

LEBOKA Agriculture [Pty] Ltd
Farm Blaauwbank 241 JQ Ptn 10 & 15
Brits District

FINAL BASIC ASSESSMENT REPORT
(FBAR)

**Construction and operation of a pig farm for
the production of fresh meat [pork] products
to the market**

NW - DEDECT

Rustenburg

NWP/EIA/95/2024

June 2025



ANNEXURES

ANNEX A

Site Plan

Lay-out Plan



ANNEX B

Photographs

PHOTOGRAPHS

North



North East



East



South East



South



South West



West



North West



ANNEX C

Facility Illustration

Modern pig farm operations

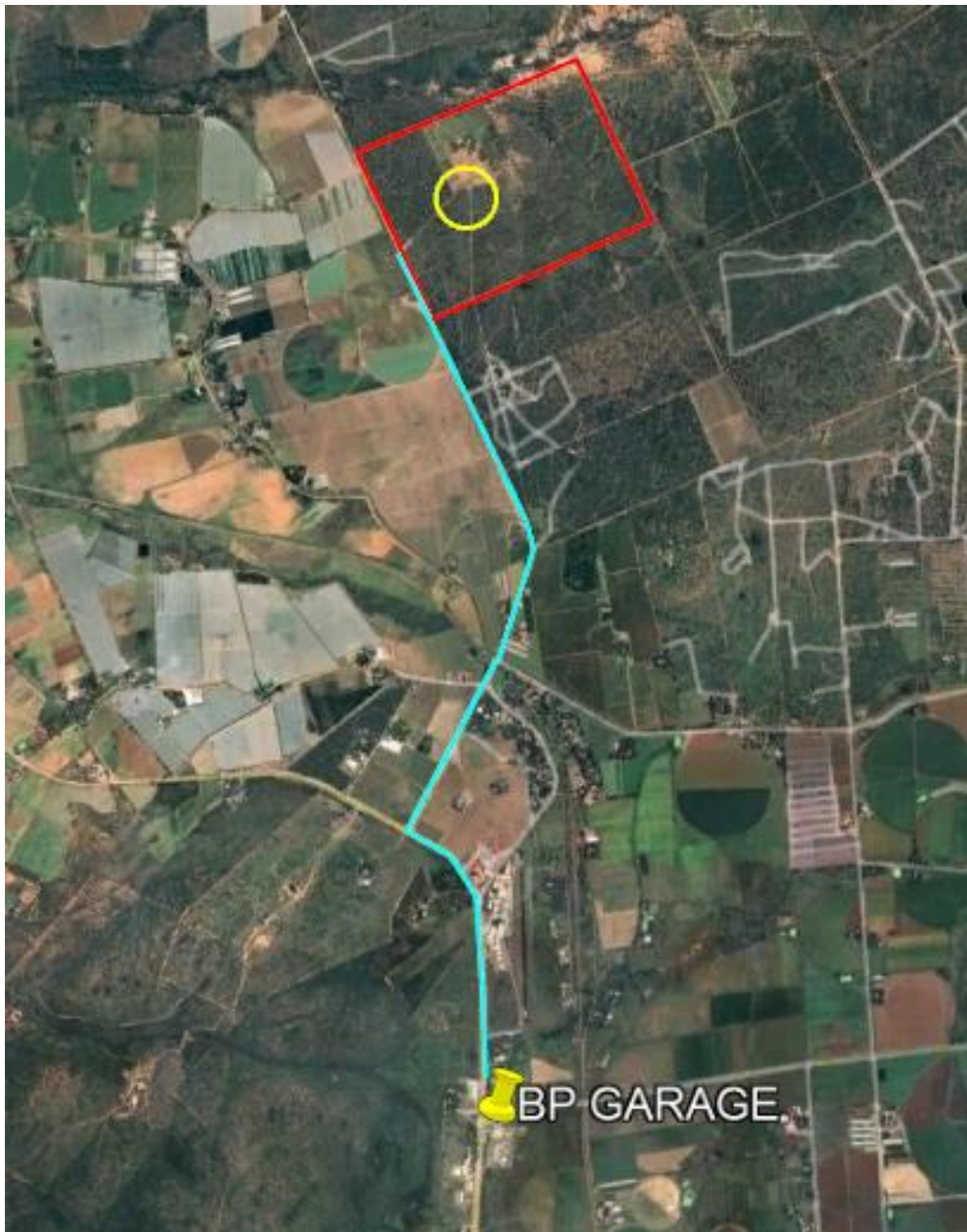


ANNEX D

Route Position

Route Position Map

From the town of Brits drive north on VAN DEVENTER road for around 11.5km. Then turn RIGHT on the road marked SABLE RANCH / Manzi Maningi Lodge. Drive around 3.4km to the entrance of the farm on the RIGHT.



ANNEX E

Public Participation

SITE NOTICE – Pig Farm



Site Notice consisted of:

- Background information
- Map #1 – the farm in relation to the overall area
- Map #2 – the farm specifically with location of each structure to be built
- I&AP Rights
- QR Code for downloading information to a cellphone
- Individual plastic pouches with Background Info Sheet and I&AP Registration Form

Modern pig farm operations



Location of the farm



THE ACTIVITY

- Application for the construction and operation of a pig farm operation with a holding capacity of 800 breeding sows [and young] on site.
- The construction of 24 houses for the holding of the breeding-sows [and young], complete with its electrical; water and feeding system.

I&APS may/are:

- Register as an Interested & Party
- Entitled to received information
- Entitled to raise questions; concerns and objections
- Entitled to get answers to questions and objection raised
- Entitled to be heard and included into the EIA documents to the NW-DEDECT
- Entitled to be notified of the Record of Decision and Right to Appeal

AUTHORITY

NW-DEDECT : Mmabatho



Scan me!

PLEASE TAKE ONE



ENVIRONMENTAL NOTICE

It is the intention of the **STRYDOM FAMILIE TRUST** as **LEBOKA AGRICULTURE Pty Ltd**, to make application to the **NW-DEDECT** for an environmental authorisation for the following development on the farm **BLAAUWBANK 241 JQ [Ptn 10 & 15]** in the Brits District / Madibeng Local Municipality.

A Piggery [pig farm] for the holding of eight hundred [800] breeding sows and their young in constructed pens [houses] as to the provisions of the law. The building will be provided with individual holding pens that will allow pigs of different ages to be held separate of one another, each pen with its own feeding trough and watering point. Total building space 50 000 sqm / 24 houses.

The building will be provided with a water point; electrical power and a bio-security fence for the safety and wellbeing of the pigs on site. The site will also be provided with feed silos for the holding of animal feed for the breeding sows and the young piglets.

Animal waste will be collected and used as a source of organic manure on other farming activities.

The application is done in terms of the **National Environmental Management Act, Act 107 of 1998** [as amended] GNR 327 [7 April 2017] for a development area of around 5.5 Ha in size on said farm:

Listing 1 Activity 4

The development and related operation of facilities or infrastructure for the concentration of animals [for the purpose of commercial production] in densities that exceed [ii][b] more than 250 pigs per facility excluding piglets that are not yet weaned;

Listing 1 Activity 27

The clearance of an area of 1 ha or more, but less than 20 ha of indigenous vegetation

The Draft Basic Assessment Report [DBAR] will be available for public scrutiny and comments in the local public library in Brits as from [28 March 2025] for a comment period of 30 days.

All interested and affected parties [I&APs] are invited to register with the Environmental Assessment Practitioner [EAP] at:

- **Email:** rpcolyn@telkomsa.net or greenservices@telkomsa.net
- **Address:** 1126 Waterpoort Street, Faerie Glen, Pretoria 0081
- **Fax:** 0866 22 55 52
- **REFERENCE:** LEBOKA Agriculture Pty Ltd

PLEASE TAKE ONE



LEBOKA AGRICULTURE Pty Ltd

ENVIRONMENTAL NOTICE

It is the intention of the STRYDOM FAMILIE TRUST as LEBOKA AGRICULTURE Pty Ltd, to make application to the NW-DEDECT for an environmental authorisation for the following development on the farm BLAAUWBANK 241 JQ (Ptn 10 & 15) in the Brits District / Madibeng Local Municipality. A Piggery (pig farm) for the holding of eight hundred (800) breeding sows and their young in constructed pens (houses) as to the provisions of the law. The building will be provided with individual holding pens that will allow pigs of different ages to be held separate of one another, each pen with its own feeding trough and watering point. Total building space 50 000 sqm / 24 houses. The building will be provided with a water point; electrical power and a bio-security fence for the safety and wellbeing of the pigs on site. The site will also be provided with feed silos for the holding of animal feed for the breeding sows and the young piglets. Animal waste will be

collected and used as a source of organic manure on other farming activities. The application is done in terms of the National Environmental Management Act, Act 107 of 1998 (as amended) GNR 327 (7 April 2017) for a development area of around 5.5 Ha in size on said farm: Listing 1 Activity 4 The development and related operation of facilities or infrastructure for the concentration of animals (for the purpose of commercial production) in densities that exceed (ii)(b) more than 250 pigs per facility excluding piglets that are not yet weaned; Listing 1 Activity 27 The clearance of an area of 1 ha or more, but less than 20 ha of indigenous vegetation The Draft Basic Assessment Report (DBAR) will be available for public scrutiny and comments in the local public library in Brits for a comment period of 30 days. All interested and affected parties (I&APs) are invited to register with the Environmental Assessment Practitioner (EAP) at: Email: rpolyn@telkomsa.net or greenservices@telkomsa.net

rpolyn@telkomsa.net or
greenservices@telkomsa.net
Address: 1126 Waterpoort
Street, Faerie Glen, Pretoria
0081 Fax: 0866 22 55 52
REFERENCE: LEBOKA
Agriculture Pty Ltd

NP000081

ENVIRONMENTAL NOTICE

It is the intention of the **STRYDOM FAMILIE TRUST** as **LEBOKA AGRICULTURE Pty Ltd**, to make application to the **NW-DEDECT** for an environmental authorisation for the following development on the farm **BLAAUWBANK 241 JQ [Ptn 10 & 15]** in the Brits District / Madibeng Local Municipality.

A Piggery [pig farm] for the holding of eight hundred [800] breeding sows and their young in constructed pens [houses] as to the provisions of the law. The building will be provided with individual holding pens that will allow pigs of different ages to be held separate of one another, each pen with its own feeding trough and watering point. Total building space 50 000 sqm / 24 houses.

The building will be provided with a water point; electrical power and a bio-security fence for the safety and wellbeing of the pigs on site. The site will also be provided with feed silos for the holding of animal feed for the breeding sows and the young piglets.

Animal waste will be collected and used as a source of organic manure on other farming activities.

The application is done in terms of the **National Environmental Management Act, Act 107 of 1998** [as amended] GNR 327 [7 April 2017] for a development area of around 5.5 Ha in size on said farm:

Listing 1 Activity 4

The development and related operation of facilities or infrastructure for the concentration of animals [for the purpose of commercial production] in densities that exceed [ii][b] more than 250 pigs per facility excluding piglets that are not yet weaned;

Listing 1 Activity 27

The clearance of an area of 1 ha or more, but less than 20 ha of indigenous vegetation

The Draft Basic Assessment Report [DBAR] will be available for public scrutiny and comments in the local public library in Brits for a comment period of 30 days.

All interested and affected parties [I&APs] are invited to register with the Environmental Assessment Practitioner [EAP] at:

- Email: rpolyn@telkomsa.net or greenservices@telkomsa.net
- Address: 1126 Waterpoort Street, Faerie Glen, Pretoria 0081
- Fax: 0866 22 55 52
- REFERENCE: LEBOKA Agriculture Pty Ltd

Registration as an Interested & Affected Party (I&AP)

Yes – I wish to be registered as an Interested & Affected Party (I&AP) for the

LEBOKA AGRICULTURE [Pty] Ltd

Surname:

Initials:

Title:

Physical address: _____ Postal Code: _____

P.O. Box : _____ Postal Code : _____

Tel : (____) _____ Fax : (____) _____ Cell : _____ Email: _____

Please register me as an I&AP.

a) I wish to register the following issues; comments and concerns about the proposed development:

b) I would like to obtain more information regarding the following:

c) I would like you to add the following person(s) to your list of I&APs:


Please forward this form to:

Fax - 0866 22 55 52

Email - rpolyn@telkomsa.net or greenservices@telkomsa.net

Reference – LEBOKA AGRICULTURE

TAKE ONE





LEBOKA Agriculture [Pty] Ltd
Farm Blaauwbank 241 JQ Ptn 10 & 15
Brits District


DRAFT BASIC ASSESSMENT REPORT
(DBAR)

Construction and operation of a pig farm for
the production of fresh meat [pork] products
to the market
NW - DEDECT
Rustenburg

LIBRARY COPY - DO NOT REMOVE







Courier service to Brits Library

THE COURIER GUY Worldwide Express
We would love to handle your package

HEAD OFFICE: P O Box 532, Lanseria, 1748
Showcall No: 0861 203 203
Fax: 096 543 3365
After Hours WhatsApp: 082 823 3254

Barcode: TCG41001808

ACCOUNT NO. (Very Important) CLIENT REFERENCE PARCELS MASS VOLUME ORIGIN DEST OFFICE REFERENCE

Contact Name: **PETER COLYN** Contact Phone Number (Very Important): **082 553 8844**
Company Name: **S E C S**
Street Address: **126 WATERPORT STR**
FAERIE GLEN
City: **PRETORIA** Country: **SA** Postal Code: **0081**

To (Contact Name): **THE CHIEF LIBRARIAN** Contact Phone Number (Very Important): **012 381 7000**
Company: **BRITS PUBLIC LIBRARY**
Exact Street Address (We cannot deliver to Box Numbers): **5 JAN VELDEN STR**
BRITS
City: **BRITS** Country: **SA** Postal Code: **0250**

Special Instructions: **CHIEF LIBRARIAN - BRITS**

NUMBER	DESCRIPTION OF CONTENTS	ACTUAL WEIGHT	DIMENSIONS (cm)
1	RICHMOND ST		
	MOROPA BAR		
	LEBUKA BAR		
	CAPE BAR		

By virtue of the client's signature hereto, the client acknowledges having read, understood and agreed to be bound by the standard conditions of carriage of The Courier Guy (Pty) Ltd., which standard conditions are annexed hereto.

INSURANCE ☐ (ONLY DECLARE VALUE IF YES)
DECLARED VALUE: R

CLIENT SIGNATURE: **[Signature]**
RECEIVED BY THE COURIER GUY (Pty) Ltd.:
DATE: **7/6/2023** TIME: **14:00**

RECEIVER'S SIGNATURE: **[Signature]**
PRINT SURNAME AND INITIALS: **[Signature]**
DATE: **7/6/2023** TIME: **14:00**

Confirmation that goods were received in good condition

PLEASE PRINT - USE A BALL POINT PEN AND PRESS HARD (5 COPIES)
1st Copy: THE COURIER GUY (Pty) Ltd. COPY
2nd Copy: COPY VAT INVOICE
3rd Copy: PROOF OF DELIVERY
4th Copy: RECEIVERS COPY
5th Copy: SENDERS COPY



1126 Waterpoort Street, Faerie Glen,
Pretoria. 0083
Tel: 012 991 2575
Email: rpolyn@telkomsa.net

... conservation today for a green future tomorrow ...

7 May 2025

To:

**The Interested & Affected Party [I&APs]
BLAAUWBANK DEVELOPMENT #2
BRITS – North West Province**

Re: Notification of a proposed development on a farm

Good day

We wish to notify potential Interested and Affected Parties [I&APs] that **LEBOKA AGRICULTURE [Pty] Ltd** intends making application to the NW-DEDECT for the construction and operation of a pig farm operation on Ptn 10 & 15 of the farm Blaauwbank 241 JQ in the Brits District.

The intention of the farm is to farm with 800 breeding sows in the production and rearing of young pigs for the fresh meat market.

Project Description:

The development on Ptn 10 & 15 of Farm Blaauwbank 241 JQ in the Brits District / Bojanala District Municipality of:

- A pig farm with a holding capacity of 800 breeding sows;
- Building / pens / breeding operation of 50 000 sqm consisting of 24 houses for the breeding sows;
- Water supply from borehole supplies;
- Electricity supply from ESKOM connection;
- Feed silos for the storage of bulk feed;
- Animal waste to be utilized as organic fertilizer once passed through an organic digester.

Is there a need for a pig farm and the production of local pork?

- **Import Volume:** South Africa imports around 50,000 tons of pork per year.
- **Production:** Domestic pork production is estimated at 350,000 tons annually.
- **Import Sources:** Major pork suppliers to South Africa are Brazil, Canada, and certain pork-producing countries in the European Union that are also free of the Pig Production Risk Standard (PPRS).
- **Meeting Demand:** The quantity of imported pork, combined with domestic production, is generally sufficient to meet South Africa's overall pork consumption needs.
- **Trade Balance:** While South Africa imports pork, it also exports some, leading to a trade balance, although there are fluctuations. For example, in May 2025, South Africa imported



ZAR60.9M of pig meat and exported ZAR42.9M, resulting in a negative trade balance of ZAR18M.

[Source: According to the Observatory of Economic Complexity]

Position of the intended development on the farm



A copy of the Draft Impact Assessment document has been placed in the local library in Brits. Interested and Affected Parties may read up and then register and make comments to the Offices of the EAP at:

- The EAP – Green Environmental Consulting
- rpcolyn@telkomsa.net or greenservices@telkomsa.net
- Fax: 0866 22 55 52

It is the intention of the developer to have a Site Verification Investigation undertaken to determine the status of the fauna & flora of the farm and to ensure that:

- no RED Data species are being involved in the development position of the piggery, and
- no potential wetlands are being affected by the development footprint.

We look forward to receiving inputs from I&APs and your being part of the overall decision making process.

Pieter Colyn

EAPASA – EAP / ASSESSOR 2019/1358

Cc: The Office of the Municipal Manager – Madibeng / Brits

The Office of the Speaker of the House – Madibeng / Brits [for circulation to Councillors]

SAHRA



Email of sending notice.

Reply Reply All Forward



Wed 2025/05/07 11:04

Pieter Colyn <rpolyn@telkomsa.net>

Formal notice of a proposed development on a farm

To 'customercare@madibeng.gov.za'; 'info@sahra.org.za'

Message Letter to identified I&APs & Council.pdf (712 KB)

Attention:

- Office of the Municipal Manager – Madibeng / Brits
- Office of the Speaker of the House – Madibeng / Brits
- SAHRA

Good morning

Herewith attached the formal notice of an intended development on a farm in the Brits District.

Regards / Groetnis

Pieter Colyn



1126 Waterpoort Street, Faerie Glen, Pretoria 0081



I&R Report

Registered I&APs for the project

Name	Contact Email
Ward Councillor – J van Rhyn	vanrhynprok@infogro.co.za
Madibeng Municipal Manager	customercare@madibeng.gov.za
Mr F du Toit – Adjacent land Owner	Fdutoit8@gmail.com

Issues raised and responses given

1 April 2025

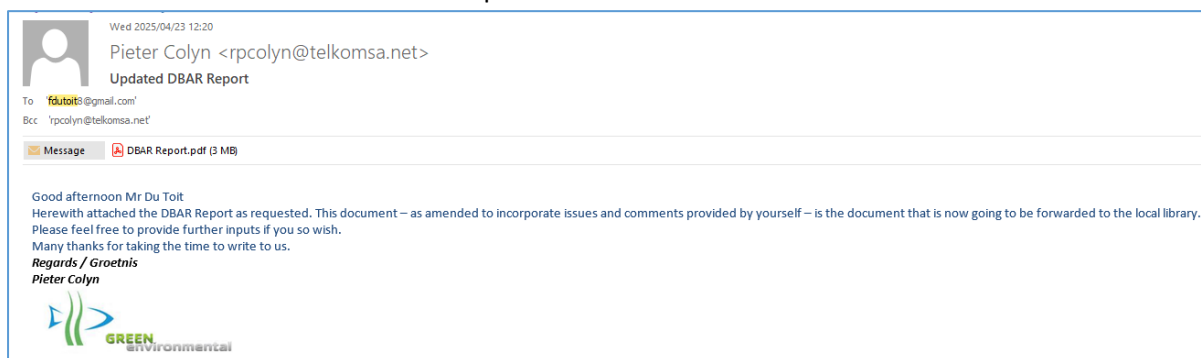
Email received from F du Toit who raised the following points:

- Odour & Air Quality
- Noise Pollution
- Ground Water and borehole contamination
- Waste handling & effluent Management
- Disease and Biosecurity
- Property valuation and Tourism Impact

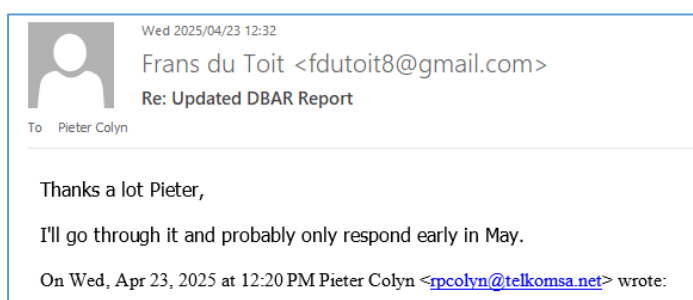
Reply

In reply the EAP updated the original Draft EIA Documents and incorporated the issues and answers into the DBAR to F du Toit.

An electronic copy of the DBAR document [Updated to include the issues raised by F du Toit] was forwarded to F du Toit via email on 23 April 2025.






F du Toit acknowledged receipt of the document



On 13 May 2025 received another email from F du Toit with more questions. See Letter #2

Letter forwarded to the applicant / developer for more inputs.
See applicant / developer inputs received and forwarded to F du Toit
See Letter #3 – Second reply from developer forwarded to I&AP.

 Reply  Reply All  Forward





Mon 2025/06/16 17:36

Pieter Colyn <rpcolyn@telkomsa.net>

pig eia questions

To 'fdutoit3@gmail.com'

 Message  pig eia questions.pdf (326 KB)

Mr Du Toit

We forwarded your questions / concerns to the Agent / Technical person overseeing the technical side of the application as well as the design.
Herewith the answers as received.

Regards / Groetnis

No further inputs; questions or comments received from any other party or government officials.

1126 Waterpoort Street
Faerie Glen
Pretoria
0081

RE: LEBOKA Agriculture Pty Limited – Application for Environmental Authorisation

To Whom It May Concern,

RE: REGISTRATION AS AN INTERESTED AND AFFECTED PARTY – PROPOSED DEVELOPMENT ON FARM BLAAUWBANK 241 JQ (Portions 10 & 15), BRITS DISTRICT

I, Frans du Toit, as the directors of Blommelot Boerdery Pty Ltd, hereby request to be registered as an Interested and Affected Party (I&AP) in terms of the National Environmental Management Act (NEMA) regarding the proposed piggery development by the Strydom Familie Trust and Leboka Agriculture (Pty) Ltd.

I am a director of Blommelot Boerdery, which operates directly adjacent to the proposed development site. Our operations include both commercial farming and a guest house that attracts visitors throughout the year.

a) Concerns to be Registered:

As a neighbouring landowner, I have a number of material concerns regarding the potential environmental and social impact of the proposed piggery:

- - Odour and Air Quality Impacts: Strong smells associated with pig waste and animal husbandry may significantly affect the comfort and experience of our guests and the quality of life on our farm.
- - Noise Pollution: Noise from animals, operational equipment, and increased vehicle traffic could disturb both our guests and livestock.
- - Groundwater and Borehole Contamination Risk: The area is reliant on underground water sources. Waste mismanagement or slurry seepage could affect the quality and safety of our borehole water.
- - Waste Handling and Effluent Management: It is not clear how animal waste, including manure and wastewater, will be managed, stored, treated, or disposed of. The letter only states that the manure will be used on other farming activities.
- - Disease and Biosecurity: The introduction of a large piggery may increase the risk of diseases spreading to other animals or livestock on our farm.

- - Property Value and Tourism Impact: The presence of a large-scale piggery may have a negative effect on tourism in the area and potentially reduce the value of surrounding properties.

b) Request for Additional Detailed Information:

In order to properly evaluate the impact of the proposed development, I respectfully request access to the following specific details as part of the Environmental Impact Assessment (EIA) process:

- - Exact Site Layout and Positioning of the Pens: Including proximity to neighbouring farms, water sources, and property boundaries.
- - Waste Management Plan: Details on handling, storage, treatment, and disposal of manure and effluent, including any planned biogas or composting infrastructure.
- - Air and Odour Control Measures: Mitigation strategies to reduce odour and air quality impact, including ventilation systems or buffer zones.
- - Noise Management Plan: Measures planned to mitigate operational noise, particularly during early mornings or evenings.
- - Groundwater and Surface Water Protection: How borehole water sources and underground aquifers will be protected from contamination, including geohydrological studies.
- - Water Usage: Quantification of expected daily water use and identification of water sources (borehole, municipal, river, etc.).
- - Biosecurity Measures: Steps to prevent disease transmission to nearby livestock, including protocols and fencing plans.
- - Purpose and Motivation for the Development: Economic, social, or food production reasons motivating the establishment of the piggery.
- - Traffic Impact Assessment: Including the expected increase in vehicle traffic (especially heavy vehicles) and how access roads will be maintained.

I request that my contact details be added to your stakeholder database and that I be notified of all future correspondence, reports, and meetings related to this development.

Yours sincerely,

Frans du Toit
 Director – Blommelot Boerdery
 Portion 1, Farm Blaauwbank 241 JQ
 fdutoit8@gmail.com
 082 316 5559

Pieter Colyn

From: Frans du Toit <fdutoit8@gmail.com>
Sent: Tuesday, 13 May 2025 15:52
To: Pieter Colyn
Subject: Re: Updated DBAR Report

Hi Pieter,

Again thanks a lot for the detailed report. It answered so many of my questions and I can see the people involved in gathering and documenting the information, did an excellent job.

I have perused the document and it is lacking in a few key aspects which could potentially impact my farm.

Notably, adequate liquid fraction application detail is lacking and buffer areas are not fully identified for a sustainable application rate of the pig slurry. I literally Google Pig SLurry treatment and reading this link below, left me wondering if the current mitigation will be sufficient.

<https://www.thepigsite.com/articles/eco-friendly-approach-to-pig-slurry-treatment>

Odour setback will not be addressed as implied by an anaerobic stage – please note that unless heated (which the report does not address) the AD may well generate even more offensive odour molecules than raw slurry. You're welcome to let me know if I misread this or if I don;t understand the report.

Can I also please ask, what will be the process and the repercussions if the requirements and details set out in the report, are not met? Please consider that I am not educated in this type of process and all the processes it entails. What course of action can I then take, because I'm worried that I will then be too late.

Are there perhaps a list of concerns or conditions I need to submit to you or to some authorities? I mean, all the Mitigations listed under point 8, seems like a good idea to me, but how can I be sure these will be implemented?

After reading the report and considering some of the points above, I am still worried about some of the points. For example:

- Noise. Pigs don;t only make a noise during the time stated. I have been on a pig farm before, they shout randomly and when they all shout at once, it's more than the decibels noted in the report.
- Borehole under point 4.5 and 4.6. Have the intended farm's borehole capacity been measured? Can it continue it's current operations plus this required quantity for the pigs and chickens (separate application)? Also, what will the impact be on the water tables/levels for the entire area?
- Dead pigs: Perhaps I missed it, but what will happen to the pigs that die. How will they be disposed of?
- Advertisement in local newspaper - can I perhaps request a copy please?
- Costs. I work in consulting mostly and the report makes it seem like a lot of costs is involved. I would at least need to have some idea of financial viability if the mitigation controls are implemented. I have read through point 3 and understand that pigs can be profitable, but I don't know at which scale it needs to run to be economically viable. For example, because I have started a small citrus farm - I had to plant a certain number of trees to make the infrastructure etc worth it. If I only planted 100 trees, I would not have been able to justify all the costs.

Again, my intention is not to be difficult. Sorry if it appears that way, but I have to get the information as I am worried that it would impact my guests and the value of my property if not done in a sustainable manner.

Thanks

On Wed, Apr 23, 2025 at 12:20 PM Pieter Colyn <rpcolyn@telkomsa.net> wrote:

Good afternoon Mr Du Toit

Herewith attached the DBAR Report as requested. This document – as amended to incorporate issues and comments provided by yourself – is the document that is now going to be forwarded to the local library.

Please feel free to provide further inputs if you so wish.

Many thanks for taking the time to write to us.

Regards / Groetnis

Pieter Colyn



1126 Waterpoort Street, Faerie Glen, Pretoria 0081

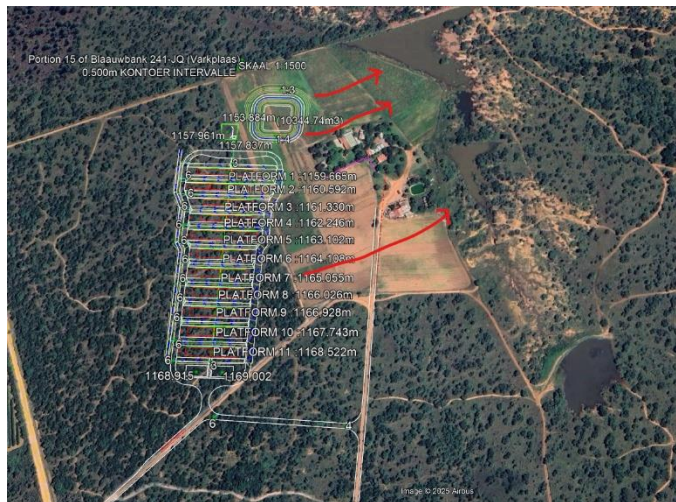
Tel: 012 991 2575

Mobile: 082 553 8844

Email: rpcolyn@telkomsa.net

“Notably, adequate liquid fraction application detail is lacking and buffer areas are not fully identified for a sustainable application rate of the pig slurry. I literally Google Pig Slurry treatment and reading this link below, left me wondering if the current mitigation will be sufficient”

The image below is an extraction of planning documents in the final design phase. This gives an indicative layout towards the final location and elevations. Please see the arrows, which confirms that more than sufficient buffer areas are provided to handle any possible spillage.



“Odour setback will not be addressed as implied by an anaerobic stage – please note that unless heated (which the report does not address) the AD may well generate even more offensive odour molecules than raw slurry. You're welcome to let me know if I misread this or if I don't understand the report.”

This development is 1.5km away from his farm, in a Northern direction. Prevailing winds are west to east, so odour is not to be a concern. Land is zoned as agricultural land, and the development is primary agriculture.

“Can I also please ask, what will be the process and the repercussions if the requirements and details set out in the report, are not met? Please consider that I am not educated in this type of process and all the processes it entails. What course of action can I then take, because I'm worried that I will then be too late.”

Normal procedure to be followed as prescribed by law.

”- Noise. Pigs don't only make a noise during the time stated. I have been on a pig farm before, they shout randomly and when they all shout at once, it's more than the decibels noted in the report.”

Land is zoned as agricultural land, and the development is primary agriculture.

“Borehole under point 4.5 and 4.6. Have the intended farm's borehole capacity been measured? Can it continue its current operations plus this required quantity for the pigs and chickens (separate application)? Also, what will the impact be on the water tables/levels for the entire area?”

Water remain in the area

Advert:

Advert CITIZEN – 30 April 2025 – Page 31 LEGALS

LEBOKA AGRICULTURE Pty Ltd
ENVIRONMENTAL NOTICE

It is the intention of the STRYDOM FAMILIE TRUST as LEBOKA AGRICULTURE Pty Ltd, to make application to the NW-DEDECT for an environmental authorisation for the following development on the farm BLAAUWBANK 241 JQ (Ptn 10 & 15) in the Brits District / Madibeng Local Municipality. A Piggery (pig farm) for the holding of eight hundred (800) breeding sows and their young in constructed pens (houses) as to the provisions of the law. The building will be provided with individual holding pens that will allow pigs of different ages to be held separate of one another, each pen with its own feeding trough and watering point. Total building space 50 000 sqm / 24 houses. The building will be provided with a water point; electrical power and a bio-security fence for the safety and wellbeing of the pigs on site. The site will also be provided with feed silos for the holding of animal feed for the breeding sows and the young piglets. Animal waste will be collected and used as a source of organic manure on other farming activities. The application is done in terms of the National Environmental Management Act, Act 107 of 1998 (as amended) GNR 327 (7 April 2017) for a development area of around 5.5 Ha in size on said farm: Listing 1 Activity 4 The development and related operation of facilities or infrastructure for the concentration of animals (for the purpose of commercial production) in densities that exceed (ii)(b) more than 250 pigs per facility excluding piglets that are not yet weaned; Listing 1 Activity 27 The clearance of an area of 1 ha or more, but less than 20 ha of indigenous vegetation. The Draft Basic Assessment Report (DBAR) will be available for public scrutiny and comments in the local public library in Brits for a comment period of 30 days. All interested and affected parties (I&APs) are invited to register with the Environmental Assessment Practitioner (EAP) at: Email: rpcolyn@telkomsa.net or greenservices@telkomsa.net

rpcolyn@telkomsa.net or greenservices@telkomsa.net
Address: 1126 Waterpoort Street, Fierie Glen, Pretoria 0081 Fax: 0866 22 55 52
REFERENCE: LEBOKA Agriculture Pty Ltd
NP000081

ENVIRONMENTAL NOTICE

It is the intention of the STRYDOM FAMILIE TRUST as LEBOKA AGRICULTURE Pty Ltd, to make application to the NW-DEDECT for an environmental authorisation for the following development on the farm BLAAUWBANK 241 JQ [Ptn 10 & 15] in the Brits District / Madibeng Local Municipality.

A Piggery [pig farm] for the holding of eight hundred (800) breeding sows and their young in constructed pens [houses] as to the provisions of the law. The building will be provided with individual holding pens that will allow pigs of different ages to be held separate of one another, each pen with its own feeding trough and watering point. Total building space 50 000 sqm / 24 houses.

The building will be provided with a water point; electrical power and a bio-security fence for the safety and wellbeing of the pigs on site. The site will also be provided with feed silos for the holding of animal feed for the breeding sows and the young piglets.

Animal waste will be collected and used as a source of organic manure on other farming activities.

The application is done in terms of the **National Environmental Management Act, Act 107 of 1998** [as amended] GNR 327 [7 April 2017] for a development area of around 5.5 Ha in size on said farm:

Listing 1 Activity 4

The development and related operation of facilities or infrastructure for the concentration of animals [for the purpose of commercial production] in densities that exceed [ii][b] more than 250 pigs per facility excluding piglets that are not yet weaned;

Listing 1 Activity 27

The clearance of an area of 1 ha or more, but less than 20 ha of indigenous vegetation

The Draft Basic Assessment Report [DBAR] will be available for public scrutiny and comments in the local public library in Brits for a comment period of 30 days.

All interested and affected parties [I&APs] are invited to register with the Environmental Assessment Practitioner [EAP] at:

- Email: rpolyn@telkomsa.net or greenservices@telkomsa.net
- Address: 1126 Waterpoort Street, Faerie Glen, Pretoria 0081
- Fax: 0866 22 55 52
- REFERENCE: LEBOKA Agriculture Pty Ltd

I&AP : Names of individuals who forwarded emails to the EAP Offices

1	Kobus vd Walt
2	Sumarie du Plooy
3	Karen Kloppers
4	Dirk Neethling
5	Jan vd Walt
6	Pieter Kruger
7	WJF
8	Wikus Schoeman
9	SH Schoeman
10	C Engelbrecht
11	Rudi & Yolanda Weyers
12	Johan Fourie
13	Jaco & Christine Markram
14	Lizarie Bierman
15	Andre Fourie
16	Abrie Smith
17	Stuart Seath
18	Charmaine Fourie
19	Hugo Bieldt
20	Willie Fourie

NB: GREEN indicates Registration forms properly completed

All others were received incomplete i.e. personal details incomplete

STATEMENT

A number of calls were received from potential I&AP s, and from the conversations we gathered that the “sudden objection” was a co-ordinated effort of one lady in the community. We were also told that environmental lawyer A Raath was taking over the process.

As per our previous experience this group merely provided names and most of the registration forms were incomplete. Requests for properly completed forms went unanswered.

Those I&APs who completed their forms received the requested information and after that no issues were raised; no inputs given; no constructive information to work with.

A Raath, as the representative of the group calling themselves **SAVE THE CROPS**, requested a copy of the document. All documents forwarded to the NW-DETECT has been forwarded via BIG FILE DROP to A Raath.

RP Colyn

EAP

ANNEX F

Wula / SAHRA / Services Letters

NOT APPLICABLE

ANNEX G

Specialist Reports

**SITE VERIFICATION REPORT – Piggery & Chicken Farm
(Blaauwbank) – Flora, Fauna & Terrestrial Biodiversity
Theme**

Commissioned by

Green Environmental (Ltd)

Compiled by

EkolInfo CC & Associates

July 2025

EkolInfo CC

P.O. Box 72847
Lynwood Ridge
0040
Pretoria
Gauteng
RSA
<http://www.ekoinfo.co.za>

Member: Willem de Frey
Registration no: CC1995/34111/23


Tel: 012-365-2546
Fax: 012-365-3217
Email: wdefrey@ekoinfo.co.za



25 Years

1995 - 2020

CONTRIBUTING ASSOCIATES

Company	EkolInfo CC				
Person	Willem de Frey				
Qualifications	MSc Wildlife Management – UP, 1999				
Field of expertise	Flora, Ecology, Soil, Wetlands, GIS				
Years experience	25 – Full time				
Professional Registration	Pr.Sci.Nat. - Botany & Ecology (400100/02)				
Component	Flora, Fauna, Terrestrial & Wetlands				
Telephone	012 365 2546				
Fax	012 365 3217				
Cell phone	082 579 5049				
Email	wdefrey@ekoinfo.co.za				
Logo					

DISCLAIMER AND COPY RIGHT

EkolInfo CC and its associates operate as independent consultants under the auspice of the South African Council for Natural Scientific Professions (SACNASP) within their spheres of expertise as determined by their peers. They have no vested interest in the project, other than to provide a professional service within the constraints of the project (timing, time and budget) based on the principals of science, namely: objectivity, transparency and repeatability while applying internationally and nationally accepted scientific methods.

The report and its content remain the intellectual property of EkolInfo CC and its associates until all accounts had been settled in full, whereby it may only be used in the project for which had been prepared for. Once released within the public domain via the Environmental Impact Assessment (EIA) process, it would be sincerely appreciated that the source is referenced when used to support approaches or results in projects of a similar nature or environment.

Report Status	Version	File Route
FINAL	1	C:\02_Projects\01_EkolInfo\20250618Eko_SiteVerificationPigChickBrits_GreenEnv\Reports\tx\EkolInfo CC Piggery_Chicken Farm Blaauwbank Site Verification Green Env.docx

1 EXECUTIVE SUMMARY

This report presents the findings of a site sensitivity verification survey conducted on portions of the farm Blaauwbank 241, located north of Brits in the North West Province, as part of an environmental assessment for proposed piggery and chicken farm developments. The study was commissioned by Green Environmental (Pty) Ltd and conducted by EkoInfo CC & Associates.

The specialist, Mr Willem de Frey, holds a Master's degree in Wildlife Management from the University of Pretoria and is a registered professional scientist with the South African Council for Natural Scientific Professions (Pr.Sci.Nat. – Botany & Ecology, Reg. No. 400100/02). Mr de Frey has over 25 years of full-time experience in flora, fauna, soil science, wetlands, and GIS-based ecological assessments.

Study Area

The development footprints fall within a largely natural landscape associated with the *Central Sandy Bushveld* vegetation type, classified as “Least Concern” in terms of national conservation status. Historical imagery from 1959 to 2022 shows that these areas have remained largely untransformed.

Piggery Footprint Results

Two plots (AP01 and AP02) were sampled in the piggery footprint area (portions 10 & 15). Both the flora and vegetation cover reflect a largely undisturbed, intact environment, except for a small section in the northeast that overlaps with cultivated land.

- **Wetland Potential:** The SAGA Wetness Index indicated low to very low potential for wetlands. Field verification confirmed no wetland presence, supported by uniform Clovelly soil profiles (800–1000 mm deep, 11% clay), which are not typically associated with wetland conditions.
- **Flora of Concern:** No plant species of conservation concern were flagged in the screening tool. However, one nationally protected species, *Sclerocarya birrea* subsp. *caffra* (Marula), was noted as potentially present.
- **Fauna of Concern:** Three fauna species were flagged — *Podica senegalensis*, *Dasymys robertsii*, and *Kinixys lobatsiana*. The first two are associated with aquatic habitats, which do not occur in the footprint. While the tortoise (*K. lobatsiana*) could occur in the broader landscape, the footprint's small size (8 ha, 6% of the property) poses minimal risk in terms of habitat loss or fragmentation.

Chicken Farm Footprint Results

Six plots (AC01 to AC06) were assessed across the chicken farm infrastructure area (portions 8 & 9), covering a cumulative footprint of 12 ha across seven proposed development sites.

- **Ecological Integrity:** The vegetation was found to be intact and undisturbed, with no evidence of historical cultivation since 1959. One plot showed a transition from dense to more open vegetation but remained natural.
- **Wetland Potential:** While the SAGA model suggested potential wetlands at AC02 and AC03, site verification found no hydromorphic soils. Shallow wetness indicators were present, but not sufficient to confirm wetland status. Vegetation at these plots did not indicate wetland conditions.
- **Flora of Concern:** Three protected tree species were recorded: *Sclerocarya birrea* (Marula), *Boscia albitrunca* (Shepherd's Tree), and *Spirostachys africana* (Tamboti). These species are listed as Least Concern but are legally protected, and permits are required for pruning or removal.
- **Fauna of Concern:** Two fauna species were flagged — *Dasymys robertsii* (wetland-dependent, not present in the footprint) and *Kinixys lobatsiana* (likely in the landscape, but not within the

site). The small footprint (10% of the property) and intact surrounding vegetation limit potential habitat disruption.

Conclusion and Recommendations

The site verification confirms that both the piggery and chicken farm footprints occur within persistent, natural vegetation with limited environmental sensitivity. The plant communities are representative of a well-drained *Sclerocarya birrea*–*Combretum apiculatum*/*Peltophorum africanum* woodland. No critical habitat fragmentation or significant fauna displacement is expected due to the small scale and localised nature of the proposed developments.

In line with the precautionary principle of the National Environmental Management Act, it is recommended that the following shifts be made to further reduce environmental risk:

- Move the **piggery footprint** 32 m westward.
- Relocate the **chicken infrastructure footprints** at AC02 and AC03 at least 32 m to the southwest.

Based on the verified findings, no additional ecological studies are deemed necessary, and the sensitivity ratings assigned by the national screening tool should be revised to reflect the low actual sensitivity of the site.

TABLE OF CONTENT

1 EXECUTIVE SUMMARY	3
2 INTRODUCTION	7
<u>2.1 Scope of work/ Terms of reference.....</u>	<u>7</u>
3 STUDY AREA	11
4 METHOD STATEMENT	11
<u>4.1.1 Limitations And Assumptions</u>	<u>11</u>
5 RESULTS.....	16
<u>5.1 Piggery Footprint (Portions 10 & 15).....</u>	<u>16</u>
<u>5.1.1 Ecological Condition.....</u>	<u>16</u>
<u>5.1.2 Wetland Potential</u>	<u>16</u>
<u>5.1.3 Flora Species Of Conservation Concern</u>	<u>16</u>
<u>5.1.4 Fauna Species Of Conservation Concern</u>	<u>16</u>
<u>5.2 Chicken Farm Footprints (Portions 8 & 9).....</u>	<u>21</u>
<u>5.2.1 Ecological Condition.....</u>	<u>21</u>
<u>5.2.2 Wetland Potential</u>	<u>21</u>
<u>5.2.3 Flora Species Of Conservation Concern</u>	<u>21</u>
<u>5.2.4 Fauna Species Of Conservation Concern</u>	<u>21</u>
6 CONCLUSION.....	25
7 REFERENCES	26
8 APPENDIX A – ABRIDGE CV, PRINCIPLE CONSULTANT	29
9 APPENDIX B – IMPORTANT FLORISTIC TAXA: CENTRAL SANDY BUSHVELD.....	31
10 APPENDIX C – GROUND BASED DIGITAL IMAGERY.....	34
<u>10.1 Piggery Footprint</u>	<u>34</u>
<u>10.2 Chicken Farm Footprints.....</u>	<u>36</u>
11 APPENDIX D – AERIAL BASED DIGITAL IMAGERY	39
<u>11.1 Piggery Footprint</u>	<u>39</u>
<u>11.2 Chicken Farm Footprints.....</u>	<u>41</u>
12 APPENDIX E – WETNESS INDEX OVERVIEW	43
13 APPENDIX F – KINIXYS LOBATSIANA THREATS.....	44
14 APPENDIX G – HABITAT LOSS AND FRAGMENTATION OVERVIEW	45

LIST OF FIGURES

Figure 1: Regional orientation of the proposed piggery and chicken farm, north of Brits – Northwest Province, South Africa	8
Figure 2: Piggery: National Environmental Screening Tool – Flora, Fauna &Terrestrial Biodiversity Themes	9
Figure 3: Chicken Farm: National Environmental Screening Tool – Flora, Fauna &Terrestrial Biodiversity Themes	10
Figure 4: Local orientation of the proposed animal production footprints	12
Figure 5: Regional vegetation (2018) and Northwest Biodiversity Sector Plan (2015) associated with the proposed animal production infrastructure	13
Figure 6: The land cover 2022 classification indicates that the study present natural grassland.....	14
Figure 7: Land change analysis of land cover classes between 1990 and 2022	15
Figure 8: Distribution of the randomly placed observation points across the study area with the SAGA wetness index in the background	17
Figure 9: Potential distribution and extent of outcrops (ridges) within the study area and surrounding landscape derived from 5 m contours.....	19
Figure 10: Old aerial image from 1959 of the study area and surrounding landscape (Approximate Study Area in Red).....	22
Figure 11: Old aerial image from 1996 of the study area and surrounding landscape (Approximate Study Area in Red).....	23
Figure 12: Google Earth Image from November 2018 showing the current status quo (Piggery footprint, Chicken Infrastructure footprints).....	24

LIST OF TABLES

Table 1: Overview of the three fauna species of conservation concern flagged for the piggery footprint. 18
Table 2: Overview of animal production footprints size relative to the property size..... 20

2 INTRODUCTION

Green Environmental Services (Pty) Ltd appointed EkolInfo CC to do a site verification survey of the flora, fauna and terrestrial biodiversity components based on the environmental screening tool results for the proposed piggery and chicken farm development on portions of the farm Blaauwbank 241, in the Northwest Province (Figure 1). The verification concerns the flora, fauna and terrestrial biodiversity themes (Figure 2, Figure 3).

2.1 Scope of work/ Terms of reference

The scope of work is based on the protocol for the specialist assessment and minimum report content requirements for environmental impacts with regards to the flora, fauna and terrestrial biodiversity¹.

This document concerns the site verification and minimum report content requirements, which require the following:

- “Prior to commencing with a specialist assessment, the current use of the land and the potential environmental sensitivity of the site under consideration as identified by the screening tool must be confirmed by undertaking a site sensitivity verification.
- 2.1. The site sensitivity verification must be undertaken by an environmental assessment practitioner or a specialist.
- 2.2. The site sensitivity verification must be undertaken through the use of:
 - (a) a desk top analysis, using satellite imagery;
 - (b) a preliminary on-site inspection; and
 - (c) any other available and relevant information.
- 2.3. The outcome of the site sensitivity verification must be recorded in the form of a report that:
 - (a) confirms or disputes the current use of the land and environmental sensitivity as identified by the screening tool;
 - (b) contains a motivation and evidence (e.g. photographs) of either the verified or different use of the land and environmental sensitivity; and
 - (c) is submitted together with the relevant assessment report prepared in accordance with the requirements of the Environmental Impact Assessment Regulations.”

Willem de Frey, a registered scientific professional in the fields of ecological – and botanical science with more than 25 years’ experience facilitated the study. The site visit was done on the 3rd of July 2025.

¹ <https://www.sanbi.org/news/national-protocols-and-guidelines-standardise-requirements-for-specialist-studies-in-eias/>

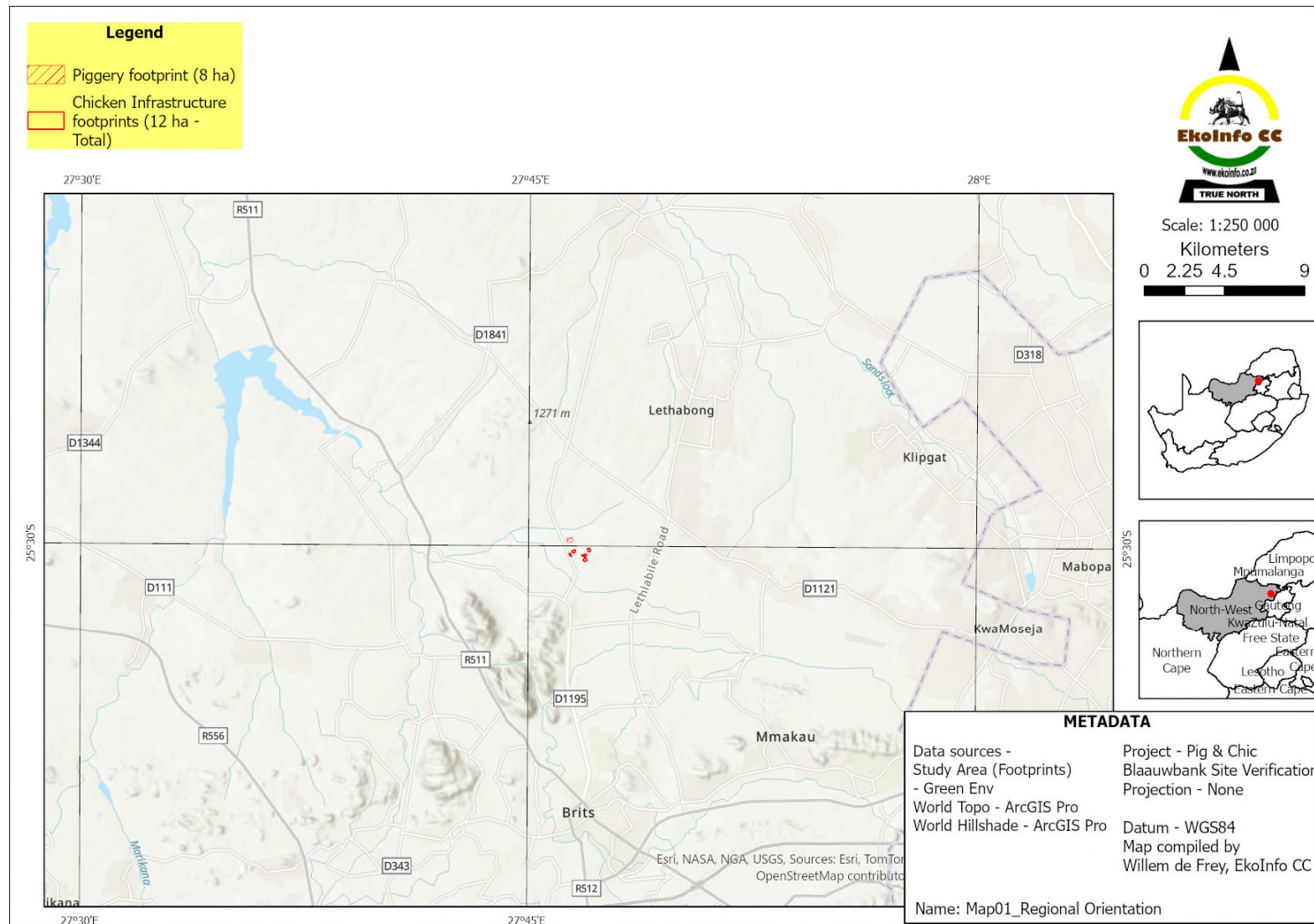


Figure 1: Regional orientation of the proposed piggery and chicken farm, north of Brits – Northwest Province, South Africa

MAP OF RELATIVE PLANT SPECIES THEME SENSITIVITY



Where only a sensitive plant unique number or sensitive animal unique number is provided in the screening report and an assessment is required, the environmental assessment practitioner (EAP) or specialist is required to email SANBI at eladatarequests@sanbi.org.za listing all sensitive species with their unique identifiers for which information is required. The name has been withheld as the species may be prone to illegal harvesting and must be protected. SANBI will release the actual species name after the details of the EAP or specialist have been documented.

Very High sensitivity	High sensitivity	Medium sensitivity	Low sensitivity
			x

Sensitivity Features:

Sensitivity	Feature(s)
Low	Low Sensitivity

A – Relative Plant Species Theme Sensitivity

MAP OF RELATIVE ANIMAL SPECIES THEME SENSITIVITY



Where only a sensitive plant unique number or sensitive animal unique number is provided in the screening report and an assessment is required, the environmental assessment practitioner (EAP) or specialist is required to email SANBI at eladatarequests@sanbi.org.za listing all sensitive species with their unique identifiers for which information is required. The name has been withheld as the species may be prone to illegal harvesting and must be protected. SANBI will release the actual species name after the details of the EAP or specialist have been documented.

