as an Interested and Affected Party.
- We undertake to disclose all material information in our possession that reasonably has or may have the potential of influencing any decision to be taken with respect to the application by a competent authority to such a relevant authority and the applicant.
- We have expertise and experience in conducting specialist reports relevant to this application, including knowledge of the Act, regulations and any guidelines that have relevance to the proposed activity.
- This document and all information contained herein are and will remain the intellectual property Benah Con cc (Environment Research Consulting) and the specialist investigator(s) responsible for conducting the study. This document, in its entirety or any portion thereof, may not be altered in any manner or form, for any purpose without the specific and written consent of the specialist investigator(s).
- We will comply with the Act, regulations and all other applicable legislation.
- All the particulars furnished in this document are true and correct.
- We realize that a false declaration is an offence in terms of Regulation 71 of NEMA and is punishable in terms of section 24F of the Act.



A.R. Götze (M.Sc.; *Pr.Sci.Nat.*)

3 EXECUTIVE SUMMARY

Based on the findings of this study it is the opinion of the specialist investigators that from a wetland point of view, the proposed development on the preferred area is considered favourably, provided that due care is taken to minimise and properly mitigate all identified impacts.

Introduction & Site Description

This study aims to assess the impact that the development of a Photovoltaic Solar Power Plant, on farmland about 45 km northwest of the Northern Cape town of Kuruman and about 10 km southeast of Hotazel, will have on the wetlands/pans within and adjacent to the site concerned (development footprint of approximately 250ha - with one preferred- and one alternative site). *Environment Research Consulting* (*ERC*) was contracted to conduct a wetland delineation of a portion of the remaining portion the farm London 275 near Hotazel in the Northern Cape Province. This report presents the findings of the delineation that was conducted between 06 and 08 March 2016.

The site falls within the Eastern Kalahari Bushveld Bioregion of the Savanna Biome (Rutherford et al. 2006). Livestock ranching dominates the immediate surrounds and mining activities are a prominent feature in the region (pers. obs.). Topography is more or less homogeneous throughout the study sites, with a slight increase in slope towards the north-western corner of the preferred site, accompanied by an increase in rockiness. There are a number of non-perennial natura pans located on the farm.

Delineation of wetlands/pans

According to Kotze *et al*. (2009) and DWAF (2005) a pan can be one of the hydro-geomorphic forms of a wetland. As a result, it was decided to study and delineate the three pans recoded in the vicinity of the preferred area of the study area. The general method described by (DWAF, 2005) for the delineation of wetlands was considered.

From a hydrological point of view none of the pans were inundated during the time of the study and only two of the three investigated pans had visibly moist soil surfaces in small patches. The current dryness of the pans is ascribed to the fact that drought conditions were experienced by the region during the time of the study. The pans were delineated on a visual level in the field, mostly focusing on the hydrology, terrain unit and the presence of water loving plants indicators. A buffer zone of 32 m from the edge of all pans, as prescribed for wetlands in Government Notice R.544 in Government Gazette 33306 of 18 June 2010, was delineated and mapped for all pan areas.

Impact Assessment

Based on the above assessment it is evident that there is an expected impact on the wetland/pan ecology in the study area. Table A summarises the findings indicating the significance of the impact before management takes place and the likely impact if management and mitigation takes place. From Table A it is evident that prior to management measures being put in place, the impact is a negative-medium level impact. If effective management takes place, the impact will be reduced to a low level impact.

Table A: A summary of the results from the impact assessment

Impact	Not mitigated / managed	Mitigated / managed
Degradation and/or destruction of natural pans.	negative medium impact	negative low impact

Due the destructive nature of the proposed development to the bio-diversity and natural habitats in the directly affected area, the no-go alternative will see the area stay in the current condition. The current impacts exerted on the area from an agricultural point of view (not assessed in this study) will remain and, depending on the management strategies employed by the land owner and natural climatic conditions, the current natural condition may improve or deteriorate in future.

A number of monitoring requirements are also listed.

4 INTRODUCTION

4.1 Background

Under the National Environmental Management Act (107 of 1998) any development that may cause significant damage to the natural environment is by law required to undergo stringent evaluation with the aim of reducing and mitigating the potential environmental impact (www.eia.org.za). This study aims to assess the impact that the development of a Photovoltaic Solar Power Plant, on farmland about 45 km northwest of the Northern Cape town of Kuruman and about 10 km southeast of Hotazel (Figure 1), will have on the wetlands/pans within and adjacent to the site concerned (development footprint of approximately 250ha (Figure 2).

Environment Research Consulting (*ERC*) was contracted to conduct a wetland delineation on a portion of the remaining portion the farm London 275 near Hotazel in the Northern Cape Province. This report presents the findings of the delineation that was conducted over a three-day period from 06 to 08 March 2016.

Figure 1: Google earth image indicating the regional setting of the study area

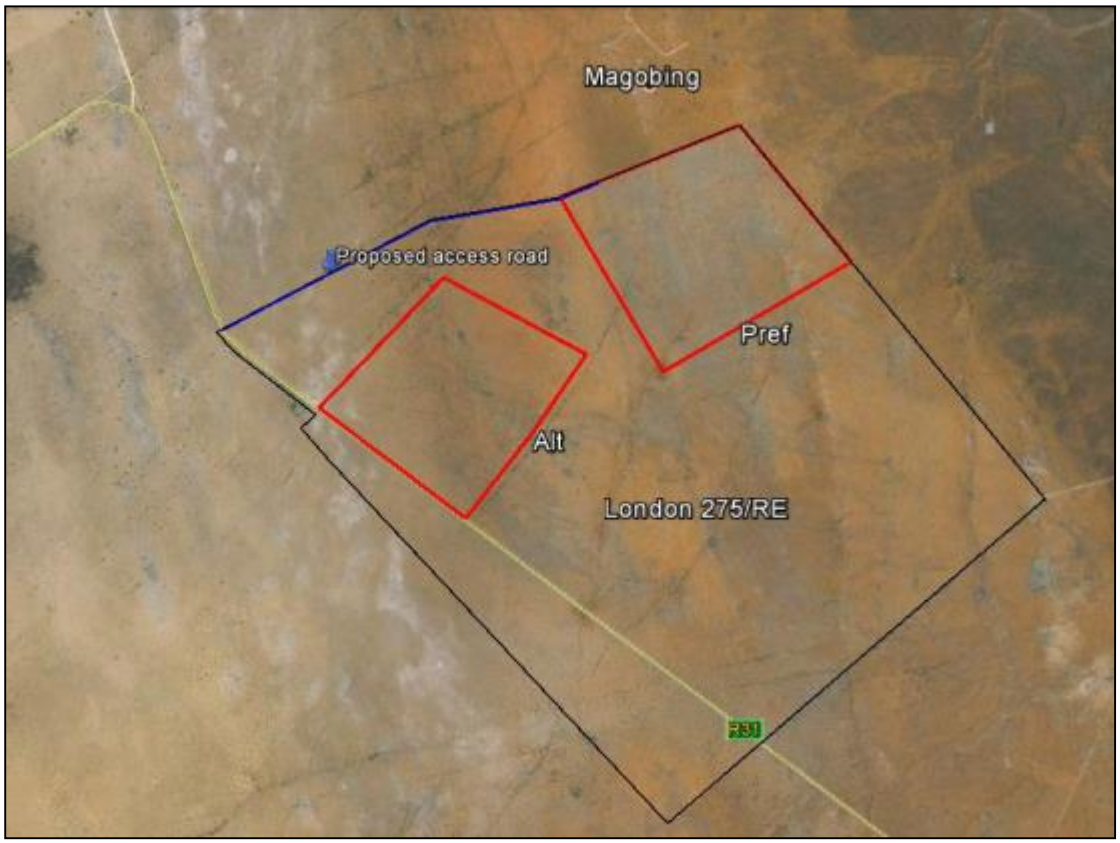


Figure 2: Image indicating the preferred and alternative development sites

4.2 Terms of Reference & General Requirements

The scope of the assessment included the PV Solar Energy Facility and its associated structures and infrastructure (such as the power line and access route). The impacts associated with the power line and access route that run beyond the site are considered to be negligible since the actual footprints of disturbance of the power lines is confined to the pylon bases. Furthermore, the power line and access route are aligned with existing roads as far as possible to avoid any negative environmental impacts.

The following ToR and general requirements were supplied by the client:

Specialists in their field of expertise will consider baseline data and identify and assess impacts according to predefined rating scales – refer to attached method of assessment. Specialists will also suggest optional or essential ways in which to mitigate negative impacts and enhance positive impacts. Further, specialists will, where possible, take into consideration the cumulative effects associated with this and other projects which are either developed or in the process of being developed in the local area.

Specialists' reports must comply with Appendix 6 of GNR982 published under sections 24(5), and 44 of the National Environmental Management Act, 1998 (Act No. 107 of 1998), as amended and whereby the following are to be included:

- The details of:
    - the specialist who prepared the report; and
    - the expertise of that specialist to compile a specialist report including a curriculum vita;
- A declaration that the specialist is independent in a form as may be specified by the competent authority;
- An indication of the scope of, and the purpose for which, the report was prepared;
- The date and season of the site investigation and the relevance of the season to the outcome of the assessment;
- A description of the methodology adopted in preparing the report or carrying out the specialised process; the specific identified sensitivity of the site related to the activity and its associated structures and infrastructure;
- An identification of any areas to be avoided, including buffers;
- A map superimposing the activity including the associated structures and infrastructure on the environmental sensitivities of the site including areas to be avoided, including buffers;
- A description of any assumptions made and any uncertainties or gaps in knowledge;
- A description of the findings and potential implications of such findings on the impact of the proposed activity, including identified alternatives on the environment;
- Any mitigation measures for inclusion in the EMP;
- Any conditions for inclusion in the environmental authorisation;
- Any monitoring requirements for inclusion in the EMP or environmental authorisation;
- A reasoned opinion-
    - as to whether the proposed activity or portions thereof should be authorised; and
    - if the opinion is that the proposed activity or portions thereof should be authorised, any avoidance, management and mitigation measures that should be included in the EMP, and where applicable, the closure plan;
- A description of any consultation process that was undertaken during the course of preparing the specialist report;
- A summary and copies of any comments received during any consultation process and where applicable all responses thereto; and
- Any other information requested by the competent authority.

In addition to the above, specialists were expected to:

- Review Scoping Reports, with specific reference to the Comments and Response Report to familiarize with all relevant issues or concerns relevant to their field of expertise;
- In addition to the impacts listed in the Scoping Report, identify any issue or aspect that needs to be assessed and provide expert opinion on any issue in their field of expertise that they deem necessary in order to avoid potential detrimental impacts;
- Assess the degree and extent of all identified impacts (including cumulative impacts) that the preferred project activity and its proposed alternatives, including that of the no-go alternative, may have;
- Identify and list all legislation and permit requirements that are relevant to the development proposal in context of the study;
- Reference all sources of information and literature consulted; and
- Include an executive summary to the report.