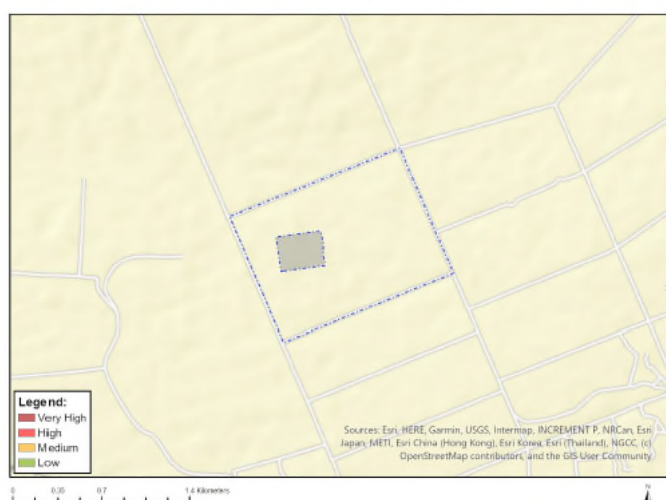
Very High sensitivity	High sensitivity	Medium sensitivity	Low sensitivity
		x	

Sensitivity Features:

Sensitivity	Feature(s)
Medium	Aves-Podica senegalensis
Medium	Mammalia-Dasyatis robertsii
Medium	Reptilia-Kinixys lobatiana

B – Relative Animal Species Theme Sensitivity

MAP OF RELATIVE TERRESTRIAL BIODIVERSITY THEME SENSITIVITY



Very High sensitivity	High sensitivity	Medium sensitivity	Low sensitivity
x			

Sensitivity Features:

Sensitivity	Feature(s)
Very High	CBA 1

C – Relative Terrestrial Biodiversity Theme Sensitivity

Figure 2: Piggery: National Environmental Screening Tool – Flora, Fauna & Terrestrial Biodiversity Themes

MAP OF RELATIVE PLANT SPECIES THEME SENSITIVITY



Where only a sensitive plant unique number or sensitive animal unique number is provided in the screening report and an assessment is required, the environmental assessment practitioner (EAP) or specialist is required to email SANBI at eiadatarequests@sanbi.org.za listing all sensitive species with their unique identifiers for which information is required. The name has been withheld as the species may be prone to illegal harvesting and must be protected. SANBI will release the actual species name after the details of the EAP or specialist have been documented.

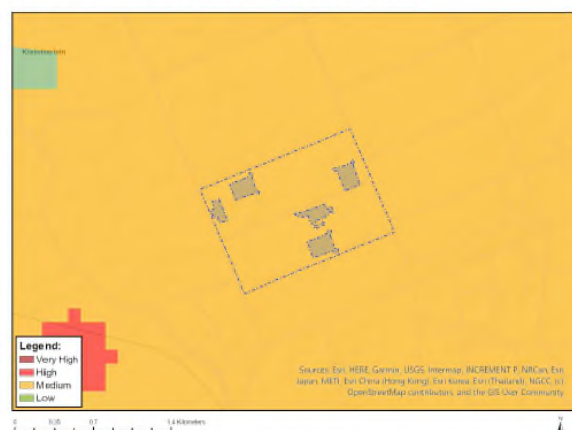
Very High sensitivity	High sensitivity	Medium sensitivity	Low sensitivity
			X

Sensitivity Features:

Sensitivity	Feature(s)
Low	Low Sensitivity

A – Relative Plant Species Theme Sensitivity

MAP OF RELATIVE ANIMAL SPECIES THEME SENSITIVITY



Where only a sensitive plant unique number or sensitive animal unique number is provided in the screening report and an assessment is required, the environmental assessment practitioner (EAP) or specialist is required to email SANBI at eiadatarequests@sanbi.org.za listing all sensitive species with their unique identifiers for which information is required. The name has been withheld as the species may be prone to illegal harvesting and must be protected. SANBI will release the actual species name after the details of the EAP or specialist have been documented.

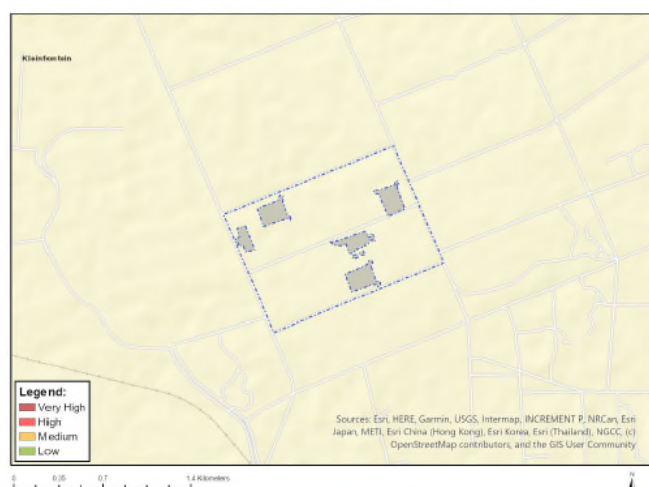
Very High sensitivity	High sensitivity	Medium sensitivity	Low sensitivity
		X	

Sensitivity Features:

Sensitivity	Feature(s)
Medium	Mammalia-Dasyatis robertsii
Medium	Reptilia-Kinixys lobatsiana

B – Relative Animal Species Theme Sensitivity

MAP OF RELATIVE TERRESTRIAL BIODIVERSITY THEME SENSITIVITY



Very High sensitivity	High sensitivity	Medium sensitivity	Low sensitivity
X			

Sensitivity Features:

Sensitivity	Feature(s)
Very High	CBA 1

C – Relative Terrestrial Biodiversity Theme Sensitivity

Figure 3: Chicken Farm: National Environmental Screening Tool – Flora, Fauna & Terrestrial Biodiversity Themes

3 STUDY AREA

The proposed agricultural activities (animal production) are located on portions of the farm Blaauwbank 241 (Figure 4). It is evident that the study area is located within an agricultural landscape. On a regional scale it is associated with a single regional vegetation unit, namely Central Sandy Bushveld (Figure 5). The conservation status of this regional vegetation unit on a national scale is Least Concern.

The footprints of the proposed animal production infrastructure are located within Critical Biodiversity Areas (CBA2) and Ecological Support Areas (ESA1) (Figure 5).

According to the 2022 land cover classification, the study area represents a mosaic of Natural Wooded Land and Natural Grassland (Figure 6). Limited change occurred in the footprints since 1990, which imply it mainly represents persistent natural vegetation (**Error! Reference source not found.**).

4 METHOD STATEMENT

Willem de Frey a registered professional scientist in the field of ecological – and botanical science did a site visit on the 3rd of July 2025 Systematic sites were selected within the proposed chicken farm expansion development site using GIS software. At each of the sites the status of the vegetation was documented:

1. Natural or Cultivated
2. If natural a species list was compiled.

In addition, the soil form was documented to provide context to why the area was cultivated or not.

Georeferenced digital images were taken with ground and aerial based remote sensor. The ground-based images were documented using a Garmin Montana 680 GPS receiver. The aerial-based images were taken with a DJI Mavic Air drone. Images were taken in all four major wind directions, as well as video imagery in a 360° panoramic view.

4.1.1 Limitations And Assumptions

1. This study represents a site verification assessment in accordance with the national environmental screening tool guidelines. It does not represent a full EIA assessment that could be used in a BAP or Scoping-EIA process.
2. Only qualitative data was collected
3. It is assumed that information from third parties (engineers, government institutions) are accurate.

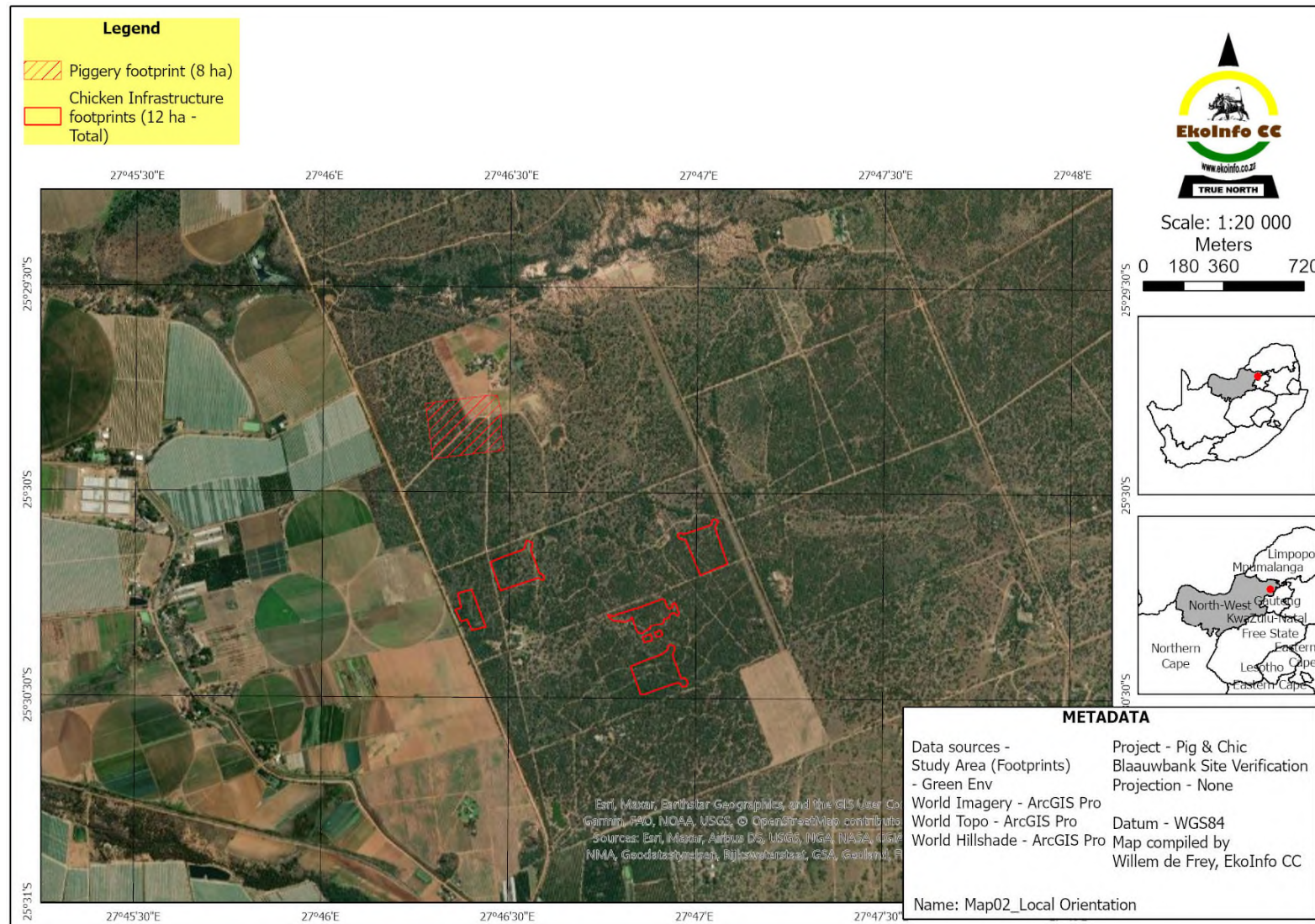


Figure 4: Local orientation of the proposed animal production footprints

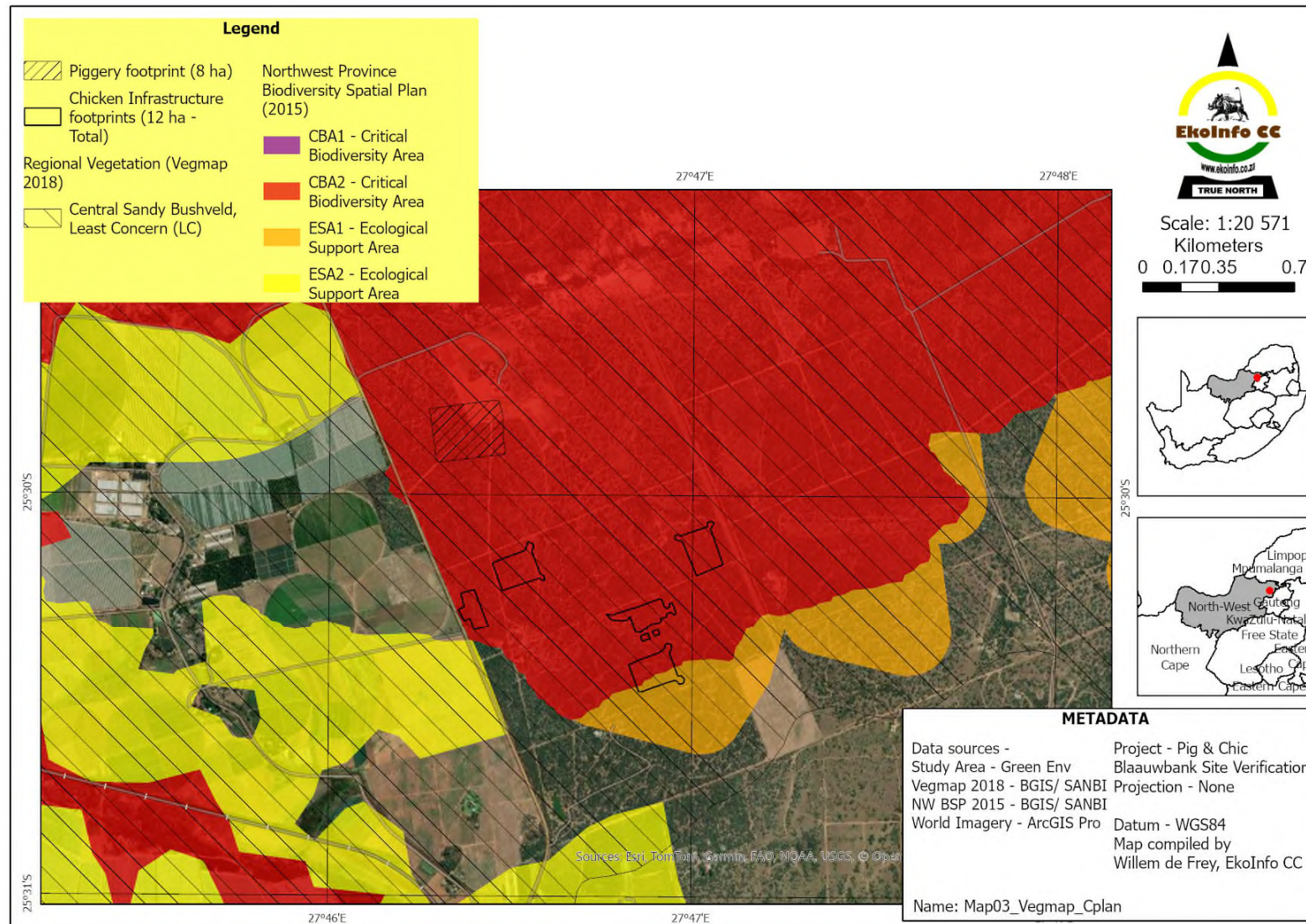


Figure 5: Regional vegetation (2018) and Northwest Biodiversity Sector Plan (2015) associated with the proposed animal production infrastructure

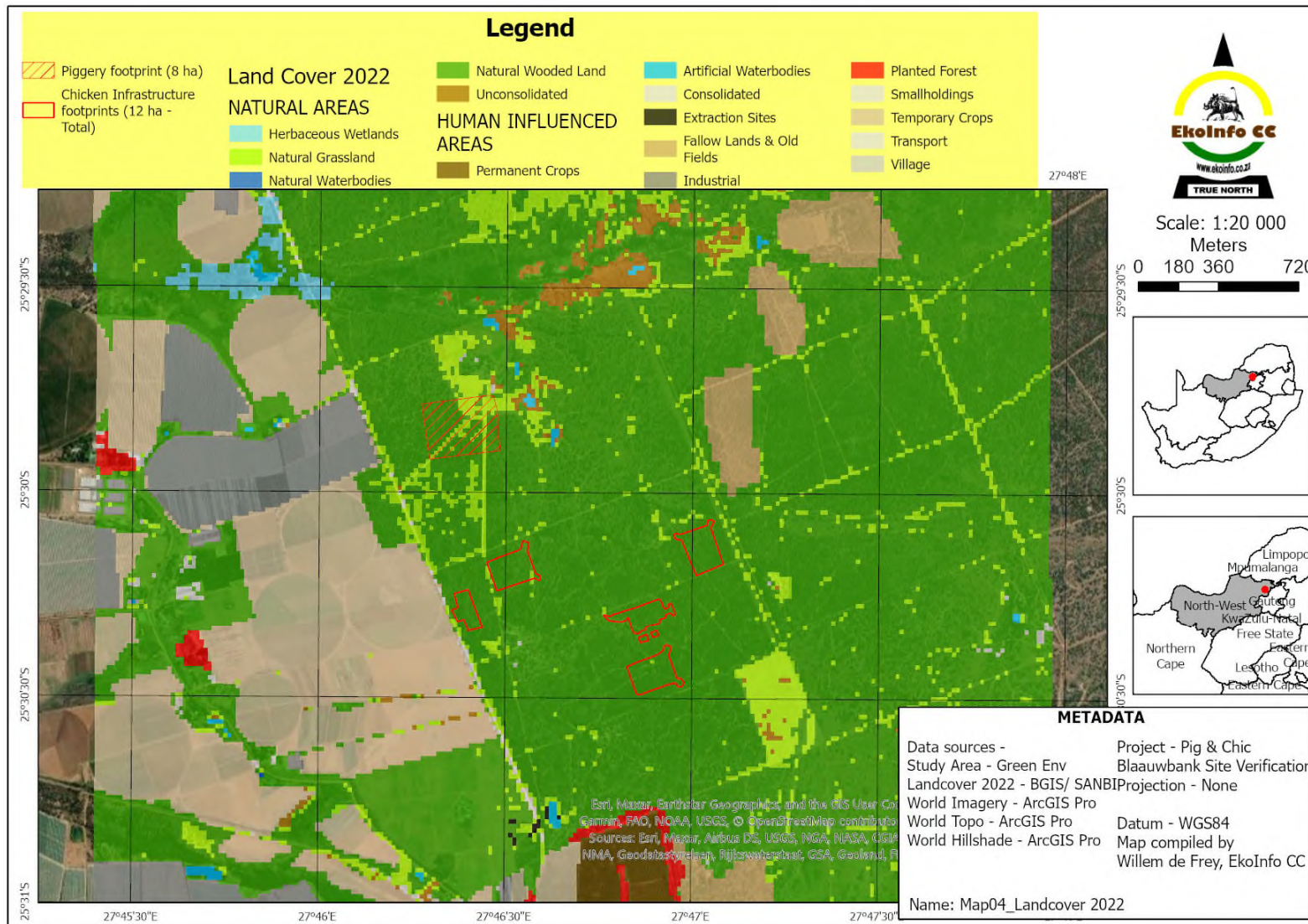


Figure 6: The land cover 2022 classification indicates that the study present natural grassland.

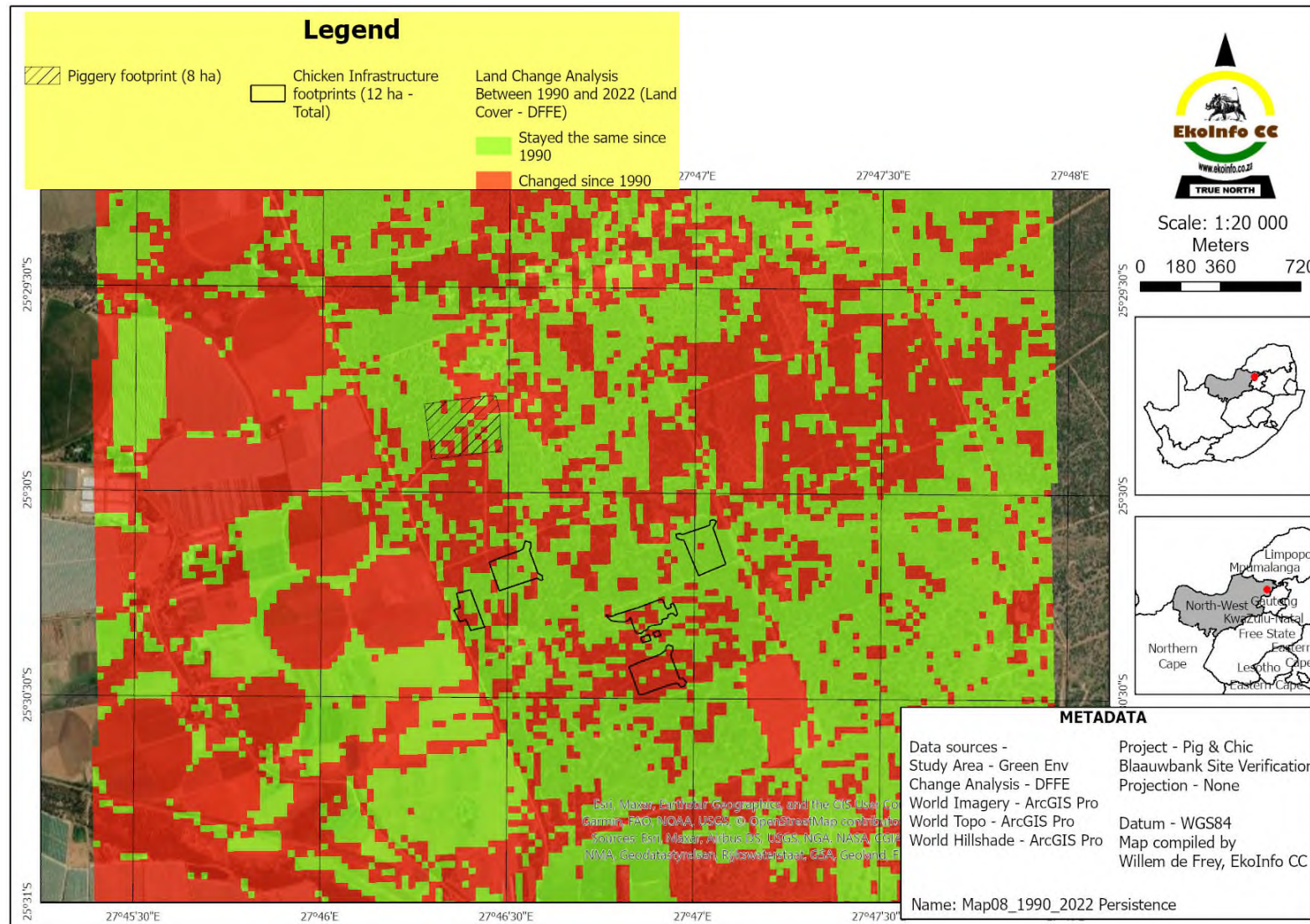


Figure 7: Land change analysis of land cover classes between 1990 and 2022

5 RESULTS

5.1 Piggery Footprint (Portions 10 & 15)

5.1.1 Ecological Condition

Two plots were sampled within the piggery footprint (Figure 8), namely plot AP01 and AP02. Appendix B lists the plant species observed within these two plots, which links the study area to the regional vegetation unit. Appendix C (10.1) shows the georeferenced ground-based observations, while Appendix D (11.1) shows the georeferenced air-based observations. Both datasets confirm the undisturbed/ intact nature of the vegetation within the piggery footprint, except for the northeast corner which cuts into a cultivated field (Figure 4)

5.1.2 Wetland Potential

The SAGA wetness index model (Appendix E) which indicates the potential for wetlands to be present, indicated that there is a very low and low potential for wetlands to be present within the piggery footprint. The site verification confirmed that there are no wetlands within this area, as the soil profile represent the Clovelly soil form with a depth range of 800 mm to 1000 mm, and 11% estimated clay content in the topsoil. The Clovelly soil form is not associated with wetland conditions (DWAf 2005).

5.1.3 Flora Species Of Conservation Concern

The screening report does (Figure 2) not list any plant species of concern for the area. However, the important taxa listed in Appendix B, does contain a nationally protected tree, namely *Sclerocarya birrea* subsp. *caffra* (Marula). No individuals were recorded within the plots surveyed, but it is possible that they could be present within the broader footprint.

A permit is required for the removal/ destruction/ pruning of this species and any other national protected trees that might be present.

5.1.4 Fauna Species Of Conservation Concern

The screening report rates the animal species theme sensitivity as medium, based on the potential presence of three fauna species (Table 1): *Podica senegalensis* (Aves), *Dasymys robertsii* (Mammalia) and *Kinixys lobatsiana* (Reptilia).

Two of the species are associated with aquatic ecosystems (rivers and wetlands), namely the bird *Podica senegalensis* and the mammal *Dasymys robertsii*, for which no habitat occurs within the piggery footprint. *Podica senegalensis* requires open water as found within rivers and waterbodies (Table 1), no open waterbodies are present within the piggery footprint or within the immediate landscape (Figure 4). *Dasymys robertsii* requires wetlands which does occur within the immediate landscape but not in the footprint of the piggery (Figure 4, Figure 8).

The third species, the reptile *Kinixys lobatsiana*, has the highest probability to occur within the landscape, but requires outcrops (ridges) (Figure 9). This species main threat is habitat loss, but other land use practices can also have a negative influence on its populations (Appendix F).

However, the small footprint (8 ha) of the piggery within the properties (portion 10 and 15) (Table 2) and in the broader landscape towards the east of the study area will have a very low risk to any of the fauna, with specific reference to the tortoise in terms of habitat loss or habitat fragmentation (Appendix G). The piggery footprint will contribute less than 10% of the properties in which it is located, and clearly even less on a landscape level, with specific reference to the tortoise (reptile) where fragmentation becomes an issue at 30% and more (Appendix G).

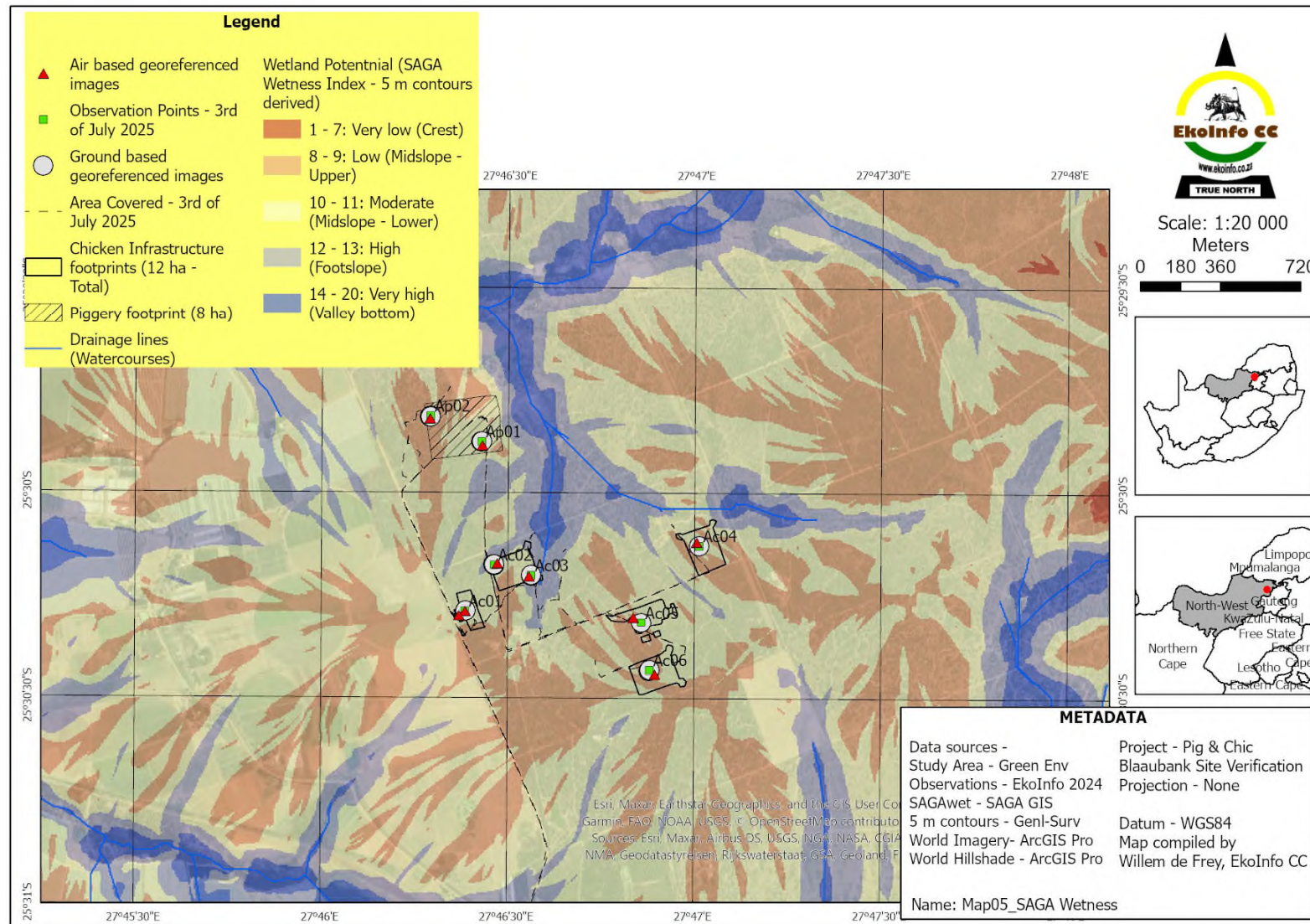


Figure 8: Distribution of the randomly placed observation points across the study area with the SAGA wetness index in the background

Table 1: Overview of the three fauna species of conservation concern flagged for the piggery footprint

Species	Class	Common Name	Habitat Preference	Associated with Central Sandy Bushveld in Northwest Province?
Podica senegalensis	Aves	African Finfoot	Gently flowing streams with overhanging vegetation. Found along rivers and streams, particularly in low-lying parts of northern and eastern South Africa.	Yes, recorded on rivers in the Northwest Province.
Dasymys robertsii	Mammalia	Robert's Marsh Rat	Intact wetland ecosystems, specifically in reed beds and among semi-aquatic grasses in wetlands, swampy areas, or along rivers and streams, as well as in grassy areas close to water. Does not occur in artificial or degraded wetlands.	Yes, approximately 40% of its associated habitat in one study was Central Sandy Bushveld. Also recorded as a new species for the Northwest Province.
Kinixys lobatsiana	Reptilia	Lobatse Hinged Tortoise	Savanna species inhabiting rocky hillsides in habitats of mixed Acacia and Combretum woodland, tropical Bushveld, and Thornveld, where vegetation ranges from dense, short shrubland to open tree savanna. Also found in open savanna habitats with low shrubs.	Yes, the species' distribution includes Central Sandy Bushveld in the Northwest Province.

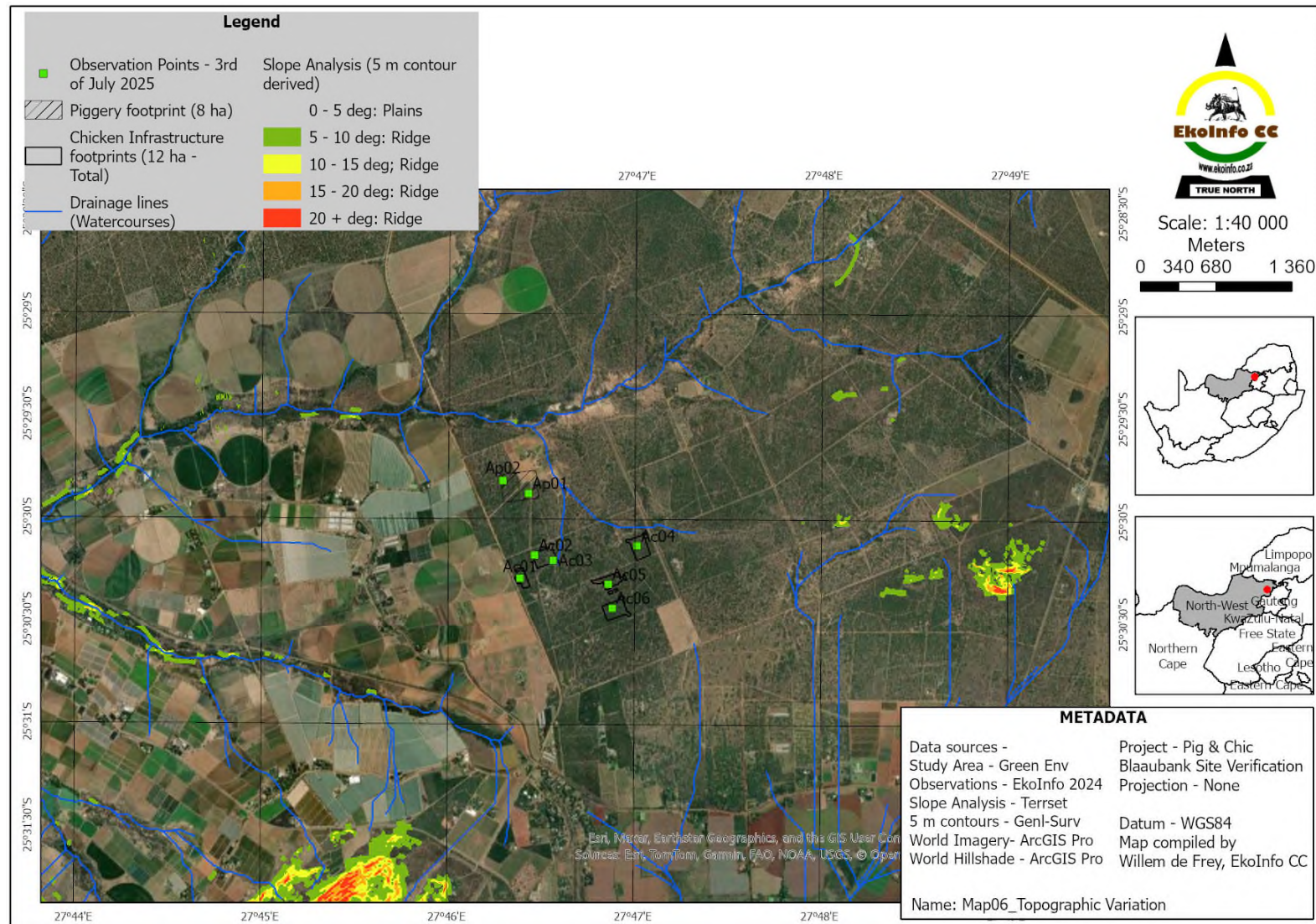


Figure 9: Potential distribution and extent of outcrops (ridges) within the study area and surrounding landscape derived from 5 m contours

Table 2: Overview of animal production footprints size relative to the property size

Footprint Property	Surface Area (ha)	Footprint extent (ha)	% of property	Note
Piggery Property	127	8	6%	Single footprint
Chicken Farm Property	115	12	10%	Seven footprints – mean size: 2 ha

5.2 Chicken Farm Footprints (Portions 8 & 9)

5.2.1 Ecological Condition

Six plots were sampled across the chicken farm infrastructure footprints (Figure 8), namely plot AC01 to AC06. Appendix B lists the plant species observed within these six plots, which links the study area to the regional vegetation unit. Appendix C (10.2) shows the georeferenced ground-based observations, while Appendix D (11.2) shows the georeferenced air-based observations. Both datasets confirm the undisturbed/ intact nature of the vegetation within the chicken farm infrastructure footprints (Figure 4). AC06 does indicate that change occurred but it was from dense vegetation to more open natural vegetation. In essence no cultivation related activities occurred within these areas since 1959 (Figure 10, Figure 11, Figure 12).

5.2.2 Wetland Potential

The SAGA wetness index model (Appendix E), which indicates the potential presence of wetlands, suggested a high likelihood of wetlands occurring at observation plots AC02 and AC03. However, the soil profiles at all six surveyed plots, including AC02 and AC03, were consistently classified as Clovelly soil form, with a depth ranging between 800 mm and 1,200 mm and an estimated 11% clay content in the topsoil. According to DWAF (2005), the Clovelly soil form is not typically associated with wetland conditions.

At plots AC02 and AC03, a thin, soft plinthic or wetness-indicating layer was observed at approximately 600 mm below the surface. Despite this, the profile below this layer transitioned into deep yellow-brown apedal B horizons, similar to the other plots. This wetness layer may suggest that during periods of good rainfall, the soil profile could become temporarily saturated up to 600 mm deep. This is likely due to the low slope, which favours infiltration over runoff, as well as the coarse soil texture, which further promotes water infiltration. No marked difference in plant species composition could be noticed at these plots from the other plots, except for an increase in *Terminalia sericea* and *Cheilanthes viridis* individuals. Neither of these two species are known as wetland related species, but are referred to as terrestrial species.

5.2.3 Flora Species Of Conservation Concern

The screening report does (Figure 3) not list any plant species of concern for the area. However, the important taxa listed in Appendix B, does contain a nationally protected tree, namely *Sclerocarya birrea* subsp. *caffra* (Marula). Marula individuals were recorded in the observation plots associated with the chicken farm infrastructure footprints. At AC03, an additional national protected tree *Boscia albitrunca* and provincial protected tree *Spirostachys africana* was observed.

A permit is required for the removal/ destruction/ pruning of this species and any other national protected trees that might be present. The owner of the land does not require a permit to pick provincial protected plants, only special protected plants which belong to the genus *Encephalartos*.

5.2.4 Fauna Species Of Conservation Concern

The screening report rates the animal species theme sensitivity as medium, based on the potential presence of two fauna species (Table 1): *Dasymys robertsii* (Mammalia) and *Kinixys lobatsiana* (Reptilia).

The mammal *Dasymys robertsii* requires wetlands which does occur within the immediate landscape but not in the footprint of the chicken farm infrastructure footprints (Figure 4, Figure 8).

The second species, the reptile *Kinixys lobatsiana*, has the highest probability to occur within the landscape, but requires outcrops (ridges) (Figure 9). This species main threat is habitat loss, but other land use practices can also have a negative influence on its populations (Appendix F).

However, the small cumulative footprint (12 ha – mean 2 ha) of the chicken farm infrastructure footprints within the properties (portion 8 and 9) (Table 2) and in the broader landscape towards the east of the study area will have a very low risk to any of the fauna, with specific reference to the tortoise in terms of



Figure 10: Old aerial image from 1959 of the study area and surrounding landscape (Approximate Study Area in Red)

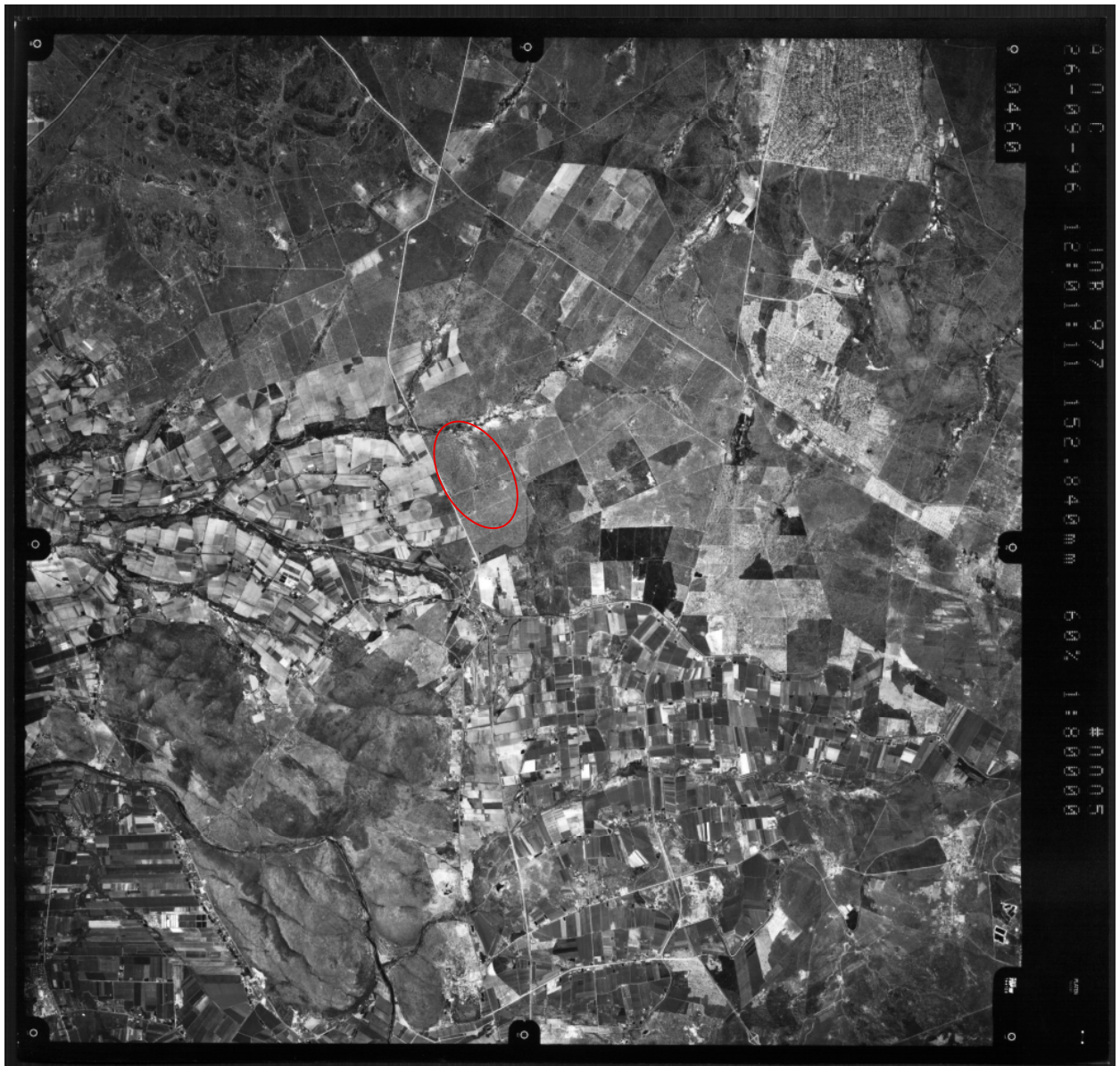


Figure 11: Old aerial image from 1996 of the study area and surrounding landscape (Approximate Study Area in Red)

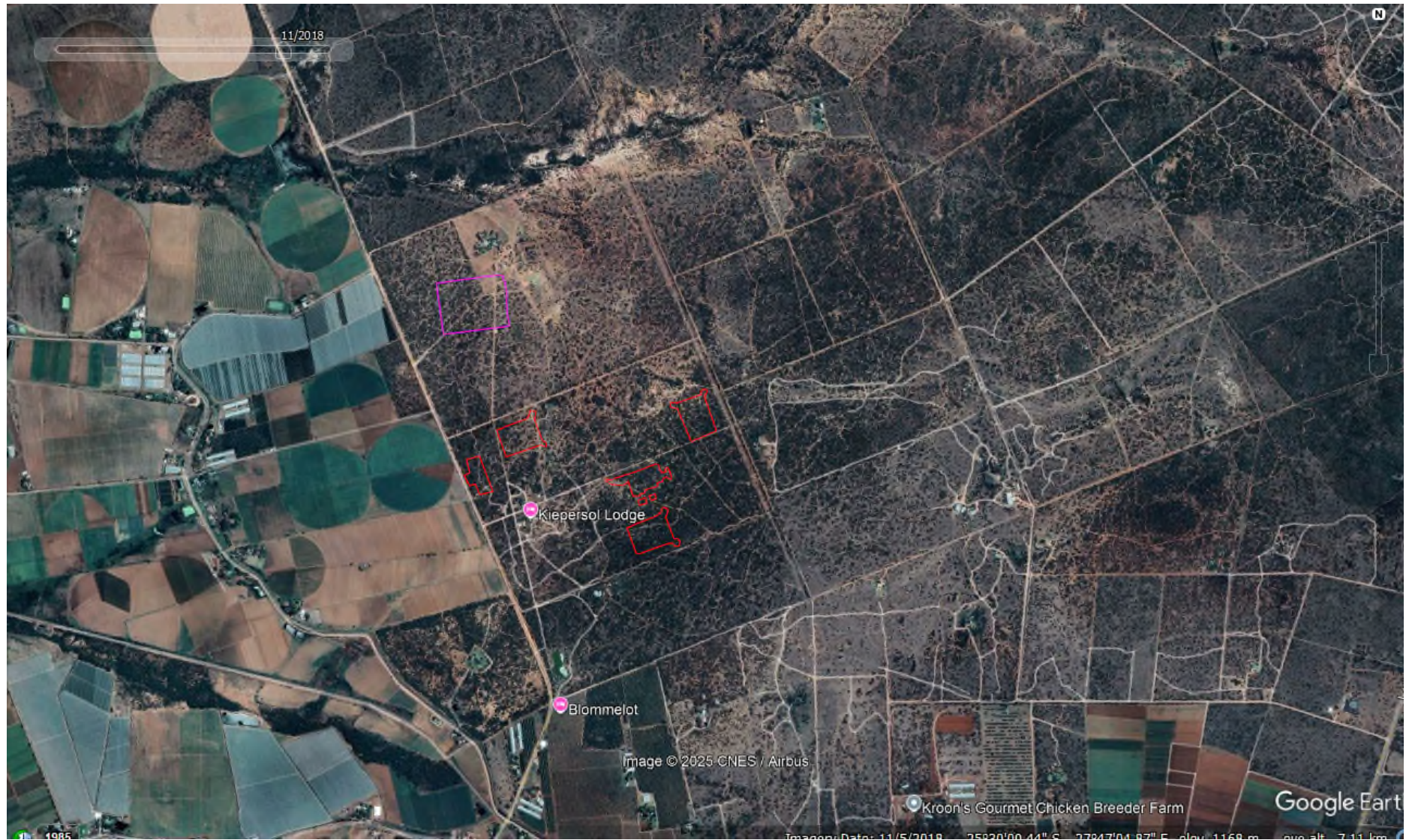


Figure 12: Google Earth Image from November 2018 showing the current status quo (**Piggery footprint**, **Chicken Infrastructure footprints**)

habitat loss or habitat fragmentation (Appendix G). The chicken farm infrastructure footprints cumulatively contribute to 10% of the properties in which it is located, and clearly even less on a landscape level, with specific reference to the tortoise (reptile) where fragmentation becomes an issue at 30% and more (Appendix G).

6 CONCLUSION

The footprints of the proposed animal production activities, namely a piggery and chicken farm are located within persistent climax natural vegetation, with a low sensitivity rating according to the screening tool. Based on the absence of topographic and pedological variation and subsequent plant diversity, this low sensitivity is supported. The overall vegetation would represent a *Sclerocarya birrea* – *Combretum apiculatum*/ *Peltophorum africanum* woodland community on well drained coarse textured soils (Clovelly) in a flat (plains) landscape within the Least Concern Central Sandy Bushveld regional vegetation unit. Two national protected trees, Marula and Shepard Tree had been observed, as well as a single provincial protected tree Tamboti. All of these species threat status is Least Concern²

Of the three fauna species of conservation no habitat occurs within the footprints, as two of the species are associated with aquatic ecosystems namely open water or wetland in a pristine state, and the third species, the tortoise requires outcrops which occur in the landscape, but not in the footprints. The localised nature and small extent of these footprints contribute to limit habitat loss and no habitat fragmentation; there is enough intact vegetation for any fauna species to move around the proposed infrastructure. Therefore, with regards to the study area (footprints) and immediate landscape the medium sensitivity state of animal theme should rather be low, and no additional studies are required.

The Critical Biodiversity Area (CBA) status on provincial level has relevance as the area has been untransformed as far back as the 1959 (available records), there is protected trees present albeit with a Least Concern threat status, and the area can support a variety of wildlife, not within the properties specifically, but as part of the larger landscape. However due to the extensive human influence (cultivation, human settlements) in the broader landscape (Figure 11), this potential is limited, and therefore the very high sensitivity for the terrestrial biodiversity should be low with regards the proposed infrastructure footprints, unless the broader remaining natural landscape can be consolidated.

In consideration of the precautionary principle as contained within the National Environmental Management Act, it is recommended that the following footprints are shifted at least 32 m:

1. Piggery footprint towards the west
2. Chicken infrastructure footprint associated with AC02 and AC)3 towards the southwest.

² <https://redlist.sanbi.org>

7 REFERENCES

- BARBOUR, M.G.BURK, J.H. & PITTS, W.D. 1980. Terrestrial Plant Ecology. Benjamin/Cummings Publishing Company, California.
- BROMILOW. C. 2010. Probleemplanten en Indringeronkruiden van Suid - Afrika. Briza Publikasies BK
- BROWN, L.R., DU PREEZ, P.J., BEZUIDENHOUT, H., BREDENKAMP, G.J., MOSTERT, T.H.C. & COLLINS, N.B., 2013, 'Guidelines for phytosociological classifications and descriptions of vegetation in southern Africa', Koedoe 55(1), Art. #1103, 10 pages. <http://dx.doi.org/10.4102/koedoe.v55i1.1103>
- BOTHMA, J du P. 1995. Wildspasbestuur Nuwe uitgebreide uitgawe. 2de Uit. Struik Uitgewers
- COATES-PALGRAVE, M. 2002. Keith Coates-Palgrave Trees of Southern Africa, 3 rd edn, 2nd imp. Struik Publishers, Cape Town
- COWAN, G.I. (ed) 1995. Wetlands of South Africa. Department of Environmental Affairs and Tourism, Pretoria
- DE FREY, W.H. 1999. PHYTOSOCIOLOGY OF SOUTHEASTERN MPUMALANGA HIGH ALTITUDE GRASSLANDS. MSc. Thesis, University of Pretoria.
- DWAF. 2005. A practical field procedure for identification and delineation of wetlands and riparian areas. Department of Water Affairs and Forestry
- DYER, C. (Director) (2014) New names for the African Acacia species in Vachellia and Senegalia , Southern Forests: a Journal of Forest Science, 76:4, iii-iii, DOI: 10.2989/20702620.2014.980090
- EDWARDS, D. 1983. A broad-scale structural classification of vegetation for practical purposes. Bothalia 14, 3 & 4: 705 - 712.
- EWART-SMITH, J., OLLIS, D., DAY, J & MALAN, H 2006. NATIONAL WETLAND INVENTORY: Development of a Wetland Classification System for South Africa. The Water Research Commission (WRC)
- FEY, M. 2010. Soils of South Africa. Cambridge
- FORMAN, R.T.T., SPERLING, D., BISSONETTE, J.A., CLEVINGER, A.P., CUTSHALL, C.D., DALE, V.H., FAHRIG, L., FRANCE, R., GOLDMAN, C.R., HEANUE, K., JONES, J.A., SWANSON, F.J., TURRENTINE, T., WINTER, T.C. 2003. ROAD ECOLOGY Science and Solutions. Island Press.
- GERMISHUIZEN, G & MEYER, N.L. (eds) 2003. Plants of southern Africa: an annotated checklist. Strelitzia 14. National Botanical Institute, Pretoria.
- GIBBS RUSSELL, G.E., WATSON, L., KOEKEMOER, M., SMOOK, L. BARKER, N.P., ANDERSON, H.M. & DALWITZ, M.J. 1990. GRASSES OF SOUTHERN AFRICA. National Botanical Gardens, South Africa
- GDARD. 2014. GDARD REQUIREMENTS FOR BIODIVERSITY ASSESSMENTS VERSION 3. Department Of Agriculture, Conservation And Environment Directorate Of Nature Conservation. Enquiries: Phuti.Matlamela@gauteng.gov.za SCIENTIFIC SERVICES
- GOLDING, J (Ed.s), 2002. Southern African Plant Red Data Lists. Sabonet Report no. 14. Southern African Botanical Diversity Network. Pretoria
- HENNEKENS, S.M. 1996. TURBO(VEG) Software package for input, processing, and presentation of phytosociological data. User's guide. University of Lancaster.

- HILTY, J.A., LIDICKER JR., W.Z. & MERENLENDER, A.M. 2006. CORRIDOR ECOLOGY The Science and Practice of Linking Landscapes for Biodiversity Conservation. Island Press
- JOHNSON, M.R., ANHAEUSSER, C.R. & THOMAS, R.J. (Eds) 2006. The Geology of South Africa. Geological Society of South Africa, Johannesburg/ Council of Geoscience, Pretoria, 691 pp
- KENT, M. & COKER, P. 1992. Vegetation Description and Analysis: A practical Approach. John Wiley & Sons, Chichester
- KRUGER, G.P. 1983. 1: 2 500 000 scale. Terrain morphological map of southern Africa Soil & Irrigation Institute. Dept. of Agriculture.
- LAND TYPE SURVEY STAFF. 1985. Land types of the maps 2628 East Rand, 2630 Mbabane. Mem. agric. nat. Resour. S. Afr. No. 5
- LAND TYPE SURVEY STAFF. 1987. Land types of the maps 2526 Rustenburg, 2528 Pretoria. Mem. agric. nat. Resour. S. Afr. No. 8
- LE ROUX, J. 2002. The Biodiversity of South Africa 2002 Indicators, Trends and Human Impacts. Endangered Wildlife Trust
- LEISTNER, O.A. (ed) 2000. Seed plants of southern Africa: families and genera. Strelitzia 10. National Botanical Institute, Pretoria
- LINDENMAYER, D.B. & FISCHER, J. 2006. Habitat Fragmentation And Landscape Change An Ecological And Conservation Synthesis. Island Press, USA
- MC MURTY, D., GROBLER, L, GROBLER, J. & BURNS, S. 2008. Field Guide to the ORCHIDS of Northern South Africa and Swaziland. Umdaus Press, Hatfield
- McCARTHY, T. & RUBIDGE, B. 2005. The Story Of EARTH & LIFE A southern African perspective on a 4.6-billion-year journey. Struik Publishers
- MUCINA, L. & RUTHERFORD, M.C. (eds) 2006. The vegetation of South Africa, Lesotho and Swaziland. Strelitzia 19. South African National Biodiversity Institute, Pretoria.
- NEL, J., MAREE, G., ROUX, D., MOOLMAN, J., KLEYNHANS, N., SILBERBAUER, M. & DRIVER, A. 2004. South African National Spatial Biodiversity Assessment 2004: Technical Report. Volume 2: River Component. CSIR Report Number ENV-S-I-2004-063. Council for Scientific
- NEL, J.L., DRIVER, A., STRYDOM, W.F., MAHERRY, A., PETERSEN, C., HILL, L., ROUX, D.J., NIENABER, S., VAN DEVENTER, H., SWARTZ, E., & SMITH-ADAO, L.B. 2011. Atlas of Freshwater Ecosystem Priority Areas in South Africa: Maps to support sustainable development of water resources. WRC Report No. TT 500/11
- READ, H.H. & WATSON, J. 1983. Introduction to Geology Volume 1 PRINCIPLES. Macmillan Press Ltd, Hong Kong
- NORMAN, N. & WHITFIELD, G. 2006. A traveller's guide to South Africa's rocks and landforms Geological Journeys. Struik Publishers
- RETIEF, E. & HERMAN, P.P.J. 1997. Plants of the northern provinces of South Africa: keys and diagnostic characters. Strelitzia 6: 1 – 681.
- ROUGET, M., REYERS, B., JONAS, Z., DESMET, P., DRIVER, A., MAZE, K., EGOH, B. & COWLING, R.M. 2004. South African National Spatial Biodiversity Assessment 2004: Technical Report. Volume 1: Terrestrial Component. Pretoria: South African National Biodiversity Institute.
- SMIT, N. 2008. Field Guide to the Acacias of South Africa. Briza Publications

- SOIL CLASSIFICATION WORKGROUP 1991. Soil classification a taxonomic system for South Africa. Memiors oor die Natuurlike Landbouhulpbronne van Suid-Afrika Nr. 15.
- STRAHLER, A.N. & STRAHLER, A.H. 1987. Modern Physical Geography Third Edition. Wiley & Sons, New York
- STRAHLER, A.N. 1962. Physical Geography. John Wiley & Sons, New York
- TAINTON, N. 1999. Veld Management in South Africa. University of Natal Press
- TURNER, M.G., GARDNER, R.H., & O'NEILL, R.V. 2001. Landscape Ecology In Theory And Practice Pattern And Process. Springer, USA
- VAN ANDEL, J & ARONSON, J (Eds). 2006. RESTORATION ECOLOGY - The New Frontier. Blackwell Publishing
- VAN OUDTSHOORN, F.P. 1991. Gids tot grasse van Suid-Afrika. Briza Publikasies Bk. Arcadia.
- VAN WYK, A.E. & SMITH, G.F. 2001. Regions of Floristic Endemism in Southern Africa. Umदाus Press, Hatfield
- VAN WYK, B. & MALAN, S. 1988. Veldgids tot die veldblomme van die Witwatersrand- & Pretoria-gebied. Struik Uitgewers, Kaapstad.
- VAN WYK, B-E., VAN OUDTSHOORN, B. & GERICKE, N. 2000. Medicinal Plants of South Africa. Briza
- VAN WYK, B. & VAN WYK, P. 1997. Field Guide to Trees of Southern Africa. Struik Nature, Cape Town
- VAN WYK, B., VAN WYK, P. & VAN WYK, B-E. 2000. Photo Guide to Trees of Southern Africa. Briza Publications
- VILJOEN, M.J. & REIMOLD, W.U. 1999. An Introduction to South Africa's Geological and Mining Heritage. Mintek
- WHITE, R.E. 1987. Introduction to the Principles and Practice of Soil Science. Blackwell Scientific Publications, Australia
- WIENS, J.A., MOSS, M.R., TURNER, M.G. & MLADENOFF, D.J. 2006. Foundation Papers In Landscape Ecology. Columbia University Press, New York

8 APPENDIX A – ABRIDGE CV, PRINCIPLE CONSULTANT

Name of firm: EkolInfo cc Environmental and Wildlife Management Consultancy

Name of staff: WILLEM HENDRIK DE FREY

Profession: Environmental and Wildlife Management consultant

Years with firm: Since 1995

Nationality: RSA

Membership of professional societies:

The South African Council for Natural Scientific Professions (Reg no 400100/02)

Categories: Botanical Science and Ecological Science

Currently in the process of affiliating to:

South African Association of Botanist (SAAB)

Grassland Society of Southern Africa

South African Institute of Ecologist and Environmental Scientists (SAIE)

KEY QUALIFICATIONS:

Mr W de Frey has been involved in the discipline of ecology since 1989. During this period he prepared himself for a profession in environmental and wildlife management, by attending courses in chemistry, geology, pedology and statistics, while majoring in Botany and Zoology. His working knowledge was obtained while completing projects for his post-graduate studies in wildlife management in both the Savanna and Grassland Biomes. In addition to his academic publications, he has contributed to numerous reports regarding EMPR's, EIA's, vegetation - and soil surveys and monitoring since the registration of his own consultation close corporation in 1995. He is actively involved in the management and marketing of his close corporation while completing tasks in his field of expertise namely soil, vegetation science and Geographical Information Systems. Mr W de Frey is task orientated with consideration of people's needs and safety. He believes in a holistic approach to environmental and wildlife management and has therefore established a network with individuals in related fields. He is also assisting previously disadvantaged persons in establishing a presence in the environmental industry, namely Lordwick Makhura of Baagi Environmental Consultancy CC and a joint venture company Bonolo Biodiversity And Environmental Management consisting of Baagi Environmental Consultancy CC and Disa Mphago Community Helpers CC.

EDUCATION:

1992 BSc Botany & Zoology, University of Pretoria

Course	Content	Level
Chemistry	Organic and Inorganic chemistry	1 st year
Geology	Introduction/ Geomorphology, Stratigraphy, Structural, Sedimentology Palaeontology, Crystallography	1 st and 2 nd year
Pedology	Introduction, soil classification, soil fertility, soil ecology, soil physics	1 st and 2 nd year
Botany	Morphology, Anatomy, Physiology, Taxonomy, Mycology, Ecology, Reproductive biology	1 st , 2 nd and 3 rd year
Zoology	Taxonomy (Vertebrates and Invertebrates), Physiology (mainly vertebrates), Ecology (mainly vertebrates), Animal behaviour (mainly vertebrates)	1 st , 2 nd and 3 rd year
Statistics	Sampling methods, Statistical Analysis, Probabilities	1 st year

1993 BSc (Hons) (Cum laude) Wildlife Management, University of Pretoria

Dissertation: 'N HOLISTIESE EKOLOGIESE BENADERING TOT DIE DRAKRAGBEPALING VAN 'N GEMENGDE WILD- EN BEESBOERDERY IN DIE UBOMBO DISTRIK, MET ENKELE BESTUURS AANBEVELINGS, 1993

1999 MSc (Cum laude) Wildlife Management, University of Pretoria

Thesis: PHYTOSOCIOLOGY OF THE MPUMALANGA HIGH ALTITUDE GRASSLANDS, 1999

COURSES/ WORKSHOPS ATTENDED

1. Red List And Threatened Species Assessment Training Workshop, Hosted by the Conservation Breeding Specialist Group Southern Africa & Endangered Wildlife Trust, December 2003
2. National State of the Environment Workshop, Hosted by DEAT and SRK, ESKOM Convention Centre – November 2004
3. Gauteng Red Data Flora Workshop, Hosted by SANBI and GDACE – November 2005
4. Gauteng Flora Minimum Requirement Workshop, Hosted by GDACE Nature Conservation – August 2007

EMPLOYMENT RECORD:

1986 – 1987

5 Signals Regiment, SADF

1998 – 1993 – Parttime

Council of Geoscience, Palaeontology Section

University of Pretoria, Botany Department

Academy of Marksmanship, Range Officer

U Huisoppasser, Own enterprise

1994 – 1995

University of Pretoria, Botany Department, Assistant researcher

1995 – present

EkolInfo cc Environmental and Wildlife Management Consultancy, Founding member and consultant

Overall EkolInfo CC's principal consultant completed or administrated more than 58 vegetation studies as part of Environmental Impact Assessments within all of South Africa's nine provinces and adjacent countries such as Botswana and Mozambique with a focus on either terrestrial vegetation and/ or wetlands. Some projects were on provincial level such as the Mpumalanga and Gauteng Degradation Projects coordinated by the Institute for Soil, Climate and Water and sponsored by National Department of Agriculture. The majority of projects were on local scale from 5 ha to 50 000 ha or more for local developers and corporate institutions (SASOL, Anglo Coal, BHP Billington, Ingwe Coal, Deneys Rietz Attorneys, ESKOM) facilitated independently or as a subcontractor/ specialist for the following institutions: Oryx Environmental CC, African EPA, Arcuss Gibb, Digby Wells and Associates, Nature and Business Alliance and Eyethu Engineers, Strategic Environmental Focus.

COMMUNITY SERVICE

1. Substitute lecture – 2nd & 3rd year Botany Practical (Vegetation Survey Methods), University of Pretoria -1994 & 1995
2. Guest lecture – Wetland Vegetation Communities (2nd year students), Department of Landscape Architecture, University of Pretoria – 1996 & 1997
3. Guest lecture – Principles of Ecology (1st year students), Department of Landscape Architecture, University of Pretoria – 2002
4. Guest lecture – Principles of vegetation survey and mapping for EIA's (3rd year students), Department of Landscape Architecture, University of Pretoria – 2003
5. Referee – ILASA Merits Awards (Environmental Planning), Institute for Landscape Architects of South Africa - 2003

LANGUAGES:

Language	Capability
----------	------------

English & Afrikaans	Speak, Read, Write - sufficient
---------------------	---------------------------------

Sepedi (Northern Sotho)	Speak, Read, Write – insufficient
-------------------------	-----------------------------------

9 APPENDIX B – IMPORTANT FLORISTIC TAXA: CENTRAL SANDY BUSHVELD

Vegmap unit	Recorded species	Significance Rating	Species Observed In Footprints	
			Piggery	Chicken Farm
Central Sandy Bushveld	Acacia burkei	Important Taxa		
Central Sandy Bushveld	Acacia robusta subsp. robusta	Important Taxa		
Central Sandy Bushveld	Agathisanthemum bojeri subsp. bojeri	Important Taxa		
Central Sandy Bushveld	Aloe greatheadii var. davyana	Important Taxa	1	1
Central Sandy Bushveld	Antheophora pubescens	Important Taxa		
Central Sandy Bushveld	Aristida scabrivalvis subsp. scabrivalvis	Important Taxa		
Central Sandy Bushveld	Asparagus buchananii	Important Taxa		
Central Sandy Bushveld	Barleria macrostegia	Important Taxa		
Central Sandy Bushveld	Blepharis integrifolia var. integrifolia	Important Taxa		
Central Sandy Bushveld	Brachiaria nigropedata	Important Taxa		
Central Sandy Bushveld	Brachiaria serrata	Important Taxa		
Central Sandy Bushveld	Burkea africana	Important Taxa		
Central Sandy Bushveld	Combretum apiculatum subsp. apiculatum	Important Taxa	1	1
Central Sandy Bushveld	Combretum hereroense	Important Taxa		
Central Sandy Bushveld	Combretum zeyheri	Important Taxa	1	1
Central Sandy Bushveld	Crabbea angustifolia	Important Taxa		
Central Sandy Bushveld	Dicerocaryum senecioides	Important Taxa		
Central Sandy Bushveld	Dichapetalum cymosum	Important Taxa		
Central Sandy Bushveld	Elionurus muticus	Important Taxa		
Central Sandy Bushveld	Eragrostis nindensis	Important Taxa		
Central Sandy Bushveld	Eragrostis pallens	Important Taxa		1
Central Sandy Bushveld	Eragrostis rigidior	Important Taxa	1	1
Central Sandy Bushveld	Evolvulus alsinoides	Important Taxa		
Central Sandy Bushveld	Felicia fascicularis	Important Taxa		

Vegmap unit	Recorded species	Significance Rating	Species Observed In Footprints	
			Piggery	Chicken Farm
Central Sandy Bushveld	<i>Geigeria burkei</i> subsp. <i>burkei</i> var. <i>burkei</i>	Important Taxa		
Central Sandy Bushveld	<i>Gnidia sericocephala</i>	Important Taxa		
Central Sandy Bushveld	<i>Grewia bicolor</i> var. <i>bicolor</i>	Important Taxa		1
Central Sandy Bushveld	<i>Grewia monticola</i>	Important Taxa		
Central Sandy Bushveld	<i>Hermannia lancifolia</i>	Important Taxa		
Central Sandy Bushveld	<i>Hyperthelia dissoluta</i>	Important Taxa	1	
Central Sandy Bushveld	<i>Hypoxis hemerocallidea</i>	Important Taxa		
Central Sandy Bushveld	<i>Indigofera daleoides</i>	Important Taxa		
Central Sandy Bushveld	<i>Indigofera filipes</i>	Important Taxa		
Central Sandy Bushveld	<i>Justicia anagalloides</i>	Important Taxa		
Central Sandy Bushveld	<i>Kyphocarpa angustifolia</i>	Important Taxa	1	
Central Sandy Bushveld	<i>Lophiocarpus tenuissimus</i>	Important Taxa		
Central Sandy Bushveld	<i>Loudetia simplex</i>	Important Taxa		
Central Sandy Bushveld	<i>Mosdenia leptostachys</i>	Biogeographically Important Taxa		
Central Sandy Bushveld	<i>Ochna pulchra</i>	Important Taxa		
Central Sandy Bushveld	<i>Oxygonum dregeanum</i> subsp. <i>canescens</i> var. <i>dissectum</i>	Biogeographically Important Taxa		
Central Sandy Bushveld	<i>Panicum maximum</i>	Important Taxa	1	1
Central Sandy Bushveld	<i>Peltophorum africanum</i>	Important Taxa	1	1
Central Sandy Bushveld	<i>Perotis patens</i>	Important Taxa		1
Central Sandy Bushveld	<i>Rhus leptodictya</i>	Important Taxa		
Central Sandy Bushveld	<i>Schmidtia pappophoroides</i>	Important Taxa		
Central Sandy Bushveld	<i>Sclerocarya birrea</i> subsp. <i>caffra</i>	Important Taxa		1
Central Sandy Bushveld	<i>Strychnos pungens</i>	Important Taxa		
Central Sandy Bushveld	<i>Terminalia sericea</i>	Important Taxa		1
Central Sandy Bushveld	<i>Themeda triandra</i>	Important Taxa	1	1
Central Sandy Bushveld	<i>Trachypogon spicatus</i>	Important Taxa		
Central Sandy Bushveld	<i>Waltheria indica</i>	Important Taxa		

Vegmap unit	Recorded species	Significance Rating	Species Observed In Footprints	
			Piggery	Chicken Farm
Central Sandy Bushveld	Xerophyta humilis	Important Taxa		
			9	12

10 APPENDIX C – GROUND BASED DIGITAL IMAGERY

10.1 Piggery Footprint

Note –

1. Image sequence – North, East, South, West, Soil Profile, Soil Texture

Observation Plot No	Photo No	Date	Image Direction	Longitude	Latitude	Altitude (m)
Ap01	DSC09085.jpg	2025-07-03 0:00:00	351.31	27.77376917	-25.49793686	1120.47
Ap01	DSC09086.jpg	2025-07-03 0:00:00	85.131	27.77378367	-25.49793506	1120.47
Ap01	DSC09087.jpg	2025-07-03 0:00:00	183.972	27.77379147	-25.49793047	1120.46
Ap01	DSC09088.jpg	2025-07-03 0:00:00	268.732	27.77378886	-25.49793317	1120.46
Ap01	DSC09089.jpg	2025-07-03 0:00:00	21.1193	27.77380092	-25.49794472	1120.2
Ap01	DSC09090.jpg	2025-07-03 0:00:00	29.461	27.77380925	-25.49793175	1118.98
Ap02	DSC09091.jpg	2025-07-03 0:00:00	358.07	27.77149331	-25.49693794	1113.46
Ap02	DSC09092.jpg	2025-07-03 0:00:00	100.269	27.77148733	-25.496945	1113.52
Ap02	DSC09093.jpg	2025-07-03 0:00:00	198.28	27.77149122	-25.49694408	1113.51
Ap02	DSC09094.jpg	2025-07-03 0:00:00	279.091	27.77149231	-25.49694536	1113.51
Ap02	DSC09095.jpg	2025-07-03 0:00:00	313.067	27.77151483	-25.49691947	1110.66
Ap02	DSC09096.jpg	2025-07-03 0:00:00	18.2936	27.771507	-25.49693592	1110.51

PLEASE REFER TO IMAGES ON NEXT PAGE



DSC09085



DSC09086



DSC09087



DSC09088



DSC09089



DSC09090



DSC09091



DSC09092



DSC09093



DSC09094



DSC09095



DSC09096

10.2 Chicken Farm Footprints

Note –

1. Image sequence – North, East, South, West, Soil Profile, Soil Texture

Observation Plot No	Photo No	Date	Image Direction	Longitude	Latitude	Altitude (m)
Ac01	DSC09097.jpg	2025-07-03 0:00:00	347.784	27.77311097	-25.50479664	1131.87
Ac01	DSC09098.jpg	2025-07-03 0:00:00	87.263	27.77312781	-25.50479825	1131.86
Ac01	DSC09099.jpg	2025-07-03 0:00:00	185.053	27.77312172	-25.50479758	1131.87
Ac01	DSC09100.jpg	2025-07-03 0:00:00	256.014	27.77311536	-25.5047975	1131.88
Ac01	DSC09101.jpg	2025-07-03 0:00:00	358.353	27.77311617	-25.50478819	1129.76
Ac01	DSC09102.jpg	2025-07-03 0:00:00	358.043	27.77309797	-25.50479506	1129.82
Ac02	DSC09103.jpg	2025-07-03 0:00:00	341.757	27.77435986	-25.50291708	1130.9
Ac02	DSC09104.jpg	2025-07-03 0:00:00	60.5028	27.77437031	-25.50292261	1130.88
Ac02	DSC09105.jpg	2025-07-03 0:00:00	158.459	27.77437208	-25.50292567	1130.87
Ac02	DSC09106.jpg	2025-07-03 0:00:00	246.083	27.77436897	-25.50292553	1130.87
Ac02	DSC09107.jpg	2025-07-03 0:00:00	61.1362	27.77437794	-25.50293575	1130.44
Ac02	DSC09108.jpg	2025-07-03 0:00:00	64.958	27.77436758	-25.50293378	1130.26
Ac03	DSC09109.jpg	2025-07-03 0:00:00	353.046	27.77602383	-25.50336206	1126.92
Ac03	DSC09110.jpg	2025-07-03 0:00:00	77.6215	27.77602567	-25.50335636	1126.92
Ac03	DSC09111.jpg	2025-07-03 0:00:00	193.415	27.77602383	-25.50335653	1126.92
Ac03	DSC09112.jpg	2025-07-03 0:00:00	270.653	27.77602717	-25.50335903	1126.92
Ac03	DSC09113.jpg	2025-07-03 0:00:00	355.872	27.77603583	-25.50337353	1128.58
Ac03	DSC09114.jpg	2025-07-03 0:00:00	4.62024	27.77604919	-25.50334589	1128.99
Ac04	DSC09115.jpg	2025-07-03 0:00:00	153.795	27.78352946	-25.50215181	1139.84
Ac04	DSC09116.jpg	2025-07-03 0:00:00	140.666	27.78353847	-25.50214547	1139.56
Ac05	DSC09117.jpg	2025-07-03 0:00:00	350.403	27.78097311	-25.50526167	1141.11
Ac05	DSC09118.jpg	2025-07-03 0:00:00	61.7168	27.78097678	-25.50526061	1141.08
Ac05	DSC09119.jpg	2025-07-03 0:00:00	170.041	27.78097503	-25.50526325	1141.06
Ac05	DSC09120.jpg	2025-07-03 0:00:00	254.468	27.78097192	-25.50526747	1141.04
Ac05	DSC09121.jpg	2025-07-03 0:00:00	118.433	27.78095894	-25.50526803	1139.64
Ac05	DSC09122.jpg	2025-07-03 0:00:00	73.2591	27.78097136	-25.505268	1139.27
Ac06	DSC09123.jpg	2025-07-03 0:00:00	345.448	27.78134461	-25.50720161	1146.9
Ac06	DSC09124.jpg	2025-07-03 0:00:00	81.3086	27.78133822	-25.50719844	1146.88
Ac06	DSC09125.jpg	2025-07-03 0:00:00	184.78	27.78133786	-25.50720264	1146.85
Ac06	DSC09126.jpg	2025-07-03 0:00:00	250.545	27.78133592	-25.50720583	1146.83
Ac06	DSC09127.jpg	2025-07-03 0:00:00	15.6229	27.78131397	-25.50721192	1146.65
Ac06	DSC09128.jpg	2025-07-03 0:00:00	340.225	27.78133469	-25.50719669	1146.32

PLEASE REFER TO IMAGES ON NEXT PAGE



DSC09097



DSC09098



DSC09099



DSC09100



DSC09101



DSC09102



DSC09103



DSC09104



DSC09105



DSC09106



DSC09107



DSC09108



DSC09109



DSC09110



DSC09111



DSC09112



DSC09113



DSC09114



DSC09115



DSC09116



DSC09117



DSC09118



DSC09119



DSC09120



DSC09121



DSC09122



DSC09123



DSC09124



DSC09125



DSC09126



DSC09127



DSC09128

11 APPENDIX D – AERIAL BASED DIGITAL IMAGERY

11.1 Piggery Footprint

Note –

1. Image sequence – North, East, South, West

Observation Plot No	Photo No	Date	Longitude	Latitude	Altitude (m)
Ap01	DJI_0001.JPG	2025-07-03 0:00:00	27.77383908	-25.49807183	19.8
Ap01	DJI_0002.JPG	2025-07-03 0:00:00	27.77383692	-25.498074	19.9
Ap01	DJI_0003.JPG	2025-07-03 0:00:00	27.77383433	-25.49807286	19.7
Ap01	DJI_0004.JPG	2025-07-03 0:00:00	27.7738335	-25.49807219	19.9
Ap02	DJI_0006.JPG	2025-07-03 0:00:00	27.77148403	-25.49699742	19.5
Ap02	DJI_0007.JPG	2025-07-03 0:00:00	27.771487	-25.49699764	19.5
Ap02	DJI_0008.JPG	2025-07-03 0:00:00	27.77149053	-25.49699611	19.5
Ap02	DJI_0009.JPG	2025-07-03 0:00:00	27.77149314	-25.49699586	19.7
Ap02	DJI_0010.JPG	2025-07-03 0:00:00	27.77149731	-25.49699394	19.7

PLEASE REFER TO IMAGES ON NEXT PAGE



DJI_0001



DJI_0002



DJI_0003



DJI_0004



DJI_0007



DJI_0008



DJI_0009



DJI_0010

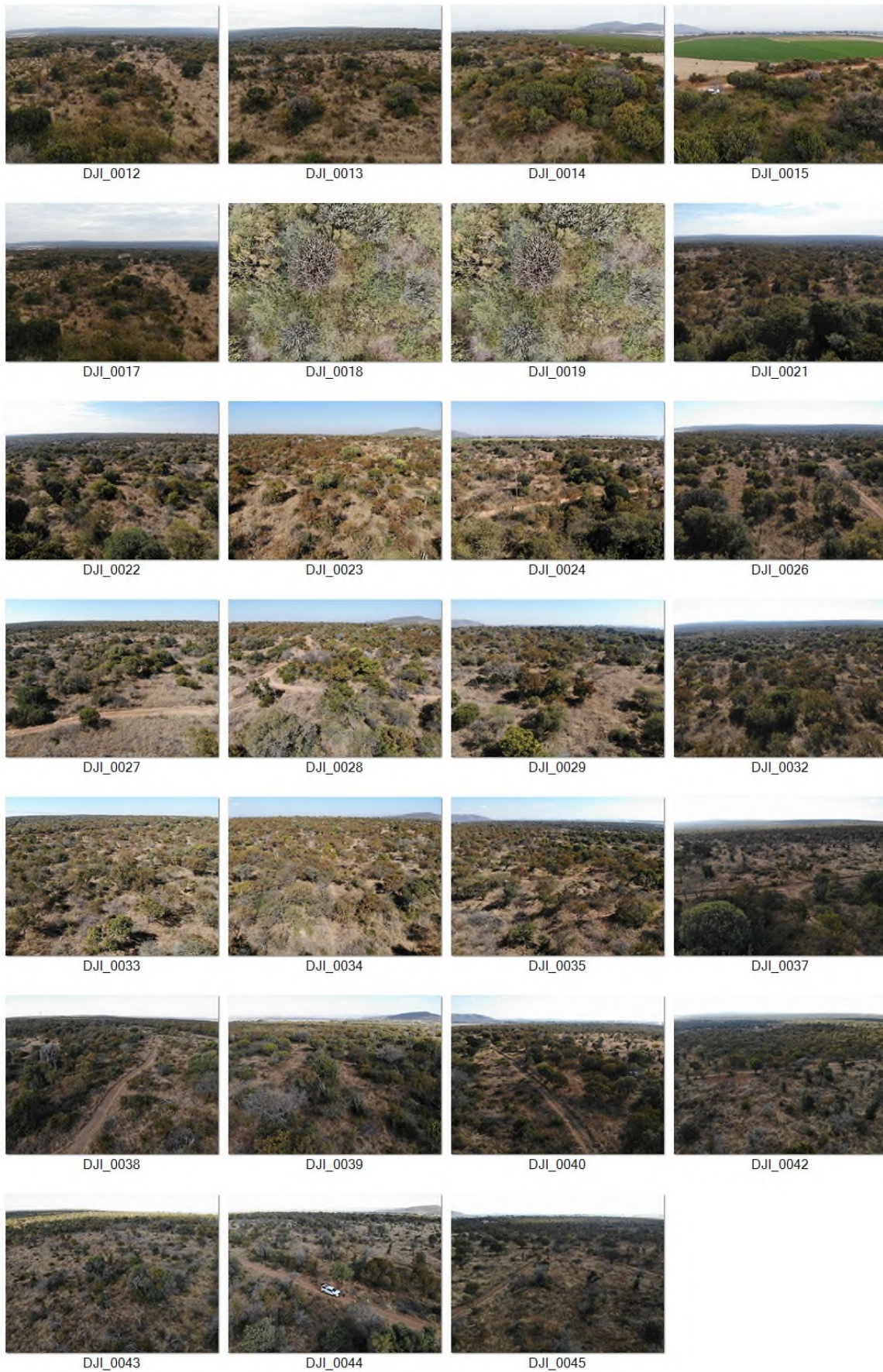
11.2 Chicken Farm Footprints

Note –

1. Image sequence – North, East, South, West

Observation Plot No	Photo No	Date	Longitude	Latitude	Altitude (m)
Ap02	DJI_0010.JPG	2025-07-03 0:00:00	27.77149731	-25.49699394	19.7
Ac01	DJI_0012.JPG	2025-07-03 0:00:00	27.77308922	-25.50478567	20
Ac01	DJI_0013.JPG	2025-07-03 0:00:00	27.77308875	-25.50478414	20
Ac01	DJI_0014.JPG	2025-07-03 0:00:00	27.77308783	-25.50478453	19.9
Ac01	DJI_0015.JPG	2025-07-03 0:00:00	27.77309036	-25.50478272	19.9
Ac01	DJI_0017.JPG	2025-07-03 0:00:00	27.77308817	-25.50478517	19.9
Euphorbia ingens stands	DJI_0018.JPG	2025-07-03 0:00:00	27.772815	-25.50495608	20
Euphorbia ingens stands	DJI_0019.JPG	2025-07-03 0:00:00	27.77281456	-25.50495458	20
Ac02	DJI_0021.JPG	2025-07-03 0:00:00	27.77451939	-25.50285517	19.9
Ac02	DJI_0022.JPG	2025-07-03 0:00:00	27.77452267	-25.50285319	19.8
Ac02	DJI_0023.JPG	2025-07-03 0:00:00	27.77452175	-25.50284906	19.7
Ac02	DJI_0024.JPG	2025-07-03 0:00:00	27.77452272	-25.50284828	19.8
Ac03	DJI_0026.JPG	2025-07-03 0:00:00	27.77594058	-25.50337328	20.1
Ac03	DJI_0027.JPG	2025-07-03 0:00:00	27.77593992	-25.50337353	20
Ac03	DJI_0028.JPG	2025-07-03 0:00:00	27.77593894	-25.50337161	19.8
Ac03	DJI_0029.JPG	2025-07-03 0:00:00	27.775941	-25.50336922	19.8
Ac04	DJI_0032.JPG	2025-07-03 0:00:00	27.78342849	-25.50197485	19.3
Ac04	DJI_0033.JPG	2025-07-03 0:00:00	27.78342815	-25.50197268	19.5
Ac04	DJI_0034.JPG	2025-07-03 0:00:00	27.7834266	-25.50197256	19.3
Ac04	DJI_0035.JPG	2025-07-03 0:00:00	27.78342485	-25.50196974	19.4
Ac06	DJI_0037.JPG	2025-07-03 0:00:00	27.78157181	-25.50735394	19.5
Ac06	DJI_0038.JPG	2025-07-03 0:00:00	27.78157553	-25.50735003	19.5
Ac06	DJI_0039.JPG	2025-07-03 0:00:00	27.7815765	-25.50734922	19.5
Ac06	DJI_0040.JPG	2025-07-03 0:00:00	27.78157717	-25.50734903	19.5
Ac05	DJI_0042.JPG	2025-07-03 0:00:00	27.78060936	-25.505029	19.5
Ac05	DJI_0043.JPG	2025-07-03 0:00:00	27.78060997	-25.50503033	19.5
Ac05	DJI_0044.JPG	2025-07-03 0:00:00	27.78060869	-25.50502978	19.6
Ac05	DJI_0045.JPG	2025-07-03 0:00:00	27.7806085	-25.50502711	19.4

PLEASE REFER TO IMAGES ON NEXT PAGE



12 APPENDIX E – WETNESS INDEX OVERVIEW

A **wetness index** in GIS is a spatial metric used to predict the distribution and persistence of surface or subsurface water in a landscape based on topography. It is particularly useful in hydrological modeling, soil moisture estimation, and ecological studies. Wetness indexes help identify areas prone to water accumulation, making them important for understanding flood risks, vegetation patterns, and habitat suitability.

Purpose of a Wetness Index

The wetness index reflects:

1. **Water Accumulation:** Predicts zones where water is likely to collect due to topography.
2. **Soil Saturation:** Indicates areas with higher potential for soil saturation.
3. **Hydrological Connectivity:** Helps in modeling runoff and drainage patterns.
4. **Environmental Applications:** Supports agricultural planning, wetland identification, and habitat conservation.
- 5.

Topographic Wetness Index (TWI)

The **Topographic Wetness Index (TWI)**, or **Topowet**, is a widely used index calculated as:

$$TWI = \ln(\alpha / \tan\beta)$$

- α : **Upslope contributing area per unit width (m^2/m)** – the area draining into a point, reflecting water input.
- $\tan\beta$: **Slope angle (radians)** – representing water flow potential (steeper slopes promote faster drainage).

Key Features:

- Highlights areas where water accumulates based on slope and upslope area.
- Commonly used for hydrological and soil moisture studies.
- Assumes uniform soil properties and water flow.

SAGA Wetness Index (SWI)

The **SAGA Wetness Index (SWI)**, developed in the SAGA GIS software, is a modified version of TWI that incorporates additional considerations for areas with minimal slope. It is calculated as:

$$SWI = \ln(\alpha / \tan\beta + 1)$$

Key Features:

- Addresses issues in areas with very low slope angles ($\tan\beta$ approaches 0), which can cause TWI to become unrealistically high.
- Adds a constant (+1) to the slope term, stabilizing the index in flat areas.
- Provides more realistic wetness predictions in low-relief landscapes and floodplains.

Differences Between TWI and SWI

Aspect	TWI (Topowet)	SWI (SAGA Wetness Index)
Slope Adjustment	No correction for flat areas; sensitive to small $\tan\beta$.	Adds 1 to $\tan\beta$, stabilizing calculations in flat areas.
Application Focus	Better for steep and moderate slopes.	More effective for flat or gently sloping terrain.
Calculation Simplicity	Straightforward logarithmic function.	Slightly more complex, with added slope term.
Usability in GIS	Used in various GIS platforms.	Primarily available in SAGA GIS but adaptable.

When to Use Each

- Use **TWI** for areas with moderate to steep slopes where slope and water accumulation dominate hydrology.
- Use **SWI** in low-relief or floodplain environments where small slopes can exaggerate wetness predictions.

Both indexes are valuable tools, and the choice depends on the topography and the hydrological characteristics of the study area.

13 APPENDIX F – KINIXYS LOBATSIANA THREATS



Source: https://www.inaturalist.org/guide_taxa/705962

The Lobatse Hinged Tortoise (*Kinixys lobatsiana*) faces significant threats primarily from **habitat destruction and degradation**. This is driven by various human activities including:

- **Urbanization:** Expansion of urban areas encroaches on their natural habitat.
- **Mining:** Mining operations lead to direct habitat loss and fragmentation.
- **Agriculture:** Conversion of land for agricultural purposes reduces available habitat.
- **Alien species invasion:** Introduced non-native species can alter and degrade their preferred environments.

Evidence of this degradation is apparent in studies showing widespread deterioration of land cover in provinces where the species occurs.

Beyond habitat loss, other threats include:

- **Fire:** The use of fire for livestock and biodiversity management can directly kill large numbers of tortoises.
- **Collection for consumption:** Tortoises are actively hunted for food.
- **Cultural and medicinal purposes:** They are also collected for traditional practices.
- **International pet trade:** Both legal and illegal collection for the pet trade contributes to local extinctions, although quantitative data on local or regional hunting pressure is limited.

Source: <https://speciesstatus.sanbi.org/assessment/last-assessment/2446/>

14 APPENDIX G – HABITAT LOSS AND FRAGMENTATION OVERVIEW

Summary of Landscape Transformation and Its Impact on Habitat Loss and Fragmentation

With Quantitative Thresholds and Scientific References

1. Introduction

Landscape transformation through agriculture, infrastructure, mining, and settlement expansion leads to **habitat loss** (the direct reduction of available natural habitat) and **habitat fragmentation** (the division of remaining natural areas into smaller, isolated patches). These processes are among the most significant drivers of biodiversity loss globally and are especially critical in biodiversity-rich but development-vulnerable regions such as southern Africa.

2. General Ecological Thresholds

% of Landscape Transformed Ecological Impact

<20%	Habitat largely intact; ecological processes functional.
20–30%	Early signs of fragmentation; sensitive species begin to decline.
>40%	Significant reduction in connectivity; population isolation increases.
>50%	Fragmentation dominates; core habitat area becomes insufficient.
>70%	Landscape is functionally fragmented; risk of local extinctions escalates.
>90%	Only habitat remnants remain; long-term species persistence unlikely.

Sources: Andrén (1994); Fahrig (2001); Swift & Hannon (2010); Betts et al. (2019)

3. Mammals

- Large mammals (e.g. ungulates, carnivores) are impacted when **>40–50% of habitat is transformed**, as their home range requirements are no longer met and movement is restricted (Crooks, 2002; Woodroffe & Ginsberg, 1998).
- Small mammal species experience reduced gene flow and increased isolation at **30–40% transformation** (Epps et al., 2005).
- Beyond **60% transformation**, mammalian community structure shifts toward generalist or synanthropic species (Gaston & Fuller, 2008).

4. Reptiles

- Reptiles are particularly sensitive to edge effects, temperature shifts, and vegetation structure changes.
- Negative effects of habitat fragmentation become evident at **30% transformation**, and intensify significantly beyond **50–60%** (How & Dell, 2000; Jellinek et al., 2004).

- Species with limited dispersal and specific habitat needs (e.g., rocky outcrops, sandy soils) are especially vulnerable in arid and semi-arid systems.

5. Birds

- Avian diversity declines below **70% natural habitat cover**, with sharp declines in specialists (e.g. forest interior or ground-nesting birds) below **30–40% cover** (Robinson et al., 1995; Watson et al., 2005).
- Fragmentation disrupts nesting, foraging, and migratory movements, especially when patches fall below **10–20 ha** in size or when **>50% of the matrix** is disturbed (Laurance et al., 2002).
- Generalist and edge species may persist, but at the cost of ecological integrity.

6. Practical Conservation Guidelines

To maintain functional ecosystems that support mammals, reptiles, and birds:

- **Retain at least 60–70% of natural habitat** in any given landscape unit to ensure ecological integrity (Fahrig, 2001).
- **Avoid exceeding 30–40% habitat loss**, particularly in biodiversity hotspots or key corridors.
- Ensure patch sizes are **>10–20 ha**, and maintain **ecological connectivity** using corridors or stepping stones.
- Implement long-term **monitoring** to detect species-level responses to transformation.

Conclusion

Once landscape transformation exceeds **50%**, the ecological effects of fragmentation escalate rapidly, and many species — particularly those with large area requirements or narrow habitat preferences — struggle to persist. Recognising these thresholds helps guide land-use planning, environmental assessments, and conservation prioritisation to safeguard biodiversity across transformed and semi-natural landscapes.

References

- Andrén, H. (1994). Effects of habitat fragmentation on birds and mammals in landscapes with different proportions of suitable habitat: a review. *Oikos*, 71(3), 355–366.
- Betts, M.G. et al. (2019). Extinction filters mediate the global effects of habitat fragmentation on animals. *Science*, 366(6470), 1236–1239.
- Crooks, K.R. (2002). Relative sensitivities of mammalian carnivores to habitat fragmentation. *Conservation Biology*, 16(2), 488–502.
- Epps, C.W. et al. (2005). Highways block gene flow and cause a rapid decline in genetic diversity of desert bighorn sheep. *Ecology Letters*, 8(10), 1029–1038.
- Fahrig, L. (2001). How much habitat is enough? *Biological Conservation*, 100(1), 65–74.
- Gaston, K.J. & Fuller, R.A. (2008). Commonness, population depletion and conservation biology. *Trends in Ecology & Evolution*, 23(1), 14–19.

-
- How, R.A. & Dell, J. (2000). Ground vertebrate fauna of Perth's vegetation remnants: impact of 170 years of urbanisation. *Pacific Conservation Biology*, 6(3), 198–217.
 - Jellinek, S. et al. (2004). Predicting the occurrence of reptiles across south-eastern Australian landscapes from field data and GIS. *Journal of Applied Ecology*, 41(3), 335–350.
 - Laurance, W.F. et al. (2002). Ecosystem decay of Amazonian forest fragments. *Conservation Biology*, 16(3), 605–618.
 - Robinson, S.K. et al. (1995). Regional forest fragmentation and the nesting success of migratory birds. *Science*, 267(5206), 1987–1990.
 - Swift, T.L. & Hannon, S.J. (2010). Critical thresholds associated with habitat loss: a review of the concepts, evidence, and applications. *Biological Reviews*, 85(1), 35–53.
 - Watson, J.E.M. et al. (2005). A new frontier in conservation science. *Bioscience*, 55(6), 485–492.
 - Woodroffe, R. & Ginsberg, J.R. (1998). Edge effects and the extinction of populations inside protected areas. *Science*, 280(5372), 2126–2128.

ANNEX H

EMPr

EMPr in terms of NEMA Act (107 of 1998)

Environmental Impact Regulations

APPENDIX 4 – EMPr

EMPr for the development and operation of a Piggery

***** Pig Farm Operation *****

OVERVIEW

An Environmental Management Programme (EMPr) is a living document which is assembled to govern and direct an activity from inception, through construction into the final operational phase. Throughout the life of a project circumstances may change and as such the EMPr must be such that it may be altered, added to and changed in order to provide ongoing guidance to the operations but ultimately provide protection to the environment in which the activity is taking place.

As the EMPr is a guidance document to ensure environmental protection and compliance, the structure is such that it will initially “explain” the issue and then provide direct guidance under the heading **OPERATOR ACTIONS**. These Operator Actions are the direct instruction[s] to the operator of what is expected and what should be implemented.

1. Project Description

The development on Ptn 10 & 15 of Farm Blaauwbank 241 JQ in the Brits District / Bojanala District Municipality of:

- A pig farm with a holding capacity of 800 breeding sows;
- Building / pens / breeding operation of 50 000 sqm consisting of 24 houses for the breeding sows;
- Water supply from borehole supplies;
- Electricity supply from ESKOM connection;
- Feed silos for the storage of bulk feed;
- Animal waste to be utilized as organic fertilizer

2. Who is the EAP?

- RP Colyn / Green Environmental Consulting Services (Pty) Ltd / EAPASA EAP 2019/1358
- 1126 Waterpoort Street, Faerie Glen, Pretoria 0081
- Tel: 012 991 2575
- Mobile: 082 553 8844
- Email: rpolyn@telkomsa.net

2.1 Expertise of the EAP

- EIA Consultant since 1996
- EAP Registered / EAPASA 2019/1358
- CV (attached as annexures)

2.2 Map showing the existing and proposed additions

Refer Annexures – MAP – showing the existing infrastructure [farm house] as well as the proposed new additions.

2.3 Property Details

Ptn 10 & 15 of Farm Blaauwbank 241 JQ Brits District / North West Province

3. Aspect of the activity contained in this EMPr

The EMPr will be looking at specific aspects in terms of:

- **Construction Phase**
 - Design of the infrastructure [buildings]
 - Excavations and Foundations
 - Building materials and its storage

- Waste and waste handling
- Sanitation in terms of staff ablutions and health
- **Operational Phase**
 - Traffic and Dust
 - Delivery times of incoming and outgoing trucks
 - Light and Light pollution
 - Animal waste and its handling / removal at the end of a cycle
 - Mortalities and its handling
 - Bio-Security and a Bio-Security Plan for the operation
 - Electricity and Water Supply
 - Supplies of new breeding stock to the facility
- **Closure Phase**
 - Actions and considerations should the facility need to close down permanently.

NOTE:

This EMPr will govern the operation, from inception and construction, through operational for the life time of the facility.

As a living document the EMPr may be amended as and when required, with all changes documented and the EMPr being the main document against which compliance must be determined via an independent audit.

SECTION A – Planning & Pre-Construction Phase

1. Management objectives in terms of impacts and risk that require consideration during the PLANNING & DESIGN Phase.

The main objective of assessment and consideration of risks and impacts is to:-

[a] avoid impacts as far as possible, and

[b] where impacts cannot be avoided to mitigate and minimise impacts and risks to a point where it becomes small in the bigger picture of development.

The following has been brought into consideration during the **PLANNING & DESIGN** of the proposed project and the impact management outcome required:-

- **Solar**
The inclusion of solar for water heating and where possible for solar power is being considered. Such installation will minimise the impact on electricity supply from the National Grid and will also be more carbon neutral in terms of emissions.
- **Rainwater**
Harvesting of rainwater where possible to offset against the use of water from borehole. Borehole water is a valuable resource and should be protected. Utilising rainwater saves on electrical power to run the pumps and save power from the National Grid.
- **External lights**
The consideration of down-lighters to minimise the effect of light pollution in terms of the adjacent properties. Lights are necessary for security, however there is no need to light up the surrounding properties but rather provide light at key points that are vulnerable.
- **Separation of Waste**
The separation of waste to promote recycling and re-use of waste items before being sent to landfill.
- **Integration of existing infrastructure**
The integration of the new development into the existing infrastructure and the sharing of common infrastructure to minimise the development requirements and footprint.

2. Documentation and Actions required during Pre-Construction

The following is required to be in place and readily available as part of the “site office” set-up before the commencement of any construction activity:-

- **EA / Authorisation**
A copy of the formal NW-DEDECT approved Environmental Approval [EA], for the construction, development and operation of a piggery [800 nbreeding sows];
- **EMPr**
A copy of the approved EMPr, to be on file at the Site Office;
- **Contractor Acceptance**
Signed acceptance of the approved EMPr by all contractors that will provide a service during the development /construction, on file at the Site Office;
- **Site Office**
A demarcated Site Office area with storage for documents and authorisations together with:
 - First Aid kit;
 - Specific waste bins for biodegradable items i.e. plastics; metal and dangerous goods such as paint tins;

- Ablution facilities for the construction workers;
- Storage for cement and empty cement bags;
- Fire extinguishers
- **Development Area**
 - Demarcated area where the development will take place;
 - Chevron [Red & White plastic] tape demarcating the bio-area where no construction workers may pass into;
 - Demarcated area for the parking of construction equipment and the fuel bowser / fuel donkey together with drip trays and spill kit cleaning equipment.

Section B – Construction Phase

The possibility of impacts on the receiving environment is greatest during the Construction Phase. It is for that reason that the following has been identified and requires special attention and where necessary mitigation to minimise impacts on the environment.

The design of the buildings will be for environmentally controlled and fully enclosed type houses where an advanced computer system controls temperature; air flow; oxygen levels; feeding times and heating in the event of a cold spell.

a) Determination of the best position / portion of land to be used

A Specialist review of the land was undertaken to determine the best possible portion of the farm to be utilised. The study identified a portion of land that was formerly cultivated land [many years ago] and as such will see minimal impacts in terms of indigenous trees being removed.

b) During Construction

- **Excavations and Foundations**

All excavations or open foundation areas must be clearly marked and made safe as part of the overall H&S of the site. Trenches must be infilled and compacted to prevent soils subsiding or posing a danger to those working on site.

- **Staff training and briefing**

All construction staff are to receive an introductory briefing on protection of the environment; waste handling; safety and health issues. Attendance and training to be documented and all staff to sign off that training was done.

Regular weekly refresher sessions at the start of business to be undertaken to ensure that construction staff remain current. Attendance to be documented and kept on file.

- **Ablutions and personal wash areas**

Portable ablutions for the construction staff to be cleaned and sanitised on a daily basis.

Portable ablutions to be serviced and refreshed by a service company at least once a week.

Proof of servicing to be kept on file.

The use of the adjacent environment as a toilet convenience is not permitted.

- **Trees & Shrubs**

The removal of any vegetation may only occur in the identified portion of land.

- **Cement wash-down**

A specific area must be provided for cement wash-down to take place. This area must be allowed to dry and the dried cement removed for disposal. No indiscriminate wash-down is allowed.

- **Rubble and refuse**

Daily cleaning of the construction site will reduce the risk of rubble blowing around and polluting the adjacent area / other properties.

Rubble must be sorted into the correct bins as to their nature i.e. bio-degradable; glass; plastic; cardboard and metal. The use of different coloured bins for the different types of waste stream is encouraged.

Cement bags must be kept aside and must be disposed of at an appropriate site.

No burning of waste or cement bags to take place on site at any time!

No burying of waste or cement bags to take place anywhere on site!

- **Building rubble**

The construction will produce solid building rubble i.e. broken bricks and concrete. Such items should be placed in a proper waste skip [obtainable from the municipality or private contractor], and should be removed and emptied when full to an approved landfill site.

Building rubble not utilised as infill should be disposed of at an approved landfill site and not left as rubble heaps on the property or merely disposed of onto vacant land.

All waste removal to an approved landfill site must be documented and a receipt obtained for future audit purposes.

- **Audits and Audit Reports**

An Internal Audit must be undertaken at least **once a week** to ensure that the construction phase adheres to the approved EMPr. The audit must be undertaken by the on-site Environmental Control Officer [ECO]. These Audit Reports must be kept on file for external audit purposes or inspections by the NW-DEDECT when undertaken.

A **monthly External Audit** must be undertaken by the EAP / External ECO or another independent auditor as the next level of checking of compliance and adherence to the approved EMPr. Such audits must be accompanied by a formal report and the reports must be kept on file for auditing by the NW-DEDECT.

- **Non-Compliance; Issues & Remedies**

All issues; non-compliance and remedies must be recorded and kept on file for audit purposes. Where remedies are suggested and changes to the actual EMPr is made, such changes must be fully documented and the signed off as part of the overall audit programme.

- **Environmental Incident Register**

The on-site ECO must keep a formal **Environmental Incident Register** where all complaints received; information of plaintiff along with contact details and the remedy provided must be recorded. This will ensure that similar incident do not occur again.

c) After Construction

Certain aspects need specific attention at the end of construction before operations commence in terms of the rehabilitation of the environment.

- **Building rubble**

All building rubble not used as infill during construction must be removed from site to an approved landfill.

No burning or burying of rubble allowed on site and no trash heaps to be left unattended.

- **Excess soils**

Excess soils not utilised during the construction of the new houses must be levelled out, any rubble removed for disposal. No waste soils may be dumped without authorisation.

d) Ensuring Compliance

As the Construction Phase is the time where most impacts may occur and where there is likely to be unwanted impacts, the following must be adhered to:-

- **EMPr**

Ensuring that each contractor receives a copy of the EMPr before starting to work on sit; signs acceptance of the EMPr and all signed document to be kept on file at the on-site ECO station. That all contractors receive a list of fines for non-compliance and signs acknowledgement of the information.

- **Audits**

Environmental Audit by an independent person to be undertaken once a month in addition to the weekly audits undertaken by the on-site ECO. The independent audit report must contain a list of irregularities [if there are any] as well as the rectifications required.

- **Daily checks**

The on-site ECO must undertake daily checks to ensure compliance of the EMPr; ensure staff training; address issues as they arise and assist in solving problems as and when they arise. Careful record keeping of all actions must be kept for audit purposes.

e) Who are the main players?

The following are the main players during the Construction Phase in terms of enforcing and maintaining the EMPr:-

- **ECO [on-site] [Environmental Control Officer]**

The on-site ECO must ensure daily enforcement and compliance as well as record keeping of all actions; rectifications and adjustments made to the approved EMPr.

The on-site ECO must also ensure that the construction phase undergo a weekly internal audit to ensure compliance.

- **EAP / External Auditor / Independent ECO**

The EAP / External Auditor must ensure monthly audits; an audit report and assist in rectifying issued as and when they arise. All reports and amendments to the EMPr must be documented and kept on file at the on-site ECO station.

Section C – Operational Phase

During the Operational Phase certain aspects require careful attention in order to protect the receiving environment. The following aspects have been identified.

- **Traffic & Dust**

Traffic and dust creation goes hand in hand. The operation must enforce speed control where possible and advise deliveries to adhere to speed limitations in order to minimise dust creation and also the noise coming from large trucks.

- **Traffic times**

Being a rural area the noise of vehicles may be bothersome. As such deliveries and uplifting of stock should ultimately be scheduled for normal day light hours in order to minimise disturbances.

- **Waste**

No animal waste or mortalities collected may be left outside to develop odours; attract flies or cause an environmental nuisance. Bins, readily available, should be at hand to receive any form of rubble [i.e. municipal waste] where it must be removed to an approved landfill site. Waste separation should be done prior to deposition in order to assist in recycling of waste of value i.e. glass; plastic and cardboard.

Bins must be sanitised on a weekly basis to ensure that they remain odour free and do not allow the breeding of flies.

- **Animal Waste**

Animal waste is a major source of smells and fly infestations.

All animal waste collected at the end of a rearing cycle must be removed from site on the day that the waste is collected.

Timeous planning for the uplifting by end users must be made so that they can uplift the waste on the day that it becomes available.

Waste heaps **are not allowed** to lie outside the animal houses where water and heat can cause flies to breed uncontrolled.

No burying of animal waste is allowed to occur on the farm.

NOTE: Records must be kept of who takes/buys the animal waste; where its final destination [address] will be and what will the waste be used for [i.e. fertiliser]

- **Flies**

To maintain an environment where flies do not abound the operation should:-

- Employ a formal fly spray regime to control flies on the farm [normally contact spray];
- Ensure that feed has the required dosage of larvae control substance included to prevent larvae from developing;
- That all water points are properly working and does not cause leaks / wet areas in the animal house;
- That roofs are clear of leaks to prevent the animal waste becoming wet and being a place where flies can abound.

- **Mortalities**

All animal houses must be checked for sick or dead birds at least twice a day.

All mortalities must be removed to the cold storage area, awaiting removal by the contracted lion farm or animal feed manufacturer.

All mortalities removed from the farm must be transported in an enclosed container.

Equipment used to collect and gather mortalities must be disinfected after each use to protect the rest of the animals from any disease.

NOTE: Records of mortalities taken; by whom; final destination and final use to be documented and saved for audit purposes.

NOTE: No incineration of mortalities are allowed on site. Should incineration be considered then the appropriate application and an Air Emissions License Application be done.

- **Bio-Security**
The area around the operation must be clearly demarcated as a Bio-Security Area with proper access control; footbaths and sanitiser for all entering or leaving the site is a requirement. The site must have a biosecurity plan in place, and the staff must be trained in its requirements.
- **Supply of day-old chicks**
There are a number of suppliers of breeding animals to piggeries in South Africa. All new breeding stock must arrive having undergone their first set of inoculations. No “outside stock” from unknown sources should be allowed on site, as this may be dangerous to the rest of the operation.
- **Access points**
All access points to the farm must provide, as a minimum standard, foot baths and sanitising liquid for all incoming and outgoing staff.
- **Entrance Notices**
All access points to the farm must display the required information boards to announce bio-security area; the need to sanitise and the right of access being controlled.
- **Ablution facilities**
The farm must supply proper ablution facilities for staff to **shower in** and **shower out** at the end of a working day. This forms part of the bio-security regime for the operation.
- **External Lighting**
All external lighting to be down-lighter type lights where possible in order to prevent light pollution and light being a nuisance to adjacent properties.
- **Electricity and Water Supply**
Electricity supply; connections and installations must be approved and duly signed off along with the required CoC Certificates.
- **Incineration**
The incineration of mortalities on site is not allowed. Incineration requires an additional Air Emissions License to be obtained from the NW-DEDECT.
- **Coal Bunkers**
All coal bunkers must be supplied with a cement floor and either a roof or a sturdy tarpaulin to prevent the ingress of water taking place.

NOTE: The dumping of coal and ash on the bare ground is not allowed.

All coal dumps must be provided with a proper coal bunker.

All bunkers must either be covered by a roof or by a tarpaulin.

Water ingress is not allowed.

a) Compliance to Environmental Management Standards

There are certain standards and practices that the operation must follow at all times:-

- **EMPr**

It is important to scrutinise and follow the dictates of the approved EMPr at all times. This will ensure complete compliance; regular evaluation of the operation and its environmental standards and amendments being implemented to ensure that the environment is always the No.1 priority.

- **Bio-Security**

Bio-security and adhering to the rules of the bio-security plan for the operation are of prime importance.

Staff must be fully trained in all aspects of the bio-security plan and know exactly what is allowed and what is not.

Record keeping of training is essential and will form part of the audits in future.

- **Audits**

It is essential to ensure that the operation undergoes an external independent audit in terms of its environmental compliance, at least once a year. Such an audit must be accompanied by a formal report and suggested remedies [should there be any].

Formal record keeping is required for inspections by the NW-DEDECT.

Once in every five [5] year cycle a formal external audit report must be forwarded to the NW-DEDECT Compliance Division for insight and compliance.

NOTE: In the event that an environmental audit reveals major non-compliance issues to be present, the independent environmental auditor can issue a non-compliance notice requesting remedy within a period not exceeding 30 days followed by a second audit to ensure compliance.