4.3 Aims of the study

- Conduct a literature investigation of wetlands occurring on site.
- Conduct a wetland delineation of all wetlands on and in close proximity to the study area.
- Identify potential impacts on wetlands/pans that could occur as a result of the development.
- An assessment of the potential direct and indirect impacts resulting from the proposed development during the construction, operation and decommission phases.
- Make recommendations to reduce or minimize impacts, should the development be approved.

4.4 Assumptions and Limitations

- It is assumed that wetland plant species flowering only during specific times of the year could be confused with a very similar species of the same genus.
- Some wetland plant species that emerge and bloom during another time of the year or under very specific circumstances may have been missed entirely.
- *ERC* reserves the right to amend this report, recommendations and/or conclusions at any stage should any additional or otherwise significant information come to light.

4.5 General Site Description

The study sites (S27° 14' 02.86" E23° 02' 51.11", alt. 1100 m) are about 45 km northwest of the Northern Cape town of Kuruman and about 10 km southeast of Hotazel and located next to the R31 between Kuruman and Hotazel. The site falls within the Eastern Kalahari Bushveld Bioregion of the Savanna Biome, with annual precipitation and temperature averaging 362 mm and 17.8 °C, respectively. The bioregion naturally includes xeric shrubland habitat (Rutherford et al. 2006). Livestock ranching dominates the immediate surrounds and mining activities are a prominent feature in the region (pers. obs.). Topography remains homogeneous throughout the sites, with a slight increase in slope towards the north-western corner of the preferred site, accompanied by an increase in rockiness. There are a number of non-perennial pans located around the preferred site (note the indents in the white border, Figure 3).

5 VEGETATION

Because a wetland is also strongly defined by the vegetation that occurs in it, a general review of the vegetation of the general study area is given.

According to Mucina & Rutherford (2006) the studied area is situated in the Kuruman Thornveld vegetation type (SVk9). The following description of SVk9 has been summarized from Mucina & Rutherford (2006):

Kuruman Thornveld

The Kuruman Thornveld vegetation type (SVk9) occurs in the North-West and Northern Cape Provinces on flats from the Postmasburg and Danielskuil area in the south extending via Kuruman to Tsineng and Dewar in the north. The area receives summer and autumn rainfall (MAP: 300 – 450 mm) and winters are very dry. Summer temperatures reach an average of 35.9 degrees Celsius on average in January and winter nights average –3.3 degrees Celsius in June.

Geologically some Campbell Group dolomite and chert and mostly younger, superficial Kalahari Group sediments occurs. Locally, rocky pavements are also formed in places. Soils in the area are mostly of the Hutton form and consist of windblown red sand, which vary in depth from shallow to deep. Important land types are Ae, Ai, Ag and Ah.

The landscape and vegetation features of SVk9 consists of flat rocky plains and some sloping hills which support a well developed, closed shrub layer dominated by *Acacia mellifera* subsp. *detinens* and *Tarchonanthus camphoratus* and sometimes a well developed open tree layer dominated by *Acacia erioloba*. Important trees and tall shrubs are *Acacia erioloba, A. mellifera* subsp. *detinens, A. haematoxylon, A. hebeclada* subsp*. hebeclada, Boscia albitrunca, Grewia flava, Gymnosporia buxifolia, Lycium hirsutum* and *Tarchonanthus camphoratus.* Low shrubs and herbs that generally occur are *Elephantorrhiza elephantina, Dicoma schinzii, Monechma divaricatum, Gisekia africana, Gnidia polycephala, Harpagophytum procumbens* subsp*. procumbens, Helichrysum zeyheri, Hermannia comosa, Indigofera daleoides, Limeum fenestratum, Nolletia ciliaris, Pentzia calcarea, Plinthus sericeus, Seddera capensis, Tripteris aghillana* and *Vahlia capensis* subsp*. vulgaris.* Grasses of importance are *Aristida meridionalis, A. stipitata* subsp*. stipitata, Eragrostis lehmanniana, E. echinochloidea* and *Melinis repens.* Biogeographically important species include the small trees and tall shrubs *Acacia haematoxylon, A. luederitzii* var. *luederitzii* (Kalahari endemics) and *Terminalia sericea* (southernmost distribution in SA interior), the low shrub *Blepharis marginata*, the herb *Corchorus pinnatipartitus* and grass *Digitaria polyphylla* (all three Griqualand West endemics). One species endemic to SVk9, *Gnaphalium englerianum* also occurs.

The conservation status of SVk9 is Least Threatened. A conservation target of 16% is envisioned by conservation authorities, but to date no portion of SVk9 is statutorily conserved. Only 2% is totally transformed by mainly mining activities and settlements. This vegetation type resembles the description of Acocks' (1953) *Kalahari Thornveld and Shrub Bushveld* (VT 16) and also the description in Low and Rebelo (1996) of *Kalahari Plains Thorn Bushveld* (LR 30).

The habitat characteristics of the study area largely resemble the description given for SVk9 above. The areas studied (i.e. the preferred and alternative sites – see Figure 2) differ slightly in terms of landscape features and habitat characteristics. The preferred site is mostly a flat sandy plain with shrubs and tall *Acacia erioloba* trees and is closest in its habitat description to SVk9. In its eastern and western corners, the preferred site rises slightly in its topographical character with rocky soils. Some linear tree lines are present and are presumably associated with geological features rather than being drainage lines – although on a satellite image they resemble drainage lines. The alternative site is situated on slightly undulating terrain with rocky soils on the eastern side, becoming sandy westwards. Three non-perennial pans were observed on the preferred site, but no clearly defined drainage lines were recorded on either the preferred or alternative sites.