Should the issues persist then the environmental auditor must report the non-compliance to the relevant authority with a request for inspection and further actions.

b) Ensuring Compliance

In order to ensure compliance and the enforcement of the EMPr as approved during the operational phase the following must be adhered to:-

- **EMPr**

The developer/operator must provide a signed acceptance of the approved EMPr and this acceptance letter must be placed along with the EA and EMPr onto the company environmental file.

- **Operational Documents**

An environmental file containing [a] Environmental Authorisation; [b] EMPr; [c] Signed EMPr acceptance letter by the developer and [d] Incident Report Form, must be available on site at all times for any inspection by the NW-DEDECT.

- **Audits**

Monthly internal audits by the operator / farm manager to ensure compliance. The operation will be provided with a check-list called **Aspects for Environmental Compliance / Operations** against which compliance must be checked.

REFER: Annexures - Aspects for Environmental Compliance / Operations

After the first year of full capacity operations, the operations will receive an environmental audit by an independent consultant, inclusive of a report and a list of non-compliance issues.

All non-compliance issues will be remedied and the correct procedures will be brought in place.

All audit reports; non-compliance issues; remedies and other actions undertaken will be kept on the on-site environmental file for inspection purposes. A copy of the Audit Report must be forwarded to NW-DEDECT once every 5 years [Compliance Division].

c) Who are the main players?

The following are the main players during the Operational Phase in terms of enforcing and maintaining the EMPr:-

- **Farm Manager**

The Farm Manager must ensure daily enforcement and compliance as well as record keeping of all actions; rectifications and adjustments made to the approved EMPr.

The Farm Manager must also ensure that the operational phase undergoes a monthly internal audit to ensure compliance.

- **EAP / External Auditor**

The EAP / External Auditor must ensure that a yearly audit is undertaken; an audit report is provided and assist in rectifying issues as and when they arise. All reports and amendments to the EMPr must be documented and kept on file at the Farm Manager's office.

d) Special Precautions

It is an acceptable practice that animal mortalities are taken away by other farming activities such as lion farms and crocodile farms where the mortalities are used as supplement feeding.

- a. No mortalities may be buried without authorisation from the authorities as such action poses a threat to underground water reserves;
- b. No mortalities may be incinerated as the action of incineration triggers activities under NEM:AQA and NEM:WA where additional licensing and an AEL will be required.

WHEN IN DOUBT ASK YOUR ENVIRONMENTAL CONSULTANT
ILLEGAL ACTIVITIES MAY INCUR FINES FROM THE AUTHORITIES

Section D – Closure Phase

NOTE: Closure is not contemplated and as such is NOT APPLICABLE for this EMPr.

Should a situation arise where the developer decides to close down the operation and scrap the activity, then the NW-DEDECT should be contacted in order to follow the correct procedure for closure and rehabilitation.

As there is no intention to proceed to closure no financial provision has been made for rehabilitation.

Section E – Roles & Responsibilities

Planning & Pre-Construction Phase

Impact Management Outcome: Design for renewables and other aspects to protect the environment						
Impact Management Actions	Implementation			Monitoring		
	Responsible Person	Method of implementation	Timeframe for implementation	Responsible person	Frequency	Evidence of compliance
Plan for renewables i.e. solar; rainwater harvesting; solar heaters and down lighter	Owner Architect	Through design	During design before construction	Owner Architect	ECO throughout the construction phase	ECO Signoff of installations as per architect design

Impact Management Outcome: Legal Authorisations and infrastructure						
Impact Management Actions	Implementation			Monitoring		
	Responsible Person	Method of implementation	Timeframe for implementation	Responsible person	Frequency	Evidence of compliance
Ensure that EA; EMPr and signed EMPr from contractors are on file; Ensure ablution facilities are available; Ensure H&S are in place	Owner ECO	Site office with documents; Installation of temporary toilets on site	Before the onset of Construction Phase	Owner Contractor ECO	Ongoing throughout the set-up and Construction Phase	ECO audit reports ; External Audit Reports

Construction Phase

Impact Management Outcome:						
Impact Management Actions	Implementation			Monitoring		
	Responsible Person	Method of implementation	Timeframe for implementation	Responsible person	Frequency	Evidence of compliance
Owner / Operator to sign acceptance of the EMPr and copy on file	Owner Farm Manager	Signed documents on file	Before construction and operational phase	Farm Manager Owner	Quarterly	Documents of file
File with copy of approved EMPr on site	Farm Manager	Copies on file	Before construction and operational phase	Farm Manager	Quarterly	Documents of file
Incident record keeping on file on site	Farm Manager	Record keeping on file	Before the construction and operational phase	Farm Manager	Quarterly	Documents of file
Audit after 1 year and record on file	Farm Manager External Auditor	Records on file	At end of first year of operations	Farm Manager Owner to arrange	Yearly	Documents of file

Impact Management Outcome: Construction Compliance						
Impact Management Actions	Implementation			Monitoring		
	Responsible Person	Method of implementation	Timeframe for implementation	Responsible person	Frequency	Evidence of compliance
External Audits monthly with full report on file	Owner Farm Manager	Documents on file in office	Monthly	Owner Farm Manager	Monthly	Reports on file
Issues & Remedies to be implemented	Owner Farm Manager	Report on file in office	Monthly	Owner Farm Manager	Monthly	Reports on file

Impact Management Outcome: Construction Activities						
Impact Management Actions	Implementation			Monitoring		
	Responsible Person	Method of implementation	Timeframe for implementation	Responsible person	Frequency	Evidence of compliance
Daily staff briefings on environmental safety	ECO	Daily morning briefing sessions	From onset of the construction activities	Eco External Audit	Daily Monthly	ECO Report External Audit Report
Sanitising of ablution facilities	Contractor ECO	Daily in the morning	From onset of construction	Contractor ECO	Daily	ECO Report External Audit Report
Rubble clearing	Contractor ECO	Collection daily at close of work	From onset of construction	Contractor ECO	Daily	ECO Report External Audit Report
Sorting of Waste Streams	Contractor ECO	Daily when rubble is collected	From onset of construction	Contractor ECO	Daily	ECO Report External Audit Report
Availability of waste drums and coloured waste bins	Contractor ECO	At start of construction	From onset of construction	Contractor ECO	Daily	ECO Report External Audit Report
Waste removal to landfill must be documented and proof retained	Contractor ECO	At start of construction	From onset of construction	Contractor ECO	Daily as required	ECO Report External Audit Report
Audit Reports must be retained on file	ECO	At start of construction	From onset of construction	ECO	Weekly and monthly	ECO Report on file External Audit Report on file
Non-compliance and remedies to be kept on file	ECO	From start of construction through audit reports	From onset of audits	ECO Contractor	Daily	ECO Audits External Audit Reports

Impact Management Outcome: Implementation of impact management actions – Construction Phase						
Impact Management Actions	Implementation			Monitoring		
	Responsible Person	Method of implementation	Timeframe for implementation	Responsible person	Frequency	Evidence of compliance
Day by day checks and remedies	ECO	Check list and internal audits	From start of construction	ECO	Daily	Records and internal audit reports
Monthly independent audits	EAP External Auditor	External audits with report	From start of construction	EAP External Auditor	Monthly	External Audit Reports and recommendations

Impact Management Outcome: Avoiding pollution or degradation						
Impact Management Actions	Implementation			Monitoring		
	Responsible Person	Method of implementation	Timeframe for implementation	Responsible person	Frequency	Evidence of compliance
Regular Internal and External Audits to monitor compliance	ECO External Auditor	ECO Reports EAP Audits once a month	From onset of construction phase	ECO External Auditor	Daily, weekly and monthly	ECO Report External Audit
Regular staff training and record keeping of training given	ECO Contractor	ECO Contractor	From onset of construction phase	ECO Contractor	Weekly	ECO Report External Audit
EMPr to each contractor against signature	ECO	ECO	From onset of construction phase	ECO	Start of each contract	ECO Report External Audit
Waste separation to take place in support of recycling	ECO Contractor	ECO Contractor	From onset of construction phase	Contractor ECO check	Daily	ECO Report External Audit
No burning of cement bags or burying of bags on site	ECO Contractor	ECO check Contractor	From onset of construction phase	Contractor ECO	Daily	ECO Report External Audit
No removal of any trees unless authorised by the EAP for the project	ECO Contractor EAP	ECO check Contractor	From onset of construction phase	Contractor ECO EAP	Ongoing for construction phase	ECO Report External Audit
Cement tools wash down in designated area only	ECO Contractor	ECO Contractor	From onset of construction phase	Contractor ECO	Daily	ECO Report External Audit
Ensure that ablutions are clean and serviceable. No use of the bushes or adjacent environment as a toilet	ECO Contractor	ECO	From onset of construction phase	ECO	Daily	ECO Report External Audit

Impact Management Outcome: Rehabilitation of the environment						
Impact Management Actions	Implementation			Monitoring		
	Responsible Person	Method of implementation	Timeframe for implementation	Responsible person	Frequency	Evidence of compliance
Removal of rubble not used as infill to landfill	Contractor ECO	By truck to landfill and receipt for deposition	Upon start of construction	Contractor ECO	As and when rubble is large enough for removal	ECO Report External Audit Report
No burning or burying of waste allowed	Contractor ECO	Daily checks by ECO	Upon start of construction	Contractor ECO	Daily checks by ECO	ECO Report External Audit Reports
Waste soils to be used in foundations or disposed at an approved site	Contractor ECO	Daily checks if soils are not being used	Upon start of earth works on site	Contractor ECO	Ongoing throughout construction	ECO Report External Audit Report
Must be infilled and compacted to ensure safety	Contractor ECO	Checked at end of construction	At end of construction	Contractor ECO	Whenever a trench needs closing in	ECO Signoff External Audit Report
Removal of the temporary site office and mobile toilets to final clean-up	Contractor ECO	End of construction phase removal by contractor	At end of construction	Contractor	End of Construction Phase	ECO Report External Audit Report

Operational Phase

Impact Management Outcome: Operational aspects						
Impact Management Actions	Implementation			Monitoring		
	Responsible Person	Method of implementation	Timeframe for implementation	Responsible person	Frequency	Evidence of compliance
Environmental Incident Register at reception	Owner Farm Manager	Environmental File at reception	As from the Construction Phase throughout the life span of the facility	Owner Farm Manager	Ongoing daily	Internal Audit quarterly External Yearly
Communicate Health Regime for safety of animals and employees	Farm Manager	Farm Manager Weekly training	From start of operations	Farm Manager	Weekly staff training	Record keeping
Light; signage, display boards are operational and clear	Farm Manager	Physical checking	Weekly checks & maintenance	Farm Manager	Weekly checks and maintenance	Record keeping
Communicate best route for deliveries to minimise dust generation	Farm Manager	Communicate when placing an order	At time of ordering stock i.e. feed; coal; day old chicks	Farm Manager	When making orders	Record keeping
Communicate speed restrictions to delivering companies	Farm Manager	Communicate when placing an order	At time of placing an order	Farm Manager	When making orders	Record keeping
Communicate bio-security rules to delivery companies	Farm Manager	Communicate when placing an order	At time of placing an order	Farm Manager	When making orders	Record keeping
All houses to be checked twice a day for mortalities	Farm Manager Staff	Physical walk through	Daily in the morning and afternoon	Farm Manager Staff	Daily	Record keeping
Mortalities to be removed to refrigeration pending removal	Staff working in the animal houses	Physical removal and transferring mortalities to refrigeration	Twice a day as and when mortalities are encountered	Farm Manager Staff	Daily morning and afternoon	Record keeping
Ablution facilities to be disinfected and provided with warm water and soap for staff	Farm manager Staff	Physical clean down and replenishing of soap	Daily in the morning and in the afternoon	Farm Manager Staff	Daily morning and afternoon	Record keeping
All access points to have foot baths	Farm Manager	Physical filling and checking	Twice per day	Farm Manager Staff	Daily	Record keeping
Timeously notify 3 rd party users of the animal waste on date that waste must be removed from site	Farm Manager	Call and arrange for removal	As and when clean-out is contemplated	Farm Manager	When cleaning out	Record keeping
All old bedding and manure to be removed from site upon clean-out – no stock piling to occur	Farm Manager	Physical collection and removal from the houses for old bedding	As and when clean-out is being done	Farm Manager	When cleaning out	Record keeping
Implement as secure fly spray regime to combat flies	Farm Manager Farm Vet	Add additives to the feed as prescribed	Weekly operation	Farm Manager Company Vet	Weekly	Record keeping
Use contact spray on outside of the houses to combat flies	Farm Manager Farm Vet	Spray down as prescribed by the company Vet	Weekly operation	Farm Manager Company Vet	Weekly	Record keeping
Undertake daily farm area clean-up of rubble	Farm Manager Staff	Physical walk through	Daily pick-up	Farm Manager	Daily	Record keeping
Ensure rubble sorted at source for recycling purposes	Farm Manager Staff	Physical sorting as and when rubble is collected	Daily	Farm Manager Staff	Daily	Record keeping
Ensure weekly removal of waste to landfill	Farm Manager	By vehicle to the landfill	Once a week to landfill	Farm Manager	Weekly	Record keeping
Ensure waste removal is done against receipt	Farm Manager	Person taking waste must request a receipt	When waste goes to landfill	Farm Manager	Weekly when removal is done	Record keeping
Waste bins to be disinfected once a week	Farm Manager	Physical wash down and	Weekly at least once	Farm Manager	Weekly	Record keeping

	Staff	disinfection inside				
Impact Management Outcome: Prescribed Standards & Practices						
Impact Management Actions	Implementation			Monitoring		
	Responsible Person	Method of implementation	Timeframe for implementation	Responsible person	Frequency	Evidence of compliance
Ensure Health & Safety and Bio-security rules communicated to staff Sign-off on record	Farm Manager	Staff training and sign-off of training	From start of operations	Farm Manager	Weekly training	Record keeping sign-off on training
Internal Audit of aspects as contained in the approved EMPr	Farm Manager	Record keeping of audits undertaken	From start of operation	Farm Manager	Quarterly	Record keeping
Undertake internal audit quarterly and external audit once a year	Farm Manager EAP	Records of audits on file	From start of operations	Farm Manager EAP	Internal quarterly External Yearly	Record keeping
Ablution facilities must be sanitised and kept clean – service twice a day	Farm Manager	Check and record keeping	From start of operations	Farm Manager	Daily morning and afternoon	Record keeping
Coal bunkers must have either roof or tarpaulin	Farm Manager	Physical check	From start of operation	Farm Manager	Daily	Part of regular audit

Impact Management Outcome: Operational compliance						
Impact Management Actions	Implementation			Monitoring		
	Responsible Person	Method of implementation	Timeframe for implementation	Responsible person	Frequency	Evidence of compliance
Quarterly external audits in 1 st year of operations	Owner Farm Manager	External audit with full report	Once operations start	Owner Farm Manager	Quarterly	Report and findings on file
After 1 st year only yearly external audits	Owner Farm Manager	External audit with full report	After 1 year of operations	Owner Farm Manager	Yearly	Report and findings on file

Impact Management Outcome: Operational Activities						
Impact Management Actions	Implementation			Monitoring		
	Responsible Person	Method of implementation	Timeframe for implementation	Responsible person	Frequency	Evidence of compliance
Waste must be containerised and not be left outside to create problems	Owner Farm Manager	Daily checks Daily removal	From the onset of the operational phase	Owner Farm Manager	Daily	Internal Audits Yearly external audit
Waste separation for ease of recycling	Owner Farm Manager	Daily checks	From the onset of the operational phase	Owner Farm Manager	Daily	Internal Audits Yearly external audit
Exit / entrance points must provide sanitising and footbaths	Owner Farm Manager	Equipment at the gates	Prior to the onset of operational phase	Owner Farm Manager	Daily	Internal Audits Yearly external audit
All exit / entrance points must have correct signage	Owner Farm Manager	Signage at the gates	Prior to the onset of the operational phase	Owner Farm Manager	Daily	Internal Audits Yearly external audit
Proper ablution facilities and showers for staff on site	Owner Farm Manager	To be constructed during the construction phase	Must be available from onset of the Operational Phase	Owner Farm Manager	Daily	Internal Audits Yearly external audit
Exterior lights must be down-lighter to prevent light pollution	Owner Farm Manager	To be installed during construction phase – ongoing maintenance	During construction phase	Owner Farm Manager	Ongoing maintenance and upkeep	Internal Audits Yearly external audit

Impact Management Outcome:						
Impact Management Actions	Implementation			Monitoring		
	Responsible Person	Method of implementation	Timeframe for implementation	Responsible person	Frequency	Evidence of compliance
Owner / Operator to sign acceptance of the EMPr and copy on file	Owner Farm Manager	Signed documents on file	Before construction and operational phase	Farm Manager Owner	Quarterly	Documents of file
File with copy of approved EMPr on site	Farm Manager	Copies on file	Before construction and operational phase	Farm Manager	Quarterly	Documents of file
Incident record keeping on file on site	Farm Manager	Record keeping on file	Before construction and operational phase	Farm Manager	Quarterly	Documents of file
Audit after 1 year and record on file	Farm Manager External Auditor	Records on file	At end of first year of operations	Farm Manager Owner to arrange	Yearly	Documents of file

Impact Management Outcome: Implementation of impact management actions – Operational Phase						
Impact Management Actions	Implementation			Monitoring		
	Responsible Person	Method of implementation	Timeframe for implementation	Responsible person	Frequency	Evidence of compliance
Uphold the dictates of the approved EMPr	Owner Farm Manager	Signed EMPr and acceptance by signature	From time of operations	Owner Farm Manager	Quarterly for 1 st year then yearly	Documents on file
Monthly external audits	Owner EAP	Full audit with report	From time of operations	Owner Farm Manager EAP	Monthly	Records on file
Guidance and remedies where required	EAP	Written Report	After each audit	EAP Farm Manager	Monthly or as and when required	Record on file
Record keeping of all findings and remedies suggested	Owner Farm Manager	Reports on file	After each audit	Owner Farm Manager	Monthly	Records on file

Additional Aspects to be added:

NOTE: The EMPr is a living document and allows for additions to be made as and when circumstances arise that demand changes or additions. ALL additions or changes must be documented and properly dated in order to maintain a date line and proper paper trail.

- This EMPr has been accepted by the developer of the proposed activity for on behalf ofand will be circulated, against signature to all contractors involved in the construction process.
- Such signed documents will be kept on file for audit purposes by the relevant authorities.

Signed for and on behalf of the developer:

_____ Signature	_____ Name	_____ Date
--------------------	---------------	---------------

EAP (RP Colyn / EAPSA 2019/1358)

Aspects for Environmental Compliance – CONSTRUCTION

ITEM	YES	NO
Is the construction site clearly demarcated?		
Is there a clearly demarcated barrier between the existing infrastructure and the new area to indicate where construction workers may not go?		
Is there a footbath and disinfectant for all arrivals on site?		
Is the site office in place?		
Is there a bulk skip on site?		
Are there bins for waste separation on site?		
Has staff received training on environmental issues?		
Are ablutions in place and being serviced?		
Has an area for cement wash down been set aside?		
Has an area been demarcated for the keeping of building sand; stone; cement etc?		
Has an area been demarcated where staff may prepare food and tea / coffee?		
Is the environment clear of rubble and waste?		
Are all documentation i.e. EA; EMPr; Contractor Acceptance docs on file and on site?		
Has an Incident Record File been opened and kept on site?		
Are copies of waste removal receipts kept on file on site?		
Are copies of ablution services kept on file on site?		
Are all excavations / trenches safe and clearly marked?		
Are the weekly audits and monthly external audits on file and on site?		

Aspects for Environmental Compliance - OPERATIONAL

ITEM	YES	NO
Is the environmental file with all authorisations on site?		
Is traffic speed being regulated?		
Are delivery trucks following the best possible routes via tar roads to minimise dust?		
Are vehicle activities restricted to day light hours?		
Is the site free of waste?		
Is daily site clean-up being done?		
Is the area clear of animal waste?		
Are the take-off agreement in place and on file?		
Are mortalities kept refrigerated pending removal?		
Are mortalities removed in enclosed containers?		
Is the operation following a fly spray regime?		
Is the operation adding medication to feeding to prevent fly larvae from developing?		
Is the operation following a bio-security plan?		
Are access point to the premises provided with foot baths and sanitiser?		
Are ablution facilities clean and serviced?		
Are the coal bunkers cover and kept closed to prevent ingress of water?		
Are the coal ashes kept covered pending removal to landfill?		
Is internal audits being undertaken by the farm manager?		
Is external audits being undertaken by the independent auditor?		
Coal bunkers – roof or covered?		
Coal bunkers – no water ingress?		
Coal Ash bunkers – available to accept ash from the heating system?		

ANNEX I

Other Information

- **EAP Info**

**Environmental Assessment
Practitioners Association
of South Africa**



Registration No. 2020/1358

Herewith certifies that

RIËL PIETER COLYN

is registered as an

Environmental Assessment Practitioner

**Registered in accordance with the prescribed criteria of Regulation 15. (1)
of the Section 24H Registration Authority Regulations
(Regulation No. 849, Gazette No. 40154 of 22 July 2016, of the
National Environmental Management Act (NEMA), Act No. 107 of 1998, as amended).**

Effective: 01 March 2025

Expires: 31 March 2026

Chairperson

Registrar



- **Screening Tool Report**

**SCREENING REPORT FOR AN ENVIRONMENTAL AUTHORIZATION AS
REQUIRED BY THE 2014 EIA REGULATIONS – PROPOSED SITE
ENVIRONMENTAL SENSITIVITY**

EIA Reference number: NW-DEDECT

Project name: LEBOKA Agriculture Pty Ltd

Project title: Leboka Pig Farm

Date screening report generated: 14/02/2025 11:58:20

Applicant: LEBOKA Agriculture Pty Ltd

Compiler: RP Colyn

Compiler signature:

.....

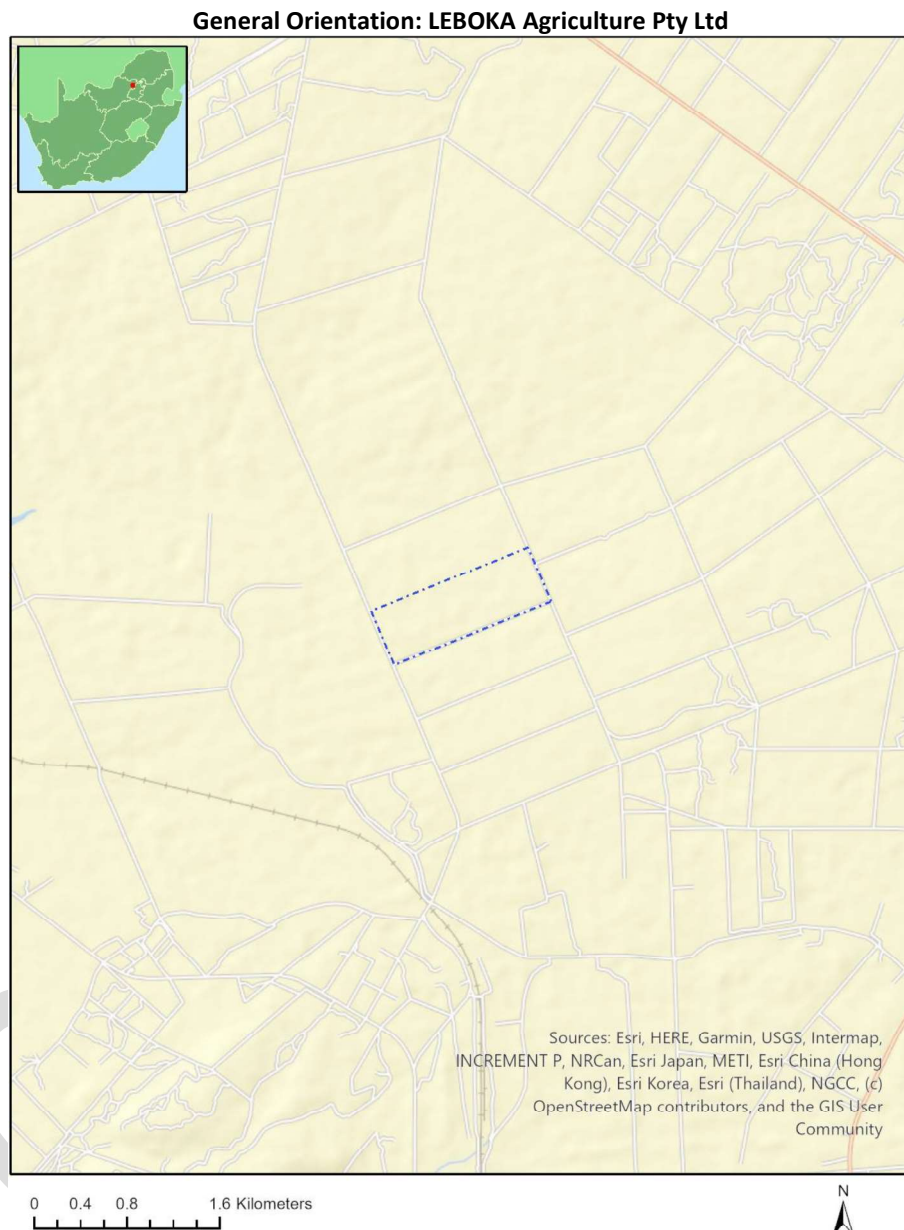
Application Category: Agriculture_Forestry_Fisheries|Animal Production

Table of Contents

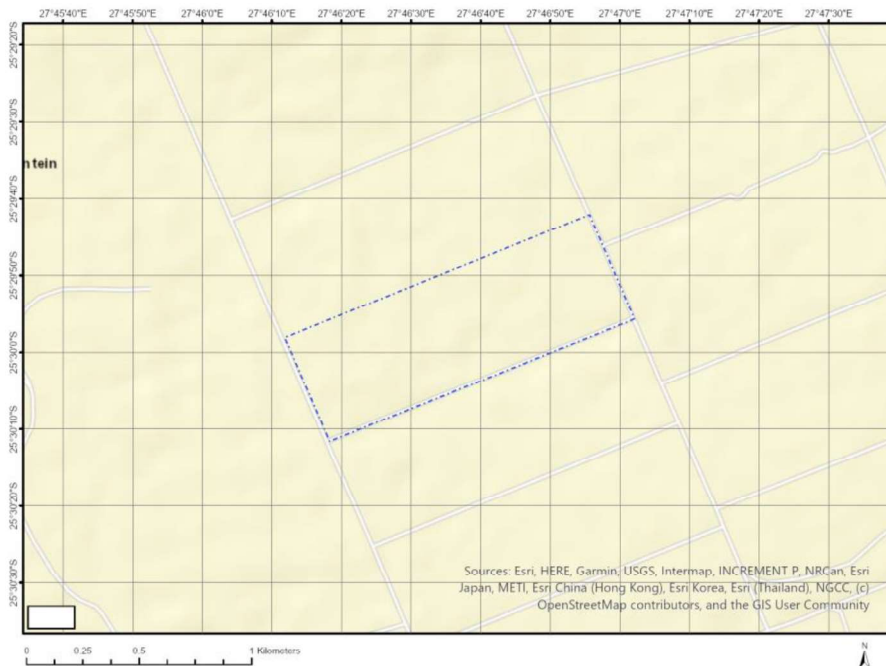
Proposed Project Location	3
Orientation map 1: General location	3
Map of proposed site and relevant area(s)	4
Cadastral details of the proposed site	4
Wind and Solar developments with an approved Environmental Authorisation or applications under consideration within 30 km of the proposed area	4
Environmental Management Frameworks relevant to the application	5
Environmental screening results and assessment outcomes	5
Relevant development incentives, restrictions, exclusions or prohibitions	5
Proposed Development Area Environmental Sensitivity	6
Specialist assessments identified	6
Results of the environmental sensitivity of the proposed area	8
MAP OF RELATIVE AGRICULTURE THEME SENSITIVITY	8
MAP OF RELATIVE ANIMAL SPECIES THEME SENSITIVITY	9
MAP OF RELATIVE AQUATIC BIODIVERSITY THEME SENSITIVITY	10
MAP OF RELATIVE ARCHAEOLOGICAL AND CULTURAL HERITAGE THEME SENSITIVITY	11
MAP OF RELATIVE CIVIL AVIATION THEME SENSITIVITY	12
MAP OF RELATIVE DEFENCE THEME SENSITIVITY	13
MAP OF RELATIVE PALEONTOLOGY THEME SENSITIVITY	14
MAP OF RELATIVE PLANT SPECIES THEME SENSITIVITY	15
MAP OF RELATIVE TERRESTRIAL BIODIVERSITY THEME SENSITIVITY	16

Proposed Project Location

Orientation map 1: General location



Map of proposed site and relevant area(s)



Cadastral details of the proposed site

Property details:

No	Farm Name	Farm/ Erf No	Portion	Latitude	Longitude	Property Type
1	BLAAUWBANK	241	0	25°28'52.24S	27°47'42.64E	Farm
2	BLAAUWBANK	241	10	25°29'56.85S	27°46'37E	Farm Portion

Development footprint¹ vertices:

No development footprint(s) specified.

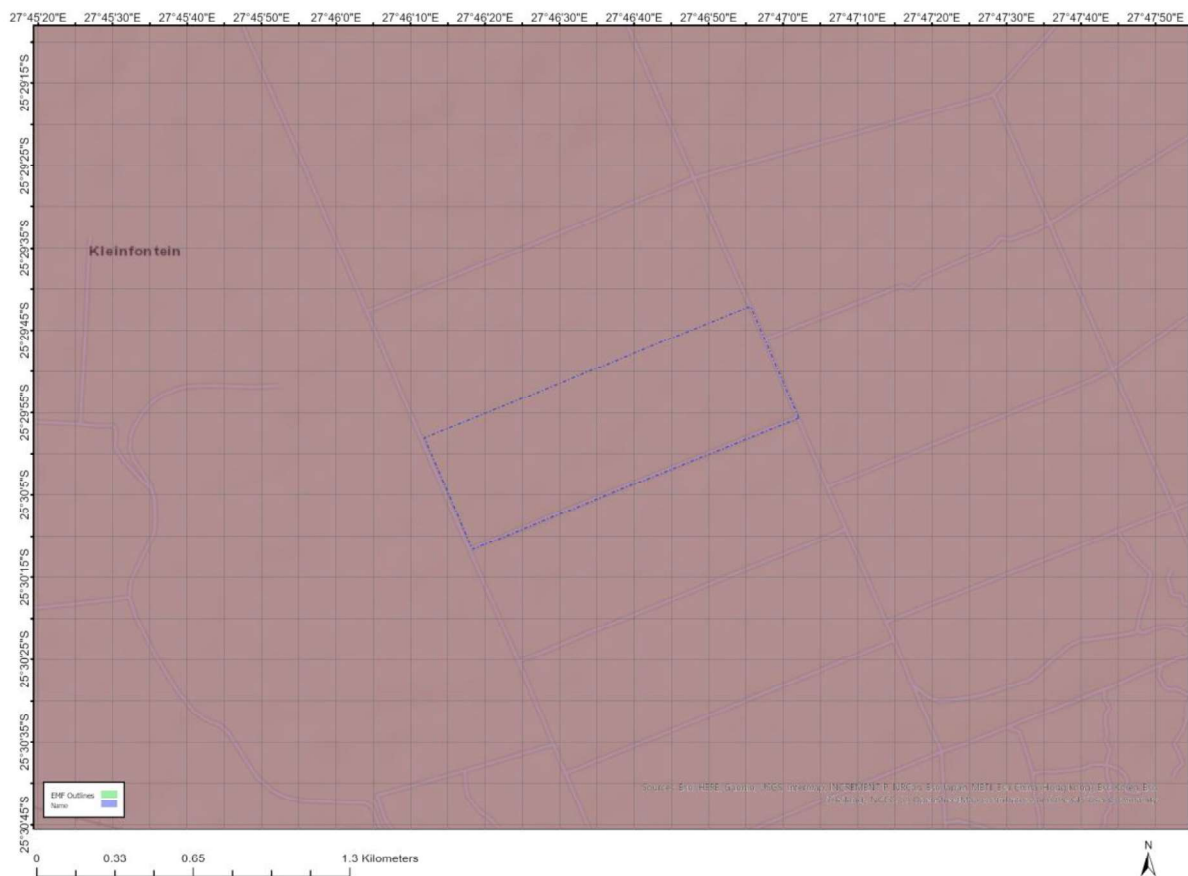
Wind and Solar developments with an approved Environmental Authorisation or applications under consideration within 30 km of the proposed area

No	EIA Reference No	Classification	Status of application	Distance from proposed area (km)
1	14/12/16/3/3/2/850	Solar PV	Approved	23.4
2	14/12/16/3/3/2/510/AM1	Solar PV	Approved	14.9
3	14/12/16/3/3/1/492	Solar PV	Approved	14.9
4	14/12/16/3/3/1/1842	Wind	Approved	23.4
5	12/12/20/2172	Solar PV	Approved	23.6
6	14/12/16/3/3/1/491	Solar PV	Approved	14.9

¹ "development footprint", means the area within the site on which the development will take place and includes all ancillary developments for example roads, power lines, boundary walls, paving etc. which require vegetation clearance or which will be disturbed and for which the application has been submitted.

7	14/12/16/3/3/2/850/AM2	Solar PV	Approved	23.4
8	12/12/20/2220/AM2	Solar PV	Approved	20

Environmental Management Frameworks relevant to the application



Environmental Management Framework	LINK
Bojanala EMF	https://screening.environment.gov.za/ScreeningDownloads/EMF/BojanalaEMF.pdf

Environmental screening results and assessment outcomes

The following sections contain a summary of any development incentives, restrictions, exclusions or prohibitions that apply to the proposed development site as well as the most environmental sensitive features on the site based on the site sensitivity screening results for the application classification that was selected. The application classification selected for this report is:

Agriculture_Forestry_Fisheries|Animal Production.

Relevant development incentives, restrictions, exclusions or prohibitions

The following development incentives, restrictions, exclusions or prohibitions and their implications that apply to this site are indicated below.

Incentive, restriction or prohibition	Implication
Air Quality-Waterberg-Bojanala Priority Area	https://screening.environment.gov.za/ScreeningDownloads/DevelopmentZones/gg39489_nn1207a.pdf

Proposed Development Area Environmental Sensitivity

The following summary of the development site environmental sensitivities is identified. Only the highest environmental sensitivity is indicated. The footprint environmental sensitivities for the proposed development footprint as identified, are indicative only and must be verified on site by a suitably qualified person before the specialist assessments identified below can be confirmed.

Theme	Very High sensitivity	High sensitivity	Medium sensitivity	Low sensitivity
Agriculture Theme			X	
Animal Species Theme			X	
Aquatic Biodiversity Theme	X			
Archaeological and Cultural Heritage Theme				X
Civil Aviation Theme		X		
Defence Theme				X
Paleontology Theme			X	
Plant Species Theme				X
Terrestrial Biodiversity Theme	X			

Specialist assessments identified

Based on the selected classification, and the known impacts associated with the proposed development, the following list of specialist assessments have been identified for inclusion in the assessment report. It is the responsibility of the EAP to confirm this list and to motivate in the assessment report, the reason for not including any of the identified specialist study including the provision of photographic evidence of the site situation.

No	Specialist assessment	Assessment Protocol
1	Landscape/Visual Impact Assessment	https://screening.environment.gov.za/ScreeningDownloads/AssessmentProtocols/Gazetted_General_Requirement_Assessment_Protocols.pdf
2	Archaeological and Cultural Heritage Impact Assessment	https://screening.environment.gov.za/ScreeningDownloads/AssessmentProtocols/Gazetted_General_Requirement_Assessment_Protocols.pdf
3	Palaeontology Impact Assessment	https://screening.environment.gov.za/ScreeningDownloads/AssessmentProtocols/Gazetted_General_Requirement_Assessment_Protocols.pdf
4	Terrestrial Biodiversity Impact Assessment	https://screening.environment.gov.za/ScreeningDownloads/AssessmentProtocols/Gazetted_Terrestrial_Biodiversity_Assessment_Protocols.pdf
5	Aquatic Biodiversity Impact Assessment	https://screening.environment.gov.za/ScreeningDownloads/AssessmentProtocols/Gazetted_Aquatic_Biodiversity_Assessment_Protocols.pdf
6	Hydrology Assessment	https://screening.environment.gov.za/ScreeningDownloads/AssessmentProtocols/Gazetted_Hydrology_Assessment_Protocols.pdf

		ssmentProtocols/Gazetted_General_Requirement_Assessment_Protocols.pdf
7	Traffic Impact Assessment	https://screening.environment.gov.za/ScreeningDownloads/AssessmentProtocols/Gazetted_General_Requirement_Assessment_Protocols.pdf
8	Socio-Economic Assessment	https://screening.environment.gov.za/ScreeningDownloads/AssessmentProtocols/Gazetted_General_Requirement_Assessment_Protocols.pdf
9	Ambient Air Quality Impact Assessment	https://screening.environment.gov.za/ScreeningDownloads/AssessmentProtocols/Gazetted_General_Requirement_Assessment_Protocols.pdf
10	Plant Species Assessment	https://screening.environment.gov.za/ScreeningDownloads/AssessmentProtocols/Gazetted_Plant_Species_Assessment_Protocols.pdf
11	Animal Species Assessment	https://screening.environment.gov.za/ScreeningDownloads/AssessmentProtocols/Gazetted_Animal_Species_Assessment_Protocols.pdf

Results of the environmental sensitivity of the proposed area.

The following section represents the results of the screening for environmental sensitivity of the proposed site for relevant environmental themes associated with the project classification. It is the duty of the EAP to ensure that the environmental themes provided by the screening tool are comprehensive and complete for the project. Refer to the disclaimer.

MAP OF RELATIVE AGRICULTURE THEME SENSITIVITY

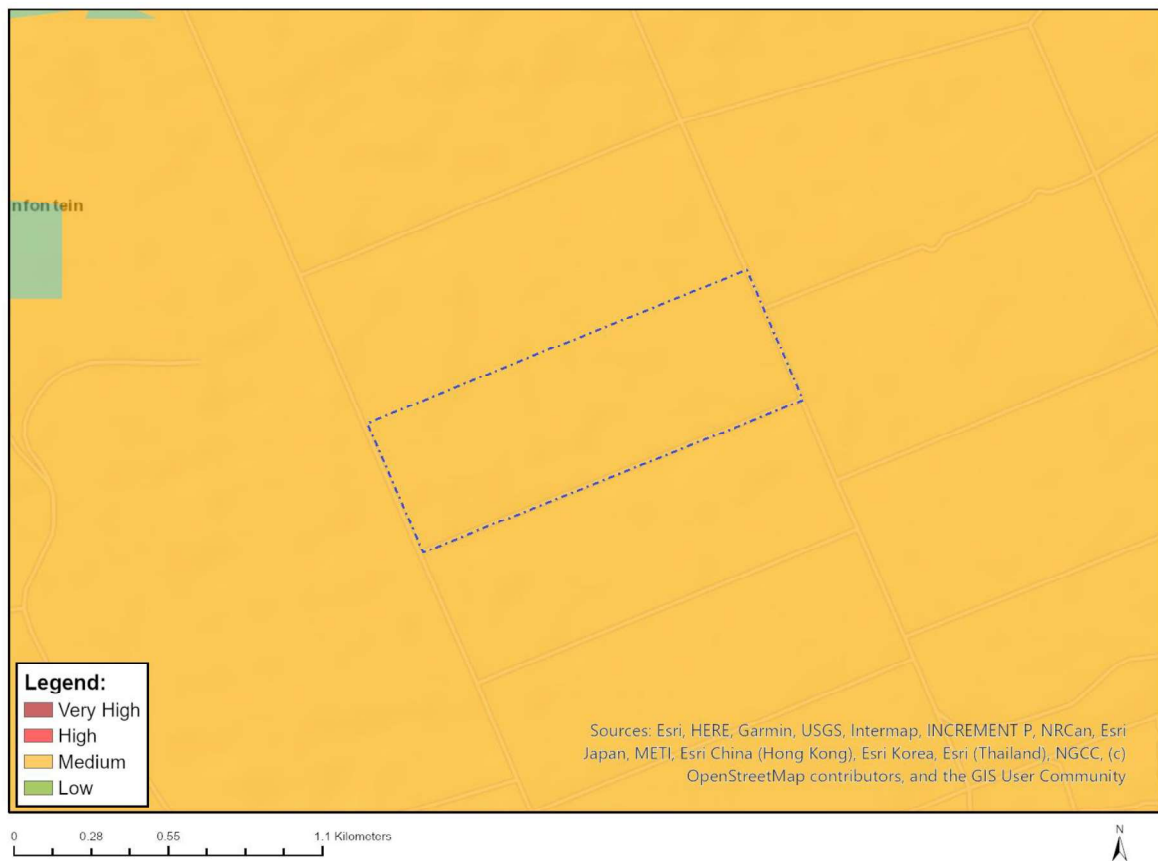


Very High sensitivity	High sensitivity	Medium sensitivity	Low sensitivity
		X	

Sensitivity Features:

Sensitivity	Feature(s)
Medium	Land capability;06. Low-Moderate/07. Low-Moderate/08. Moderate

MAP OF RELATIVE ANIMAL SPECIES THEME SENSITIVITY



Where only a sensitive plant unique number or sensitive animal unique number is provided in the screening report and an assessment is required, the environmental assessment practitioner (EAP) or specialist is required to email SANBI at eiadatarequests@sanbi.org.za listing all sensitive species with their unique identifiers for which information is required. The name has been withheld as the species may be prone to illegal harvesting and must be protected. SANBI will release the actual species name after the details of the EAP or specialist have been documented.

Very High sensitivity	High sensitivity	Medium sensitivity	Low sensitivity
		X	

Sensitivity Features:

Sensitivity	Feature(s)
Medium	Mammalia-Dasymys robertsii
Medium	Reptilia-Kinixys lobatsiana

MAP OF RELATIVE AQUATIC BIODIVERSITY THEME SENSITIVITY



Very High sensitivity	High sensitivity	Medium sensitivity	Low sensitivity
X			

Sensitivity Features:

Sensitivity	Feature(s)
Low	Low sensitivity
Very High	ESA 1

MAP OF RELATIVE ARCHAEOLOGICAL AND CULTURAL HERITAGE THEME SENSITIVITY

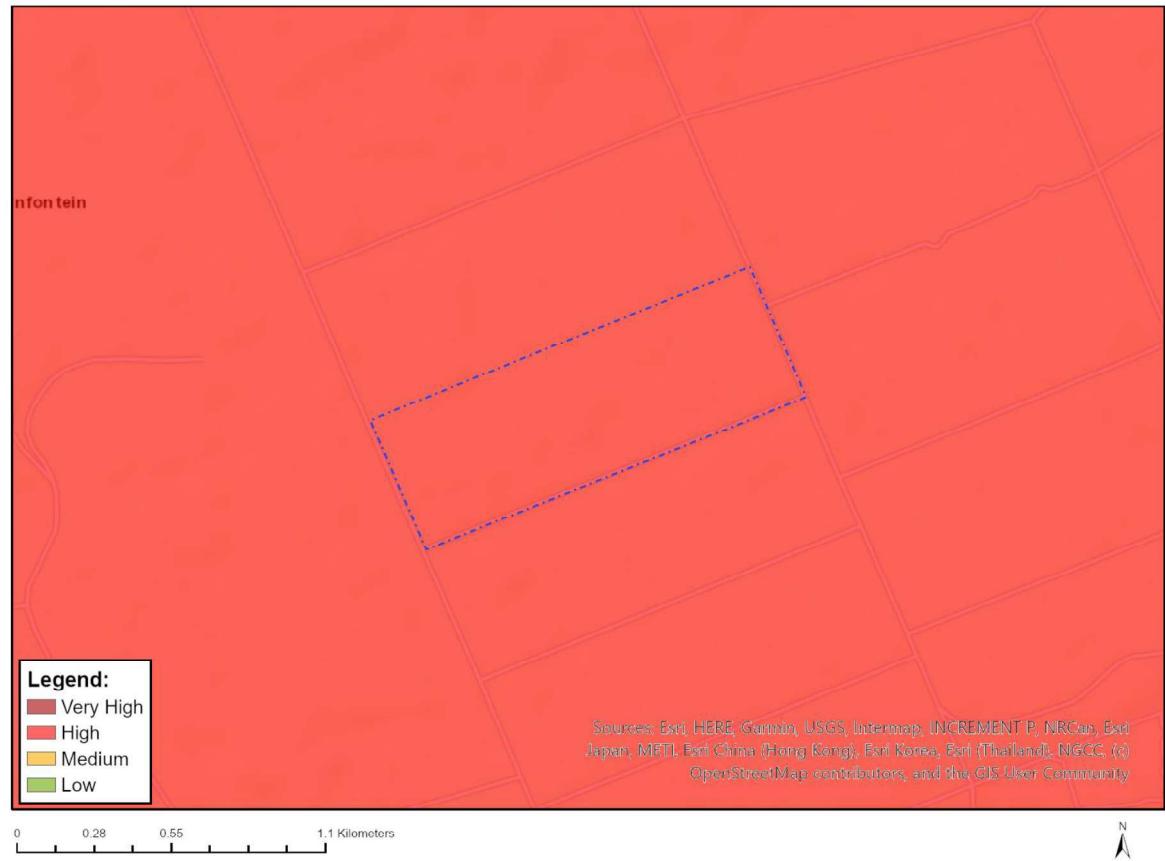


Very High sensitivity	High sensitivity	Medium sensitivity	Low sensitivity
			X

Sensitivity Features:

Sensitivity	Feature(s)
Low	Low sensitivity

MAP OF RELATIVE CIVIL AVIATION THEME SENSITIVITY

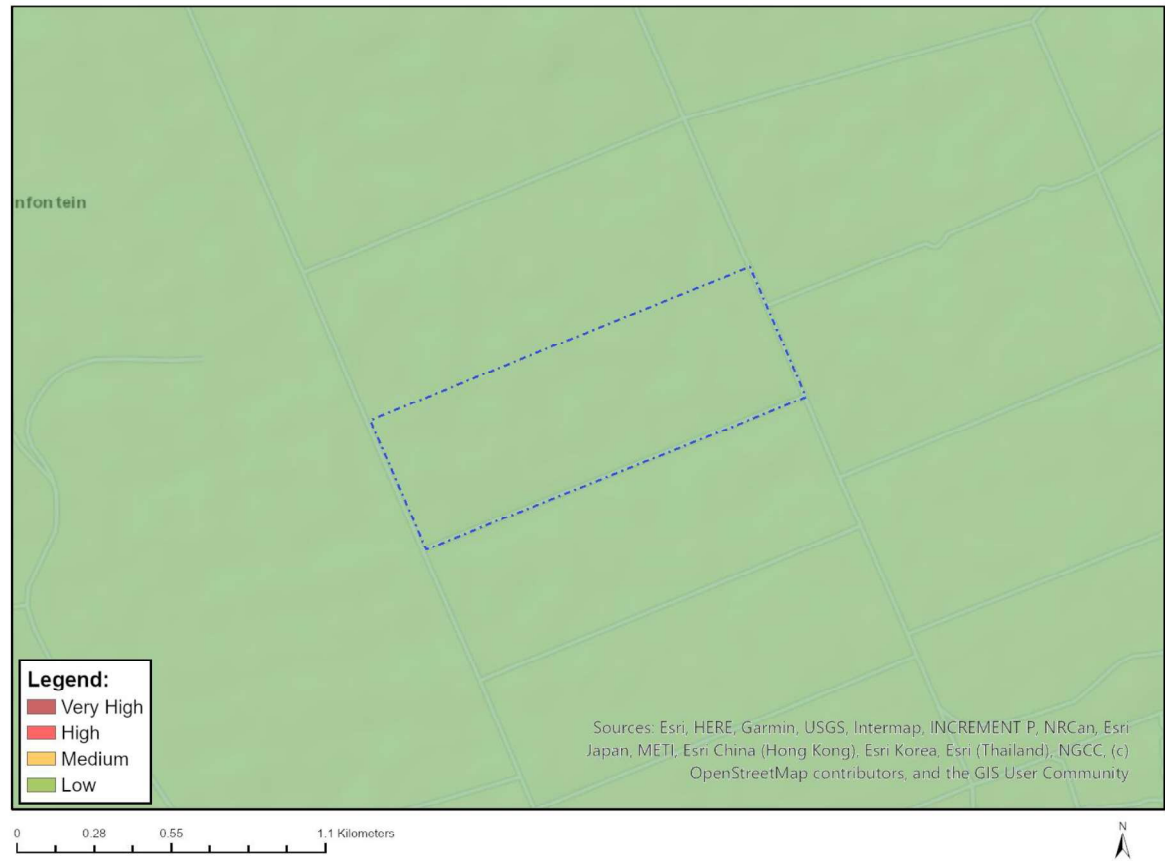


Very High sensitivity	High sensitivity	Medium sensitivity	Low sensitivity
	X		

Sensitivity Features:

Sensitivity	Feature(s)
High	Within 8 km of other civil aviation aerodrome

MAP OF RELATIVE DEFENCE THEME SENSITIVITY

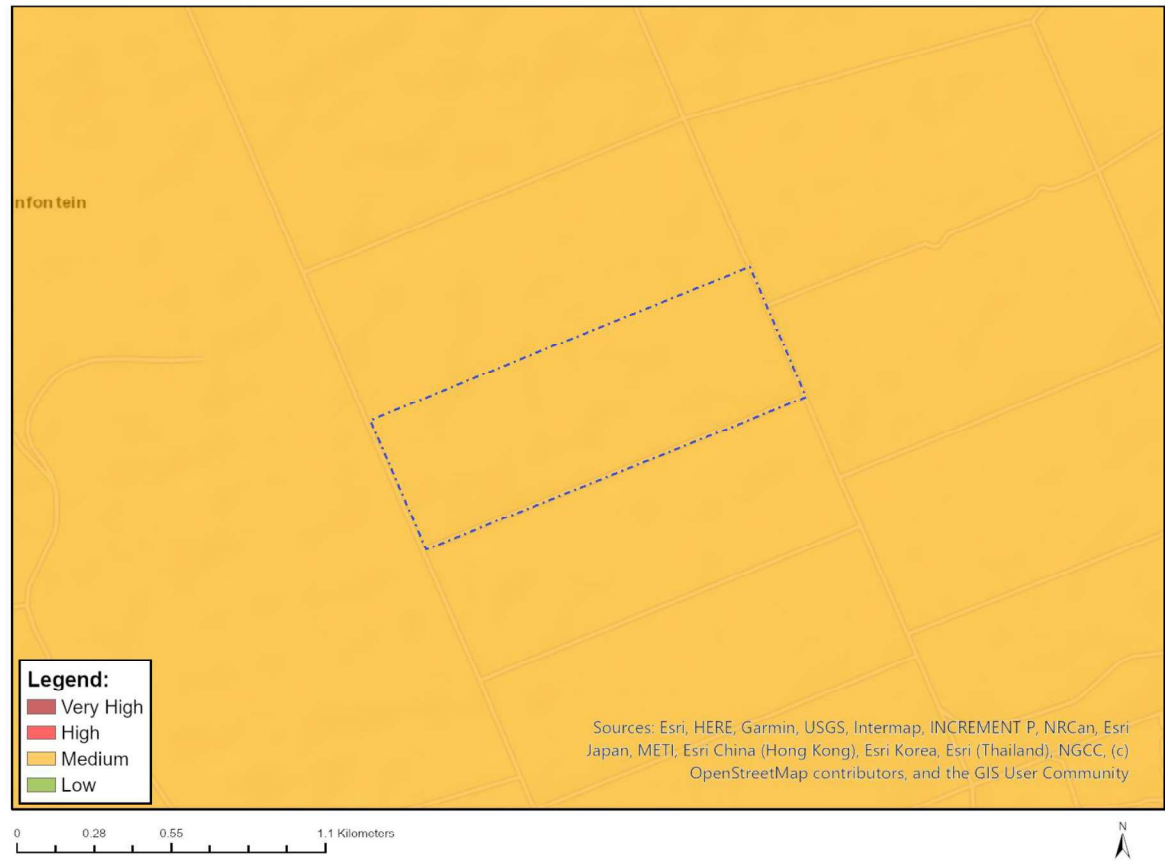


Very High sensitivity	High sensitivity	Medium sensitivity	Low sensitivity
			X

Sensitivity Features:

Sensitivity	Feature(s)
Low	Low Sensitivity

MAP OF RELATIVE PALEONTOLOGY THEME SENSITIVITY

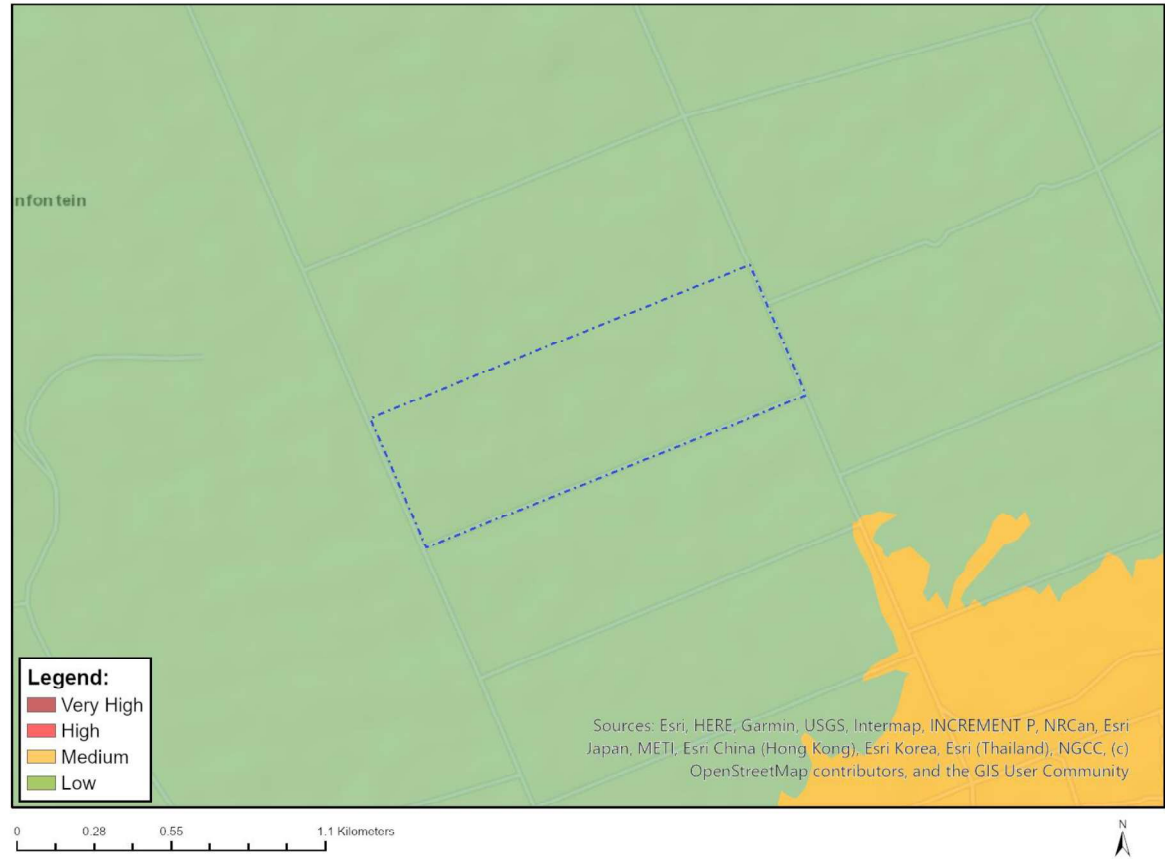


Very High sensitivity	High sensitivity	Medium sensitivity	Low sensitivity
		X	

Sensitivity Features:

Sensitivity	Feature(s)
Medium	Features with a Medium paleontological sensitivity

MAP OF RELATIVE PLANT SPECIES THEME SENSITIVITY



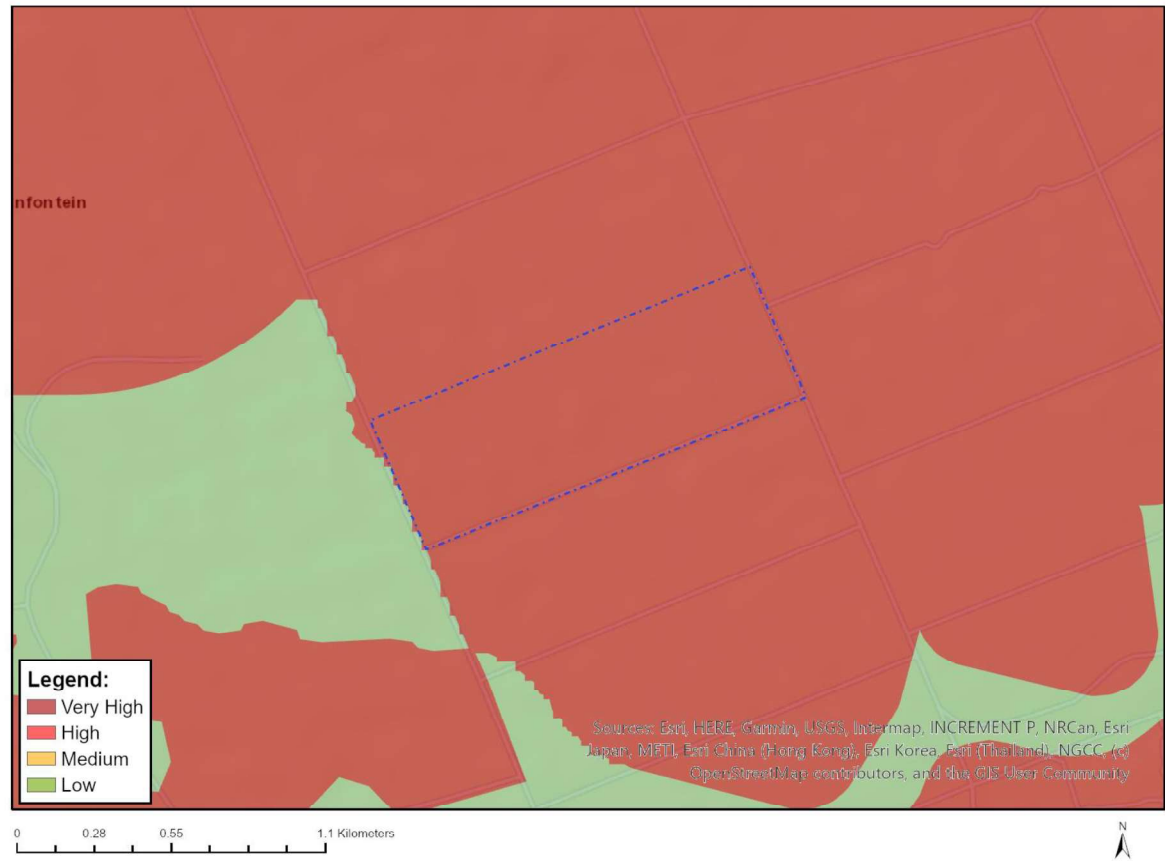
Where only a sensitive plant unique number or sensitive animal unique number is provided in the screening report and an assessment is required, the environmental assessment practitioner (EAP) or specialist is required to email SANBI at eiadatarequests@sanbi.org.za listing all sensitive species with their unique identifiers for which information is required. The name has been withheld as the species may be prone to illegal harvesting and must be protected. SANBI will release the actual species name after the details of the EAP or specialist have been documented.

Very High sensitivity	High sensitivity	Medium sensitivity	Low sensitivity
			X

Sensitivity Features:

Sensitivity	Feature(s)
Low	Low Sensitivity

MAP OF RELATIVE TERRESTRIAL BIODIVERSITY THEME SENSITIVITY



Very High sensitivity	High sensitivity	Medium sensitivity	Low sensitivity
X			

Sensitivity Features:

Sensitivity	Feature(s)
Low	Low Sensitivity
Very High	CBA 2
Very High	National Protected Area Expansion Strategy (NPAES)

**SCREENING REPORT FOR AN ENVIRONMENTAL AUTHORIZATION AS
REQUIRED BY THE 2014 EIA REGULATIONS – PROPOSED SITE
ENVIRONMENTAL SENSITIVITY**

EIA Reference number: NW-DEDECT

Project name: LEBOKA

Project title: LEGOKA PIG FARM [Ptn 15]

Date screening report generated: 14/02/2025 10:41:39

Applicant: LEBOKA Agriculture Pty Ltd

Compiler: RP Colyn

Compiler signature:

.....

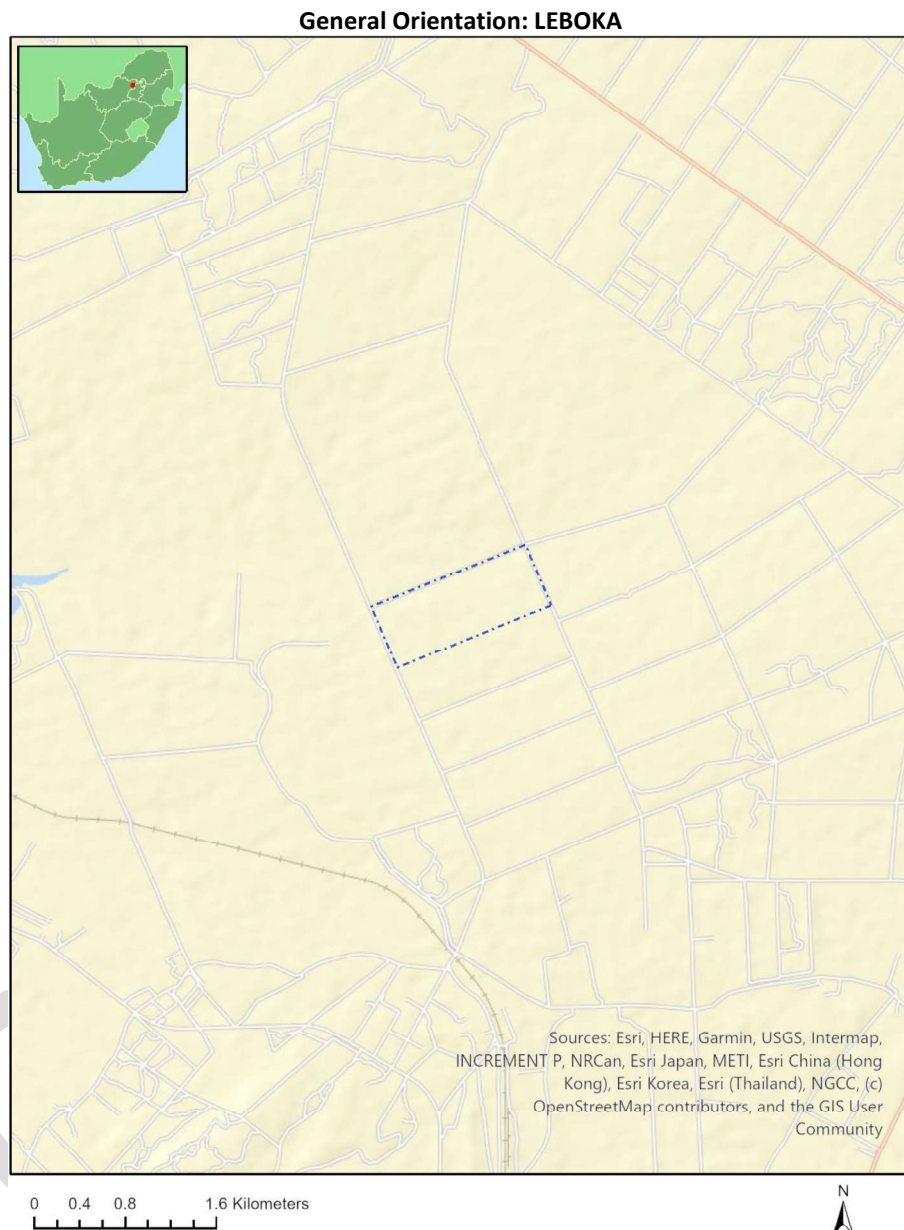
Application Category: Agriculture_Forestry_Fisheries|Animal Production

Table of Contents

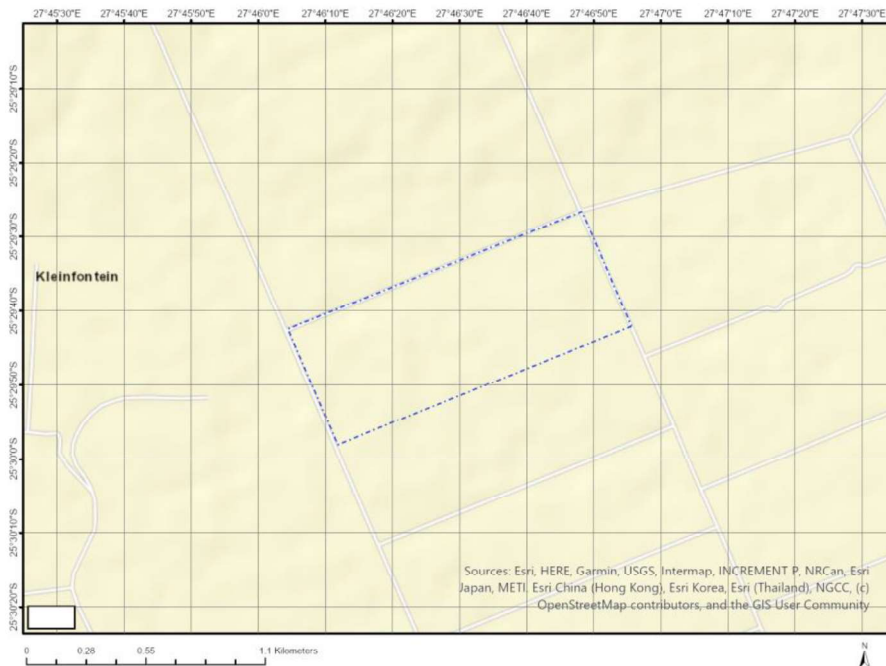
Proposed Project Location	3
Orientation map 1: General location	3
Map of proposed site and relevant area(s)	4
Cadastral details of the proposed site	4
Wind and Solar developments with an approved Environmental Authorisation or applications under consideration within 30 km of the proposed area	4
Environmental Management Frameworks relevant to the application	5
Environmental screening results and assessment outcomes	5
Relevant development incentives, restrictions, exclusions or prohibitions	5
Proposed Development Area Environmental Sensitivity	6
Specialist assessments identified	6
Results of the environmental sensitivity of the proposed area	8
MAP OF RELATIVE AGRICULTURE THEME SENSITIVITY	8
MAP OF RELATIVE ANIMAL SPECIES THEME SENSITIVITY	9
MAP OF RELATIVE AQUATIC BIODIVERSITY THEME SENSITIVITY	10
MAP OF RELATIVE ARCHAEOLOGICAL AND CULTURAL HERITAGE THEME SENSITIVITY	11
MAP OF RELATIVE CIVIL AVIATION THEME SENSITIVITY	12
MAP OF RELATIVE DEFENCE THEME SENSITIVITY	13
MAP OF RELATIVE PALEONTOLOGY THEME SENSITIVITY	14
MAP OF RELATIVE PLANT SPECIES THEME SENSITIVITY	15
MAP OF RELATIVE TERRESTRIAL BIODIVERSITY THEME SENSITIVITY	16

Proposed Project Location

Orientation map 1: General location



Map of proposed site and relevant area(s)



Cadastral details of the proposed site

Property details:

No	Farm Name	Farm/ Erf No	Portion	Latitude	Longitude	Property Type
1	BLAAUWBANK	241	0	25°28'52.24S	27°47'42.64E	Farm
2	BLAAUWBANK	241	15	25°29'42.33S	27°46'30.03E	Farm Portion

Development footprint¹ vertices:

No development footprint(s) specified.

Wind and Solar developments with an approved Environmental Authorisation or applications under consideration within 30 km of the proposed area

No	EIA Reference No	Classification	Status of application	Distance from proposed area (km)
1	14/12/16/3/3/2/850	Solar PV	Approved	23.9
2	14/12/16/3/3/2/510/AM1	Solar PV	Approved	15.3
3	14/12/16/3/3/1/492	Solar PV	Approved	15.3
4	14/12/16/3/3/1/1842	Wind	Approved	23.9
5	12/12/20/2172	Solar PV	Approved	24.1
6	14/12/16/3/3/1/491	Solar PV	Approved	15.3

¹ "development footprint", means the area within the site on which the development will take place and includes all ancillary developments for example roads, power lines, boundary walls, paving etc. which require vegetation clearance or which will be disturbed and for which the application has been submitted.

Incentive, restriction or prohibition	Implication
Air Quality-Waterberg-Bojanala Priority Area	https://screening.environment.gov.za/ScreeningDownloads/DevelopmentZones/gg39489_nn1207a.pdf

Proposed Development Area Environmental Sensitivity

The following summary of the development site environmental sensitivities is identified. Only the highest environmental sensitivity is indicated. The footprint environmental sensitivities for the proposed development footprint as identified, are indicative only and must be verified on site by a suitably qualified person before the specialist assessments identified below can be confirmed.

Theme	Very High sensitivity	High sensitivity	Medium sensitivity	Low sensitivity
Agriculture Theme			X	
Animal Species Theme			X	
Aquatic Biodiversity Theme	X			
Archaeological and Cultural Heritage Theme				X
Civil Aviation Theme		X		
Defence Theme				X
Paleontology Theme			X	
Plant Species Theme				X
Terrestrial Biodiversity Theme	X			

Specialist assessments identified

Based on the selected classification, and the known impacts associated with the proposed development, the following list of specialist assessments have been identified for inclusion in the assessment report. It is the responsibility of the EAP to confirm this list and to motivate in the assessment report, the reason for not including any of the identified specialist study including the provision of photographic evidence of the site situation.

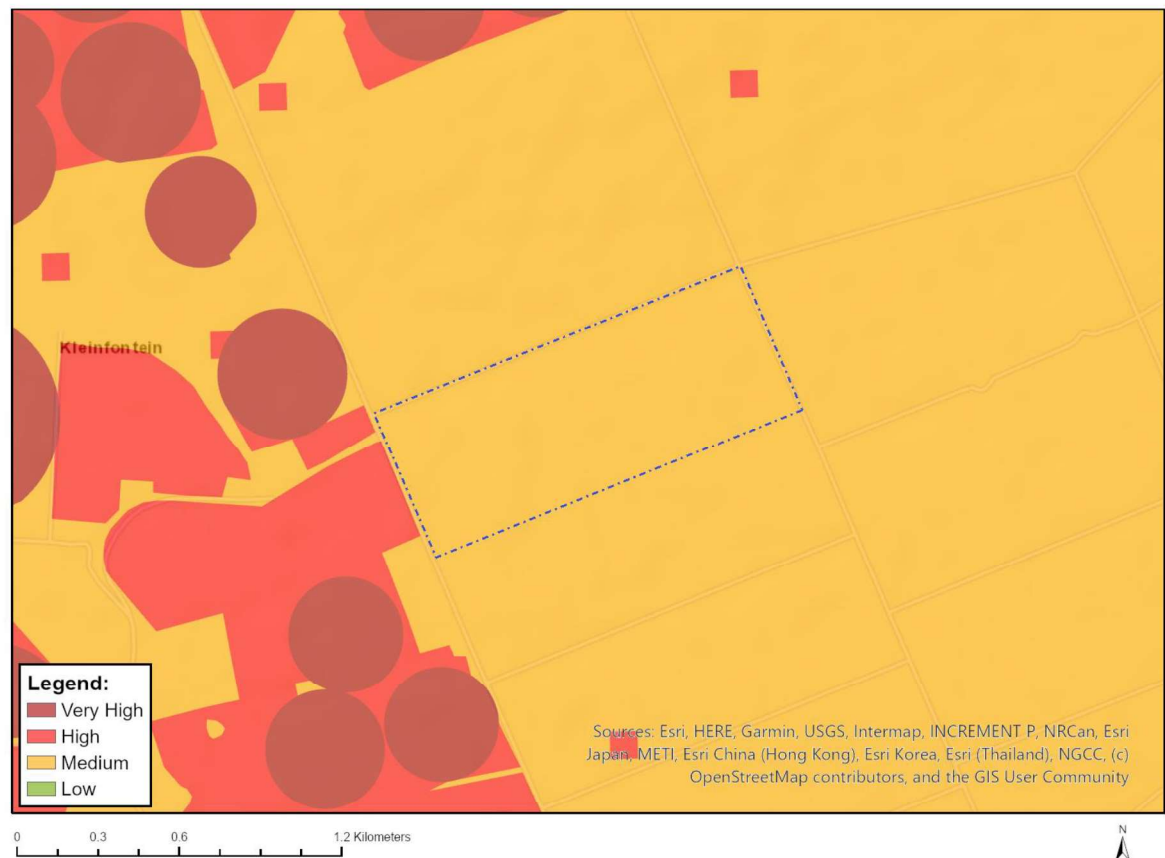
No	Specialist assessment	Assessment Protocol
1	Landscape/Visual Impact Assessment	https://screening.environment.gov.za/ScreeningDownloads/AssessmentProtocols/Gazetted_General_Requirement_Assessment_Protocols.pdf
2	Archaeological and Cultural Heritage Impact Assessment	https://screening.environment.gov.za/ScreeningDownloads/AssessmentProtocols/Gazetted_General_Requirement_Assessment_Protocols.pdf
3	Palaeontology Impact Assessment	https://screening.environment.gov.za/ScreeningDownloads/AssessmentProtocols/Gazetted_General_Requirement_Assessment_Protocols.pdf
4	Terrestrial Biodiversity Impact Assessment	https://screening.environment.gov.za/ScreeningDownloads/AssessmentProtocols/Gazetted_Terrestrial_Biodiversity_Assessment_Protocols.pdf
5	Aquatic Biodiversity Impact Assessment	https://screening.environment.gov.za/ScreeningDownloads/AssessmentProtocols/Gazetted_Aquatic_Biodiversity_Assessment_Protocols.pdf
6	Hydrology Assessment	https://screening.environment.gov.za/ScreeningDownloads/AssessmentProtocols/Gazetted_Hydrology_Assessment_Protocols.pdf

		ssmentProtocols/Gazetted_General_Requirement_Assessment_Protocols.pdf
7	Traffic Impact Assessment	https://screening.environment.gov.za/ScreeningDownloads/AssessmentProtocols/Gazetted_General_Requirement_Assessment_Protocols.pdf
8	Socio-Economic Assessment	https://screening.environment.gov.za/ScreeningDownloads/AssessmentProtocols/Gazetted_General_Requirement_Assessment_Protocols.pdf
9	Ambient Air Quality Impact Assessment	https://screening.environment.gov.za/ScreeningDownloads/AssessmentProtocols/Gazetted_General_Requirement_Assessment_Protocols.pdf
10	Plant Species Assessment	https://screening.environment.gov.za/ScreeningDownloads/AssessmentProtocols/Gazetted_Plant_Species_Assessment_Protocols.pdf
11	Animal Species Assessment	https://screening.environment.gov.za/ScreeningDownloads/AssessmentProtocols/Gazetted_Animal_Species_Assessment_Protocols.pdf

Results of the environmental sensitivity of the proposed area.

The following section represents the results of the screening for environmental sensitivity of the proposed site for relevant environmental themes associated with the project classification. It is the duty of the EAP to ensure that the environmental themes provided by the screening tool are comprehensive and complete for the project. Refer to the disclaimer.

MAP OF RELATIVE AGRICULTURE THEME SENSITIVITY

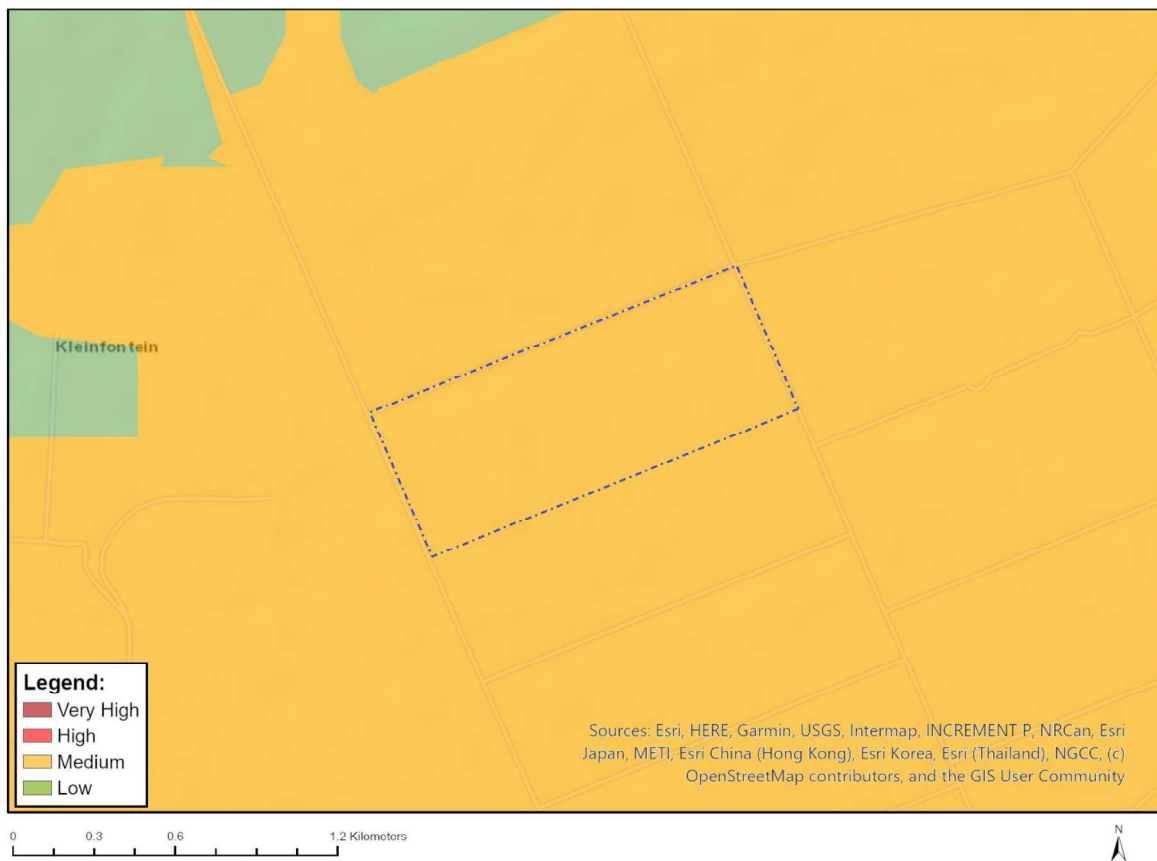


Very High sensitivity	High sensitivity	Medium sensitivity	Low sensitivity
		X	

Sensitivity Features:

Sensitivity	Feature(s)
Medium	Land capability;06. Low-Moderate/07. Low-Moderate/08. Moderate

MAP OF RELATIVE ANIMAL SPECIES THEME SENSITIVITY



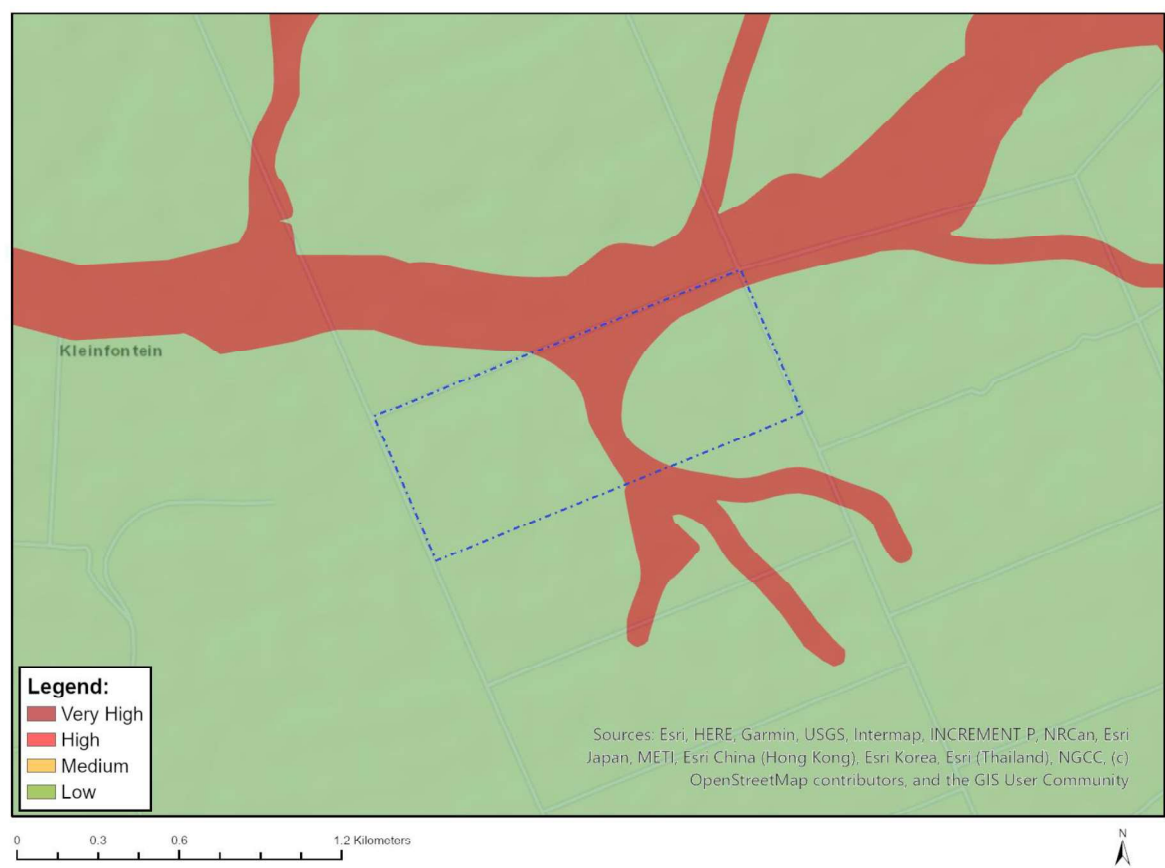
Where only a sensitive plant unique number or sensitive animal unique number is provided in the screening report and an assessment is required, the environmental assessment practitioner (EAP) or specialist is required to email SANBI at eiadatarequests@sanbi.org.za listing all sensitive species with their unique identifiers for which information is required. The name has been withheld as the species may be prone to illegal harvesting and must be protected. SANBI will release the actual species name after the details of the EAP or specialist have been documented.

Very High sensitivity	High sensitivity	Medium sensitivity	Low sensitivity
		X	

Sensitivity Features:

Sensitivity	Feature(s)
Medium	Aves-Podica senegalensis
Medium	Aves-Hydroprogne caspia
Medium	Mammalia-Dasymys robertsii
Medium	Reptilia-Kinixys lobatsiana

MAP OF RELATIVE AQUATIC BIODIVERSITY THEME SENSITIVITY

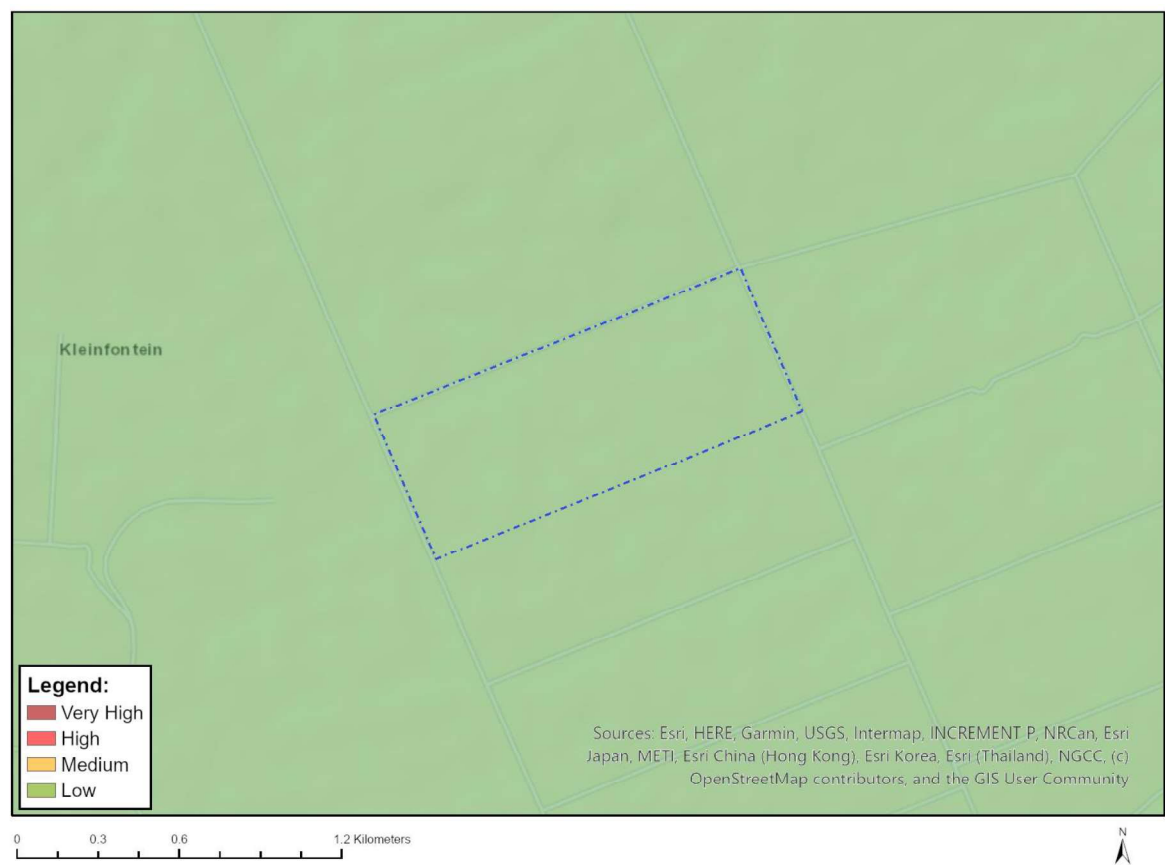


Very High sensitivity	High sensitivity	Medium sensitivity	Low sensitivity
X			

Sensitivity Features:

Sensitivity	Feature(s)
Low	Low sensitivity
Very High	CBA 2
Very High	ESA 1

MAP OF RELATIVE ARCHAEOLOGICAL AND CULTURAL HERITAGE THEME SENSITIVITY



Very High sensitivity	High sensitivity	Medium sensitivity	Low sensitivity
			X

Sensitivity Features:

Sensitivity	Feature(s)
Low	Low sensitivity

MAP OF RELATIVE CIVIL AVIATION THEME SENSITIVITY

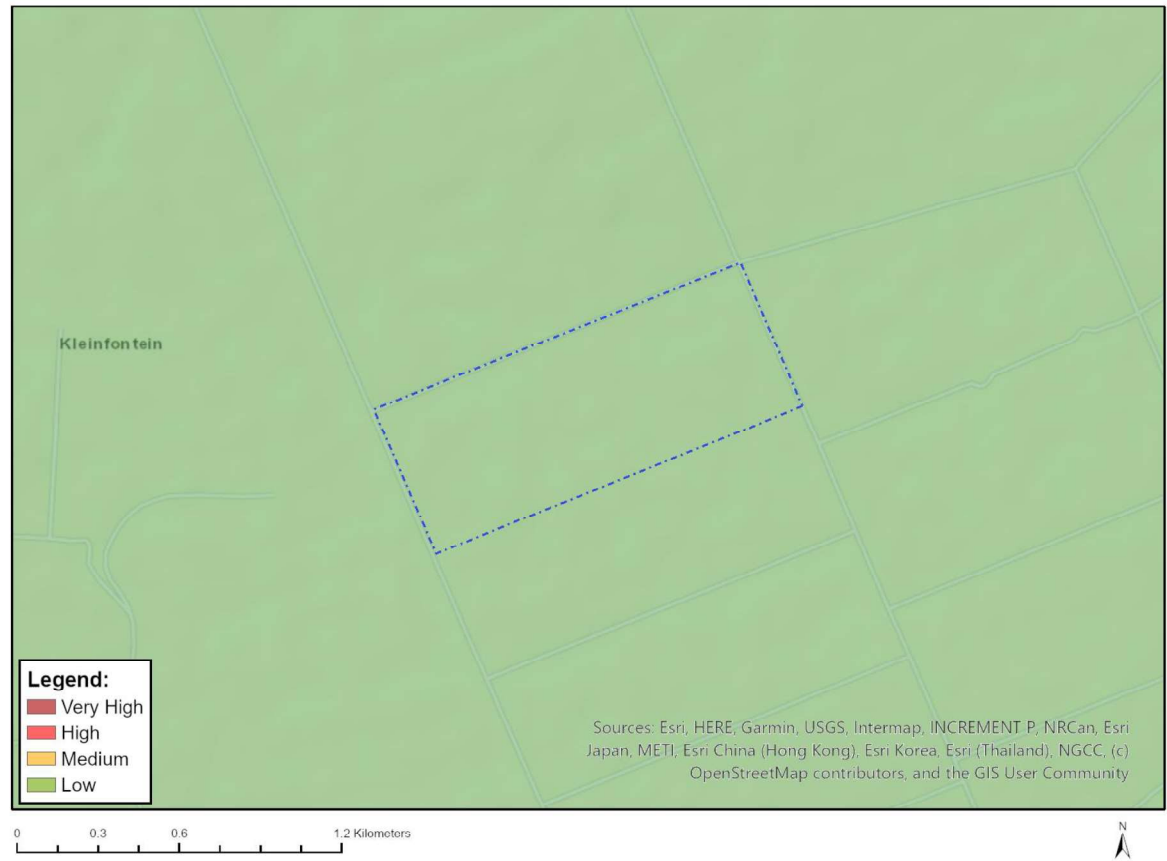


Very High sensitivity	High sensitivity	Medium sensitivity	Low sensitivity
	X		

Sensitivity Features:

Sensitivity	Feature(s)
High	Within 8 km of other civil aviation aerodrome

MAP OF RELATIVE DEFENCE THEME SENSITIVITY

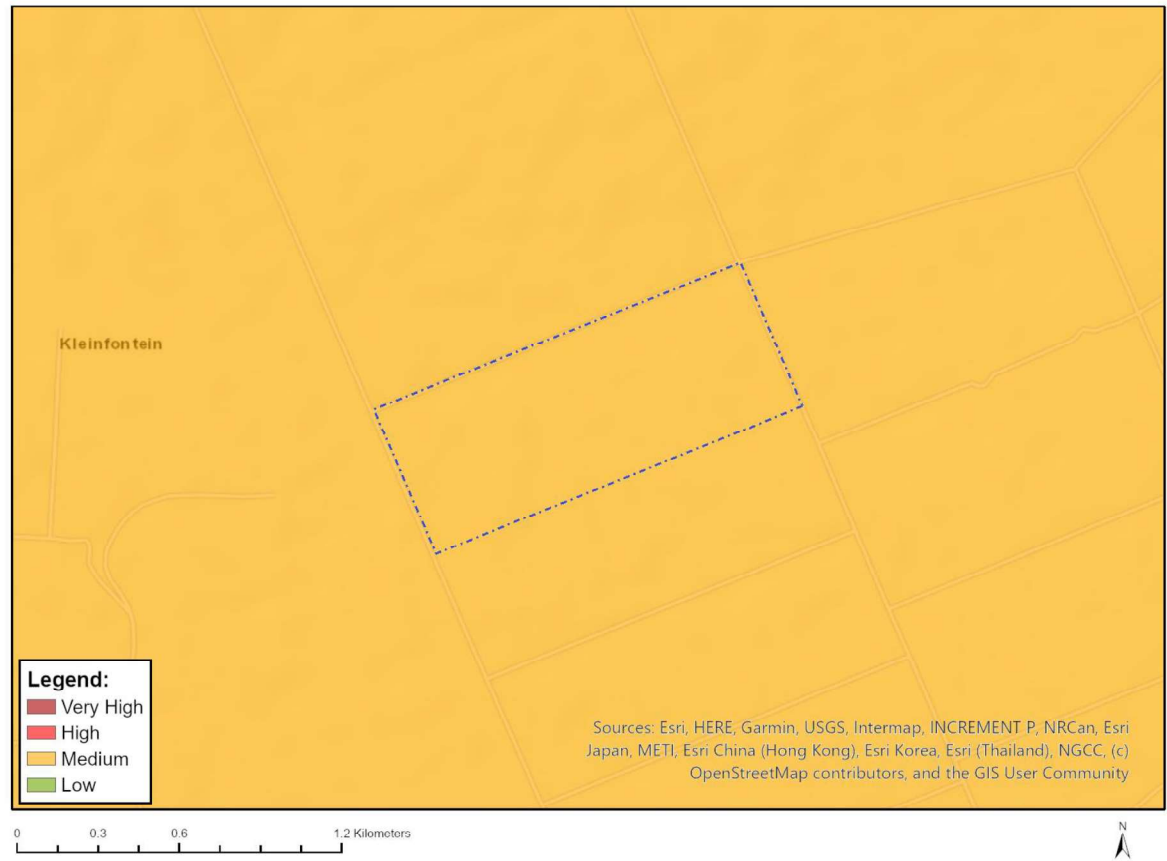


Very High sensitivity	High sensitivity	Medium sensitivity	Low sensitivity
			X

Sensitivity Features:

Sensitivity	Feature(s)
Low	Low Sensitivity

MAP OF RELATIVE PALEONTOLOGY THEME SENSITIVITY



Very High sensitivity	High sensitivity	Medium sensitivity	Low sensitivity
		X	

Sensitivity Features:

Sensitivity	Feature(s)
Medium	Features with a Medium paleontological sensitivity

MAP OF RELATIVE PLANT SPECIES THEME SENSITIVITY



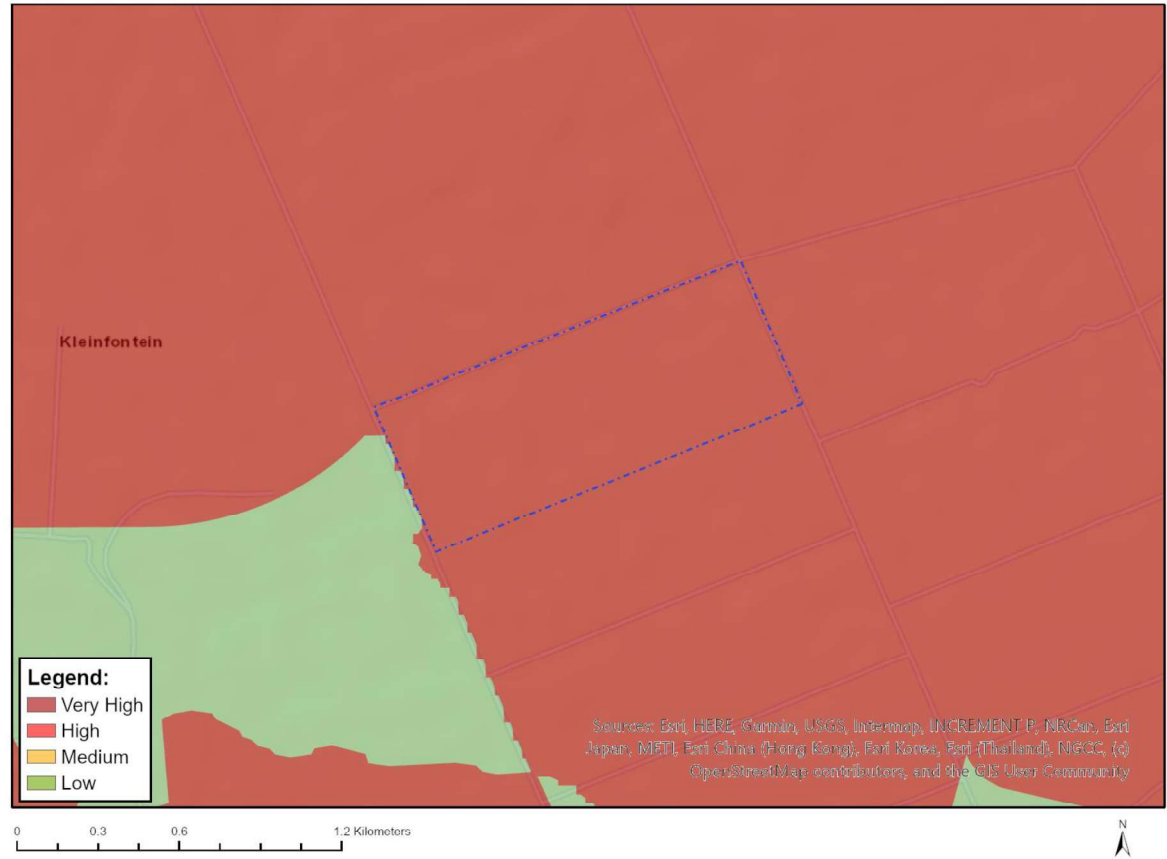
Where only a sensitive plant unique number or sensitive animal unique number is provided in the screening report and an assessment is required, the environmental assessment practitioner (EAP) or specialist is required to email SANBI at eiadatarequests@sanbi.org.za listing all sensitive species with their unique identifiers for which information is required. The name has been withheld as the species may be prone to illegal harvesting and must be protected. SANBI will release the actual species name after the details of the EAP or specialist have been documented.

Very High sensitivity	High sensitivity	Medium sensitivity	Low sensitivity
			X

Sensitivity Features:

Sensitivity	Feature(s)
Low	Low Sensitivity

MAP OF RELATIVE TERRESTRIAL BIODIVERSITY THEME SENSITIVITY



Very High sensitivity	High sensitivity	Medium sensitivity	Low sensitivity
X			

Sensitivity Features:

Sensitivity	Feature(s)
Very High	CBA 2
Very High	National Protected Area Expansion Strategy (NPAES)

- **Bio-Security**

Bio-Security Risks for Pig Farming

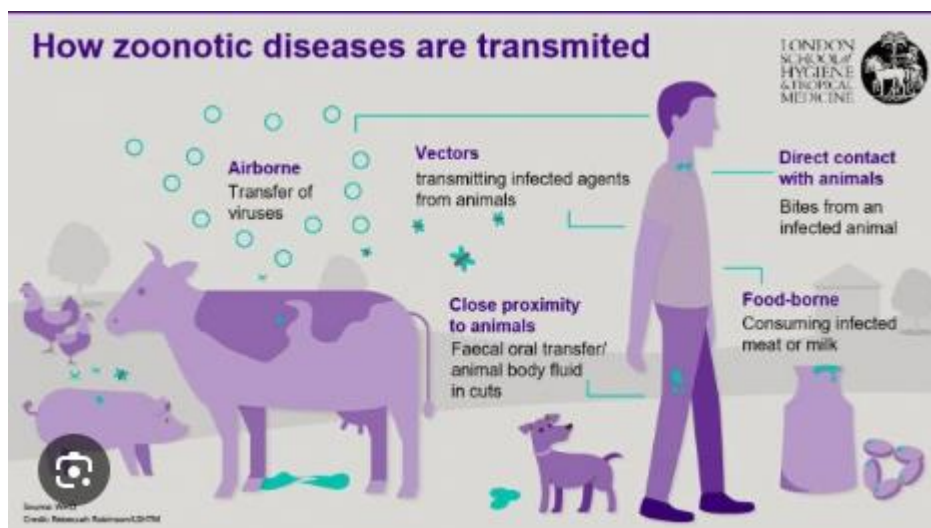


A biosecurity risk is anything that could increase the impacts of pests, diseases, weeds or contaminants on the economy, environment or community. The risk may not directly impact you and your property, but may impact someone else.

Biosecurity risks can be associated with artificial insemination. Boar semen can contain a number of potential pathogens, such as Porcine Reproductive and Respiratory Syndrome Virus and Porcine Circovirus.

Health and Safety Risks for Pork Producers

- Gases and Needle Sticks. The hazards of gases that are produced from the anaerobic digestion of manure, and needle sticks.
- Respiratory System Illness risks. ...
- Noise. ...
- Vet Pharmaceuticals. ...
- Psychosocial. ...
- Infections. ...



Abstract

The perception of the importance of animal health and its relationship with biosecurity has increased in recent years with the emergence and re-emergence of several diseases difficult to control. This is particularly evident in the case of pig farming as shown by the recent episodes of African swine fever or porcine epidemic diarrhoea. Moreover, a better biosecurity may help to improve productivity and may contribute to reducing the use of antibiotics. Biosecurity can be defined as the application of measures aimed to reduce the probability of the introduction (external biosecurity) and further spread of pathogens within the farm (internal biosecurity). Thus, the key idea is to avoid transmission, either between farms or within the farm. This implies knowledge of the epidemiology of the diseases to be avoided that is not always available, but since ways of transmission of pathogens are limited to a few, it is possible to implement effective actions even with some gaps in our knowledge on a given disease. For the effective design of a biosecurity program, veterinarians must know how diseases are transmitted, the risks and their importance, which mitigation measures are thought to be more effective and how to evaluate the biosecurity and its improvements. This review provides a source of information on external and internal biosecurity measures that reduce risks in swine production and the relationship between these measures and the epidemiology of the main diseases, as well as a description of some systems available for risk analysis and the assessment of biosecurity. Also, it reviews the factors affecting the successful application of a biosecurity plan in a pig farm.

Introduction

The prevention of infectious diseases in pigs is important for both animal welfare and economic productivity. Moreover, prevention is also important for food safety and public health when zoonotic pathogens are concerned. Biosecurity embraces all aspects of the prevention of pathogens entering and spreading within a group of animals. In recent years, with the emergence and re-emergence of difficult-to-control diseases such as African swine fever or porcine epidemic diarrhoea, the perception of the critical importance of pig health and its relationship with biosecurity has increased in recent years. In other cases, for example, influenza A virus, animal pathogens have the potential for producing a pandemic event. The implementation of biosecurity measures all along the production chain minimises the risk of introduction of new pathogens into the farms, as well as their spread within farms. Nevertheless, the implementation of sustainable biosecurity programs and its continuous improvement is still a challenge for many pig farms.

The origin of the biosecurity concept in swine production

From the decade of 1960, swine production shifted progressively from a system made of small family-owned farms towards a large-scale industry. This evolution made evident that the management of health and disease should be oriented in a new way [1]. In the 1980 decade, concepts such as “minimal disease” or “specific-pathogen free farms” began to be common and led to the modern concept of biosecurity [2, 3].

Early publications defined biosecurity as “the security form of transmission of infectious diseases, parasites and pests” [4]. However, at that time most of the available information was mainly based in a combination of knowledge on the epidemiology of some diseases, common sense and experience [4,5,6]. It became increasingly evident that a more methodical approach was needed. Soon thereafter scientific journals started to publish papers on biosecurity in swine farms [7,8,9].

The modern concept of biosecurity

Since the early, almost intuitive, definitions of biosecurity, this concept has evolved at the same pace than swine production. Nowadays, in developed countries, pig production shows a trend towards concentration: bigger farms in lesser hands together with an increasing need of animal movements.

Within this frame, the introduction of a new pathogen in a farm can have serious or even catastrophic consequences, not only for the affected farms, but also for all other connected operations. A recent example of this was the introduction and spread of porcine epidemic diarrhea virus in the Americas or of African swine fever virus in Europe and Asia [10,11,12]. As a result, the concept and perception of the diseases have changed from the individual to the farm and, from the farm to the region. Keeping diseases away is now one of the key elements in animal production [13].

Academically, biosecurity can be defined as the application of measures aimed to reduce the probability of introduction and spread of pathogens [5, 14]. When the measures are aimed at the reduction of the probability of introduction, the term external biosecurity is used. When the measures aim to reduce the spread of pathogens once they are already present in the farm, the term internal biosecurity is used.

The key concept in biosecurity is to avoid transmission, either between farms or within the farm. Therefore, the applicable measures must result in a reduction of the probability of effective transmission. This implies a knowledge of the epidemiology of the diseases to be avoided, particularly of the routes of transmission, the stability of the agent in the environment and the role of fomites and vectors [15].

For many important diseases, knowledge of epidemiology is much less than complete. This is an important gap that needs to be filled. However, since the ways in which a pathogen can be transmitted are limited to a few, for most diseases it is possible to foresee a set of potentially efficacious measures. A completely different point is to establish a prioritisation of the measures based on its potential efficacy. This requires a quantitative knowledge on the contribution of each route or element in the transmission of the infection. Beyond that, the actual implementation of the selected biosecurity measures involves economic, sociological and even psychological aspects.

Main biosecurity measures

In this section we will review the most commonly applied biosecurity measures.

Common external biosecurity measures

The concept of external biosecurity can be intuitively understood as the blocking of the farm from the “dangers coming from the outside world”. This implies that many of the measures aimed at the external biosecurity are physical barriers or rules banning the introduction of certain animals, people or vehicles.

Introduction of replacements, quarantines and use of semen

The highest probability of introduction of a new pathogen is the introduction of animals [5, 16,17,18]. Due to the nature of the current production systems, to keep productivity within the desired standards, replacement of breeders is needed. In most cases, this can imply a renewal of the whole breeding population every 2–2.5 years. Those replacements can be produced internally; namely some of the female offspring is selected as the replacement for the existing sows or, they may be purchased from an external source. Internal replacements may be convenient for some farms that operate as a closed system and rely on males (semen) for genetic improvement. Eradication of diseases endemic in the farm is often difficult when internal replacements are used. A similar reasoning applies to the use of semen produced in-farm.

In other production systems, external replacements are preferred in order to fully control all management and health aspects of the replacement gilts. In this later case, the implications of this fact are double: firstly, the higher the frequency of new entries, the higher the probability of entering a pathogen and; secondly, the higher the replacement rate, the more difficult to maintain herd immunity against the endemic farm pathogens. To this, it must be added the need for insemination doses that, if purchased from an external source, can be a risk for the introduction of new pathogens as well.

Assuming that many farms must rely on external replacement sources, the way in which those new animals are to be managed will become the key to success. At present, the most efficient way of organizing production is in mating/farrowing batches (usually every week or every 3 weeks). Ideally, this organization requires entry of replacements with the same periodicity of the farrowing batches (weekly or every 3 weeks). In these systems, one first biosecurity barrier would be to set a list of health requirements for the sources of gilts. This list must classify diseases based on the risk they pose to the farm and must indicate which verification tests are to be performed (as a routine). While for some pathogens the mere suspicion of its presence in the source farm would be enough to discard that source as a supplier (e.g., the presence of PRRSV seropositive gilts in a source aimed to supply a PRRS-negative herd), for other pathogens, their presence would be admissible under certain conditions (e.g., porcine parvovirus is acceptable since vaccination is highly effective). In any case, a well-designed and well-managed quarantine is the most effective measure to reduce risk associated to the introduction of external pathogens.

Quarantines must be designed as biocontainment units; namely, they must be designed to avoid the spillover of any undesired pathogen brought by the incoming animals. Therefore, direct connection between the quarantine unit and the main farm must be blocked. Usually, this means locating the quarantine far from the main units of the farm and treating quarantines as if they still were the “outside world”; that is, managing them as independent facilities. Additionally, the quarantine has to be managed in a strict all-in/all-out system to avoid potential transmission of pathogens between different gilt batches. Risk associated to the entry of gilts can be reduced by decreasing the frequency of entry of the new batches. However, this implies changes in the whole organization of the farm and in the managing of breeding batches, with the consequent problems for allocating the animals in the available spaces. The bigger the batch, the larger the space needed for each batch.