The following is a description of the vegetation and some ecological/habitat aspects of the pans as taken from the faunal and floral assessment for the same project:

This non-perennial pan Vegetation Unit (VU), consisting of three non-perennial pans (Figures 3 – 5), occur imbedded in the general landscape in low lying depressions where rainwater accumulates during wet seasons. These areas are not necessarily associated with clearly defined drainage lines. Soils are shallow sandy clays to sandy loam with some rocks on the soil surface. Structurally the vegetation is mostly dominated by grasses and forbs with a cover of trees and tall shrubs surrounding the pans. From an ecological point of view this VU varies from a moderate to poor condition. The grass cover is fairly good in the pans, but poor in the directly surrounding areas.

The dominant tree species are *Searsia lancea, Grewia flava, Ziziphus mucronata, Tarchonanthus camphoratus* and *Acacia mellifera*. The most significant graminoids are *Panicum impeditum, P. lanipes, P. maximum, Eragrostis rotifer, Setaria verticillata, Leptochloa fusca, Cenchrus ciliaris and Chloris virgata*. The herbaceous shrubs and forbs that mostly occur are the indigenous *Vahlia capensis, Lotononis* species*, Euphorbia inaequilatera,* and the exotic *Gomphrena celosioides, Alternanthera sessilis* and *Schkuhria pinnata*.

42 plant species (37 indigenous, 5 exotic) were recorded in this VU. Eight are woody trees/shrubs (1 exotic), 15 are graminoids (none exotic) and 18 are dwarf and herbaceous shrubs and other forbs (5 exotic).

Figure 3: Pan 1.

Figure 4: Pan 2.

Figure 5: Pan 3.

6 DELINEATION OF PANS

According to Kotze *et al*. (2009) and DWAF (2005) a pan can be one of the hydro-geomorphic forms of a wetland. As a result, it was decided to study and delineate the three pans recoded in the vicinity of the preferred development site of the study area (Figure 6) because of their potential ecological importance in the larger ecological system within which the study area falls.

From a hydrological point of view none of the pans were inundated during the time of the study and only two of the three investigated pans had visibly moist soil surfaces in small patches. The current dryness of the pans is ascribed to the fact that drought conditions were experienced by the region during the time of the study.

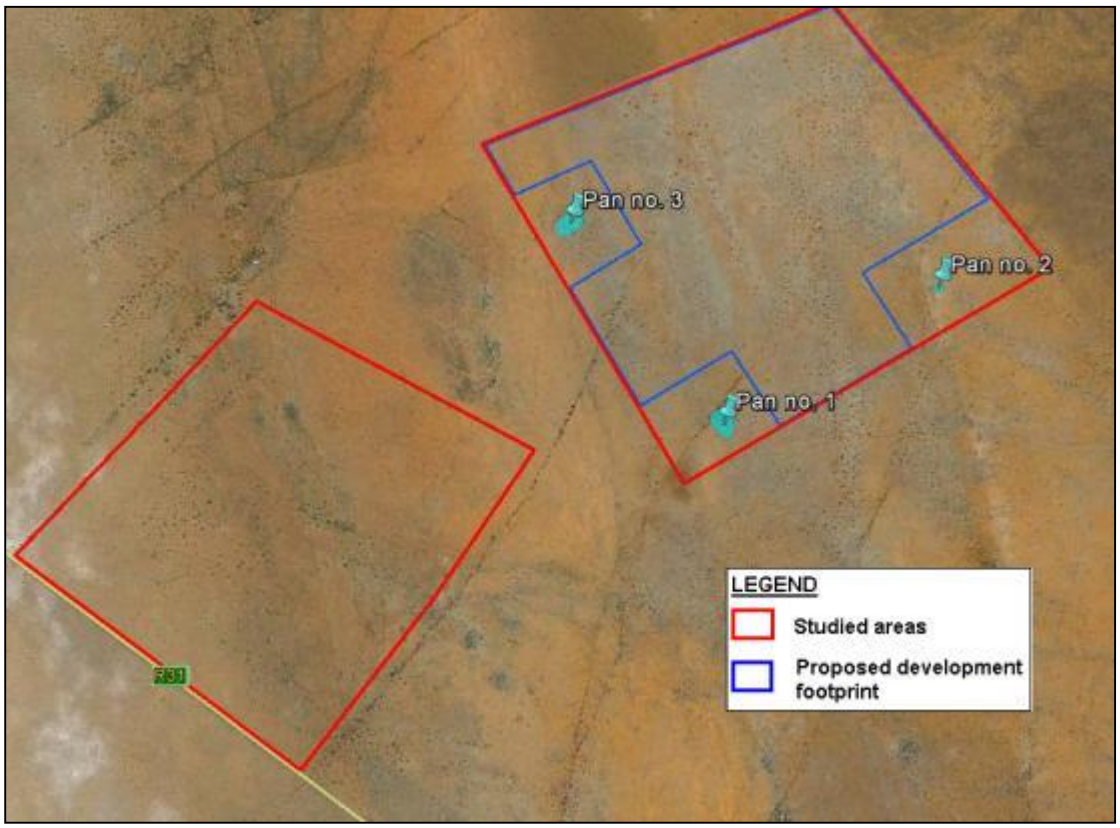


Figure 6: Positions of three pans recorded in the study area

6.1 Legislation, definitions and terminology relevant to the description surface water resources

The National Water Act (Act No. 36 of 1998) (NWA, 1998) was drafted in order to ensure the protection and sustainable use of water resources (including wetlands) in South Africa. According to NWA (1998) a water resource is defined as one of, or a combination of, the following

- A watercourse.
- Surface water.
- An estuary.
- An aquifer.

The NWA (1998) 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”. From this definition is may be argued that a pan, such as those recorded in the study area, fits the description of a wetland and therefore warrants further investigation.

Moreover, wetlands are regarded as an area of land on which the period of saturation of water is sufficient to allow for the development of hydric/hydromorphic soils, which in normal circumstances would support

hydrophilic vegetation (i.e. vegetation adapted to grow in differing levels of saturated and anaerobic soil conditions).

According to the Department Water Affairs and Forestry – DWAF (2005), the four main indicators of the presence of a wetland are:

- The presence of water (hydrology).
- The presence of wetland (hydromorphic) soils.
- The presence of water loving plants (hydrophytes).
- The terrain unit, which indicates the position in the landscape where wetlands are most likely to occur.

Although all four indicators are important in the identification and delineation of a wetland the soil form indicator is the most important and the most accurate due to the fact that the morphological indicators in the soil are far more permanent and will hold signs of frequent saturation long after a wetland has been drained or otherwise transformed. The other three indicators are used more in a confirmatory role (DWAF, 2005). Because of this and because it is difficult to define the minimum frequency and duration of saturation that creates a wetland, the finding of the outer edge of the wetland is dependent on four, more specific indicators:

- The Terrain Unit Indicator (as mentioned above).
- The Soil Form Indicator, which identifies soil forms, as defined by the Soil Classification Working Group (1991), which are associated with prolonged and frequent saturation.
- The Soil Wetness Indicator, which identifies the morphological signatures that develop in the soil profile as a result of prolonged and frequent saturation.
- The Vegetation Indicator, which identifies hydrophilic vegetation that is associated with permanent or frequently saturated soils.

Three zones are distinguished within a wetland i.e. the permanent zone (all year round wetness), the seasonal zone (wet for at least three months of a year), and the temporary zone (wet for less than three months of a year). The object of a wetland delineation procedure, therefore, is to identify the outer edge of the temporary zone. This outer edge marks the boundary between the wetland and the adjacent terrestrial areas (DWAF, 2005).

Wetlands may either be palustrine (marsh-like) or lacustrine (lake-like) in nature. Palustrine and lacustrine wetlands can be divided up into different hydro-geomorphic forms, based on their position within the landscape, hydrological connectivity and water input. Kotze *et al*. (2009) have described a number of different wetland hydro-geomorphic forms:

- Hillslope Seepage feeding a stream.
- Hillslope Seepage not feeding a stream.
- Channelled Valley Bottom.
- Un-channelled Valley Bottom.

- **Pan / Depression.**
- Floodplain.

6.2 General Methodology

The general method described by (DWAF, 2005) for the delineation of wetlands is as follows:

- First the position of the wetland is visually determined (Terrain Unit Indicator).
- Starting at the wettest parts, a transect is then followed width ways across the wetland and using a soil auger the soil profile is examined up to a depth of 50cm for the presence of soil form indicators and / or soil wetness indicators. Vegetation indicators are also recorded.
- Proceeding outwards towards the estimated edge of the wetland, sampling continues at regular intervals to check for wetness and vegetation indicators.
- The outer edge of the wetland is subsequently defined as the point where soil wetness indicators are no longer visible within the top 50cm of the soil profile.
- The outer edge is recorded with a handheld GPS and eventually the GPS waypoints are plotted and joined on a map to visually indicate the extent of the outer edge (temporary zone) of the wetland.
- Several further transects are then also followed at regular intervals and at other strategic points in the wetland paying particular attention to features that may disrupt the wetland boundary, such as seeps entering the wetland, large floodplains, etc.
- Where access to a wetland or section(s) of a large wetland was restricted the onsite delineation of adjacent areas was extrapolated on a desktop level.

6.3 Delineation results

The pans in the study area were delineated on a visual level in the field mostly focusing on the hydrology, terrain unit and the presence of water loving plants indicators. A buffer zone of 32 m from the edge of all pans, as prescribed for wetlands in Government Notice R.544 in Government Gazette 33306 of 18 June 2010, was delineated and mapped for all areas.

6.3.1 Pan 1

Pan 1 is about 0.9 ha in extent and is situated in the southern corner of the preferred area at coordinate: 27° 14' 09.7"S, 23° 03' 23.0"E (Figure 19).