Regarding the localisation of quarantines, most often it is said that they must be located no less than 1000 m from any other pig unit. This is considered a safe distance for airborne transmission of most pathogens (but not all), and for transmission by rodents, flies, etc. [19, 20]. However, some viral pathogens such as Aujeszky’s disease virus, foot and mouth disease virus or porcine reproductive respiratory virus 2 (PRRSV2) or bacteria such as *Mycoplasma hyopneumoniae* have been reported to be transmitted -or could be potentially transmitted- by air to longer distances (up to 20 Km for foot and mouth disease virus, 9 Km for Aujeszky’s disease virus, PRRSV2 or *M. hyopneumoniae*) [21,22,23]. Air filtration is proven to prevent pathogen introduction in high density areas. The use of HEPA air filters in the windows or ventilation inlets reduces the entrance of pathogens [24,25,26,27]. HEPA filters are the gold standard of microbiological air filtration but less expensive filters may also have a good efficiency. Under laboratory conditions, a combination of fine filters (EU class M and F) resulted in > 98% of efficiency to filter equine arteritis virus and > 99.9% for bacteria such as *Actinobacillus pleuropneumoniae* [28]. Similarly, Dee et al. (2010) showed that MERV 14 (EU 8) filters, or multi-layered polypropylene filters treated with microbicidal compounds were fully efficient to block PRRSV or *Mycoplasma hyopneumoniae* [27]. Other low-cost filtration methods were less efficient although provided some level of protection [25]. In an economic evaluation analysis of air filtration systems to prevent PRRSV, Alonso et al. (2013) [29] calculated a payback time between 2 and 7 years depending of the reduction of the frequency of outbreaks and on the premium received for being free of PRRSV. Provided that the quarantine is far enough from other sections of the farm, the main connection between the quarantine and the main farm will be the personnel. Transmission of pathogens from personnel to pigs is mainly related to the role of humans as fomites (clothes, boots, hair, etc.) (with the exception of some diseases such as influenza). Accordingly, barrier methods are highly effective: use of clothes, boots, gloves, etc. of exclusive use of the quarantine plus the obligation of taking a shower before leaving the quarantine are generally considered enough (section 3.1.2. below revise the general requirements for entering the farm). Use of exclusive clothes, shoes and tools together with handwashing are the minimum compulsory measures. In transmission experiments for foot-and-mouth disease those measures were able to stop transmission by caretakers of pigs but not when the used species was sheep in which case the addition of a shower was a necessary measure

[30, 31] Beyond this, the potential airborne spread of pathogens from the quarantine can be minimized using a system of locked doors and windows in the pens with an adequate play of air flow and air pressures.

How long the quarantine must be prolonged? The duration of the quarantine depends on three elements: a) The incubation period of the diseases included in our “avoid” list, b) the duration of the contagious period for such diseases and, c) the time needed to establish a diagnosis [5, 32]. Accordingly, the duration will be determined by the diseases included in our list and the availability of diagnostic facilities. Moreover, animals must be inspected, preferably daily, for any sign of disease [30]. Also, it is necessary to have a contingency plan for the event of a positive result for an unwanted disease. This contingency plan may range from extending isolation of the replacement batch until the gilts are no longer a threat, to discarding just positive individuals and extending quarantine of the others with continuous monitoring, to complete depopulation of the quarantine and monitoring of the destination farm.

At this point of the review it is worth to note that quarantine and acclimation are somewhat opposed concepts. While quarantine is aimed to avoid the entry of pathogens brought by incoming animals and, therefore, minimizing contact between existing and new animals is critical; acclimation is aimed, among other goals, to develop immunity against the pathogens existing in the farm [33, 34] and, this often requires to have a close contact between newcomers and the present stock of breeders. Thus, a clear-cut separation must be made between the quarantine and acclimation phases. In Brazil, Serafini Poeta Silva et al., (2019) [35], associate the adaptation of the replacement to a lower seroprevalence and better control of Swine Influenza in breeding herds. Use of externally purchased semen is, in practical terms, equivalent to the introduction of a boar. Again, suppliers should be certified to be free of the diseases in our “unwanted” list and must be auditable with regards to their health status [18]. The number of providers should be as limited as possible (ideally, only one) to reduce the risk [36,37,38].

People and vehicles

People and vehicles can be important pathways for the introduction of new diseases in the farm [39,40,41,42]. By its own way of operation, farms receive lots of visits and vehicles: workers of the farm, veterinarians, repair workers, transports of feedstuff, dead-animals, etc. Beyond that, transport of animals is a category of its own.

Fomites carried by people (boots, clothes, etc.) or even the people itself, through contaminated skin, can spread various pig pathogens such as Salmonella, PRRSV, PED, TGEV, Brachyspira or Lawsonia [43,44,45,46,47,48,49]. People can also act as introducers of diseases common to people and animals. This is the case of influenza. In fact, classical H1N1 viruses or the original introduction of H3N2 originated from humans, just like the 2009 H1N1 pandemic virus (reviewed by Rajao et al.) [50].

The risk associated to visits may be minimized by a combination of barrier measures and regulations restricting the entrance to the farm. Who (people or vehicles) must be allowed to enter the farm? The generic answer to the question is simple, only those that are essential; the practical application of this principle is much more complicated. A list on who can or who cannot enter should be elaborated stating the rules for entering. In the next lines the main actions to minimize these risks will be reviewed.

The essential measure to restrict visitors and vehicles in the farm is to establish a clear delimitation of clean and dirty areas [51]. Clean areas are those inside the farm perimeter, in contact with pigs. The clean areas include barns, offices and connecting hallways and all the areas and equipment in contact with pigs. Dirty areas are those that may contain sources of infection for the pigs present in the farm and, in practical terms, everything outside of the clean areas can be considered a dirty area. Entrance doors, walls, a changing room, a shower or a line painted in the floor maybe the interface between clean and dirty areas. Nothing should be allowed to cross the dirty area towards the clean area without being decontaminated. Clean and dirty roads may also exist. The dirty road must be used for any transport that serves multiple companies or farms. Work routines must be organized.

A perimeter fence with a permanently closed door that can only be opened from inside the farm is the main division between “inside” and “outside” the farm. A side use of this fence is to restrict access of wild animals such as wild boars, which are a serious risk for some diseases such as Classical or African swine fever [52,53,54]. To note, materials of the fence have to be chosen for that purpose, as wild boars can easily destroy regular wire fences. Beyond that, barriers preventing excavation under the fence must be built.

A parking area outside the farm must be implemented [55] for all those operations that do not require entrance to the farm with the vehicle (for example, the veterinarian visiting the farm).

Some operations require some level of contact with the farm. This is the case of vehicles delivering feedstuff, collecting dead animals or slurry. The most adequate approach for those operations is a proper design of the farm. The activities requiring such contact need to be located, as far as possible, in the external perimeter with no need to enter the farm. For feedstuff, the most adequate way is to locate the silos for feed close to the perimeter fence, allowing the loading from the truck without the need of entering the farm. Containers for dead animals and slurry tanks must be located immediately outside the perimeter fence to avoid the collecting truck entering the farm. Both vehicles circle in “dirty road”. In farms where the design does not allow that, a clear delimitation of the road and of the clean and dirty areas is essential. Under any circumstance the trucks, the drivers or other assistant personnel should be allowed to enter in contact with the animals [40, 41]. Kim et al. [48] showed the importance of this measure. They examined the transmission of porcine epidemic diarrhoea virus under low and high biosecurity measures and observed that clothes and boots of personnel exposed to infected animals easily got contaminated with amounts of virus likely causing transmission, particularly for boots and coveralls. Small amounts of contaminated faeces in the boots of a driver could be enough to infect a farm.

Once a vehicle/visitor is allowed to enter in to the farm perimeter, a set of rules to minimize risk must be applied. Entry of people must be compulsorily done through a reception building. They must register in a registry book indicating name, company and/or reason for visiting and indicating the latest day that they visited a pig farm. In many farms, safety procedures usually indicate a 24-48 h period to consider that a previous visit to a farm is not a risk. However, this is not based in a real evaluation of the lability of different swine pathogens since survival of different virus, bacteria or parasites may be very different and has not been thoroughly studied. An additional factor to be considered when establishing this period is the health status of the farm, the barriers established at entering the premises (showering, handwashing, changing clothes, etc.). In a farm with a good standard requiring at least handwashing and changing outwear and boots, the main risks would be associated to contamination of hair or to presence of pathogens in the oronasal mucosa. Kim et al. (2017) found *Porcine epidemic diarrhoea virus* RNA in the hair of personnel in contact with infected animals 1 day after contact but the positive personnel was not able to transmit the infection. Oma et al. (2018) [56] in a model of exposure to bovine viruses (bovine coronavirus and bovine respiratory coronavirus) viral RNA was not found in the oronasal mucosa of exposed people 6 h after the exposure although most of them were positive at 1 h. Taking the previous data in consideration, 24 h could be a reasonable time for a farm with a good health standard and applying basic biosecurity measures. Certainly, the higher the health standard and the potential of impact of a new disease, the longer that restriction period (up to 48 h). Introduction in the farm of laptops, cell phones and other electronics may be a risk if they are not decontaminated. Browne C., et al., (2016) [57] observed the viability of *Mycoplasma hyopneumoniae* on various surfaces for up to 8 days at 4 °C.

The next step would be to establish the rules for entering into the facilities allocating the animals. The minimum acceptable regulation would be to change clothes and boots for ones of exclusive use of the farm, washing hands and not sharing materials between farms. In those cases, that materials must be shared, it can be useful to expose them to UV irradiation [58] or to immerse them in disinfectant solution [3]. These can range from diluted bleach to commercial disinfectants. To note that most disinfectants have lower or poor activity in the presence of high concentrations of organic material. Wearing gloves, and eventually a cap, is advisable. A higher level of biosecurity would include a

compulsory shower. As commented above, taking a shower and fully changing outwear is able to fully reduce transmission of FMDV between pigs or sheep by contaminated personnel [30, 31] although for many pathogens handwash and outwear change probably are effective.

In this case, again, clean and dirty areas have to be delimited. A very simple rule would be to consider any area where it is allowed to wear clothes or shoes from the “outside” as dirty. A simple separation can be a bench that delimitates the clean and dirty area of the changing room. Relevance of these measures are supported by transmission studies on Influenza, PRRS or FMD, where these viruses were transmitted through contaminated boots, gloves, contaminated skin or overalls that had been in contact with infected pigs [45, 59, 60]. Pork products consumption in the farm, either by visitors or personnel, should also be avoided as some important pathogens such as ASF can survive in them [61].

Transport of animals

Vehicles used to transport animals between farms or to the slaughterhouse and drivers from these vehicles can have an important role in the transmission of pathogens between farms, as it has been described elsewhere [40, 41, 62]. Several measures can be applied to reduce such risks.

The first one would be to define the uses allowed for a specific truck. A “safe” animal transport truck should not be used for a risky transport. For example, a truck destined for the transport of replacements must not be used for transport of animals to the slaughterhouse. Similarly, a truck should not pick up animals on different farms as this increases the risk of spread of pathogens. Therefore, establishing a list of “allowed transports and permissible actions” for each truck, along with the design of its routes, would be the first measure. Secondly, truck cleaning and disinfection must be done in a planned and conscientious manner. Cleaning and disinfecting trucks is a very difficult task to carry out in practice [63]. As a matter of fact, it has been shown that a high percentage of slaughterhouse trucks were positive for *Salmonella* after cleaning and disinfection procedures [63]. There is a general agreement that for this cleaning and disinfection to be effective, the process must include the removal of organic matter, cleaning with water, preferably hot and soapy or with descaling, drying and subsequent disinfection with appropriate substances [57, 58]. The main problems arise from the difficulty of removing organic residues from corners and recesses in the truck bed and from drying the trucks. In winter, particularly in cold climates, natural drying of a truck can take days. For this, alternatives such as air drying or heated boxes have been designed [64, 65]. Actually, Dee et al. (2004) [64] found that when trucks were washed, disinfected and dried, PRRS virus could not be found by RT-PCR nor transmission happened to sentinel pigs. All other methods allowed the presence of the virus.

Loading and unloading animals is one of the most critical situations regarding the contact of animals present in the farm with vehicles or persons from outside the farm. The best approach to minimize risks is to build a loading/unloading dock. This structure must have a dirty area (outside the farm) where trucks may park. This dirty area leads to a managing corridor (narrow enough to allow animals passing one by one) that has a gate. That gate should be low enough to permit only the crossing of an animal but not of a person standing. Usually, this is achieved by means of a sliding door or a similar mechanism. From the gate inwards should be considered “clean” area.

Neighbourhood

This term is related to the spatial clustering of cases, whereas the specific path by which transmission occurs among neighbours is not always clear [66]. For example, Torremorell et al. [67] attributed 80% of new PRRSV infections on negative commercial farms to spread from neighbours, but the exact path of transmission was not identified. The probability of infection due to the farm location will be variable and influenced by what is present in the neighbourhood [67]. The number and type of pig farms (e.g., presence of fattening farms versus breeding farms), presence of slaughterhouses, garbage dumps or dead-animals rendering plants in a radius of 1 km to the farm could increase such probability [5, 68, 69].

One possible path of pathogen transmission among neighbours is airborne spread. As mentioned before, distance by which pathogens can be transmitted through air is variable and will also be dependent on weather conditions (i.e., optimal in winter with high humidity and constant moderate winds) and on landscape (i.e., optimal in flat land).

Probably, FMDV and PRRSV have been the best studied pig pathogens with regards to airborne transmission. For FMDV it was shown that long-distance (up to 10 Km) airborne transmission was more likely to occur with high humidity (> 60%), low speed wind with stable direction, cloud cover, temperature below 27°C (better at lower temperatures) and no precipitation [70,71,72,73,74]. For PRRSV, one of the main factors for the viability of the virus in the aerosols was temperature with a very short half-life (less than 30 min) at 20°C. In the case of PRRSV, low humidity seems to favour survival in aerosols under laboratory conditions [27, 75, 76]. A 2-year study showed that cool temperatures, low sunlight levels, winds of low velocity in conjunction with gusts and rising humidity and pressure were the conditions more likely to favour PRRSV airborne transmission [27]. Moreover, in the case of PRRSV2, the aerosol transmission of different strains may differ. For PRRSV1 airborne transmission seems less likely, maybe because of the lower levels of viremia [77].

The measures to prevent this transmission are basically barrier measures. The simplest is to raise a hedge or plant a grove that acts as a barrier in the most frequent direction of the wind in the area but more sophisticated systems, such as the installation of HEPA or other type of filters, can be used as mentioned before.

Other paths of pathogen transmission linked to the neighbourhood include rodents, mechanical vectors such as flies, and other animals (either stray or belonging to neighbouring farms) or birds. Rodents can be carriers of numerous pathogens that affect pigs, such as some *Salmonella* serovars, *Leptospira*, *Yersinia pseudotuberculosis*, *Toxoplasma gondii*, *Campylobacter* spp., *Brachyspira* spp., *Lawsonia intracellularis* or the encephalomyocarditis virus [78,79,80,81,82,83]. Generally, mice have a radius of action of 25 to 150 m and therefore, their role in transmission between farms is limited. However, individual rats can move 3 km away in one night [79, 84]. Flies can act as mechanical vectors, although their flight radius (2-3 km) and the narrow range of temperatures at which they survive [85] limit their role as mechanical spreaders of pathogens at large distances. Nevertheless, some studies showed the presence of infectious PRRS virus in a proportion of houseflies captured at 1.7 Km from the source farm [86]. Anyway, transmission has not been proven farther than hundreds of metres [62]. Evidences exist for the role of flies in the transmission of other pathogens such as *Streptococcus suis* or *Brachyspira* spp. [21, 87, 88].

Dogs and cats may also be the source of some pathogens for pigs [89,90,91,92] although these animals should not be present in a pig farm. A perimeter fence may prevent stray or neighbouring animals from entering into the farm premises.

Some species of birds have been associated with disease outbreaks. For example, in one study it was estimated that around 30% of new TGE outbreaks were caused by starlings [93]. Birds have also been involved in the spread of some pathogens such as *Salmonella*, *Lawsonia intracellularis*, *Brachyspira hyodysenteriae* and *E. coli* [83, 94,95,96] and may act as a reservoir perpetuating circulation on the farm. The main biosecurity measure would be the placement of bird proof nets on windows and keeping the doors closed to avoid the entry and nesting of birds. All buildings must be bird proofed. Any damage to bird netting or the facility exterior which allows pest entry must be repaired immediately. Furthermore, silos and feed tanks should be kept closed to prevent access by birds and contamination by faeces. This may be important in the case of *Salmonella* [70].

Feed and water

Feedstuff itself does not generally pose a risk due to the hygienic conditions in the production, particularly if the feed is heat-treated. For example, pelleting eliminates PEDV from contaminated feedstuff [97]. Nevertheless, different pathogens can contaminate and survive on feed ingredients and could therefore be introduced in a farm [98,99,100,101,102,103]. For example, Dee et al. (2016) detected the PEDV, ASFV, SVA, CSFV, PRV, and FMD in soybean meal (conventional and organic),

vitamin D supplements, lysine and choline [99]. Actually, pigs fed with PEDV-spiked feedstuff were successfully infected, proving that this can be a potential source of spread for this virus [103]. Gordon et al. (2019) [104] reviewed the role of non-animal ingredients as a source of viral pathogens for swine. This risk can be maintained below critical status by minimizing the likelihood that a pathogen can enter the feed supply chain, such as by excluding high-risk ingredients from facilities, extending biosecurity to mills, and considering proactive mitigation strategies [105,106,107]. Some of these are, develop storage facilities for incoming products 'feed quarantine', and determining and setting a schedule for a validated sampling method [108] of ingredients that are considered higher risk (origin animal or not animal). Limit and establish a flow of movement of people (employees in the feed mill and visitors, such as guests, truck drivers, and subcontractors people) or vehicles in or out of a facility because also has the potential to introduce contaminants into a feed manufacturing facility [109]. Several studies have shown that chemical additives for the feedstuff can be reliable methods for mitigating such risk for both viruses and bacteria [110,111,112,113]. Effective additives are organic acids such as formic, lactic or propionic, but also fatty acids and essential oils have been proven to have efficacy against certain pathogens [114]. Formaldehyde has been shown to be effective at preventing risk associated with PEDV [110, 115] as well as *Salmonella* [106, 107]. Furthermore, the use of formaldehyde in feed may lead to detrimental bacterial shifts in the pig gut [116]. Another strategy that has been proven to be effective in mitigating this risk is flushing feed manufacturing equipment with rice hulls treated with chemical compounds with antimicrobial properties such as formaldehyde or a hexanoic:octanoic:decanoic mix [117]. Therefore, feed should be provided by a reputable supplier with a recognized quality assurance system and food ingredients should not be transported in a vehicle that is used to transport pigs or other livestock [98].

Drinking water used on farms could also be a source of pathogens introduction [8]. A disease that has classically been related to water contamination is leptospirosis. *Leptospira* from rats and other animals can contaminate water, or even rats can be ingested by pigs. Furthermore, most pathogens that follow a cycle of faecal-oral transmission have the potential to be carried through the water. Silva et al., (2018) [118], develop the biosecurity vulnerability scores for PRRS the results suggest that events related transmission by air and water, and people/animals movements should be prioritized. Therefore, the bacteriological quality of the water should be checked regularly, at least once a year [119]. Water systems, tanks and pipes should be cleaned and disinfected regularly as biofilm can be a source of bacteria for pigs [32]. Also the source water treatment is an important tool in risk management. Common water treatment techniques used include physically removing chemical and biotic contaminants through filtration (reverse osmosis system and /or inactivating pathogens by applying ultraviolet light [120] or chemical oxidant disinfectants such as chlorine, [121] chloramines and ozone.

Common internal biosecurity measures

As previously mentioned, internal biosecurity aims to reduce the probability of the spread of pathogens once the farm has been infected. These measures can be grouped into: a) measures related to management of the herd, b) general hygiene of facilities, c) cleaning and disinfection and, d) personnel.

Measures related to management

The main objective of this group of measures is to control the flow of animals to avoid mixing pigs from different age groups. Usually, it is considered essential to avoid movements against the production flow. This is achieved with the strict application of an all-in / all-out system complemented by cleaning and disinfecting the facilities for the new batches of animals. This measure has been reported to be effective to reduce the circulation of pathogens [122] and to reduce the amount and variety of drug application on farms. These last authors observed that in Japanese farms where the all-in / all-out system was applied in all production stages, there was a lower use of antimicrobials for

the treatment of pneumonia and oedema disease. In France, a reduction in the prevalence of *Salmonella* in pigs sent to the slaughterhouse was also observed when this measure was carried out [123].

However, this flow control is not enough for all diseases. For example, for those diseases in which transmission can occur in maternities, cross fostering, even between sows of the same batch, can contribute to the spread of the disease. This has been shown for PRRS virus, in fact, limiting adoptions is one of the measures that is usually implemented during a PRRS outbreak in maternity areas [124]. Another important fact to consider when applying management measures is that sows are the reservoir for many of the pathogens present on the farm. From the late 1970s, early weaning systems began to be studied based on the idea that certain pathogens were transmitted from mother to offspring at certain times. Separating piglets from the mother earlier would prevent this transmission and, consequently, would reduce or even eliminate the presence of certain diseases [125,126,127]. These techniques, while partially effective, are detrimental to pig well-being and in Europe, contravene community welfare standards. It is also important to establish a work routine that takes into account the role in disease transmission of the different age groups within the farm. The usual recommendation is to establish a workflow following the pig flow, from younger to older. Thus, personnel working in the fattening units should not enter into the nurseries after contacting fatteners or go back to a maternity from a nursery.

Measures related to facilities and cleaning and disinfection

The facilities should contribute to reduce the transmission of diseases or, at least, must not facilitate their spread. A very basic aspect to start with would be its design. In poorly designed or poorly planned farms it is relatively common for animals to have to move between different sections for loading, unloading or between production phases so that animals of different ages can have contact. Likewise, it is important that the facilities allow a correct organization of work and, to a certain extent, contribute to respect a separation between the different ages present on the farm. This can be achieved with physical barriers such as doors, foot baths, or intermediate areas for hand washing and changing boots.

However, all these barrier measures tend to hinder work routines. Sometimes the different areas can be painted with different colours and clothes and boots of the corresponding colour can be used to make more difficult to violate the rule of non-contact between different stages of production.

The nature of the materials used in the facilities is an important factor. The separations between pens or rooms and the floor are usually cited as the most important elements. For example, discontinuous separations between pens are known to facilitate the transmission of respiratory pathogens while solid separations facilitate the transmission of enteric pathogens [128]. On the other hand, something similar happens with floors, particularly in maternity areas. While metal and plastic floors are cleaner, they have a negative impact on comfort. Straw beds are very comfortable, but increase the risk of presentation of diarrhoea outbreaks [122]. The ventilation system should also be added to this section, since inadequate ventilation contributes to an increase in the environmental microbial load, particularly for respiratory pathogens.

Regarding hygienic measures, the most basic element is the cleaning and disinfection of the pens. Similar to what happens with trucks, pens should be cleaned first by removing organic debris, then they should be washed with soapy water, and after rinsing and drying they should be disinfected. Dione et al. [129] evaluated 276 farms in Uganda, and found a reduction in seropositivity to *Streptococcus suis* by the use of disinfectants on farms. This pathogen is rapidly eliminated by phenyl compounds, chlorine, and iodine.

The second fundamental hygienic measure refers to the administration of vaccines and drugs. Needles should be exchanged between individuals, although this is very difficult to achieve in practice. Often workers see the change of needle as a waste of time. To teach them the importance of this practice is essential. The minimum acceptable would be to use individual needles in sows and, at least, to change needles for each litter or pen.

Measures related to personnel

Personnel working in the farm are key elements to keep internal biosecurity. Their role is double, in one hand, they have to implement the rules and, on the other hand, they may act themselves as means for the spread of pathogens within the farm.

Personnel must know well which are the assigned areas of work and what the work routines are. For example, a worker in the fattening area should not go to a maternity hospital. Often, a colour code for walls and clothes may help to this end. This implies to have specific clothing and footwear of the corresponding colour. Obviously, this requires additional planning for cleaning and replacement and areas for changing must be designed.

Finally, measures such as the use of gloves, periodic hand washing and foot baths will lessen the impact of the worker acting as a fomite within the farm. It is known that the maintenance of foot baths requires continuous attention to avoid the excessive accumulation of organic matter. The contact time with the disinfectant required to sanitize the boot varies with the product but usually is measured in minutes. Moreover, the presence of organic materials may affect the practical efficacy or the time needed to act. In farms where is not likely that footbaths and foot bath procedures are to be followed, having specific clean boots for each area can be a good alternative.

Simply walking on a foot bath and not removing the faecal matter from the boots before entering the disinfectant solution does not reduce the number of pathogens in them [6, 130]. It is therefore recommended to first clean the boots in a preliminary foot wash, using a brush and soapy water and then, followed by the immersion of the clean boot in the disinfectant solution for at least 5 min and covering no less than 15 cm of the boot sole. This is effective for disinfection and does not waste disinfecting solution in the foot baths. Disinfecting solution must be changed preferably daily and every 3 days would be the least acceptable routine [6]. If foot baths are not an option in the farm, a less effective, but still recommended measure, could be the use of different boots for the outside and inside of the different farm buildings, with the establishment of a periodic cleaning and disinfection system for them.

Vaccines are an essential part of the internal biosecurity of animal populations. Recent advances in molecular biology make it possible to generate more effective vaccines. Many of these are used to protect production species such as pigs and/or prevent zoonosis, for example, the vaccines used to control Swine Influenza [131].

Biosecurity assessment

When designing a biosecurity program, it may be useful to have a system allowing an objective assessment of farm biosecurity. Such assessment can be used to prioritize which biosecurity measures should be improved or implemented first in order to reduce the likelihood of disease introduction and/or spread. In addition, it might enable to monitor farm biosecurity over time and to compare it with that of other farms (benchmarking). This may be especially important when applied to an entire production system of a company. It allows planning of the production flow and to determine what contacts and risk are admissible. Therefore, biosecurity evaluations will allow to improve risk management associated with the transmission of diseases both at the farm and at the company or territory level [131]. In addition, estimates about farm biosecurity might help to calculate the benefits in production, health status or antimicrobial consumption produced by the implementation of a given measure, contributing therefore to a more precise application and to increase motivation and awareness on farmers and veterinarians [132,133,134,135].

Assessing biosecurity includes measuring the potential routes for disease transmission. The first step is to collect biosecurity practices applied on the farm. For this, epidemiological surveys including questions that evaluate the external and internal biosecurity measures applied to the different routes of pathogen introduction and spread can be used. Epidemiological connections must be investigated as well.

Several methods to assess farm biosecurity have been developed. This is presented in the next sections.

Biosecurity assessments based on scores

The most common biosecurity assessment has been the creation of scores. Most of these scores are based on values attributed to the biosecurity practices by expert opinion panels. Some of the scoring systems evaluate measures that are common to the transmission of different types of infectious agents while others are disease-specific.

One first approach is produce a score for farm that results from summing up the scores for different biosecurity practices and setting a threshold from action [7, 136].

Researchers from Ghent University developed the Biocheck.UGent™ biosecurity scoring system [137]. In this system, biosecurity practice values, as well as the different pathways for disease transmission, are multiplied by a weight factor accounting on their relative importance, obtaining therefore a risk-based weighted score for the farm biosecurity. Sasaki et al. [138] developed a similar evaluation system named BioAsseT. Several scoring systems developed for specific pathogens (PRRS, *Brachyspira hyodysenteriae*, *Mycoplasma hyopneumoniae*) have been reported [139,140,141,142].

On the other hand, some authors have applied statistical methods to develop biosecurity scores based on the rank of biosecurity practices according to their importance. For example, Zang et al. [143] used a multi-criteria Decision Analysis (MCDA), a method that assesses the relative importance of biosecurity practices by pair-wise comparison of measures in order to estimate how many times more important is one measure in relation to other [144]. Silva et al. [118] applied this method to PRRS.

Silva et al. (2018) [118] used the item response theory to create a general biosecurity score in pig farms. This method is based on the notion that farms that implement some biosecurity practices will also implement others related to it. By using this method, they were able to reduce the number of variables needed to quantify the biosecurity level of pig farms, simplifying thus the method.

All of the above-mentioned systems (with the exception of the study of Silva et al. (2019) [145] have used data obtained from experts. This often introduces some bias as uses subjective estimates. Expert opinion might be influenced by different factors, mostly previous experiences, the epidemiological situation in a country, or the prevailing idea in an area, among others. However, when no sufficient data are available in the literature this is a valid option as far as some basic principles are followed [146]. An adequate selection of experts based on their knowledge, experience and background but also on the lack of conflicts of interest is paramount.

Biosecurity assessments providing probability estimates

Multivariate statistical models [147], Bayesian Belief Networks [148] and machine-learning algorithms [149] are some of the statistical models used to quantify the probability of disease occurrence and to evaluate the impact of the implementation of biosecurity practices. Although they do not consider the biological plausibility of the included variables they may be useful methods for the development of tools for measuring, benchmarking and managing biosecurity practices as described by Silva et al. [149] for PRRSV.

Quantitative risk assessment, as described by OIE [146], may also be useful to estimate the probability of disease introduction and to prioritize biosecurity measures based on their impact on the probability of disease transmission. The ultimate goal of risk analysis is to provide evidences to support decisions taken for mitigating risk of disease spread. This type of models considers the different pathways by which a pathogen can be introduced and transmitted and, within each of them, considers the different events that should have occurred for the pathogen to be transmitted. Events may depend on others and, each of them is assigned a probability based on the best knowledge available at that time, considering uncertainty or variability. Next, the probability is determined for each pathway and globally with indication of the confidence intervals [146]. Quantitative risk assessment models have

been mainly used to estimate the probability of introduction of diseases at a country level [150] and for a single disease but generic risk assessment tools are also under development [151].

Quantitative risk assessment models also have several limitations. On the one hand, they are complex and time consuming and, on the other hand, they require of many data that are not always available. Nevertheless, they have the advantage of estimating the probability of disease introduction based on existing biosecurity practices and therefore, support the decision making on which biosecurity measures should be prioritized to reduce such probability. Some attempts to use this kind of models for biosecurity assessment at farm level have been developed for other species [152] but for the moment, to the best of our knowledge, not for pig farms.

Design and implementation of biosecurity programs

A biosecurity program can be designed for a specific disease and focus on the measures towards that disease, or it can be more generic and can be designed to reduce the risks common to different diseases. In any case, as a first step, it is advisable to establish a list of undesirable diseases and identify the routes by which they are more likely to enter the farm, so that prevention measures can be placed where they will be most effective. Biosecurity assessments described in the previous section could be useful for this task.

Once the list is set, the forms of transmission have been identified, the risks associated with each circumstance have been identified and, the measures to be applied have been selected, they must be implemented effectively. At this stage, the program development should be evaluated and followed-up leading to the modification or expansion of the existing measures. To carry out the implementation of the biosecurity program, management protocols must be generated that describe step by step the actions to be applied, together with the training of the farm staff and the professionals involved.

One of the main problems for this long-term maintenance of the program is that, if it is effective, the result will be that the entry of new diseases will not be seen or the spread of existing ones will be reduced. In other words, if the program is successful, nothing will happen and this will give a false feeling of lack of risk. This might lead to the relaxation of the implementation of biosecurity practices, which, in turn, could increase the probability of disease introduction or transmission.

The application of biosecurity in each farm is a responsibility of the industry and, ultimately, of the owners of the farms [153, 154]. However, sociological and even psychological factors must be considered. It is critical to know the attitude and the expectations regarding disease prevention of people in charge of implementing the biosecurity program [155]. Possible motivators and barriers must be considered as well.

In recent years, several studies explored the factors influencing decision-making by pig farmers, as well as their attitude towards biosecurity [156,157,158,159,160,161]. Some of the reported factors could be classified as “personal” including knowledge about the transmission of diseases and about biosecurity, gender (often women do a better implementation of biosecurity programs), age and years of experience, the personality, as well as the connection of people to sources of information (technical advice, producer network, etc.) [160,161,162,163,164].

Regarding the availability and credibility of information sources, different studies showed that veterinarians are the source of information in which farmers place greater confidence when animal health and biosecurity are to dealt with [162,163,164] but not the only one. Farmers do also consider the recommendations of other sources such as those coming from the food industry or producer groups, among others [162]. Nevertheless, increasing awareness on biosecurity and disease prevention on veterinarians have been suggested as of paramount importance to improve farm biosecurity [165].

Another factor of great impact in the application of biosecurity measures is the risk perception of a disease and its consequences on the farm. Greater application of biosecurity measures has been observed after outbreaks of diseases such as PRRS [157] or influenza [148] as well as in densely populated areas of pigs, probably due to a higher perception of the transmission risk between neighbours [160]. Producer education is also an important factor, as described by Nöremark et al.

[165]. In that study, the perspectives of Swedish farmers on the incidence, control and communication related to infectious livestock diseases were investigated. Results indicated that farmers who believe that they have the necessary knowledge, have a greater sense of control and also demanded that others took responsibility for preventing the spread of disease.

Therefore, to improve the application of biosecurity measures, farmer and veterinarian's awareness should be increased, probably using participatory methods. In this sense, various governments and institutions have developed guides, manuals and materials to persuade producers and veterinarians on why and how to apply biosecurity measures. Unfortunately, many of these manuals have little real impact as producers think that those recommendations are irrelevant or impractical, even for those who have had disease outbreaks or may receive financial support. Part of this failure is due to the low confidence on government institutions. Likewise, part of the producers believes that the responsibility for the application of the measures lies with the health organizations, particularly when the measures are intended to zoonosis control or are applied by international legal or market pressures [156, 166].

Conclusion

Biosecurity has become an essential element of livestock production, particularly in intensive systems such as in the pig industry. The avoidance of the introduction of new pathogens and the limitation of their spread will contribute to increase the wellbeing of pigs, the productivity of the farms and will contribute to public health as well. A better knowledge of the epidemiology of the pig diseases will contribute to the design of better biosecurity programs. Moreover, the development of quantitative assessment methods will permit a more precise selection of measures and a fine evaluation of their impact. Collaboration with other branches of science such as sociology or psychology may help to the sustainable implementation of biosecurity plans.

As taken from:

<https://porcinehealthmanagement.biomedcentral.com/articles/10.1186/s40813-020-00181-z>

Biosecurity of Pigs and Farm Security



**Donald G. Levis, Professor Emeritus,
Department of Animal Science, University of Nebraska–Lincoln
Rodney B. Baker, Senior Clinician,
Veterinary Diagnostic and Production Animal Medicine, Iowa State University**

Table of Contents

Item	Page
A. Introduction	3
B. Biosecurity	3
B1. Prioritization of Biosecurity Factors to Implement.....	4
B2. Location of Farm	6
B3. Sources of Swine Diseases.....	6
B4. Purchasing Replacement Gilts and Boars	7
B5. Isolation of Incoming Pigs	8
B6. Pig Flow	9
B7. Fencing	10
B8. Assessing Visitor Risk and Controlling Access	10
B8.1. Risk Assessment.....	10
B8.2. Entrance to Farm.....	10
B8.3. Signage	11
B8.4. Parking Area.....	11
B8.5. Unauthorized Entry by Intruders.....	11
B8.6. Authorized Visitors.....	11
B8.7. Farm Employee.....	13
B9. Worker Training and Abidance	14
B10. Feed Delivery and Feed Storage	14
B11. Water Supply	15
B12. Air Filtration	15
B13. Vehicles	16
B14. Equipment and Consumable Supplies.....	16
B15. Farm Machinery and Equipment.....	17
B16. Bedding Material.....	17
B17. Hygiene and Sanitation of Buildings	17
B18. Boot Baths	17
B19. Dead Pig Postmortem and Disposal	18
B20. Wild Mammals, Birds, Parasites, and Pets	18
B21. Loading/Unloading Chute and Load-Out Area	22
B22. Manure Disposal and Waste Management	23
B23. Herd Health Management.....	23
B24. Facility Maintenance.....	24
B25. Maintenance of Biosecurity Program	24
C. Farm Security.....	24
C1. Develop Farm Security Plan.....	25
C2. Training for Emergency	25
C3. Access and Barriers to Farm	25
C4. Hazardous Materials.....	26
C5. Visitors and Personnel	26
C6. Hiring New Employees	26
C7. Employee Training.....	27
C8. Employee Monitoring.....	27
C9. Community Involvement	28
C10. Law Enforcement Involvement	28

This publication is partially funded by the United States Department of Agriculture, National Research Initiative of the National Institute of Food and Agriculture, Grant #2008-04179 received by Donald G. Levis.

Risk factors for security of a farm and biosecurity of pigs on the farm are unique to that farm. Therefore, each biosecurity plan should be farm specific. The best plans are created by working with a swine veterinarian or veterinary consultant who has extensive knowledge of the farm, employees, and local risk factors.

A. Introduction

Biosecurity of pigs at the farm level is the set of practical measures taken to prevent entrance of infection into a pig farm and control the spread of infection within that farm. The goal of a biosecurity program is to keep out pathogens that the herd has not been exposed to and to minimize the impact of endemic pathogens. Pig farm security can be defined as the planning and implementation of a program to minimize various types of risk that can have detrimental effects on the farmstead and pigs. Biosecurity and security procedures are intertwined to enhance the health and productivity of pigs. Numerous factors are involved in the development and maintenance of a cost-effective program for biosecurity. These factors can be thought of as links in a chain; a biosecurity program is only as strong as its weakest link. The purpose of this publication is to provide information about the various aspects to consider when implementing and managing a biosecurity and farm security program. **It is not practical, nor is it recommended, for every farm to implement all of the procedures described.** All farm biosecurity and security risk factors are unique to that farm and, thus, each biosecurity plan should be farm specific. The best plans are created by working with a swine veterinarian or veterinary consultant who has extensive knowledge of the farm, employees, and local risk factors.

B. Biosecurity

The components of a pork operation that need to be biosecure are shown in *Figure 1*. The application of biosecurity measures differs among farms due to the geographic location of the farm, proximity to other pig farms, epidemiological situation (causes, distribution, and control of disease in the herd), type of swine operation, level of technology used for production, and whether other people are employed on the farm. The development and implementation of a biosecurity program provides an essential component of many on-farm food safety programs; greater consumer acceptability of the quality and safety of the food supply; healthy animals that are more productive; improved animal welfare; and improved efficiency and profitability for the pork producer. In addition, supermarket buyers and consumers want pork producers to use less medication when producing pork.

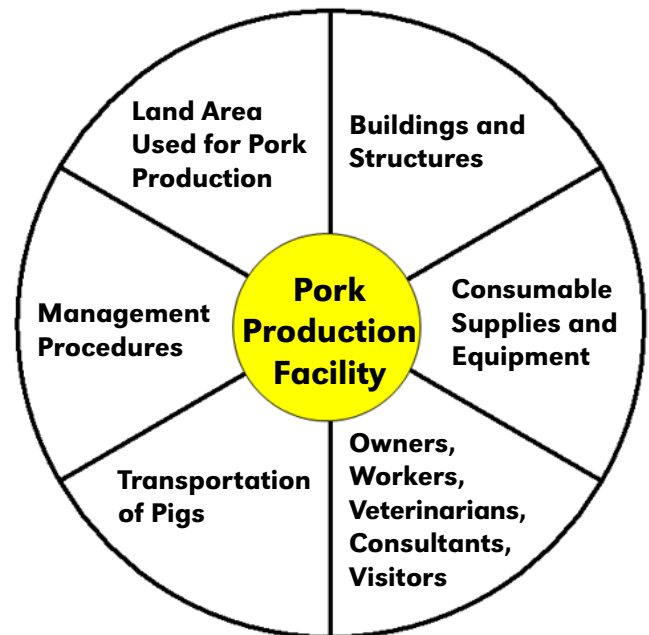


Figure 1. Components of a pig farm required for adequate biosecurity

Biosecurity is made up of three separate, but often blended, sets of actions and overlapping components. These are bio-exclusion, bio-containment, and bio-management. The goals of the production unit or farm will determine how these are blended into a biosecurity plan. Most often, producers focus on bio-exclusion and bio-management while neglecting bio-containment. The purpose of bio-containment is preventing the spread of disease agents to neighbors or even long distance transfer, but also the very important process of protecting the food supply for consumers. It is the single most important component of strategies that will be implemented if a foreign animal disease is introduced into the United States. Even though it is often ignored in day-to-day production biosecurity, this component is extremely important in any pig production system and often is the “right thing to do” for neighbors and other pig producers in a community.

Bio-exclusion is simply preventing the introduction of unwanted disease agents into the farm or system. This is where most producers focus and has been the focus of recent research. Bio-management is the combined effort to control economically important infectious diseases that are already present in the farm population. Room

disinfection, vaccines, all-in/all-out pig movement and many other procedures designed to reduce the pathogen level or enhance immunity levels in the pigs are key components of bio-management. Each of these areas can have significant impact on the economic viability of a producer or producers in a geographically linked animal agriculture area.

Disease control is one of the most challenging areas for pork producers, regardless of whether the pigs are housed indoors or outdoors. Pork producers aim for minimal clinical disease status (bio-management) because it is economically and technically infeasible to exclude all important pathogens from a herd of swine. However, certain disease agents should always be excluded since bio-management methods are ineffective while exclusion opportunities are practical. To develop a useful biosecurity plan, it is necessary to know: (1) the prevalence of diseases that can affect your herd; (2) how each disease is transmitted; (3) how each disease can be controlled; (4) how to prevent each disease from entering the herd; and (5) the potential cost of an introduction and outbreak.

All biosecurity efforts come with a cost, and ineffective methods should be avoided. Likewise, production practices that impose the greatest risk should be the focus, rather than low-risk activities. It is essential to have a swine veterinarian help develop the written and detailed biosecurity plan. Biosecurity plans are intended to prevent adverse situations and improve the pork production business. All it takes is one breach of on-farm biosecurity to ruin a herd's health status or that of a neighbor's. This loss could have long-lasting and devastating production and financial effects on any farm. The following situations contribute the greatest risks to the health of pigs in a swine operation. These factors will be discussed later in more detail.

- Adding new pigs to the farm without a quarantine period.
- Failing to quarantine new additions for 30 to 60 days.
- Failing to require testing for specific diseases prior to addition.
- Failing to require vaccination for specific diseases prior to addition.
- Allowing pigs to return from fairs, shows, or exhibitions without quarantine and testing.
- Allowing other domestic or wild animals to have contact with the pigs, feedstuffs, or water sources.
- Failing to prevent disease transfer via pig transportation, human contact, other vehicular traffic, or equipment used with more than one animal or used

at other locations such as a buying station, slaughter plant, or off-site farm.

It is common for small- and medium-sized pork operations to house their animals outdoors. Preventing the introduction of disease is difficult when pigs are housed outdoors or have access to outdoor lots because producers cannot control pig contact with wildlife, stray animals, rodents, insects, aerosols (containing disease agents), contaminated soil, and people. Feral and wild pigs are one of the greatest risks to outdoor producers since they carry most pig disease agents, including pseudorabies and brucellosis, which have been eradicated from U.S. and Canadian domestic pigs. Securing an outdoor facility is always challenging; however, various procedures can be used that discourage unwanted visitors and pests.

B1. Prioritization of Biosecurity Factors to Implement

B1.1. Small Farms. This publication provides information about numerous factors that can influence biosecurity of pigs and farms. Some factors are more important to implement for biosecurity on small farms (such as 100 sows or less). Farms with a small number of pigs typically do not have employees. Managers of small pig farms who work with a swine veterinarian and meticulously implement the following biosecurity principles generally have high herd health status:

- Bring in only clean breeding stock verified by a swine veterinarian.
- Always take extra care that biosecurity is a priority at the marketing access point and other trips to town.
 - Always make sure to keep boots, hands, pickup cab, and trailer a clean zone so pathogens are not hauled home.
- Use batch farrowing whereby all the pigs are moved at the same time and same age during each phase of production (weaning, nursery, grower, and finisher).
- Make sure all tail-end pigs from the growing-finisher phase are moved off-site before a batch of sows farrow.
- Use the same breeding stock for four to eight parities.
- When repopulating the sow herd,
 - Option 1. Replacing entire sow herd:
 - Make sure the entire sow herd has been depopulated.
 - Make sure all pigs from the growing-finisher phase are marketed or moved off-site before replacement animals arrive on the farm.

- If possible, have the depopulation period occur during the summer months to take advantage of the dry environment and high ultraviolet light period to help kill pathogens.
 - All replacements should come from a single source, which could be home-raised gilts or purchased females.
 - This option will affect cash flow due to lower productivity at the beginning and end of each turnover of the sow herd.
 - If pigs are finished indoors, the availability of space might be a problem during the middle of the high productivity period.
- Option 2. Partial replacement of sow herd:
- A proportion of the sows are replaced on a regular quarterly or longer period.
 - All the replacement animals should come from a single source (such as original source of the sows being replaced).
 - The replacement source has the same health status as the farm. This requires monitoring of the source farm and communication, preferably veterinarian to veterinarian prior to receiving each group of replacement stock.
 - If possible, have the depopulation period occur during the summer months to take advantage of the dry environment and high ultraviolet light period to help kill pathogens.

B1.2. Larger Farms. Strategies for biosecurity of the pigs and farm should be developed by using a Hazard Analysis of Critical Control Point approach. Knowledge from scientifically applied field trial methodology, peer-reviewed publications, and significant field experience should be heavily relied upon when establishing the critical control points (CCP). Extensive interviews and inputs from all farm staff should be included in the early stages of the hazard analysis assessments. Without participation of the farm employees, many CCPs will be overlooked.

Once the CCPs are identified, then and only then can biosecurity interventions be developed. Only those evidence-based biosecurity interventions that have demonstrable usefulness in the field are applicable. Based on relative risk assessment, a hierarchy of biosecurity interventions can then be developed; in the end, focusing on those factors that have greatest impact and opportunity for success. A helpful formula in determining appropriate implementation decisions is:

Appropriate Biosecurity Intervention Value (BIV) =

$$\frac{\text{DEV} * \text{RR}}{\text{DD}} - \text{IC}$$

Where:

DEV = Disease Exclusion Value per pig per year (often very difficult to determine other than historical experience)

RR = percent Risk Reduction per year for each intervention (from the PRRS Risk Assessment Tool, etc.)

DD = Degree of Difficulty (Ranking 1-10 with 10 = very difficult/maintain)

IC = Intervention Cost per pig per year

Using this formula, each agent and each intervention strategy can be qualitatively and semi-quantitatively analyzed. These computations can then be used for choosing those strategies that have a final BIV greater than zero. Although arbitrary, the DD allows consideration of a customized score for the complexity of an intervention and the ability of the farm staff to adopt, implement, and sustain an intervention procedure or process. It becomes farm or system specific, which is ideal in the real world. If several diseases have similar risk reduction for the same intervention, the DEVs can be added together and the sum entered into the equation. As multiple agents are considered, the strength of the intervention strategy becomes apparent. Of course not all the risk factors, values of disease exclusion, or the percent RR are known, but a veterinarian can arrive at reasonable approximations by using the risk assessment tool (Holtkamp et al., 2011), published information, and biosecurity experts.

Developing a value equation for each disease is often a matter of benchmarking diseased pigs with those that are free of disease in the same system. Some average disease cost numbers are published for porcine reproductive and respiratory syndrome (PRRS) (Neumann et al., 2005), transmissible gastroenteritis (TGE) (Mullan et al., 1994; Regula et al., 2000), *Actinobacillus pleuropneumoniae* (Losinger, 2005), and *Mycoplasma hyopneumoniae* (Maes, 1999). These estimates for cost of disease are useful benchmarks. The amount of RR for each biosecurity intervention and the perceived value for exclusion helps arrive at a logical expectation for those interventions. With this approach, only those interventions that have a value greater than zero are applied.

Calculating IC can be difficult and often relies on farm or industry experience. The cost of building a shower facility is relatively straight forward, but the variable costs associated with implementing showers for all who enter the farm is highly variable. Clothing costs and frequency of replacement; increased use of water, shampoo, soap, the washing machine, clothes dryer, and

Table 1. Factors influencing risk of a breakdown in biosecurity program due to location of pig farm (modified from Barcelo and Marco, 2003)

<ul style="list-style-type: none"> • <i>Pig farms nearby:</i> A farm with 500 animals (sows, nursery pigs, and growing-finishing pigs) at a distance of .6 mile away represents less risk than a herd of 5,000 at 1.2 miles away. If the 5,000 animals are a breeding herd, the risk is much lower compared to a finishing site with 5,000 growing pigs. Locating your outdoor pig production unit at least 2 miles from other swine could minimize the risk of infection by aerosol and other natural routes of transmission. Although aerosol transmission does occur with some agents, it is probably extremely rare for most agents.
<ul style="list-style-type: none"> • <i>Local pig density:</i> Local pig density can be defined as the average number of pigs per .4 square mile within a 3-mile radius of the farm. <i>Figure 2</i> is a schematic of this principle. Densities of less than 100 pigs per .4 square mile are considered to have less risk compared to densities of greater than 1,000 pigs per .4 square mile.
<ul style="list-style-type: none"> • <i>Other possible sources of contamination:</i> A slaughter facility at less than .6 mile represents an enormous health risk, whereas at greater than 3 miles, the risk is reduced. Rubbish dumps represent a biosecurity risk when situated at less than .6 mile. The manner in which nearby pig facilities are managed for vegetation growth, drainage from the farm, and biosecurity procedures can influence the risk of a breakdown in biosecurity of other pig farms in the area.
<ul style="list-style-type: none"> • <i>Type of terrain:</i> Ideally, the land should be hilly and protected from winds. Flat land without trees or other kinds of protection would have a higher level of aerosol risk compared to hilly land.
<ul style="list-style-type: none"> • <i>Roads:</i> A road with a high density of vehicles transporting pigs at less than 55 yards from the herd represents an important contamination risk. Distances over .25 to .50 miles from the herd greatly minimize biosecurity risk. However, some breeding stock companies have concluded that transport risk associated with driving near pig sites along a route or in-route exposure to vehicles hauling slaughter pigs appears to be very low.
<ul style="list-style-type: none"> • <i>Other animals:</i> The presence of cattle, sheep, or poultry could be a biosecurity risk if housed at less than 110 yards.
<ul style="list-style-type: none"> • <i>Climate:</i> During optimal climatic conditions (such as winter months, high humidity level, constant moderate winds, flat land), windborne dust or aerosol droplets present in the air can infect swine. Cold and humid climates are more favorable to disease transmission than dry and hot days. Aerosol spread of pathogens is usually reported to occur up to approximately 2 miles around an infected farm. Many viruses like cold, dark, and wet conditions. TGE and PRRS viruses are susceptible to drying, ultraviolet light, and heat. Movement by aerosol likely occurs at night under very specific conditions; thus, aerosol transmission is rare. With respect to PRRSV, one aerosol transmission every two years is still a big issue for a producer in harm's way.

electricity; employee lost work time; morale; employee retention; and many other details should be objectively considered and calculated. Comparing this to a boot and outerwear exchange facility (Danish entry) is worth considering, especially for smaller operations. Downtime rules often create significant costs but have very limited exclusion value. Determining IC for downtime rules is difficult but no more difficult than the calculation of its DEV. Establishing universal DEV and IC for each economically important disease agent is worthy of considerable research dollars. For example, calculating the value of barn filtration also may be a daunting task, but disease (PRRS) exclusion must be near 100 percent with current filtration application and maintenance costs.

B2. Location of Farm

One of the main factors that increases the risk of a herd acquiring a new disease is often the proximity of the farm to other live pigs. The nearby presence of growing pigs is a much greater risk compared to a breeding herd that sends all weaned pigs to an off-site facility. Theoretically,

pig production facilities should be located as far as possible from other pig facilities. *Table 1* indicates factors influencing risk of a breakdown in a biosecurity program due to location of a pig farm. Although location is important, factors within the farm can influence all aspects of biosecurity. The positioning of buildings within the unit, position of ventilation inlets and outlets, people movement, isolation procedures, pig movement, and other factors will affect the success of biosecurity plans.

B3. Sources of Swine Diseases

Swine diseases are a concern for nearly every pork producer, regardless of size of operation. A disease outbreak can be economically devastating to a swine operation. It is important that people involved with pork production understand how swine diseases are spread and how people can influence the spread of diseases among pigs and farms. Swine disease can be spread in a number of ways, including:

- through diseased swine or healthy swine incubating disease, or unaffected carriers,

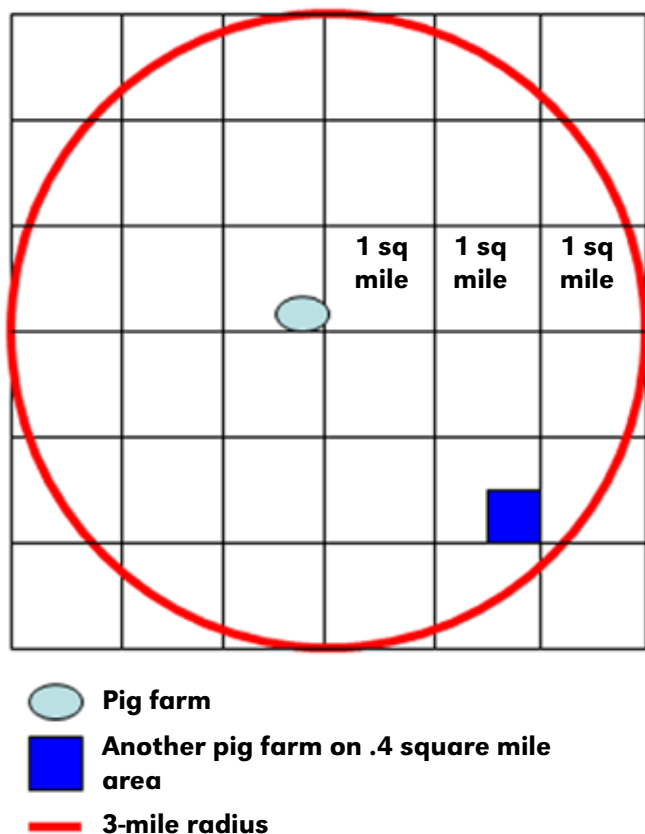


Figure 2. Schematic of a local pig density defined as the average number of pigs per .4 square mile (.63 mile x .63 mile = .4 sq. mi.) within a 3-mile radius of the farm

- through new replacement gilts and boars,
- purchased semen,
- through other farm animals, insects, pets, birds, and wild animals,
- on the clothing and shoes of visitors and employees moving from farm to farm,
- on employees who did not follow all the biosecurity procedures of the farm,
- any employee or visitor who has had recent direct contact with other pigs,
- on contaminated feed, water, bedding, and soil,
- from the carcasses of dead animals,
- on contaminated equipment and vehicles used on the farm,
- on contaminated veterinary equipment,
- any equipment that has been in contact with pigs from another site,
- on contaminated commercial vehicles hauling culls, slaughter, or growing pigs,

- delivering feed (truck and even more so the driver) in airborne particles and dust blown by the wind, and
- on consumable supplies entering the farm.