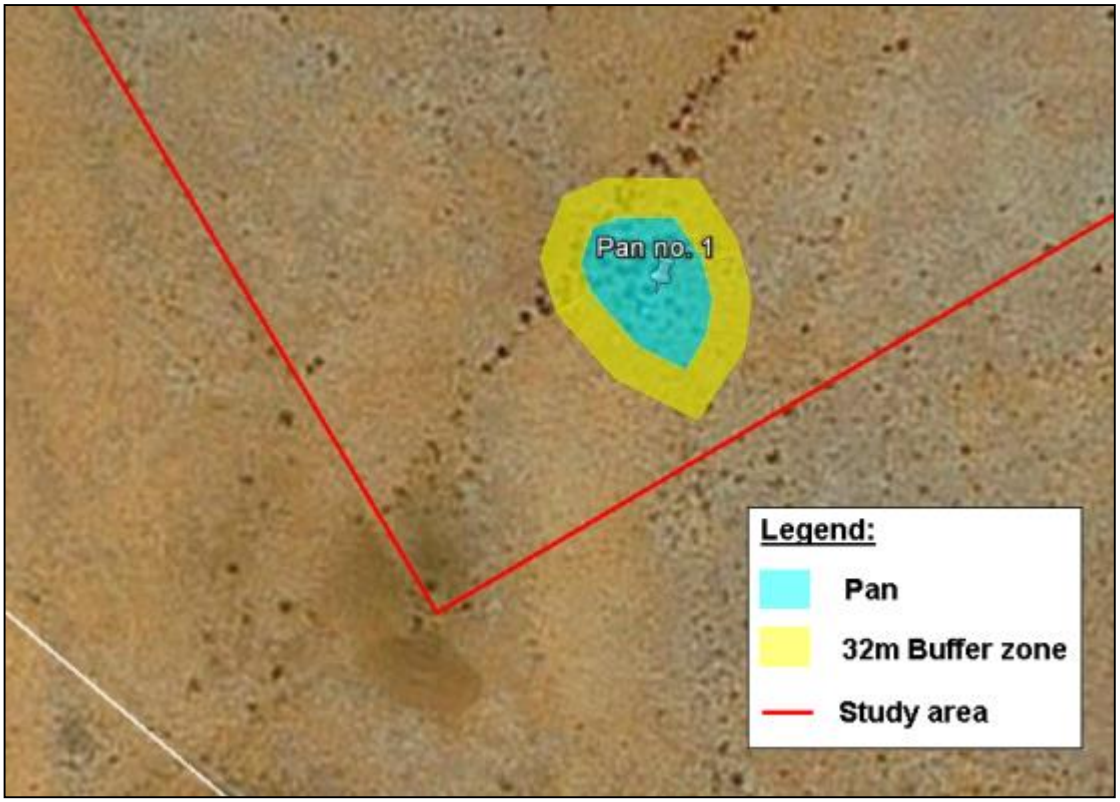


Figure 7: Outer edge of Pan 1 with a delineated 32 m buffer zone.

6.3.2 Pan 2

Pan 2 is the smallest of the three and about 0.14 ha in size and is situated in the about 500 m west of the eastern corner of the preferred area at coordinate: 27° 13' 50.0"S, 23° 03' 57.8"E (Figure 20).

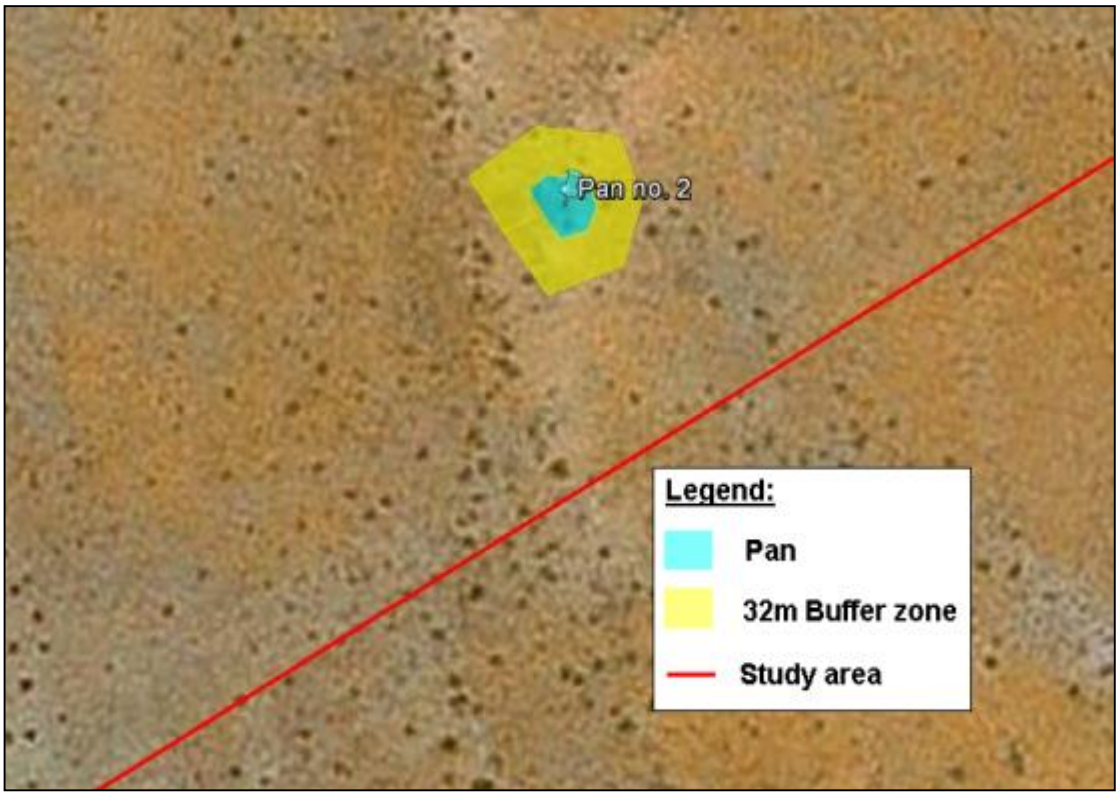


Figure 8: Outer edge of Pan 2 with a delineated 32 m buffer zone.

6.3.3 Pan 3

Pan 3 is about 0.85 ha in extent and is situated approximately 525 m ESE of the western corner of the preferred area at coordinate: 27° 13' 40.6"S, 23° 02' 58.1"E (Figure 21).

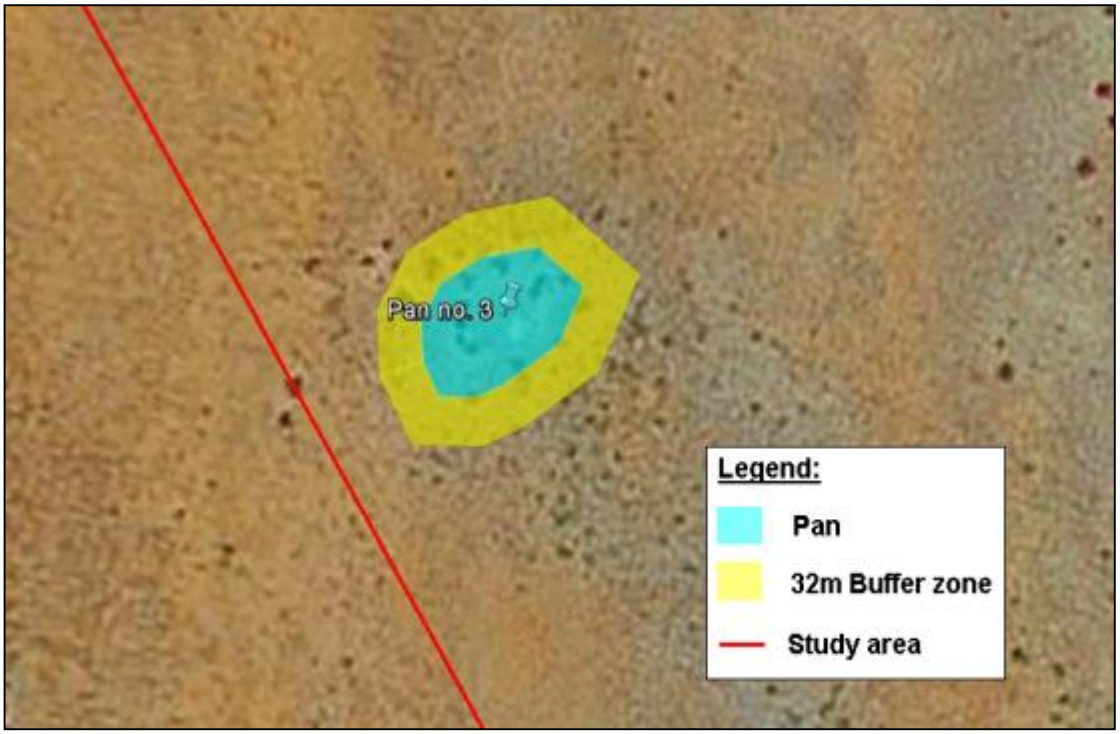


Figure 9: Outer edge of Pan 3 with a delineated 32 m buffer zone.

7 IMPACT ASSESSMENT

7.1 Assessment of expected impacts and relevant mitigation

The tables in the section below (Tables 7-1 & 7-2) serve to summarize the significance of expected and potential impacts on the wetland/pan habitats occurring on or directly adjacent to the study area. A summary of expected construction, operational and decommissioning phase impacts are provided. No significant impacts are expected during the pre-construction phase. Table 7-2 presents the descriptions of impacts as well as impact assessments according to the method and rating system described in Table 7-1. In addition, Table 7-2 also indicates migratory and management measures needed to minimize the expected ecological impacts.

Table 7-1: Rating system for the evaluation of impacts related to the proposed development

NATURE		
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 experienced.		
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).
DURATION		
This describes the duration of the impacts. Duration indicates the lifetime of the impact as a result of the proposed activity.		
1	Short term	The impact will either disappear with mitigation or will be mitigated through natural processes in a span shorter than the construction phase (0 – 1 years), or the impact 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 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 – 30 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 indefinite.
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. Rehabilitation and remediation often impossible. If possible rehabilitation and remediation often unfeasible due to extremely high costs of rehabilitation and remediation.
REVERSIBILITY		
This describes the degree to which an impact 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.
CUMULATIVE EFFECT		
This describes the cumulative effect of the impacts. A cumulative 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

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. 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.

Table 7-2: Assessment of Impact: Degradation and/or destruction of natural pans.

Impact	Construction phase	Operational phase	Decommissioning phase
IMPACT: Degradation and/or destruction of natural pans.	Sedimentation of pans due to soil erosion as a result of construction activities nearby leading to a loss of natural functioning.	Sedimentation of pans due to soil erosion as a result of operational activities nearby leading to a loss of natural functioning.	Continued sedimentation during closure and decommissioning leading to a loss of natural functioning.
	The surface catchment area (size and quality) of the pans as well as the natural drainage of water to the pans could be negatively affected by construction activities. Water that will naturally flow from the surrounding areas that feed the pans and associated habitats may be cut off due to ditches, water runoff control structures, etc.	Natural drainage of water to the pans could be negatively affected by operational activities. Water that will naturally flow from the surrounding areas that feed the pans and associated habitats may be cut off due to ditches, water runoff control structures, etc.	Natural drainage of water to the pans could be negatively affected by post operational activities. Water that will naturally flow from the surrounding areas that feed the pans and associated habitats may be cut off due to ditches, water runoff control structures, etc.
	Environmentally harmful pollutants (fuel, oil, hydraulic fluids, cement, paint, turpentine, hydrochloric acid, cleaning chemicals, etc.) from the construction phase of the development may end up in the pans.	Environmentally harmful pollutants (fuel, oil, hydraulic fluids, cement, paint, turpentine, hydrochloric acid, cleaning chemicals, etc.) from the operational phase of the development may end up in the pans.	Environmentally harmful pollutants (fuel, oil, hydraulic fluids, cement, paint, turpentine, hydrochloric acid, cleaning chemicals, etc.) from the decommissioning phase of the development may end up in the pans.