Unexplained disease transmission over short distances is often attributed to aerosol infection. Aerosol and air-borne spread of infections depends on numerous factors, such as: the type of pathogen, number and density of animals excreting and susceptible to infection, method of housing, droplet size, relative humidity, ambient temperature, ventilation fans, wind speed, wind direction, sunlight, topography, natural barriers, and methods of manure application. Although a minimum distance (2 miles) between neighboring pig farms is desirable to limit the risk of aerosol disease spread, this may be impractical for existing pig farms. Many times disease agents have other routes of transmission that are more important and more frequent compared to aerosols but just as difficult to document. Like aerosols, distance from other pigs is also an effective deterrent against these methods. Distance has a dilution effect on all pathogens by reducing the likelihood of all means of transmission. The risk of aerosol is also related to the numbers of pigs on the distant sites. Large numbers of growing pigs increase the odds of a random introduction. There have been outbreak investigations that imply aerosol movements up to 5 miles with PRRS virus and as much as 2 miles for Mycoplasma. Aerosol transmissions are very difficult to substantiate but likely occur in special weather-related situations.

B4. Purchasing Replacement Gilts and Boars

Finding a source of minimal disease animals is not always easy. Essential elements of a biosecurity program are often ignored on small pork operations, such as procurement of new breeding animals from a reliable source and isolation of new animals before introduction into the herd. Word of mouth and testimonials often take precedence rather than direct veterinary knowledge from health monitoring and pathogen testing. Direct contact with other pigs is always the greatest risk for acquiring new diseases. The following guidelines are suggested when purchasing replacement gilts and boars:

- Know the disease status of both recipient and source herds.
- Consider the location and health history of the source herd.
- Select replacement gilts from a single source that has a documented genetic improvement program and sound disease control (biosecurity) programs.
- Select replacement boars from a single source that has a documented genetic improvement program and sound disease control (biosecurity) programs.

- Most breeding companies utilize a veterinarian and maintain an internal health-recording program. Have your veterinarian consult with the source herd's veterinarian to:
 - confirm that the source herd has not had any recent disease outbreaks,
 - determine what diseases have or have not been detected or tested for in the source herd,
 - determine what vaccination programs are used, and
 - determine what antimicrobials are being used in the feed or water.
- Maintain animal movement records. List the contact information of the seller(s), the origin of the pigs, the number of pigs purchased, date pigs are moved onto your farm, and, if available, the premise identification.
- In principle, fewer introductions of new gilts and boars into the herd would seem to reduce the odds of bringing a disease into the herd. However, the parity distribution and genetic improvement cost of infrequent introductions may offset the risk, especially if a good single source of replacement animals is involved. The risk of disease transmission is minimized when: (1) there is open communication between the producer's veterinarian and source herd's veterinarian, and (2) all new replacement animals are brought into the herd after spending 30 to 40 days in a biosecure isolation facility that has an excellent and functioning disease monitoring/detection program in place.

B4.1. Artificial Insemination. The alternative to purchasing replacement animals is to utilize a closed-herd policy. Artificial insemination is the easiest method to bring new genes into a sow herd. However, biosecurity risks can be associated with artificial insemination. Boar semen can contain a number of potential pathogens, such as Porcine Reproductive and Respiratory Syndrome Virus and Porcine Circovirus. Most boar studs routinely test semen from AI boars for the presence of PRRSV and only bring in negative boars that have never been exposed to PRRSV.

Generally, semen arrives at the farm by either a boar stud courier or an external courier, such as UPS or FedEx. Semen shipped via an external courier is normally packaged and sealed into a temperature-controlled (63°F), double-boxed Styrofoam container. Semen delivered by a boar stud courier is generally transported in paper/plastic bags placed in a cooler during transport. When the courier arrives at the farm, the bags of semen are removed from the courier and placed in a semen cooler with a temperature of 63°F. The semen cooler is located in the "dirty" area of the farm.

All semen packaging (bags, Styrofoam cooler, etc.) should remain outside the farm. Only the semen should enter by passing across the clean-dirty barrier. Although the semen source may be free of those disease agents generally considered economically critical like PRRS virus, other pathogens may be present and a contaminated cooler could bring in unwanted bacteria or virus agents from the boar stud. Likewise, the courier should never enter the farm because his or her route is unknown and a courier would not have knowledge of potential disease agents that may be present at other drop destinations. Generally, an area outside the clean-dirty barrier is designated for drop off. This can be off-site at the producer's house or other location. In the latter situation, the producer may place the semen into a shuttle cooler to move to the farm. Before showering into the pork production facility, move the doses of semen from the shuttle cooler across the clean-dirty barrier into an appropriate container, such as a Styrofoam cooler. After showering, place the doses of semen into the farm's semen cooler.

When delivered by a courier directly from the stud, a dirty side semen refrigerator is often placed where the semen can be delivered after hours. Once again, this could be off-site. In this case, the semen should be double bagged so that any potential contamination that could occur during the courier's route will most likely be in the outer bag. The outer bag is often paper with a plastic bag with the semen placed inside and stapled by the boar stud employee who packages the semen for shipment. When placing the semen in the refrigerator, the courier first will take the two-bag package out of the vehicle cooler. The second step is pulling the inner bag out and placing it in the refrigerator. The outer bag goes back to the vehicle and is placed in a rubbish bag and discarded at an off-site trash collection location. This bag should never return to the stud or be left at the delivery point. When the semen is needed in the farm, personnel dump the semen across the clean-dirty barrier, only touching the bag. This bag is disposed of outside the farm. Some farms spray disinfectant on all supplies, including semen containers, entering the farm as they pass the clean-dirty barrier.

B5. Isolation of Incoming Pigs

Pork producers should discuss with their veterinarian the procedures to use during isolation and acclimation of the replacement gilts and boars. Regardless of whether a pork producer is purchasing replacement animals from the same genetic supplier and health monitoring program, an isolation facility and program should be in place. Because the incubation period for different disease agents is highly variable and the replacements may not exhibit any signs of sickness for some time, it is essential these replacements remain in quarantine until test results and observation give reasonable assurance they are healthy.

The quarantine period also allows the source herd to discover any new disease introduced into that herd.

In addition, contamination could have occurred during transportation. It is important that incoming gilts or boars undergo a period of isolation for 30 to 60 days. The duration of isolation will depend on the specifications set by your veterinarian and particular disease(s) of concern. Isolation allows pigs to recover from the stress of transport to the farm, adapt to a new environment, and any incubating infections to become evident. The period of isolation provides an opportunity for inspection of animals by a veterinarian, a laboratory analysis of blood samples for diseases, and vaccination of animals before entering the herd. Guidelines for isolation units are:

- Make sure that biosecurity of the isolation facility is at least as good as the biosecurity of the main herd.
- The isolation unit should be in a location that is as far from other area pigs as possible, ideally more than 2 miles from the nearest neighboring pig facility. The ideal distance the isolation facility should be from the farm can vary depending on the management, testing protocols, biosecurity precautions, number of replacements in each quarantined group, and the disease(s) that are to be prevented. Work with your veterinarian to determine the best location in any specific situation.
- The isolation facility should prevent direct contact with all other pigs, domestic livestock, and wildlife. Where appropriate, a security fence should be erected around the isolation unit.
- The isolation facility should provide an air space, a water source, and a feed source that are separate from all other pigs and livestock.
- The isolation unit should be operated on an all-in/all-out basis.
- The risks of manure storage and drainage on disease transmission should be eliminated. Isolation facilities should have their own manure-handling facilities.
- The isolation facility should provide a clean, dry, comfortable resting space for all the pigs.
- When appropriate, animals should be provided with clean and dry bedding.
- Animals should be provided with clean and readily available water.
- During summer months, it may be necessary to move gilts housed outdoors to an area that will prevent sunburn. White-colored gilts can get severely sunburned.
- Where possible, use a separate person and equipment in the isolation unit. If one person cannot be dedicated to taking care of the isolation unit, the unit should be the last work task of the day. This

person should shower, if possible, and put on clean clothes and boots prior to entering the isolation unit. Many successful isolation facilities have no shower, and the farmer checks the animals on the way to the house. A boot exchange, isolation-specific coveralls, and hand washing are highly effective. Make sure the indoor facility has good lighting and accessibility of animals for visual inspection.

- The isolation facility should provide adequate restraint facilities for examinations and administration of treatments.
- The isolation facility should have an equipment and storage area. This equipment (such as boots, clothing, scrapers, shovels, buckets, etc.) is only used in the isolation area.
- All animals should be closely observed each day for clinical signs of any disease, including coughing, excessive sneezing, diarrhea, blood or mucus in the feces, loss of appetite, skin lesions, or lameness. Rectal temperatures should be taken in pigs that show any of these signs. Any abrupt changes in behavior or onset of clinical problems should be immediately reported to the veterinarian.
- Your veterinarian should visit the isolation area for blood sampling and inspections of animals. Depending on the diseases that are to be excluded and the nature of test diagnostics utilized, sampling shortly after arrival and again three to four weeks later may be necessary to assure freedom from disease. Allow enough time for laboratory results and expect to re-test on occasion.
- When possible, an acclimation program to the diseases on your farm should start in the isolation facility. Make sure the isolation facility is easy to clean and disinfect between batches of replacement animals. The cleaned and disinfected facility should remain empty and be allowed to completely dry before the next entry. This usually takes two weeks but can be shortened with heated drying.

B6. Pig Flow

Pigs should be moved as a group in an all-in/all-out (AIAO) manner. In other words, all the pigs are moved at the same time and same age during each phase of production (weaning, nursery, grower, and finisher). Once a group is established, younger pigs are never added to the group and, likewise, older pigs are never mixed with a younger group. The main reasons for using AIAO are: (1) to reduce exposure levels of disease causing pathogens in the pig's environment, (2) to prevent transmission of diseases from older pigs to younger pigs, and (3) to improve feed efficiency and rate of gain by maintaining a high health status. With careful planning, an AIAO system

Table 2. Guidelines for visitor risk assessment (modified from Dalrymple and Innes, 2004)

<i>Item</i>	<i>Low Risk</i>	<i>Moderate Risk</i>	<i>High Risk</i>
Number of farm visits per day	No other farm contact	One or occasionally more than one farm visit per day	Routinely visits many farms or auctions
Protective clothing	Wears sanitized shoes or boots. One pair of clean coveralls per site	Wears sanitized shoes or boots; if clean, may not change coveralls	Does not wear clean or protective clothing
Animal ownership	Does not own and/or care for livestock	Owens and/or cares for a different species of animal	Owens and/or cares for a swine production unit
Contact with animals	No animal contact	Minimal or no direct contact — exposure to housing facilities	Regular direct contact with swine
Biosecurity knowledge	Understands and promotes biosecurity for pork industry	Aware of basic biosecurity principles but is not an advocate	Little appreciation or understanding of biosecurity principles
Foreign travel	Does not travel out of USA	Limited travel outside of USA, without animal contact	Travel to foreign countries with animal contact in those countries

can be used in most pig production units. When pigs are housed indoors, a thorough cleaning and disinfection of the pen or barn between each group is required for best results. When possible, the facility should be allowed to completely dry before the next group enters. Care must be taken to properly clean the feeders, walls, ceiling, water troughs, penning, and flooring. High pressure with hot water and detergent is recommended.

B7. Fencing

Many small- and medium-sized pork operations often house their pigs outdoors in large dirt lots or pastures. They do not use an outer perimeter fence for biosecurity. A “pig proof” fence that surrounds your outdoor pig facility is recommended, especially if other pigs are close to your farm. However, a pig-proof perimeter fence is very expensive to construct.

There is no way to keep pigs housed outdoors away from all types of wild animals, birds, and blowing dust. In some geographic areas, the use of a 4-strand, high tensile electric fence is adequate to help increase biosecurity, and the cost is much less than a chain link or woven wire fence. Placing an appropriately designed and functional 4-strand electric fence 40 to 50 feet away from the pig production unit will enhance the prevention of stray livestock and feral pigs from obtaining nose-to-nose contact with the pigs. An electric fence with biosecurity signs will only keep out people who obey the signs.

B8. Assessing Visitor Risk and Controlling Access

B8.1. Risk Assessment. Risk assessment is a method of evaluating the likelihood and severity of the risk posed by a visitor. By identifying key risk factors, appropriate preventative procedures and protocols can be determined.

Table 2 is a guideline for assessing the risk level of visitors to a livestock operation.

B8.2. Entrance to Farm. Entry to the pig unit can be controlled by well-maintained fences, locking gates that enter the pig unit, using a communication system (such as buzzer, alarm, or two-way speaker system) at the locked entry gate for visitors to indicate their arrival, and signs at the entry gate or vehicle parking area that provide instructions for entry by authorized visitors (Figure 3). People can be discouraged from entering the



Go to office located at: _____

Or call: _____

Phone number: _____

Figure 3. Signage for a biosecure area

pig farm and contacting pigs by posting “No Trespassing” and “No Visitor” signs on the perimeter of the property and on entrance roads. Only one entrance road to the farm is best. Signs posted on the perimeter should direct visitors to a central sign-in area (office), away from fields, animal pens, and other restricted areas. Providing a phone contact number with clear instructions, including a no-entry policy, will prevent most biosecurity breaches by unwanted visitors. Periodically check the signs and replace or repair them, as necessary.

B8.3. Signage. Signs can help get the importance of the biosecure message across to both visitors and farm employees. However, poor wording or location of signs may undermine efforts to improve biosecurity. Signs that portray a professional image will convey a commitment to biosecurity and will be more effective than a piece of paper stapled to a door or post. Location of signs is also very important. Signs should be large and visibly placed where visitors cannot miss seeing them. Signs mounted off to the side of a door or among a number of other signs are likely to be missed or ignored.

Two simple ways to place signs effectively are to hang them from a barrier chain or mount them on a post placed in the visitor’s path of travel. Chains made of yellow plastic links and posts made of scrap angle iron and set into a bucket of cement are effective, cheap, and easy to move out of the way when necessary. Post “Do Not Enter” signs outside of all buildings. Some producers who keep their pigs outdoors on pasture lots next to a road install signs that say “Do Not Feed the Pigs.”

B8.4. Parking Area. Parking areas should be located away from pigs and other livestock, feed delivery areas, and manure-handling routes. Visitors’ vehicles should be visibly clean of manure and organic matter. Only the farm’s vehicles should be allowed in livestock handling and housing areas or around feed storage areas. If needed, the farm’s vehicles should be used to transport visitors, employees, and agricultural service personnel. Parking should be outside the site perimeter fence.

B8.5. Unauthorized Entry by Intruders. You will not be able to prevent access to people with bad intentions; therefore, it is important to be aware of any signs of unauthorized entry or tampering. Security breaches are also biosecurity breaches. When pigs or farm equipment disappears, the culprits have often visited other pig sites during their clandestine operations with no concern for biosecurity.

- Evidence of trespassing might include non-explained injection sites on pigs, food wrappers, cigarette butts, tire tracks, footprints, and broken equipment.
- Evidence of pigs being stolen or disease-carrying pigs being added can be detected by taking frequent pig inventories.

- Appearance of unusual signs of disease can possibly indicate that trespassing occurred. Daily monitoring for disease can help detect an outbreak early.
- Farm entrance gates should be locked at night to serve as a deterrent and as an indicator of intrusion.
- Video security cameras may be useful if the cost can be justified.

B8.6. Authorized Visitors. All authorized visitors need to understand the possible risk they present when entering a farm with a swine operation and what precautions need to be taken between farms that are visited. The list of authorized visitors might include neighbors and friends; agribusiness and service representatives; veterinarians and consultants; regulatory personnel and inspectors; dead stock collectors; and custom manure haulers and applicators.

Equipment brought into the swine area to repair buildings and machinery, to treat or handle animals, and to carry out testing or other procedures can be potential sources of contamination. Ensure all equipment used by visitors has been thoroughly cleaned and disinfected appropriately before being used on your premises. The risk of a breakdown in biosecurity is increased with visitors who regularly go from farm to farm as part of their employment or routine.

All visitors wanting to enter the pig area should make an appointment and should ask the farm operator about the biosecurity protocol and whether special measures must be taken prior to the visit. Strict visitor policies should be enforced, with only necessary personnel allowed access to pig areas. Visitor entry to the pig area should be by a single entry point.

- Control all visitors’ access to the herd.
- Prior to allowing them to enter the farm, all visitors should be briefed about the biosecurity procedures and policies. Determine if, when, and what types of farms the visitors have been to prior to visiting your farm. Do not allow foods of animal origin to be brought onto the premises. The visitors must state that they:
 - have showered and changed clothes since their last exposure to pigs,
 - have not returned from overseas travel within the last 7 to 10 days,
 - are not experiencing fever or any flu-like symptoms.
- Generally, a visitor’s log is maintained at a location where people are required to complete the requested information prior to their taking a shower or

entering the pig facility. Information to be recorded in a visitor's log includes:

- a place the visitor can check that confirms he or she understands and will abide by all the policies and procedures for biosecurity of the farm,
 - date of visit,
 - name of visitor,
 - address of visitor,
 - company name,
 - purpose of visit,
 - date of last contact with pigs,
 - time of arrival at farm,
 - time of departure from farm, and
 - signature.
- The duration of time a visitor needs to be away from all pigs before allowed entry into a pig farm is quite variable (12 to 72 hours). The farms that have used the 12-hour (overnight) pig-free period also require visitors to shower before entering the farm. The most common duration of time for people to be away from all pigs before entering a pig unit is 24 to 48 hours.
 - Make sure all suppliers of products, maintenance service, and other farm visitors follow the biosecurity measures.
 - Place restricted entry notices on the doors to animal facilities.
 - Restrict access to animal facilities to essential visitors only. Keep visitors out of animal pens and feed alleys, and do not allow direct contact with animals if not essential.
 - Clearly demarcated “clean” and “dirty” areas should be established to ensure there is no confusion about where people need to remove their off-farm “dirty” clothes and footwear. Require all visitors to wear clean boots, clothing, and disposable gloves while visiting the pig unit. Some biosecurity procedures may require visitors to shower and change into clothes and boots provided by the farm. To ensure that appropriately sized clothes and boots are available, visitors should make arrangements prior to visiting the pig farm. Some biosecurity procedures may only require visitors to wash their hands, scrub fingernails, and wear protective outerwear provided by the farm.

- Drivers of pig transportation vehicles should be treated as visitors and never allowed into housing areas. Like the front entry, a clean/dirty demarcation should be observed at loading areas.
- Drivers of feed delivery vehicles should never be allowed into the pig facilities and should fill bins from outside the perimeter fence when possible. Receipts can be placed in a mail-like box as the truck exits the site so the driver doesn't enter the office or shower area.

The below procedure has been used when showering is not required to enter a pig farm. This method is known as the S.P.F. Danish entry procedure (*Figure 4*). The use of a non-shower Danish entry procedure is a reasonable biosecure method to enter an area that only has finishing barns.

- Walk through the entry door of the building into the change room that leads to the pig production unit. The entry door should be locked at all times, except when authorized people enter the building. Ideally, a system should be developed to unlock the door without someone inside the building having to go back through the shower to open the door.
- Remove top clothes, shoes, and hat and leave them in the designated “dirty side” of the change room. Except for the floor grate area, a wall separates the dirty side from the clean side of the room.
- Walk onto the floor grate that separates the dirty area from the clean area.
- Wash hands thoroughly with soap and water and scrub under the fingernails. Dry hands with a clean towel.
- Walk off the grate to the clean side of the room.
- Put on the clothes and boots provided by the farm.
- When exiting the change area, walking through a footbath containing disinfectant, or scrubbing boots with a scrubbing brush and disinfectant, may be required before entering the pig unit.
- Provide a container or plastic bag for collecting dirty clothing or disposable items used by visitors.
- Ask visitors to wash their hands prior to leaving the premises, especially if in contact with the pigs. If hosting tours, provide hand-washing facilities or disinfectant hand gel. If food is to be served, do this away from the animal facilities and after hand washing.

The Danish entry method also has been used in combination with a shower. The Danish entry is a separate shed connected to the shower-in area of the farm office facility by a bird-proof walkway or sometimes a

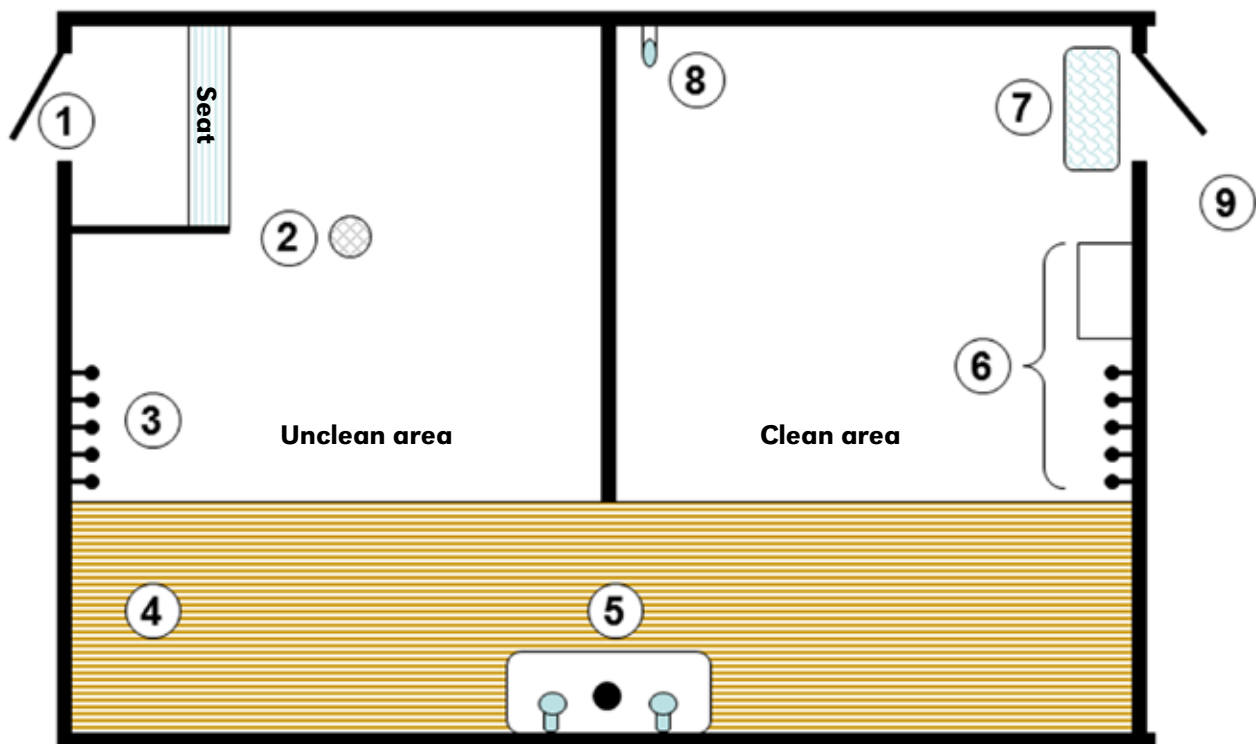


Figure 4. Danish entry method for a non-shower farm. 1. Only entrance to facility and footwear is removed; 2. Floor drain; 3. Street clothes are removed; 4. Wooden-grate passage is only entered in stocking feet; 5. Hands are washed and disinfected; 6. Protective clothing and boots; 7. Use footbath before entering unit; 8. Water-tap with hose; 9. Pig facility (adapted from Moore, 1992)

sidewalk. Inside the single room Danish entry, a bench divides the room in half. Jackets and hats are hung on hooks in the dirty side. The employee/visitor sits on the bench divider and removes his or her footwear (boots/shoes) without letting stocking feet touch the floor. After removing footwear, the visitor turns around and puts on farm footwear to cross over to the shower area. This keeps dirt, mud, snow, etc. from entering the changing and shower area.

B8.7. Farm Employee. The term “farm employee” means anyone working on the farm (owner, family members, office staff, and daily pig unit workers). Some of the biosecurity procedures that all these people are required to abide by are:

- They are not permitted to own or work with other pigs.
- They are not allowed to live at another pig farm.
- They must not come to work if they have influenza-like symptoms. Flu-like symptoms include fever, cough, body aches, and sometimes vomiting and diarrhea. Some farms recommend that people with these symptoms be seen by a doctor immediately. Sick workers or family members should inform their doctor of their contact with pigs. Some farms

recommend that all workers be vaccinated against the seasonal influenza virus. This requires the owner/operator to have a lenient sick leave policy. If an employee is forced to take vacation time or leave without pay, they may ignore this policy.

- Entering pork production facilities:
 - Procedure 1 — There is a demarcated “dirty” area with a shower where people have to undress, shower, and put on farm-provided clothes before entering the pig area. A Danish entry also may be employed, as described previously. Shower installation should be designed so that people have to go through the shower to the clean side to put on the clothes provided by the farm. After showering, no one is allowed to come back into the entrance or contaminated area.
 - Procedure 2 — There is a demarcated “dirty” area with a locked door where people undress and put on farm-provided clothes and boots before entering the clean farm areas. The use of the previously described Danish system should be considered.
- Clothing and boots used on the unit should be worn specifically on that unit and washed and cleaned on the unit itself.

B9. Worker Training and Abidance

With the assistance of a veterinarian, it is very important that protocols — developed in detail — cover all aspects of biosecurity to prevent diseases from entering or leaving the herd and to minimize the impact of those already present. The creation of detailed standard operating procedures (SOPs) clearly defines the procedures to be used to enhance biosecurity. However, the SOPs are of little value if the people who take care of the pigs do not believe in the concepts. The entire workforce has to believe in and abide by the SOPs to prevent diseases from entering the herd. The complete concept of biosecurity must become part of the work ethic and farm culture. This requires regular training and discussion. The most effective biosecurity efforts are on farms that have these meetings at least four times a year with all employees in attendance. An excellent training program needs to be developed whereby workers clearly understand:

- the purpose of SOPs for biosecurity,
- the risks associated with coming in contact with pigs outside of work, e.g., all types of livestock shows and agricultural exhibitions,
- how biosecurity enhances animal performance, minimizes disease, reduces death losses, reduces medication costs, and improves quality assurance of the pork chain,
- that biosecurity rules are non-negotiable,
- that willful neglect and ignoring of biosecurity rules will not be tolerated,
- that a monitoring method is in place to determine whether workers are abiding by the biosecurity procedures,
- how to conduct a regular checklist audit to monitor the practical implementation of the biosecurity procedures,
- how to look for signs of tampering or unauthorized entry to the pig production area and farmstead,
- how and where to report concerns or suspicious activities,
- how to recognize signs of disease in the herd, and
- where to promptly report any unusual signs of disease or unexplained deaths.

B10. Feed Delivery and Feed Storage

Because feed delivery trucks may be on several farms each day, they can be a serious risk for transmission of disease to a pig farm. In larger operations, dedicated feed delivery trucks are often required, but this is impractical

for smaller farms. Ideally, trucks delivering feed to a pig production unit should be able to unload the feed without entering the pig site. This procedure requires that all bulk bins and facilities storing bagged feed be on the inside edge of the pig site perimeter. Having the feed truck fill all bulk bins without entering the pig site is not practical on many pig farms because numerous bulk bins are located at different sites within the pig unit; some bins hold a small volume of feed; and several different diets are simultaneously used. Therefore, other procedures to minimize risk of disease transmission by the feed truck and driver must be used. The driver is always the greater risk and must not come in direct or indirect contact with the pigs.

Clean commercial feed truck. It is impossible for feed transport vehicles to avoid dirty roads and possible contamination. Generally, a feed delivery truck is not used on Sunday; thus, the best day for delivery of feed is Monday morning. You need to let the feed company know that before feed is delivered to your farm, you would like: (1) the interior of the feed truck cab to be cleaned and disinfected, (2) the outside of the feed truck to be washed and disinfected at least the night before feed is delivered to your farm, and (3) the first load of feed on the truck that day is delivered to your farm. During the winter months in cold climates, the delivery of feed in a clean and disinfected feed truck is challenging and difficult to accomplish. Most likely, smaller farms will have little clout with feed mill operations, and their biosecurity requests may be ignored.

Commercial feed truck driver. Upon arrival at the farm, the truck driver must follow certain biosecurity rules, such as:

- The truck driver must put plastic boots over his or her shoes before exiting the cab. Because plastic boots can easily tear, the farm should provide the truck driver with easily accessible external farm boots.
- If the truck driver must exit and return to the truck several times, the driver should wear farm boots and then a set of boot covers so when he/she re-enters the cab, boot covers are placed on the shoes or boots. This is only appropriate if the interior of the feed truck cab was cleaned and disinfected before leaving the feed mill and the driver has not been on another pig farm prior to arriving. This procedure can be frustrating for the driver when he/she is having trouble lining up the feed delivery auger with the bin opening. A common option is to have disposable floor mats in the truck. When the driver exits the site, the disposable floor mats are left in a designated trash container with the farm-specific boots and/or boot covers.

- The truck driver should be able to open and close the feed bin lid from the ground while outside of the perimeter fence. Opening the feed bin lid from the ground also enhances safety of the truck driver.
- Invoices are left in a designated area, most commonly in mailboxes attached to the bin leg or at the entry to the farm.
- The truck driver must not enter the office at the farm except for an emergency.

Farm-owned vehicle. If a farm-owned vehicle (truck, pickup, and trailer) is used to deliver feed to the farm, the vehicle must be thoroughly cleaned, washed, and disinfected prior to picking up the feed. The driver should avoid contact with other people involved with pigs, wear rubber boots when out of the vehicle, and wear boots and disposable coveralls when loading feed at the feed mill/distribution center. Prior to departing the feed mill/distribution center, the boots should be placed in a “dirty box” for cleaning and disinfection between loads.

Bagged feed. Bagged feed deliveries should be minimized to reduce the number of deliveries. Bags should be transported in a manner to prevent road contamination or in a separate compartment of the bulk truck. Bagged feed should be dropped in a designated storage area where the bags undergo disinfection prior to farm entry. Dirty, opened, or otherwise damaged bags should be rejected and sent back to the supplier. If the bag drop area is within the pig production site, the truck driver should follow the same biosecurity procedure as previously described. After the bags have been disinfected, the bags of feed or feed ingredients should be stored off the floor (e.g., on pallets) in a manner that will prevent contamination and access to rodents, birds, dogs, cats, and other wildlife. Opened bags should be placed in or emptied into barrels with tight lids. Materials or containers that have been used on another farm should never be allowed on the pig unit. Make sure water is not entering the storage area.

On-farm feed manufacturing. If feed is manufactured on the farm, feed ingredients and pre-mixes should be purchased from a reputable supplier with a recognized quality assurance system. Generally, corn and soybean meal are not identified as a frequent source of pathogen introduction. Ideally, feed ingredients and pre-mixes should be delivered to storage facilities located on the perimeter of the farm. Do not haul feed ingredients in a vehicle that is used to haul pigs or other livestock. Bagged ingredients should always arrive clean, sealed, and undamaged. Like bag feed, they should be rejected and returned if not in good order.

Bulk bins. Regularly emptying and cleaning bulk bins helps ensure they remain watertight and dry, and prevents the development and buildup of mold or bacteria in the bin. The opening and closing mechanism should ensure that the lid is tightly and securely held closed.

B11. Water Supply

- If water storage tanks are used, they must be clean and have a lid to prevent rats, mice, and birds from using or falling in the tanks.
- Make sure a regular cleaning schedule of water troughs and tanks is followed.
- If the water supply is from an on-farm well, test the water regularly for bacteria and contamination.
- If the water supply comes from surface water (river, stream, lake, pond, or shallow well), it should be filtered, treated, and routinely monitored to assure it meets potable municipality standards.
- Be sure the water supply system is secured with locks on wellheads, pump houses, and outdoor water storage tanks.
- If necessary, flush and disinfect water lines and drinkers.

B12. Air filtration

Preventing the spread of PRRSV within and among pig populations is a priority on pig farms. Pigs may become infected via exposure to PRRSV by any of several routes, including saliva, nasal secretions, urine, feces, intramuscular injections, vaginal, mammary gland secretions, semen, fomites (boots, coolers, shipping parcels, and vehicles), transport trucks, and aerosol. To reduce the risk of spreading PRRSV by aerosol, some pork producers have installed air filtration systems on their buildings such as boar studs, sow facilities, and growing-finishing buildings. Factors that influence whether an air filtration system is installed depend upon the individual producer’s budget, the location of the site (high pig density vs. low pig density), the level of acceptable risk, and the type of production system (breeding stock or commercial).

Filters have been installed either in the attic through insertion of filters into the ceiling inlets or in the form of a filter bank preceding the cool cell pad. If an air filtration system is installed in a building, all areas of the barn that could serve as potential air leaks need to be sealed. This includes cracks in the building and around windows and doors, shutters, and idle fans. In addition, double door entry/exit systems must be installed to prevent potentially contaminated air from entering the animal air space at high risk points, such as personnel entryways, live/dead animal load-out rooms, delivery

and disinfection rooms, etc. In addition to contacting a swine veterinarian and an agricultural engineer with experience in the design and management of an air filtration system for pig facilities, the following references discuss various aspects about air filtration systems: Dee et al. (2010), Groth (2008), Jordhal (2010), Mohr (2010), Pitkin et al., and Reicks (2006, 2008, 2009).

B13. Vehicles

Vehicles and their drivers that present a risk of transmitting diseases into a pig production unit include straight trucks, semitractors, semitrailers, pickups and trailers, cars, ATVs, motorcycles, farm tractors, livestock carts, farm equipment, etc. A biosecurity risk due to vehicles occurs when: (1) replacement gilts and boars are transported to the farm, (2) market pigs and cull sows are transported off the farm, (3) feed, bedding, equipment, pharmaceutical supplies, semen, etc., are delivered to the farm, (4) manure and dead animals are removed from the farm, (5) workers, outside maintenance personnel, veterinarians, consultants, sales people, visitors, and others arrive at the farm, and (6) vehicles taken off the farm are returned to the farm. The degree of risk depends on how recently the vehicle has been exposed to other pigs or livestock farms and if the pigs on the farm have direct or indirect contact with the vehicle. Biosecurity procedures for handling these vehicles are:

- All vehicles of visitors, consultants, workers, and owners should be kept outside the perimeter of the pig unit.
- The only vehicles and machinery allowed within the perimeter are those owned or completely controlled by the pig unit.
- Designate a cleaning area for pig unit vehicles and equipment that have been used off the farm, such as farm vehicles used to haul pigs and cull sows to market. Make sure these vehicles are cleaned, washed, and disinfected on a hard surface located outside the pig unit. Allow them to dry between each use. Particular attention should be paid to any part of the trailer or truck that pigs have contact with. It is also important to thoroughly clean and disinfect the tires, wheel arches, and underside of the vehicle. To prevent the workers from getting contaminated while cleaning the vehicle, they should wear protective clothing and boots that remain outside the farm perimeter. It is difficult to adequately clean and disinfect the interior of a truck/pickup cab but it should be kept as clean and dry as possible. Floor mats should be washed and disinfected along with the truck and trailer.

- Keep commercial feed delivery and livestock transport vehicles as far away as possible from the pigs and pig unit.
- Require livestock transport vehicles to be properly cleaned and disinfected before arriving on the farm.
- Inspect commercial pig haul vehicles before loading pigs. Contaminated trucks or trailers should be rejected and not allowed to load or back up to the load-out.

Cleaning and disinfecting livestock trucks and trailers. Proper cleaning and disinfection of vehicles used to transport live pigs is one of the key methods to prevent transmission of disease to a swine operation. In addition to commercial vehicles, farm vehicles hauling market pigs and cull sows need to be properly cleaned and disinfected prior to returning to the farm perimeter.

Truck and trailer wash facility. Ideally, the facility used to clean and disinfect vehicles should be enclosed, heated, and well lit. This type of facility design improves the quality of the washing procedure and may provide an opportunity to dry vehicles during winter months when freezing of the disinfectant greatly decreases its effectiveness.

B14. Equipment and Consumable Supplies

All equipment and consumable supplies brought into the pig operation should arrive clean and undamaged. Many farms bring supplies through a fumigation room or spray them with disinfectant at the entry point. The greatest risk that accompanies consumables is that they may have been delivered to another farm, returned, and then redistributed by the supply company. Likewise, the delivery driver poses significant risk if other pig farms are on the delivery route. It is wise to discuss this with the local delivery carrier. Possessing a proper location and facility where items enter the farm helps ensure biosecurity compliance. The physical structure to receive items entering the farm should be located on the fence perimeter (dirty side). A door allows access to the outside. All new equipment or consumable supplies are delivered to this structure. Consumable supplies (e.g., pharmaceutical products, heat lamp/light bulbs, artificial insemination supply containers, etc.) should be disinfected by hand. If possible, all of the new equipment (e.g., sort boards, pen partitions, wrenches, hammers, etc.) should be put in a solution of disinfectant. Some operations use fogging or fumigation devices to disinfect items. However, fogging does not always reach the entire area of the bottom of items unless the items are placed on woven wire shelves. In small operations, it may be best to deliver all consumables to the owner's

home where they can be inspected and disinfected prior to moving them into the pig facilities.

Many times, equipment and supplies brought into the pig operation by contract people providing a service to the unit are not new, and, in many cases, these tools frequently are used on other farms. Therefore, it should be mandatory that the service person's equipment and supplies be thoroughly cleaned before coming to the farm, and these tools pass through a disinfection room. It is a good idea for the farm to have some of the general tools needed by service personnel. Ideally, equipment used on another pig operation by a consultant or adviser (such as an ultrasound device or individual pig scale) should not be allowed into the pig operation.

Biosecurity procedures also need to be established for the following items used on the pig operation: notebooks, paper, pencils and pens, laptop computers, mobile telephones, wrist watches, cameras, etc. These items should be farm-dedicated equipment and supplies. In addition, the office and workers' accommodations should be kept clean and uncluttered.

B15. Farm Machinery and Equipment

Farm machinery and equipment can be a risk for transmitting disease to a pig operation, especially if the machinery and equipment were used outside of the pig operation. The following procedures will help prevent disease transmission:

- Avoid borrowing equipment (especially manure handling equipment) and vehicles from other farms.
- Avoid bringing farm machinery or equipment to the pig unit unless it is essential.
- Any equipment brought into the unit must be thoroughly cleaned and disinfected prior to entry. This procedure especially includes machinery used for manure and/or slurry handling.

B16. Bedding Material

- Store bedding so it is protected from the weather. Ideally, bedding storage also should prevent contamination by vermin.
- Straw should come from a source that has not exposed the straw to livestock. Purchase bedding material from suppliers that have dedicated trucks and/or trailers that only haul bedding.

B17. Hygiene and Sanitation of Buildings

- Rubbish should be promptly and correctly removed from the pig unit. If a garbage pickup service is used, the rubbish containers should be placed outside the clean/dirty perimeter as far from the pigs as feasible.

- Buildings, barns, equipment, clothing, and footwear that pigs come in contact with should be routinely cleaned and disinfected. Disinfection should be accomplished only after thorough cleaning. Cold temperatures and organic material reduce the effectiveness of all disinfectants. The chemical agents commonly used require several minutes of contact with disease-producing agents to be effective. Cleaning and disinfection procedures should include:

- removal of all bedding, manure, and feed. These items contain a high level of contamination and interfere with effective cleaning and disinfection.
- thorough cleaning of the under-surfaces of equipment. If possible, removable equipment should be taken out and cleaned separately.
- turning over feeders after the inner surfaces are cleaned so all water drains from them and the floor can be sanitized.
- thorough cleaning with hot, soapy water, preferably through a pressure wash.
- rinsing with clear water to remove all residues.
- correct application of an approved disinfectant to everything pigs come in contact with, including the under-surfaces of equipment.
- an adequate drying period for the area before the introduction of new animals. Consult a veterinarian for the specific recommendations pertaining to the situation.

- Many infectious agents survive in wet, dark places. Sunlight and drying will destroy many bacteria and viruses, but not all.
- Some infectious agents will survive in feces and mucus on boots and clothing so clothing and footwear should be routinely laundered or cleaned.
- Clean and disinfect any equipment that has been used on sick animals prior to use on healthy herd mates.

B18. Boot Baths

Boot baths have been shown to be practically useless in eliminating bacterial contamination. To provide any protection, boots must be free of organic matter and spend more than five minutes in the disinfectant solution. Some pig farm personnel do use boot baths in an attempt to prevent mechanical transmission of pathogens among groups of pigs. However, maintenance of boot baths in most facilities is poor. Most boot baths are grossly contaminated with organic matter (fecal material). Workers commonly avoid stepping into the

boot baths, or quickly step through the boot bath without stopping to clean their boots. Two studies at Purdue University (Amass et al., 2000 and 2001) have shown that simply stepping through or standing in a boot bath without first removing all visible organic debris from boots does not provide effective boot disinfection. Virkon® S is a suitable disinfectant for use in boot baths when used appropriately. A suggested procedure is:

- Make sure the boots do not leak.
- Have a clean/dirty demarcation at each boot bath site.
- Use a boot bath that contains 1 percent Virkon® S.
- Have the people wash the organic material off their boots with a water hose and brush prior to stepping in the boot bath. This allows the disinfectant to be changed less frequently and costs less.
- Step in the boot bath for a few seconds (count to 10).

Proper disinfection has been accomplished after manure-free boots were soaked in Roccal®-D Plus for five minutes. But, removing all visible manure from boots and then soaking boots in a clean disinfectant boot bath for at least five minutes is not practical on most farms. The use of a “soaking boots bath” might be an option in areas containing valuable breeding stock or sick animals. A soaking boots station could contain a wash area for scrubbing and cleaning off manure and a disinfectant soaking bath containing spare boots. Workers remove contaminated boots, clean the boots, place them in the tub of disinfectant, and put on the spare boots that had been soaking in the disinfectant.

An alternative to the boot bath is: (1) Boots worn outdoors are removed at the entry door for the pig facility. Some farms have a bench for workers to sit on while removing their boots. The workers swing their legs over the bench to put on indoor footwear. The area under the bench is enclosed to prevent dirt from entering the building. (2) Outdoor boots are stored outdoors. (3) Boots to be worn indoors are immediately available inside the door. (4) Indoor walkways are cleaned daily. (5) Boots worn indoors are washed at the end of each day in a location that has a large drain, detergent, scrub brush, disinfectant, a pressurized water spray, and a boot drying rack. (6) Boots worn outdoors are washed, disinfected, placed on a drying rack, and kept in an appropriate storage area away from the pig facilities at the end of each day. The storage area used for boots worn outdoors may need to be heated during the winter months.

B19. Dead Pig Postmortem and Disposal

Pork producers need to seriously consider developing a plan to deal with postmortem examinations and disposal of dead pigs. If a postmortem will be performed on the farm, an area outside of the farm perimeter should be established. This procedure allows a veterinarian who may not have been away from pigs to perform the postmortem examination.

The method used for disposal of dead pigs and afterbirth can create a biosecurity hazard. Dead pigs and afterbirth must be disposed of in a manner to prevent the attraction of wild animals, birds, and insects. Excreted body fluids must be cleaned up, and the area cleaned and disinfected. Because states are continuing to modify their environmental regulations and the availability of rendering services continues to shrink, pork producers need to contact the appropriate state agency (agricultural and/or environmental) to determine what methods can be used to routinely dispose of dead animals and afterbirth. The methods include burial, rendering, composting, and incineration. When a pig dies, it needs to be disposed of in a prompt and correct manner. *Table 3* indicates the advantages and disadvantages of various swine mortality disposal methods.

B20. Wild Mammals, Birds, Parasites, and Pets

Preventing birds, rodents, pets, and other animals from coming in contact with the pigs will be impossible when housing the herd outdoors. However, you can do some things to make the farm less desirable to these creatures. Examples include keeping the unit clean and tidy by controlling the vegetation/weed growth within and surrounding the pig area; immediately cleaning up spilled feed; discarding rubbish and debris in a timely manner; and promptly removing dead animals. The insect population can be lessened by spraying and eliminating areas with standing water.

- **Rodents (rats, mice).** Rodents can transmit swine diseases such as leptospirosis, trichinosis, toxoplasmosis, erysipelas, swine dysentery, and others. Mice and rats can spread diseases from contaminated areas to uncontaminated areas via their droppings, feet, fur, urine, saliva, or blood. For example, mice may walk through infected manure and then contaminate the food and water of healthy animals several hundred feet away, or take a disease to nearby uninfected barns. A large rodent population represents a significant amount of feed wastage. One rat can eat ½ pound of feed per week and contaminate about 10 times the volume of feed eaten. Rats often travel long distances and are a significant bio-exclusion and bio-containment risk. Rodents also

Table 3. Advantages and disadvantages of swine mortality disposal methods (modified from Harper and Estienne, 2009)

<i>Method</i>	<i>Item is an advantage (+) or disadvantage (-)</i>	
Burial	Prompt burial gets dead stock out of public view.	(+)
	Prompt burial coverage prevents odor, flies, and scavengers.	(+)
	Poor or delayed coverage can result in odor, flies, and scavengers.	(-)
	Burial pits can collect rainwater.	(-)
	Burial potentially results in pollutants going into the soil; thus, environmentally sensitive locations are not acceptable for burial.	(-)
	Depending on burial location, groundwater could be contaminated. Proximity to water sources, wetlands, wells, shallow water tables, and bedrock are important considerations.	(-)
	States may require permits for the burial of waste materials, including animals.	(-)
	Burial pits can be difficult to dig in winter.	(-)
Rendering	Rendering converts animal mortality into useful byproducts.	(+)
	Prompt transport to rendering plants removes dead stock from the farm.	(+)
	The collection area for dead animals should be located away from the pig unit.	(+)
	The collection point and associated equipment used to transport dead animals to the collection point needs to be cleaned and disinfected after every use. If cleaning is done by farm workers, cleaning should be done at the end of the day so workers do not need to re-enter the farm or buildings that day.	(+)
	Rendering trucks are a serious risk for a breakdown in biosecurity. There should be a clear demarcation between the farm access and the collection service access. Ideally, the rendering vehicle should not be allowed to come closer than 1 mile from the pig unit. Contact with the driver and farm personnel should always be avoided.	(+)
	Some states only have a few rendering plants that process dead stock. Thus, some pork producers do not have access to a rendering plant.	(-)
	Some rendering plants charge fees for accepting carcasses.	(-)
	Vehicles and personnel traveling to and from the farm and rendering plant can compromise biosecurity.	(-)
	Storage of dead hogs in “dead boxes” or other methods prior to being picked up by the rendering truck can cause odor and attract flies and scavengers unless refrigerated.	(-)
Composting	Proper composting generates minimal odor, fly, or scavenger problems.	(+)
	Prompt composting gets dead stock out of public view.	(+)
	Proper composting has low potential for pollution and produces a final product that can improve soil tilth and fertility.	(+)
	On-farm composting is considered biosecure.	(+)
	A readily available supply of carbon-rich bulking material such as sawdust, ground cornstalks, or other suitable material is required.	(-)
	Some initial capital cost is necessary for construction of composting facilities.	(-)
	Poorly managed compost units (inadequate bulking material, delayed carcass coverage, etc.) will result in odors and attract flies and scavengers.	(-)
Incineration	Prompt incineration gets dead stock out of public view.	(+)
	Modern incinerators reduce carcasses to ash and are biosecure.	(+)
	Older, less efficient incinerators may generate smoke and odor. Many environmental agencies are reluctant to permit burning of carcasses because of serious problems with air pollution.	(-)
	Modern incinerators have large capital costs and fuel requirements of 1 to 2 gallons per hour.	(-)
	State law may require that incinerators be equipped with an “afterburner” for pollution control.	(-)
	State law may require a separate Department of Environmental Quality permit for on-farm incinerators.	(-)



Figure 5. Feral pigs (Rouhe and Sytsma, 2007; Hutton et al., 2006)

may chew the insulation off of wires, causing a fire hazard. Biosecurity cannot be assured if rodents are tolerated in or around swine facilities. All pig farms should have an active rodent control and monitoring system in place. To control rodents, identify and routinely bait places where rodents could potentially den in storage areas or barns.

- Inspect buildings and feed storage areas for evidence of rodents, such as droppings and nests.
 - Identify their source of food and prevent their access to it.
 - Destroy their denning places and block off any small holes to prevent them from re-entering.
 - Eliminate hiding areas around barns and storage facilities. Consider installing a 10-foot area of 1 inch rock around buildings and removing all vegetation close to building entrances. Rodents do not like crossing wide open areas.
 - Use traps or bait stations placed 10 to 20 feet apart to catch rodents.
 - Use tamper-resistant bait stations to protect farm pets, especially dogs, from rodent poison.
 - Search for dead rodents and dispose of them appropriately. Do not touch them with bare hands.
 - Prevent more rodents from coming on the farm by maintaining a clean and regularly inspected facility.
- **Predator and scavenger animals.** Predator animals that might need to be controlled on the pig farm are wild dogs, foxes, coyotes, badgers, raccoons, opossums, and weasels. Coyotes are wild canines with dog-like features. They are well-adapted to populated areas and are not strangers to farms, fields, and woods. Coyotes are less likely to attack livestock

where wild game such as rabbits, squirrels, and mice are plentiful. How dead livestock are handled may enhance a farm's predator population and encourage predatory attack of swine housed outdoors. Predators may carry disease-causing agents (leptospirosis and others) so they should be kept out of areas where swine are pastured or housed.

- **Feral and wild pigs.** Feral swine (Figure 5) are defined as free-roaming animals that are not being held under domestic management or confinement. Feral pigs come from several sources and include released or escaped domestic swine and the truly wild European boar. When free-roaming in North America (Figure 6), all are included in the term “feral swine,” as are hybrids of the two types. Although morphologically distinct, both the feral swine and European wild swine are recognized as *Sus scrofa*. Feral swine are highly mobile disease reservoirs and can carry at least 30 important viral and bacterial diseases in addition to a minimum of 37 parasites that can affect people, pets, livestock, and wildlife. Feral swine carry brucellosis and pseudorabies, which have been eradicated from domestic U.S. swine. Feral swine are one of the greatest risks to domestic swine because reintroduction of either of these diseases will lead to farm depopulation.
- **Birds.** House sparrows, starlings, pigeons, and swallows commonly inhabit barns on livestock farms. Large numbers of birds in and around swine facilities can cause damage and unsanitary working conditions. Because birds consume and contaminate feed and water, they can potentially transmit diseases to swine. Birds are known to mechanically transmit transmissible gastroenteritis (TGE) virus to pigs, especially pigs housed outdoors. Avian tuberculosis is frequently transmitted to outdoor pigs. Infected slaughter pigs are condemned, causing the packer and producer significant economic losses. Not only

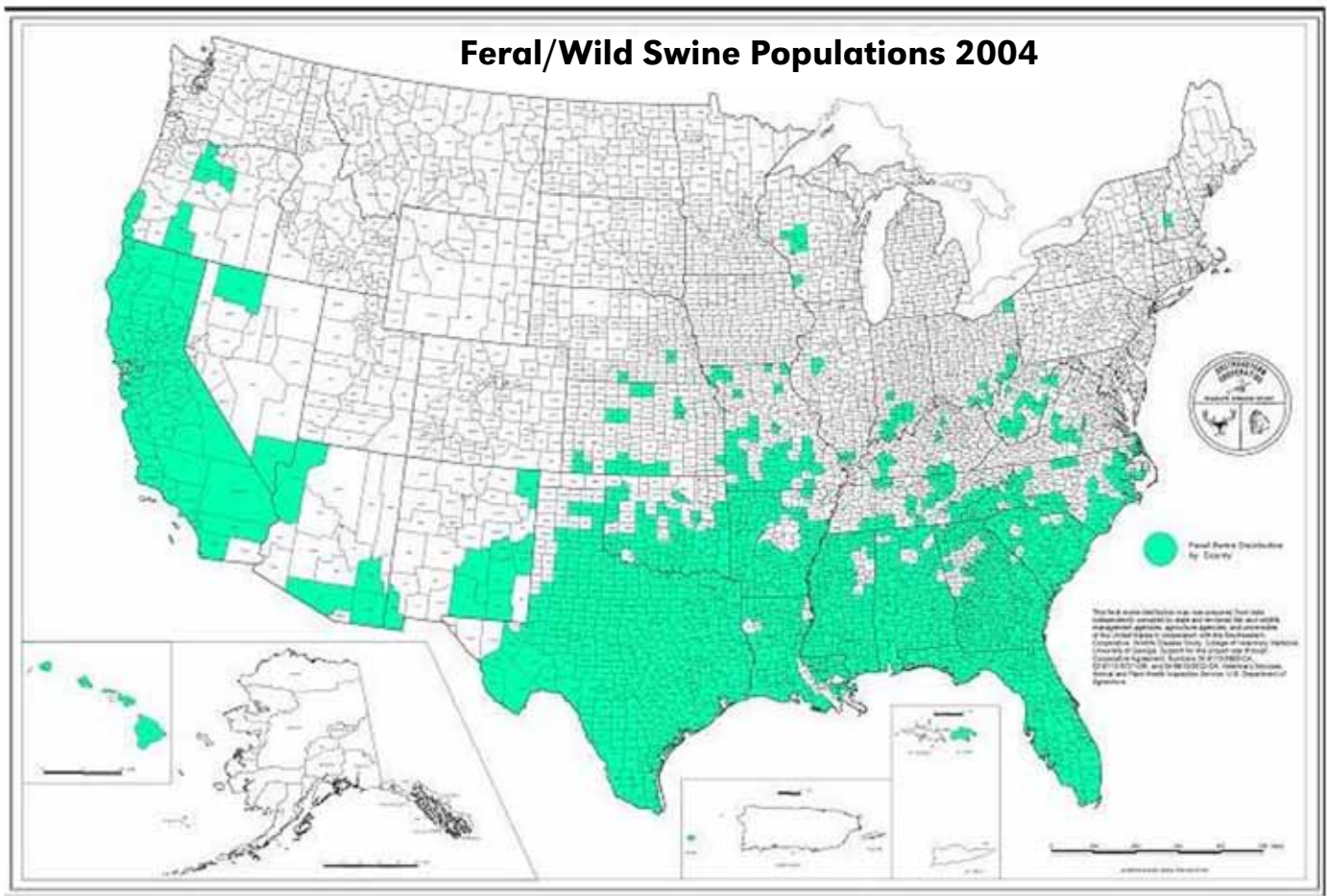


Figure 6. Distribution of feral pigs in United States (Southeastern Cooperative Wildlife Disease Center Study, 2004)

can birds spread disease onto healthy farms, they also can be an expensive nuisance. A starling will eat 50 percent of its body weight in grain each day. Nests that are made in barns close to the heat of a light fixture or faulty wiring can be a fire hazard. Accumulated bird droppings can corrode equipment. The insulation of a building can be destroyed by birds. Before beginning a bird control program, you should be familiar with the laws protecting birds. The nature of a particular bird species determines which methods to use for controlling problems the birds cause. To reduce the exposure of pigs to birds and their droppings, first evaluate the current presence of birds on the farm.