	Workers entering and using pan areas for inappropriate activities (dumping materials, depositing human and urine waste etc.) may negatively impact on the surface water resources and the general ecological health of the pans.	Workers entering and using pan areas for inappropriate activities (dumping materials, depositing human and urine waste etc.) may negatively impact on the surface water resources and the general ecological health of the pans.	Workers entering and using pan areas for inappropriate activities (dumping materials, depositing human and urine waste etc.) may negatively impact on the surface water resources and the general ecological health of the pans.
	Proliferation of alien species may alter plant community structure. Failure to implement a comprehensive alien weed control plan leading to an increase in alien vegetation encroachment.	An increase in alien species leading to altered plant community structure and composition especially in neighboring habitats.	Ineffective rehabilitation of impacted areas and failure to implement a comprehensive alien weed control plan may lead to ongoing loss of natural species diversity.

Impact assessment:

Geographical Extent	Probability	Duration	Intensity / Magnitude	Reversibility	Irreplaceable loss of resources	Cumulative Effect	Significance
1	3	3	3	3	3	3	**48** (negative medium impact)

Mitigation of impact 4:
In terms of section 19 of the NWA (1998), owners / managers / people occupying land on which any activity or process undertaken which causes, or is likely to cause pollution or degradation of a water resource must take all reasonable measures to prevent any such disturbance from occurring, continuing or recurring. These measures may include measures to (inter alia): • Cease, modify, or control any act or process causing the pollution/degradation. • Comply with any prescribed waste standard or management practice. • Contain or prevent the movement of pollutants or the source of degradation. • Remedy the effects of the pollution/degradation. • Remedy the effects of any disturbance to the bed and banks of a watercourse/wetland.
Any construction activities in or within a delineated buffer zone of a water resource may only take place after the necessary water use license has been obtained.
Where possibility exists that a pan is close to a construction site, the pan should be fenced off to avoid unnecessary or unauthorized access to these areas.
During excavations, soil stockpiling should be as far as possible away from the pan edge to avoid siltation of pans from soil stock piles.
Construction machinery and vehicles may not be allowed to enter pans. Strictly no re-fueling of vehicles or machinery should be allowed to take place in any construction area close to a pan.
During and after construction it is important to take runoff control into serious consideration. Areas of exposed soil can easily erode and subsequently end up in the pans. After construction water runoff control is equally important in order to avoid polluted water to end up in the pans. A well designed storm water drainage system must be constructed in order to channel water, which may potentially be polluted, away from pan areas. Natural runoff from the natural terrestrial habitat surrounding the pans should however not be restricted unnecessarily.
The use of potential pollutants (paint, chemicals, etc.) during construction and operational phases must be strictly controlled and a high quality of management and supervision concerning such materials must be enforced, especially close to pan areas.
Sanitary facilities must be made available to construction workers working in or near to prevent urine and other human waste entering the pans.

Populations of alien and invader plant species within as well as alongside the pan areas should be monitored on a regular basis and actions to eradicate these species at an early stage should be implemented.
According to the NWA (1998) part of the definition of pollution of water resources states that any physical alterations to a water resource, for example the excavation of a wetland / pan or changes to the morphology of such a water resource may be considered to be pollution. Activities which cause an alteration to the biological properties of a pan i.e. the fauna and flora contained within and supported by that water resource are therefore also considered to be a form of pollution.

Based on the above assessment it is evident that there is an expected impact on the wetland/pan ecology in the study area. Table 7-3 summarises the findings indicating the significance of the impact before management takes place (as described in Table 7-2) and the likely impact if management and mitigation takes place. From Table 7-3 it is evident that prior to management measures being put in place, the impact is a negative-medium level impact. If effective management takes place, the impact will be reduced to a low level impact.

Table 7-3: A summary of the results from the impact assessment

Impact	Not mitigated / managed	Mitigated / managed
Degradation and/or destruction of natural pans.	negative medium impact	negative low impact

7.2 Assessment of the no-go alternative

Due the destructive nature of the proposed development to the bio-diversity and natural habitats in the directly affected area, the no-go alternative will see the area stay in the current condition. The current impacts exerted on the area from an agricultural point of view (not assessed in this study) will remain and, depending on the management strategies employed by the land owner and natural climatic conditions, the current natural condition may improve or deteriorate in future.

7.3 Monitoring requirements

From a wetland / pans point of view the following should be monitored:

- All delineated pans in or adjacent to the development area should be treated as sensitive and need to be monitored from an ecological and hydrological point of view, throughout all project phases.
- Unnecessary movement of vehicles and persons in these areas should be strictly restricted and monitored.
- All aspects mentioned in the mitigation of impacts should be well monitored.

8 REFERENCES

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8.2 Other Literature and Field Guides Consulted

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