- Identify the species of birds contributing to the problem.
- Identify places on the farm where birds like to nest, bathe, and perch.
- Inspect the farm for places where there are lots of bird droppings.

- Observe whether birds perch on or above the pigs.
- Observe whether birds bathe in pig water troughs.

The following are options for deterring birds. However, use of these methods is no guarantee that all birds will stay off the farmstead.

- Install bird screening to prevent birds from accessing barns.
- Ensure lids are kept on feeders and bulk bins.
- If needed, clean out water troughs and feed troughs daily.
- If pigs are housed outdoors, keep them away from ponds where birds congregate.
- Destroy nests and eggs of nuisance birds.
- Thin stands of trees where starlings roost.
- Promptly clean up spilled feed.

- Discourage migrating flocks of birds from stopping at your farm.
 - Play recordings of distress calls.
 - Blow whistles that make an irritating sound.
 - Use visual detractors.
 - Install reflectors.
 - Attract raptors like red-tailed hawks.
- **Parasites (flies, mites, mosquitoes, lice, ticks, worms).** All pig farms should control internal and external parasites. All incoming replacement pigs, unless specifically free, should receive two treatments, two weeks apart, with external and internal parasiticides. Fecal samples should be monitored from each production area on a quarterly basis to determine the presence of internal parasites. Further refinement of the deworming program is based on the results of these examinations. An effective fly and mosquito control program should be implemented. Mosquito and mite bites can reduce carcass value due to trim loss at slaughter.
 - **Dogs and Cats (pets or feral).** Dogs can transmit leptospirosis but are most often a biosecurity risk if they travel to different farms. *Toxoplasma gondii* is a protozoan (single-celled) parasite found in muscle and other tissues of many warm-blooded animals, including pigs and people. Cats and other felids are the only hosts in which the parasite can complete its entire life cycle, and the only animals that excrete the environmentally resistant and infectious stage called the oocyst (“eggs”) in the feces. Cats may shed more than 10 million oocysts per day for 3 to 10 days after infection. Pigs become infected when they accidentally ingest oocysts in soil or water or eat tissues of rodents, wildlife, or meat containing cysts. Because it takes only one oocyst to infect a pig, protection of pigs from environmental contamination, contamination of feed, and transport of oocysts on boots is vital to control. Risk analysis of management factors associated with positive pigs showed that infection correlated with the presence of infected juvenile cats (sources of oocysts) and *T. gondii* infected mice.

B21. Loading/Unloading Chute and Load-Out Area

Loading and unloading pigs is most likely one of the most common ways to bring disease into a minimal disease herd. The loading/unloading chute and entire load-out area is a serious biosecurity risk for pathogens to enter the farm. Some suggestions for minimizing the risk of diseases entering the farm at the load-out area:

- The loading/unloading chute and loading area should be sited on the perimeter of the pig unit and away from pig buildings and lots. It has been suggested that the loading area should be 65 to 165 feet from any area containing pigs. Thus, commercial vehicles used to haul livestock do not enter the farm.
- The only vehicles allowed to travel the road that connects the production unit to the loading/unloading area are farm vehicles.
- Design or redesign the loading/unloading area so that:
 - the livestock transport driver can easily and continuously see the loading chute from the left side of the transport vehicle when backing up to the chute.
 - there is easy control of pig movement and the pigs cannot return to the building or loading area.
 - there is no physical contact between farm workers and the livestock transport vehicle and the transport driver. If the pigs are loaded directly out of a building, the farm workers should not exit the building; plus, the transport driver should never enter the building.
 - the transport driver can load the pigs without any assistance from farm personnel.
 - the area can be easily cleaned and disinfected after each use. If cleaning is done by farm workers, cleaning should be done at the end of the day so workers do not need to re-enter the farm or buildings that day.
 - the cleaning water drains away from the unit.
- The vehicle used to remove animals from the farm should always arrive clean, disinfected, and empty.
- The transport driver should provide and wear clean clothes/coveralls and boots. This requires the driver to maintain a clean box and a dirty box for boots and outerwear used during the pig transfers. If clean and disinfected boots are not provided for the livestock transport driver, provide a bucket of clean water, cleaning brush, and disinfectant (Roccal-D Plus) “soaking boot bath.” After the driver has appropriately cleaned the boots (all manure removed), have the driver place the cleaned boots in the disinfectant boot bath for five minutes. Renew the boot dip solution every time the loading bay is used. During the winter months, provide the driver with appropriate clothing and boots.
- Ideally, the loading/unloading chute should be enclosed, bird-proof, have a lockable door on the truck end, and a means to be heated after washing to

prevent freezing during the winter months. Freezing temperatures reduce the effectiveness of disinfectants.

- Workers need to have discipline in accomplishing loading area biosecurity. The development and posting of the protocol for use and washing the loading area is advisable.
- A clean-dirty line should be established for the driver and farm personnel based on the biosecurity methods employed.
- Bump chutes or off-site loading/unloading areas are used by some production units to further separate the over-the-road hauler from the farm. This requires shuttling the pigs to the loading area.
- Do not use the load-out area to hold dead animals for pick up by the dead animal truck.

B22. Manure Disposal and Waste Management

Many important diseases and parasites can be transmitted by manure or urine, either directly or indirectly, via contaminated clothing and equipment. The pathogens responsible can be classified into four major types: bacterial (e.g., salmonella, {ileitis, dysentery}, *E. coli*); viral (e.g., PRRS, TGE, hog cholera, foot and mouth disease); protozoal (e.g., coccidiosis); and parasitic (e.g., round worms). Fungal diseases, such as aspergillosis, are less likely to be shed in manure, but may be present in contaminated bedding and litter. Use of sawdust/shavings can be a threat from bacteria. To reduce the risk of spreading disease via manure or urine, prevent contamination of feed and water.

- Plan and install a manure system to prevent environmental contamination and comply with your state's acceptable agricultural practices.
- If pigs are housed outdoors, maintain clean water troughs, water bowls, and feed troughs.
- Use separate shovels, forks, and skidsteer or loader bucket for handling manure and feed operations.
- Remove manure frequently from barns, yards, and holding areas to prevent completion of life cycles by intestinal parasites and flies.
- Control the fly population. Methods include fly-paper, parasitic wasps, and insecticides (baits and sprays).
- Store manure so it is inaccessible to pigs, especially young pigs. The most popular method for storing manure is the deep pit under the floor. If a lagoon is used, the pipe used to carry the manure should be rodent-proof to prevent rodents from entering the building.

- Prevent runoff of adult manure to young pig rearing areas or contamination of feed fed to young pigs.
- If slurry is spread onto fields or pasture, pigs should be kept off the land for at least three weeks.

Because production costs and manure value have increased, more producers are contracting professional handlers and haulers. However, hiring custom labor and equipment creates the risk of introducing disease. Improper sanitation procedures between farms can potentially spread a number of diseases. Ensure manure management equipment is properly maintained and cleaned, especially if being used at several farm sites. Wash all exterior surfaces of manure handling equipment; check that they are visibly free of organic matter before arriving on a farm. The operator should not enter the farm buildings and should not come in close contact with farm personnel unless they remain outside the perimeter until an overnight and shower. Ogejo and Maguire (2010) prepared a very useful publication on nutrient management for small farms.

B23. Herd Health Management

- Employ veterinary services to help implement herd health programs.
- Immediately report any unusual signs of illness to your veterinarian.
- As recommended by your veterinarian, vaccinate pigs against certain diseases.
- The health of all pigs should be monitored daily.
- All sick animals should be treated immediately.
- It is inevitable that in every swine production system, animals will become ill or injured and euthanasia will be necessary. Euthanasia is defined as a humane death without pain or distress. Because it is usually impossible or impracticable for the veterinarian to be available for all on-farm euthanasia, producers often need to perform humane euthanasia. A publication (On Farm Euthanasia of Swine — Recommendations for Producers) that describes the various approved methods to humanely euthanize pigs can be obtained from the National Pork Board's website as indicated in the reference section. Euthanasia should be performed when:
 - The animal has an inadequate or minimal prospect for improvement after two days of intensive care and treatment.
 - The animal is severely injured, non-ambulatory, and unable to recover.

- Any animal that is immobilized with a body condition score of one on a scale of 1 to 5 (Karriker et al., 2006).

B24. Facility Maintenance

It is always a biosecurity risk to allow service personnel into a pig unit to perform repairs. Therefore, good quality materials and equipment should be used in pig buildings. The equipment should be easy to wash and long-lasting. Other factors related to facility maintenance and biosecurity are:

- Off-farm maintenance personnel must be educated on the importance of biosecurity and follow all required farm biosecurity protocols.
- Any necessary tools or materials brought in to fix facilities should be new. If used equipment is required, it needs to be thoroughly cleaned and disinfected before entering the facility.
- Replace fly bait and trapping tape routinely and when necessary. Knock down and residual sprays are needed during summer months. Follow EPA, state, and local requirements. If the pigs are in contact with the insecticides, use only those approved for livestock preparations and follow withdrawal regulations.
- Be aware of hiding and denning places for rodents.
- Inspect and repair holes in buildings to prevent rodents from living in them.
- Remove piles of boards, wood, trash, or other junk from the interior and exterior of buildings.
- Keep farm grounds mowed and free of brush, weeds, or high grass.
- Check for rain and stormwater damage.
- Identify and correct manure runoff problems.
- Remove standing water, which can be a breeding ground for mosquitoes.
- If pigs are housed outdoors, check fences along farm and pasture perimeters. Damaged fences should be repaired. If appropriate, use 4-strand high tensile electric fences wherever possible.
- Make changes to bird detractors or other control methods as needed.
- Replace bird netting where needed and change bird detractors so that birds do not ignore their presence.

B25. Maintenance of Biosecurity Program

- A critical review of the measures in place to prevent entry of disease and spread of disease within and between herds should be conducted regularly.

- Constantly be aware of any diseases in the area and adjust the biosecurity program to meet specific needs.
- Train new workers so they clearly understand the concepts of biosecurity and its implementation on the farm.
- The success of a biosecurity and farm security plan is strongly influenced by the quality and the quantity of communication among all people involved with the farm and pig operation. It is important to hold regular meetings (such as quarterly or twice per year) that are convenient for everyone involved with the pork operation. A meeting involving everyone indicates the importance of biosecurity and security of all farm enterprises. Provide a setting in which everyone feels free to ask questions or mention concerns about the current biosecurity and security procedures. They need to clearly understand that teamwork is the key to a successful biosecurity and farm security plan.
- Be an excellent neighbor by visiting with your neighbors and respecting their biosecurity practices. In addition, make sure your neighbors are aware of your security and biosecurity practices.

C. Farm Security

A small- and medium-sized farm with a pork operation is diversified. These farms also have crops, forage, and, many times, other livestock species. Both security and biosecurity procedures are important for minimizing the risk of intentional or unintentional introduction of pathogens to a pig farm. Security of a pig farm can be compromised in three ways. First, intruders could use forced entry to break into a pig farm. Second, someone could use false identification to enter the farm. Third, an employee or other person who already has access to the farm could intentionally harm the farm and pigs, or steal pigs. Because threats to farm security can be varied and numerous, security of the entire farm presents unique challenges for producers. Even so, farms that do not have a functional security plan don't have a viable biosecurity plan. Some basic measures can be instituted at the farm level to help increase the security of the pork producer's farm. Sandy Amass at Purdue University prepared an excellent publication for The National Pork Board titled *Security: Guide for Pork Producers*. The 14-page publication can be used to understand risks to farm security and create a farm-specific security program. Due to the unique nature of different agricultural production operations, not all recommendations presented in the publication are appropriate for all operations. The publication can be obtained by contacting the National Pork Board (Telephone: 515-223-

2600 or downloading a copy from its website: <http://www.pork.org/filelibrary/Biosecurity/SecurityBook.pdf>.

C1. Develop Farm Security Plan

- Develop or update a risk management plan and share it with employees, family, and local law enforcement.
- Identify areas or activities where threats might occur and increase security in those areas.
- Consult with experts when you are developing your plan. Include your veterinarian, crop consultant, extension educator, university scientist, and state Department of Agriculture experts.
- Plan how to respond to threats or tampering with your animals, crops, equipment, chemicals, supplies, and energy and water sources.
- Update your plan regularly. Make sure you have contact names and telephone numbers. Include how you will notify appropriate local law enforcement officials, as well as federal and state agriculture officials.
- All security plans should make it as difficult as possible for intruders to enter both during and after business hours. Locked entrance gates, routine lock changes, locking all doors during non-working hours, security cameras, perimeter fences, and many other techniques will thwart unwanted intruders. Neither employees nor visitors should be allowed to bring cell phones, cameras, or video equipment into the facility.
- Develop a biosecurity plan that includes requirements for quarantining new stock, cleaning and disinfection procedures, and disposal of fallen stock.

C2. Training for Emergency

- Make an emergency preparation and response plan that includes:
 - current emergency phone numbers (fire, police, hospital, veterinarian) posted for easy access,
 - information that may be needed by first responders (location of farm, type of chemicals, location of all chemicals),
 - person to whom employees should report security problems,
 - plan for evacuating animals and people from buildings,
 - prioritization list of supplies, equipment, and facilities needed to maintain function of the farm,
 - current roster of employees,
 - name of person to handle news media, and

- frequent safety and security meetings with all employees and family members who work or live on the farm.

- Train all people involved with the livestock operation to recognize and report clinical signs of foreign animal diseases. Clinical signs are:
 - unusually high number of sick animals,
 - unusually high number of deaths,
 - blisters or vesicles on the animals' snouts or feet,
 - large number of lame animals,
 - large number of animals with fever,
 - large number of animals not eating,
 - large number of animals that do not want to stand,
 - discoloration of the ears, bellies, rumps, legs, or tails, and
 - animals act uncoordinated or show other neurological signs.

C3. Access and Barriers to Farm

- Limit farm entry to one gated road. Keep the gate locked when not in use.
- Distribute keys to employees on an as-needed basis and verify when they are returned. Stamp all keys with "Do Not Duplicate." This procedure can prevent unauthorized copying of keys. Swap padlocks from different areas when an employee leaves or is terminated. This will prevent you from having to re-key or purchase new locks. Changing entrance locks several times a year helps assure that non-employees have less access to the farm.
- To help prevent unauthorized intruders, have an occupied home or office at the road leading to the farm. Place buzzers on gates to alert you when a vehicle or person has crossed the farm entrance.
- Minimize the number of places where people can easily hide around the farm. Trim trees and shrubs that could provide concealment to criminals or block visibility of security patrols.
- Use fencing to secure the farm perimeter and maintain fences in good repair.
- Minimize the number of entrances to restricted areas within the farm. Keep restricted areas locked when not in use.
- Secure hazardous materials, energy sources, and production inputs like feed and nutrients.

- Be sure your water supply system is secured with locks on wellheads and pump houses, water storage tanks, or other water supplies, and identify alternative water sources as backups.
- Install entry prevention devices on exterior ladders, protecting the ladders from unauthorized use and preventing access to the top of bulk storage bins.
- Make sure that the areas surrounding and within farm buildings are well lit.
- Install backup lighting for emergencies.
- Install alarms, motion detection lights, cameras, and/or other appropriate security equipment as needed. Use electronic sensors around sensitive areas during times when no one should be working at these sites.
- Install locks on all doors and seal or lock all windows and vents on buildings that contain critical inventories and equipment.
- Lock all vehicles parked outside at night or during times of owner and employee absence. Keep the keys in a secure area. Frequently inspect trucks, tractors, and other farm equipment for signs of tampering.
- Use deadbolt locks on doors with a minimum 1.5-inch throw.
- Padlock entry and discharge points of exterior liquid tanks (aboveground and belowground) and all other storage areas when not in use.
- Keep padlocks locked on hasps while not in use.
- Keep windows, doors, and storage areas locked when rooms are not in use. Metal doors are more secure than wooden doors.
- Restrict access to computer data systems, secure online communications, and safeguard them with virus protection. Back up all files at least weekly and securely store backup files off-site.

C4. Hazardous Materials

- Maintain an up-to-date inventory of anhydrous ammonia, ammonium nitrate, bulk urea, pesticides, herbicides, disinfectants, drugs, and other hazardous materials. Immediately investigate missing materials or other irregularities. Notify law enforcement authorities of any unresolved or serious problems.
- Purchase hazardous materials from known, licensed, or permitted suppliers.
- Make sure that all storage areas for hazardous chemicals and drugs are secure and reasonably isolated. Make sure these facilities are built and vented according to national and state codes. Supervise employees with access to these materials.

- Secure chemical containers inside buildings, whether or not they are empty.

C5. Visitors and Personnel

- Have only one (clearly marked) entryway for use by visitors.
- Designate a specific area for visitor parking, and post signs to inform all visitors of the rules.
- Require all visitors who do not provide a regular, known service to the farm to check in with a designated farm representative.
- Have a separate policy for essential visitors such as consultants, service people, and health professionals that are both (1) known to you, and (2) have visited the farm on a regular basis, and understand and respect the biosecurity protocols.
- Maintain a record of non-service visitor names, companies, arrival times, departure times, and purpose of the visits. Have unknown, non-service adult visitors provide an authorized, valid reason for entry and proof of identity (valid driver's license).
- Develop a system that easily identifies visitors. Explain disease prevention procedure to visitors.
- Do not allow unknown individuals, including delivery personnel, drivers, customers, government officials, reporters, sales people, contract providers, service support, and others, to have unlimited access to the premises (e.g., storage areas for gasoline, fertilizer, and pesticides; locker rooms; computer areas; or areas where keys are kept). Clearly mark these areas with a "No Visitors without Escort" sign. Non-service visitors are escorted at all times.
- Screen prospective employees, check with references, and consider regular background checks on all employees.

C6. Hiring New Employees

- Require all applicants to completely fill out a written job application, including references from all previous employment. Straightforward questions should be asked, such as: Has the applicant ever changed his or her name? Is he/she currently working for an organization that is paying the applicant to collect information about your farm? Does the applicant intend to use any equipment that can collect audio, video, or still photographs? (Establish a policy that either prohibits their use or requires that all such tools be declared upon being hired and that they cannot be used without prior consent.) Require that these questions be answered in writing, and ensure the application is signed.

- Conduct thorough background checks on all prospective employees (seasonal, temporary, contract, and volunteers) to verify previous employment references, addresses, telephone numbers, qualifications, and employee demeanor. You will need to check state and federal regulations before performing vehicle or criminal background checks. Find out from previous employers if their previous experience was undercover or legitimate.
- Check immigration status with the U.S. Immigration and Naturalization Service.
- Have a written security policy to show prospective employees.
- Obtain permission to perform drug and alcohol testing prior to and during employment.
- Require that all new hires sign an animal care agreement. Train all employees in animal handling and specify that any employee who observes or receives information about animal mistreatment must immediately report that information to a supervisor. Abuse of animals is cause for dismissal and potential criminal charges.
- Have new employees sign and date a written security/biosecurity policy in the presence of a witness.
- Have a probationary period of 30 to 90 days.

C7. Employee Training

- Start all new employees on a day shift.
- Provide all new employees with direct supervision.
- Mandate that all new employees become certified in the National Pork Board's Pork Quality Assurance Plus program. Have a zero tolerance policy for workplace violence and animal abuse. Employees are required to promptly report such incidents.
- Train employees on how to periodically conduct random security checks along the perimeter of all fields and pastures for signs of suspicious activity or unauthorized entry.
- Train employees how to report any suspicious activity or any unauthorized personnel on or near the facility to designated contact or backup contact people. Post telephone numbers by each telephone for on-farm contacts and emergency contacts (fire department and law enforcement).
- Train employees that part of their daily job responsibility is to be alert for signs of possible tampering with crops, livestock, supplies, equipment, and facilities.

- Train employees and family members to watch for sick animals, including wildlife, especially birds, or unusual changes in the appearance of crops.
- Tell employees they can't bring smoked or uncooked pork products into the farm.

C8. Employee Monitoring

- Appropriately supervise employees at all levels, especially new hires.
- Make employees aware of who belongs on the farm and who doesn't.
- Use time clocks to monitor employee arrival and departure times.
- Require employees to notify management if they will be arriving early or staying late.
- Require employees to notify management if they are leaving the premises at an abnormal time.
- Restrict personal items allowed on the farm.
- Notify employees that contents of lockers, bags, and vehicles can be inspected when on farm property for safety and security reasons.
- Notify employees that taking or removing farm property from work is theft.
- Delegating specific responsibilities to key employees without overlap also prevents theft. For example, only a specified employee should have access to certain medications, the tool room, farm vehicle keys, etc.
- Monitor employees for suspicious activities:
 - staying unusually late after work,
 - arriving unusually early,
 - accessing or attempting to access files, information, or areas of the farm outside their area of responsibility,
 - removing documents from the facility,
 - asking questions about sensitive subjects,
 - bringing cameras or cell phones to work,
 - not wearing clothing provided by the farm,
 - wearing personal belts and using personal pens,
 - signs of tampering with equipment or facilities,
 - suspicious materials or devices, and
 - misplaced equipment.

C9. Community Involvement

- Get to know your neighbors.
- Initiate or join a local community “Crime Watch” program.
- Do not make known when you will be away from your facility, except for the person designated to take care of the facility while you are gone.

C10. Law Enforcement Involvement

- Talk with your local or county sheriff or state police office to find out if your farm or facility is subject to any specific risks based on its locality. If your farm is at risk:
 - arrange to have a security survey of your facility by local law enforcement or your insurance agent,
 - request that local law enforcement routinely conduct patrols along your facility’s perimeter, and
 - immediately report any unusual or suspicious persons, vehicles, or activity to local law enforcement.

This publication has been peer reviewed.

Disclaimer

Reference to commercial products or trade names is made with the understanding that no discrimination is intended of those not mentioned and no endorsement by University of Nebraska–Lincoln Extension is implied for those mentioned.

UNL Extension publications are available online at <http://extension.unl.edu/publications>.

References

- Amass, S. F. 2002. Biosecurity: What does it all mean? Proceedings 29th Annual Meeting American Association of Swine Veterinarians, Kansas City, Missouri, pp 279-281.
- Amass, S. F., and L. K. Clark. 1999. Biosecurity considerations for pork production units. *Swine Health and Production* 7:217-228.
- Amass, S. F., D. Ragland, and P. Spicer. 2001. Evaluation of the efficacy of a peroxygen compound, Virkon® S, as a boot bath disinfectant. *Journal of Swine Health and Production* 9:121-123.
- Amass, S. F., B. D. Vyverberg, D. Ragland, C. A. Dowell, C. D. Anderson, J. H. Stover, and D. J. Beaudry. 2000. Evaluating the efficacy of boot baths in biosecurity protocols. *Journal of Swine Health and Production* 8:169-173.
- APHIS. 2008. Biosecurity on U.S. swine sites. Veterinary Services, Centers for Epidemiology and Animal Health. United States Department of Agriculture, Animal and Plant Health Inspection Service, Fort Collins, CO. http://www.aphis.usda.gov/animal_health/nahms/swine/downloads/swine2006/Swine2006_is_biosecurity.pdf. Accessed on October 26, 2010.
- Baker, R. B. 2009. Building functional biosecurity plans. *National Hog Farmer* (October 15). <http://nationalhogfarmer.com/health-diseases/disease-prevention/1015-building-functional-biosecurity-plans/>. Accessed on November 18, 2010.
- Barcelo, J., and E. Marco. 2003. On farm biosecurity. <http://www.adiveter.com/ftp/articles/articulo31.pdf>. Accessed on October 28, 2010.
- Brittingham, M. C., and S. T. Falker. 1999. Controlling birds around farm buildings. *Wildlife Damage Control* 16. Agricultural Research and Cooperative Extension. Pennsylvania State University, University Park, PA. <http://pubs.cas.psu.edu/FreePubs/pdfs/uh126.pdf>. Accessed on October 27, 2010.
- Casal, J., A. De Manuel, E. Mateu, and M. Martin. 2007. Biosecurity measures on swine farms in Spain: Perceptions by farmers and their relationship to current on-farm measures. *Preventive Veterinary Medicine* 82:138-150.
- Coffey, R. D., G. R. Parker, and K. M. Laurent. 1999. Assessing sow body condition. Cooperative Extension Service. University of Kentucky. ASC-158. <http://www.ca.uky.edu/agc/pubs/asc/asc158/asc158.pdf>. Accessed on July 19, 2011.
- Corrigan, R. M. 2000. An overview of rodent control for commercial pork production operations. *Swine Health and Pork Safety*, Volume 2, Number 6. National Pork Producers Council. Des Moines, IA. <http://www.pork.org/filelibrary/Factsheets/Swine%20Health/rodentcntrl04648.pdf>. Accessed on October 27, 2010.
- Dalrymple, J., and P. Innes. 2004. Biosecurity fundamentals for visitors to livestock facilities. Factsheet 04-003. Ontario Ministry of Agriculture, Food and Rural Affairs, Guelph, Ontario (Canada). <http://www.omafra.gov.on.ca/english/livestock/vet/facts/04-003.htm>. Accessed on October 26, 2010.
- Dee, S. A. 1999. An overview of methods for measuring the impact of sanitation procedures for swine transport vehicles. *Swine Health Fact Sheet Volume 1. Number 2*. National Pork Producers Council. Des Moines, Iowa. <http://www.pork.org/filelibrary/Factsheets/Swine%20Health/transport sanitation04532.pdf>. Accessed on October 8, 2010.
- Dee, S. A. 2003. Biosecurity: a critical review of today's practices. Proceedings 30th Annual Meeting American Association of Swine Veterinarians. Orlando, Florida, pp 451-455.
- Dee, S., S. Otake, and J. Deen. 2010. Use of a production region model to assess the efficacy of various air filtration systems for preventing airborne transmission of porcine reproductive and respiratory syndrome virus and mycoplasma hyopneumoniae: Results from a 2-year study. *Virus Research* 154:177-184.
- Exner, R. 2007. Managing for herd health in alternative swine systems: A guide. Practical Farmers of Iowa and Iowa State University Extension, Ames, IA. http://www.pfi.iastate.edu/OFR/Livestock/Herd_Health/Guide_Introduction.pdf. Accessed on November 16, 2010.
- Fitzgerald, R. F., K. J. Stalder, P. M. Dixon, A. K. Johnson, L. A. Kariker, and G. F. Jones. 2009. The accuracy and repeatability of sow body condition scoring. *The Professional Animal Scientist* 25:415-425. <http://pas.fass.org/content/25/4/415.full.pdf+html>. Accessed on July 19, 2011.
- Gamble, H. R., and S. Patton. 2000. Toxoplasma. *Pork Facts-Pork Safety* #04494. National Pork Producers Council. Des Moines, Iowa. <http://www.pork.org/filelibrary/Factsheets/PorkSafety/toxoplasma04494.pdf>. Accessed on October 8, 2010.
- Georgia Department of Agriculture. 2005. Routine Biosecurity Measures for On-site Farm Visits or Other Livestock Concentration Points. Office of the State Veterinarian and Assistant Commissioner of Animal Industry. http://www.agrosecurity.uga.edu/annexes/Annex04_Biosecurity.pdf. Accessed on October 26, 2010.
- Groth, D. 2008. Experience with boar stud air filtration systems. Proceedings 39th Annual Meeting American Association of Swine Veterinarians. San Diego, California, pp 9-13.
- Harper, A. F., and M. J. Estienne. 2009. Composting for mortality disposal on hog farms. ID 442-305. Virginia Cooperative Extension. Virginia Polytechnic and State University, Blacksburg, VA. <http://pubs.ext.vt.edu/414/414-020/414-020.html>. Accessed on November 8, 2010.

- Holtkamp, D., H. Lin, C. Wang, D. Polson, and C. Mowrer. 2011. PADRAP: Production animal disease risk assessment program. Proceedings 42nd Annual Meeting American Association of Swine Veterinarians. Phoenix, AZ, pp 521-524.
- Hutchinson, L., F. Jayarao, R. Van Saun, and D. Wolfgang. Biosecurity risk assessment for farm visitors and exhibitions. Veterinary Science Information. College of Agricultural Sciences. Pennsylvania State University, University Park, PA. <http://vbs.psu.edu/extension/resources/pdf/biosecurity/risk-assessment.pdf>. Accessed on October 26, 2010.
- Hutton, T., T. DeLiberto, S. Owen, and B. Morrison. 2006. Disease risk associated with increasing feral swine numbers and distribution in the United States. Report for the Midwest Association of Fish and Wildlife Agencies, Wildlife and Fish Health Committee, July 11, 2006. www.michigan.gov/documents/emergingdiseases/Hutton_Pig_Paper_177657_7.doc. Accessed on October 27, 2010.
- Jordahl, R. 2010. Filtering out disease. PORK (May 1, 2010). http://208.86.102.4/directories.asp?pgID=780&ed_id=9311. Accessed on July 21, 2011.
- Karriker, L., L. Layman, A. Ramirez, D. Miller, K. Stalder, P. Holden, and A. DeMirjyn. 2006. Sow body condition scoring guidelines poster. In: National Hog Farmer blueprint. No. 42 in a series. National Hog Farmer. Prism Business Media. Overland Park, KS 66212-2216. 51:Insert. <http://nationalhogfarmer.com/posters/BodyConditionScorePoster.pdf>. Accessed on July 19, 2011.
- Keener, H., D. Elwell, and T. Mescher. 1997. Composting swine mortality - Principles and Operation. Ohio State University Extension. The Ohio State University, Columbus, OH. Fact Sheet AEX-711-97. <http://ohioline.osu.edu/aex-fact/0711.html>. Accessed on November 8, 2010.
- Laanen, M., S. Ribbens, D. Maes, and J. Dewulf. 2011. The link between biosecurity and production and treatment characteristics in pig herds. SafePork 2011. Proceedings 9th International Conference on the Epidemiology and Control of Biological, Chemical and Physical Hazards in Pigs and Pork. Maastricht, The Netherlands, pp 141-144. http://www.safepork.org/upload/SP026_PROCEEDINGSBOOK_A4_290611_DEF_lowres.pdf. Accessed on August 4, 2011.
- Losinger, W. C. 2005. Economic impacts of reduced pork production associated with the diagnosis of *Actinobacillus pleuropneumoniae* on grower/finisher swine operations in the United States. Preventive Veterinary Medicine 68:(2-4):181-193.
- Maes, D., H. Deluyker, M. Verdonck, F. Castryck, C. Miry, B. Vrijens, W. Verbeke, J. Viaene, and A. De Kruif. 1999. Effect of vaccination against *Mycoplasma hyopneumoniae* in pig herds with an all-in/all-out production system. Vaccine 17(9-10):1024-1034.
- Maes, D., H. Nauwynck, T. Rijsselaere, B. Mateusen, P. Vyt, A. de Kruif, and A. Van Soom. 2008. Diseases in swine transmitted by artificial insemination: An overview. Theriogenology 70:1337-1345.
- Mohr, P. 2010. Upgrade barn air for better hog health. The Farmer. Minnesota NewsWatch, p 8. <http://fntvets.com/wp-content/uploads/2010/11/Upgrade-Barn-For-Better-Barn-Health1.pdf>. Accessed on July 21, 2011.
- Moore, C. 1992. Biosecurity and minimal disease herds. In: R.C. Tubbs and A.D. Leman (Eds). Veterinary Clinics of North America: Food Animal Practice. W.B. Saunders Co., Philadelphia. Volume 8(3):461-474.
- Morse, D. E. 2009. Composting animal mortalities. Agricultural Development and Financial Assistance Division, Minnesota Department of Agriculture. Saint Paul, MN. <http://www.mda.state.mn.us/news/publications/animals/compostguide.pdf>. Accessed on November 9, 2010.
- Mullan, B. P., G. T. Davies, and R. S. Cutler. 1994. Simulation of the economic impact of transmissible gastroenteritis on commercial pig production in Australia. Australian Veterinary Journal 71(5):151-154.
- National Pork Board. 2002a. Security: Guide for pork producers. <http://www.pork.org/filelibrary/Biosecurity/SecurityBook.pdf>. Accessed on October 8, 2010.
- National Pork Board. 2002b. Biosecurity: Guide for pork producers. <http://www.pork.org/filelibrary/Biosecurity/BiosecurityBook.pdf>. Accessed on October 8, 2010.
- National Pork Board. 2002c. Biosecurity considerations for pigs housed outdoors or with access to outdoor lots. <http://www.pork.org/filelibrary/Biosecurity/InTheWarAgainst.pdf>. Accessed on October 8, 2010.
- National Pork Board. 2009. On farm euthanasia of swine—Recommendations for Producer. <http://www.pork.org/filelibrary/Factsheets/Well-Being/FINAL%20-%20EuthanasiabookletSINGLES.pdf>. Accessed on October 8, 2010.
- Neumann, E. J., J. B. Kliebenstein, C. D. Johnson, J. W. Mabry, E. J. Bush, A. H. Seitziner, A. L. Green, and J. J. Zimmerman. 2005. Assessment of the economic impact of porcine reproductive and respiratory syndrome on swine production in the United States. Journal of the American Veterinary Medical Association 227:385-392.
- Nold, R., D. R. Smith, and M. C. Brumm. 2004. Preventing the spread of animal diseases—Application for youth livestock shows. NebGuide 1541. University of Nebraska—Lincoln Extension. Lincoln, NE.
- Nold, R., and D. R. Smith. 2007. Biosecurity: Protecting your health and the health of your animals. NebGuide G1694. University of Nebraska—Lincoln Extension. Lincoln, NE. <http://www.ianrpubs.unl.edu/epublic/live/g1694/build/g1694.pdf>. Accessed on November 1, 2010.

- Ogejo, J. A., and R. Maguire. 2010. Nutrient management for small farms. ID 442-305. Virginia Cooperative Extension. Virginia Polytechnic and State University, Blacksburg, VA. <http://www.pubs.ext.vt.edu/442/442-305/442-305.html>. Accessed on November 3, 2010.
- Petznick, T. 2011. Biosecurity non-negotiables: Breeding stock. Proceedings 42nd Annual Meeting American Association of Swine Veterinarians. Phoenix, Arizona. pp 525-526.
- Pitkin, A., S. Otake, and S. Dee. Biosecurity protocols for the prevention of spread of porcine reproductive and respiratory syndrome virus. Swine Disease Eradication Center. University of Minnesota College of Veterinary Medicine. Saint Paul, MN (17 pages). http://www.aasv.org/aasv/PRRSV_BiosecurityManual.pdf. Accessed on July 21, 2011.
- Price, C., and L. Carpenter-Boggs. 2008. On-farm composting of large animal mortalities. EB2031E. Washington State University Extension. Washington State University, Pullman, WA. <http://cru.cahe.wsu.edu/CEPublications/eb2031e/eb2031e.pdf>. Accessed on November 9, 2010.
- Pritchard, G., I. Dennis, and J. Waddilove. 2005. Biosecurity: reducing disease risks to pig breeding herds. In Practice 27:230-237.
- Regula G., C. A. Lichtensteiger, N. E. Mateus-Pinilla, G. Scherba, G. Y. Miller, and R. M. Weigel. 2000. Comparison of serologic testing and slaughter evaluation for assessing the effects of subclinical infection on growth in pigs. Journal of the American Veterinary Medical Association 217(6):888-895.
- Reicks, D. L. 2006. Alternative filters for boars. Proceedings 33rd Annual Meeting of Allen D. Leman Swine Conference. University of Minnesota College of Veterinary Medicine. Veterinary Outreach Program. River Centre, Saint Paul, Minnesota. 33:99-100.
- Reicks, D. L. 2008. Field experience with air filtration: Results and costs. Proceedings 35th Annual Meeting of Allen D. Leman Swine Conference. University of Minnesota College of Veterinary Medicine. Veterinary Outreach Program. River Centre, Saint Paul, Minnesota. 35:42-43.
- Reicks, D. L. 2009. Application of air filtration systems in swine operations. Advances in Pork Production 20:163-171. <http://www.prairieswine.com/pdf/39205.pdf>. Accessed on July 21, 2011.
- Rouhe, A., and M. Sytsma. 2007. Feral swine action plan for Oregon. Environmental Science and Resources, Portland State University, Portland, OR. <http://www.clr.pdx.edu/docs/feral%20swine%20action%20plan.pdf>. Accessed on October 27, 2010.
- Romagosa, A., and P. Davies. 2010. Evaluation of “downtime” recommendations to prevent introduction of selected swine pathogens into herds. Pre-Conference Seminar Implementing Biosecurity and Disease Elimination. 41st Annual Meeting American Association of Swine Veterinarians. Omaha, Nebraska, pp 5-10.
- Southeastern Cooperative Wildlife Disease Center Study. 2004. Feral/wild swine populations in 2004. A map prepared in cooperation with the emergency programs, Veterinary Services, Animal and Plant Health Inspection Service, United States Department of Agriculture. University of Georgia, Athens, GA. http://www.uga.edu/scwds/dist_maps/swine04.html. Accessed on October 27, 2010.
- Thompson, R. 2000. Transportation cleaning and disinfection. Swine Health Fact Sheet Volume 2. Number 2. National Pork Producers Council. Des Moines, Iowa. <http://www.pork.org/filelibrary/Factsheets/Swine%20Health/transcleaninganddisinfect04533.pdf>. Accessed on October 8, 2010.
- USDA. 2006. Pre-harvest security guidelines and checklist. United States Department of Agriculture. Washington, DC. http://www.usda.gov/documents/PreHarvestSecurity_final.pdf. Accessed on November 1, 2010.
- Vantassel, S., S. Hyngnstrom, and D. Ferraro. 2006. Bait stations for controlling rats and mice. NebGuide G1646. University of Nebraska–Lincoln Extension. Lincoln, NE. <http://www.ianrpubs.unl.edu/epublic/live/g1646/build/g1646.pdf>. Accessed on October 27, 2010.
- Vantassel, S., S. Hyngnstrom, and D. Ferraro. 2005. Controlling house mice. NebGuide G1105. University of Nebraska–Lincoln Extension. Lincoln, NE. <http://www.ianrpubs.unl.edu/epublic/live/g1105/build/g1105.pdf>. Accessed on October 27, 2010.
- Vantassel, S. M., S. E. Hyngnstrom, and D. M. Ferraro. 2007. Controlling rats. NebGuide G1737. University of Nebraska–Lincoln Extension. Lincoln, NE. <http://www.ianrpubs.unl.edu/epublic/live/g1737/build/g1737.pdf>. Accessed on October 27, 2010.
- Vantassel, S. M., S. E. Hyngnstrom, D. M. Ferraro, and R. R. Stowell. 2009. Rodent-proof construction: Structural. NebGuide G1530. University of Nebraska–Lincoln Extension. Lincoln, NE. <http://www.ianrpubs.unl.edu/epublic/live/g1530/build/g1530.pdf>. Accessed on October 27, 2010.
- Vantassel, S. M., S. E. Hyngnstrom, and D. M. Ferraro. 2010. Rodent-proof construction: Drains and feeding equipment. NebGuide G2017. University of Nebraska–Lincoln Extension. Lincoln, NE. <http://www.ianrpubs.unl.edu/epublic/live/g2017/build/g2017.pdf>. Accessed on October 27, 2010.
- Verbeck, J., and C. Johnson. 2011. PRRSV biosecurity non-negotiables. Proceedings 42nd Annual Meeting American Association of Swine Veterinarians. Phoenix, Arizona, pp 527-528.

- **Waste Protocols**

Waste Handling Protocols

1. Overview

A pig farm has a number of waste streams. These streams need to be separated at source in order for the additional income streams to be generated. Such streams are:

- Mortalities
- Municipal solid waste
- Animal waste and bedding
- Bottom ash from the heating system
- Coal dust
- Diesel spills from the generators
- Generator parts and old oil

a) Mortalities

Mortalities occur on a daily basis and for that reason, all houses must be checked at least twice a day to check for mortalities and to remove such mortalities.

The removal of mortalities from site occurs on a daily basis and must comply with certain bio-security standards i.e.

- All mortalities must be transported in either an enclosed container, or
- Transported in enclosed plastic bags; or
- Transported in an enclosed truck.

No transportation of mortalities may occur in any open truck/vehicle from the premises at any time.

Mortalities held overnight must be refrigerated and may not be left in the open where it may attract flies or cause any disease amongst the other animals.

b) Municipal Solid Waste

Because of staff on site and having offices on site, results in the generation of municipal general waste.

The farm must have specific bins on-site for specific types of waste and waste must initially be sorted into its different categories before being placed in their respective bins. Separation at source is the operative word where the different types of waste must go into their respective bins i.e.

- GREEN - bio-degradable waste
- YELLOW - glass and glass bottles
- RED - plastic and plastic containers
- BLACK - paper; cardboard and other paper waste
- BLUE - metals

Once separated these different waste streams must be discarded at sites specifically catering for specific types of waste i.e. bottle banks for glass; bio-degradable items to the municipal waste site; plastic to plastic recyclers etc.

Municipal Solid Waste must be removed from the site at least once a week and the waste container must be sanitised to prevent the breeding of flies in and around the houses.

c) Bottom Ash from the heating system

Bottom ash is only generated when the houses require additional heat during cold spells. The generation of bottom ash is deemed as-and-when as the heating system does not run continuously.

Bottom ash, when it becomes available is taken by a third party and used in the production of a specific fertiliser for the cultivation of berries.

Bottom ash removed from the farm is done in an enclosed truck so as not to pollute the environment through which it is travelling.

d) Coal dust

Coal dust lying on the ground can cause acid leachate when allowed to come in contact with water and oxygen. This in turn can pollute underground water resources.

In general, the farm orders only washed coal for the heating system but coal dust still occurs. Such coal dust must be removed from the bunker areas where the coal is kept and must be taken for proper disposal at a registered landfill site.

Coal dust may not be left on the bare ground as it poses a pollution problem.

Fine coal dust not being used in the heating system must be collected and removed from the site before a new consignment is brought on site.

e) Diesel spills from a generator

All farms, especially those operating high end environmentally controlled houses, have generation systems as backup units for instances where the power supply to the farm fails. Such generation units run on diesel and diesel needs to be replaced regularly. Many farms also have a diesel donkey system [on-site storage facility] for the storage of bulk diesel in a bund area.

A spill may occur while refilling diesel at a generator and such spill must be cleaned up and the polluted soil removed.

All farms operating a generation system must have a spill kit [bin; scoop; plastic bags and rags] available on-site, right at the generation unit for speedy clean-ups.

All refuelling points must be supplied with a drip tray system that will contain and hold any spill or diesel excess.

f) Generator parts and old used oil

The emergency generation units require regular servicing. Such servicing entails the changing of filters and some parts as well as the changing of oil.

Used part no longer required must be returned to the supplier for processing while used oil must be taken to either a waste oil collection point or a registered garage which is willing to take in the oil for onward handling and disposal.

Waste oil may not be discarded into the receiving environment nor may filters and parts be set alight and allowed to burn.

g) Waste handling/removal frequencies

Different waste streams require attention at different times and intervals.

Item	Daily	Weekly	Per Cycle	As & When
Mortality check and removal	X			
Mortality uplifting & removal	X			
Municipal solid waste removal		X		

Bedding replacement			X	
Heating System bottom ash				X
Coal dust			X	
Generator diesel spills				X
Generator parts & old oil				X

NOTE: The handling of waste and its safe disposal may change from time to time. Just like an EMPr, the handling protocols may require adjustments from time to time. Such changes must be recorded and records kept for audit purposes.
These protocols are in support of the approved EMPr.

- **Odour Protocols**

Odour Protocols

Odours may emanate from a pig farm operation due to,

- (a) animal waste [manure] and
- (b) urine
- (c) water leaks causing waste to generate odours and smells
- (d) mortalities

Odours and smells in the farm operations are controlled and effectively eliminated through specific actions in management:

- **Water leaks**

The houses are constantly checked to detect water leaks that may cause bedding and waste from becoming water logged and generating odours and smells. By eliminating water leaks a major cause of odour generation is solved.

- **Roof leaks**

As with water leaks, water ingress because of damaged roofs may cause the generation of odours and smells to increase. As such it is important that the house structure be checked regularly for damage; roof damage from hail; rust damage and high wind damage.

- **Ventilation**

Ventilation is the easiest method of keeping animal waste and urine dry within the house. The intended environmentally controlled houses has a constant airflow from motorised fans positioned throughout the building.

- **Waste stockpiles**

Waste stockpiles [manure and bedding] lying in the open is a major source of odour as rain causes the waste to ferment / decay and release smells. As such no stockpiling is allowed on site as it also poses a health risk to the animals. Waste removed from the houses are immediately removed from site and not allowed to lie around in the open.

- **Mortalities**

Decaying mortalities can be a major source of odours and smells and as such all houses are checked at least twice a day for any sick or dead animals, and such are removed immediately. Dead animals are kept refrigerated until removed by agreement to a third party end user, usually as additional feed to a lion or crocodile farm or to be rendered into animal feed.

No dead animals are allowed to lie outside in the open to decay / rot away.

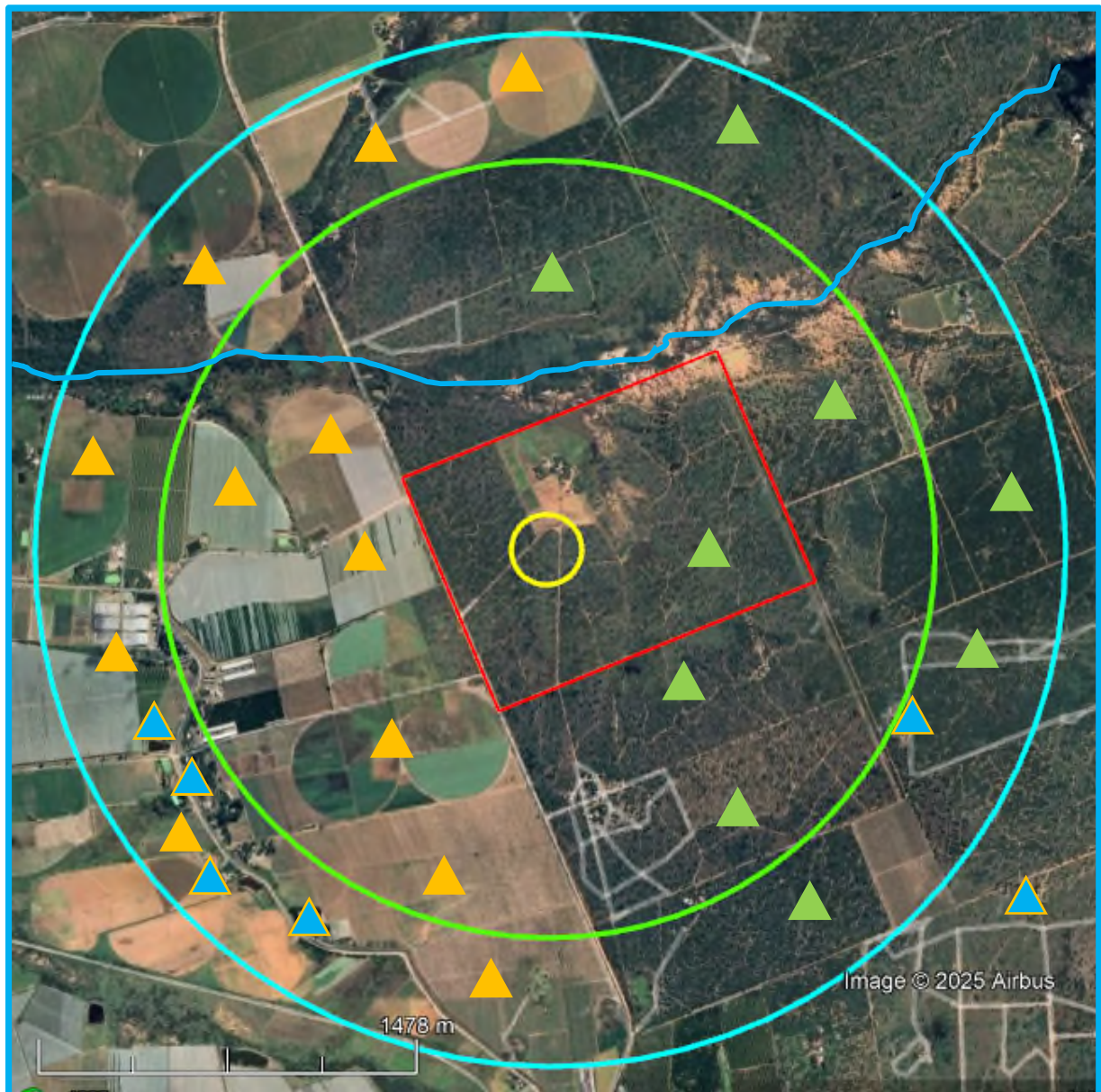
- **Impact Assessment Spreadsheet**

Impact Assessment Matrix

POTENTIAL ENVIRONMENTAL IMPACT	ACTIVITY	ENVIRONMENTAL SIGNIFICANCE BEFORE MITIGATION								CUM	STATUS	RECOMMENDED MITIGATION MEASURES / REMARKS	ENVIRONMENTAL SIGNIFICANCE AFTER MITIGATION							
		M	D	S	I	R	P	TOTAL	SS				M	D	S	I	R	P	TOTAL	SS
TOPOGRAPHY																				
Dust	roads either delivering or collecting of stock	6	5	2	2	3	5	90		90	Negative	Reduction in speed. Combining deliveries into one truck	4	4	2	1	1	3	36	
Noise - Vehicles	Vehicle noise from deliveries / collections	4	5	2	1	3	3	45		45	Negative	Reduce speed and delivery consolidations	4	3	2	1	2	3	36	
Noise - Operations	Generator of the piggery running during load shedding	6	4	2	2	4	4	72		72	Negative	As and when regular ESKOM power becomes avaiable the generator will no longer be required	2	3	2	2	1	1	10	
Smells / odours	Smells from the piggery may be unpleasant into the adjoining environment											Strict cleaning protocols are in place, with all manure processed along with waste streams from the operation, fed into the biosystem. Regular disinfection will eliminate smells developing								
		6	3	2	2	3	4	64		64	Negative		4	3	2	1	2	3	36	
Flies	Flies breeding due to wet manure and stock piles of waste on site	8	3	2	2	3	3	54		54	Negative	Remove manure, process with waste streams, no stock piles allowed.	4	3	2	1	2	2	24	
Unwanted Elements into the area	The need for labour at the abattoir will bring in more "unwanted" elements to the area											The area is hard pressed for employment and the abattoir will provide much need employment and training opportunities								
		4	4	2	2	1	2	26		26	Negative		2	4	2	1	1	1	10	
Road damage	Vehicles will damage the roads											Restrict speed, utilise tarred road and not gravel where possible, consolidate deliveries to one vehicle where possible and avoid gravel roads as far as possible								
		6	3	3	3	3	3	54		54	Negative		4	3	3	2	2	2	28	
Animal Health & Wellbeing	Reducing stress and strain on chickens being processed											Slaughter to comply with regulations and directives. Increase ventilation, dim lights result in a calmer atmosphere								
		4	4	1	1	2	4	48		48	Negative		2	3	1	1	3	1	10	
Water	Abstration of water from borehole may impact the water table of the area	6	4	2	3	3	3	54		54	Negative	Agriculture, water is strictly controlled and no excessive water is taken for any other purposes than the operation.	2	3	2	2	2	2	22	
Animal Waste	Can attract and breed fleis and cause bad smells											Waste is scraped and sprayed down daily and the area disinfected and cleaned on a regular basis in rder to minimised odours and flies								
		6	4	3	2	3	4	72		72	Negative		2	3	3	2	2	2	24	
Employment	Employment is important for the local economy											Employment of local labour is preferred as the area is short of opportunities, however due to automation there will be no large workforce.								
		4	3	2	0	3	3	36		36	Positive		4	3	2	0	2	3	33	
Food	Food security	8	3	3	1	3	3	54		54	Positive	Additional fresh meat to the market and a better supply in the food security chain of the country	6	4	4	0	3	2	34	
Coal	No use of coal on site	8	3	2	3	4	4	80		80	Negative	Provide a bunker with a concrete floor and roof to stop water ingress	2	3	1	2	3	2	22	
Bottom Ash	No bottom ash	6	3	2	3	3	3	51		51	Negative	Ash to be containerised and disposed at an approved landfill site	2	2	2	1	2	2	18	

- **Map(s)**

Pig Farm – Sensitivity Areas / Areas of note around the intended development






RED – the farm area

YELLOW – The area of development

GREEN – 1.5km radius from the development area

BLUE – 2.0km radius from the development area

BLUE LINE – drainage line towards the west and the Crocodile River

-  - Natural bush and undisturbed vegetation
-  - Agricultural activities
-  - Residential dwelling

SENSITIVITY MAP [1250m from centre point]



The 1250 m radius line and developments / residential properties within or near the 1.25km zone – marked in RED

The 1250 m / 1.25 km radius marker

There are two properties located towards the south and south east of the proposed development at the 1250 m perimeter line.

The only house / dwelling within the 1250 m perimeter circle is a dwelling belonging to the applicant / developer.

Terrestrial Bio-diversity [VERY HIGH RATING]

