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ALIEN AND INVASIVE PLANT CONTROL AND MANAGEMENT PLAN FOR THE PROPOSED GOEDGEVONDEN EMP AMENDMENT, NEAR OGIES, MPUMALANGA PROVINCE

Prepared for

Jacana Environmentals cc

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LIST OF ACRONYMS

AIP	Alien and Invasive Plant
AIPCP	Alien and Invasive Plant Control and Management Plan
CARA	Conservation of Agricultural Resources Act, 1983 [Act No. 43 of 1983]
CBs	Control Blocks
DFFE	Department of Forestry, Fisheries and the Environment
ECO	Environmental Control Officer
EMP	Environmental Management Plan
GGV	Goedgevonden
GN	Government Notice
GPS	Global Positioning System
ha	Hectares
MNCA	Mpumalanga Nature Conservation Act, 1998 [Act No. 10 of 1998]
MRA	Mining Right Area
MUs	Management Units
NEMA	National Environmental Management Act, 1998 [Act No. 107 of 1998]
NEMBA	National Environmental Management Biodiversity Act, 2004 [Act No. 10 of 2004]
NWA	National Water Act, 1998 [Act No. 36 of 1998]
OFT	Oogiesfontein
OHSA	Occupational Health and Safety Act, 1993 Act No. 85 of 1993)
PAs	Priority Areas
PPE	Personal Protective Equipment
STS	Scientific Terrestrial Services

GLOSSARY OF TERMS

Most definitions are based on terms and concepts elaborated by Richardson *et* al. (2011), Hui and Richardson (2017), Wilson *et* al. (2017) and Skowno et al. (2019), with consideration to their applicability in the South African context, especially South African legislation [notably the National Environmental Management: Biodiversity Act, 2004 (Act No. 10 of 2004), and the associated Alien and Invasive Species Regulations, 2020].

Alien species (syn. exotic species; non-native)	A species that is present in a region outside its natural range due to human actions (intentional or accidental) that have enabled it to overcome biogeographic barriers.
Biome - as per Mucina and Rutherford (2006); after Low and Rebelo (1998).	A broad ecological spatial unit representing major life zones of large natural areas – defined mainly by vegetation structure, climate and major large-scale disturbance factors (such as fires).
Category 1a Listed Invasive Species	Invasive species contemplated in Regulation 2 [GN number R.1020: Alien and Invasive Species Regulations (2020)]. "(1) Category 1a Listed Invasive Species are those species listed as such by notice in terms of section 70(1)(a) of the Act as species which must be combatted or eradicated."
Category 1b Listed Invasive Species	Invasive species contemplated in Regulation 3 [GN number R.1020: Alien and Invasive Species Regulations (2020)]. "(1) Category 1b Listed Invasive Species are those species listed as such by notice in terms of section 70(1)(a) of the Act as species which must be controlled."
Category 2 Listed Invasive Species	Invasive species contemplated in Regulation 4 [GN number R.1020: Alien and Invasive Species Regulations (2020)]. "(1) Category 2 Listed Invasive Species are those species listed by notice in terms of section 70(1)(a) of the Act as species which require a permit to carry out a restricted activity within an area specified in the Notice or an area specified in the permit, as the case may be."
Category 3 Listed Invasive Species	Invasive species contemplated in Regulation 5 [GN number R.1020: Alien and Invasive Species Regulations (2020)]. "(1) Category 3 Listed Invasive Species are species that are listed by notice in terms of section 70(1)(a) of the Act, as species which are subject to exemptions in terms of section 71(3) and prohibitions in terms of section 71A of Act, as specified in the Notice."
Degradation	The many human-caused processes that drive the decline or loss in biodiversity, ecosystem functions or ecosystem services in any terrestrial and associated aquatic ecosystems.
Disturbance	A temporal change, either regular or irregular (uncertain), in the environmental conditions that can trigger population fluctuations and secondary succession. Disturbance is an important driver of biological invasions.
Driver (ecological)	A driver is any natural or human-induced factor that directly or indirectly causes a change in ecosystem. A direct driver clearly influences ecosystem processes, where indirect driver influences ecosystem processes through altering one or more direct drivers.
Habitat (as per the definition in NEMBA)	A place where a species or ecological community naturally occurs.
Indigenous vegetation (as per the definition in NEMA)	Vegetation occurring naturally within a defined area, regardless of the level of alien infestation and where the topsoil has not been lawfully disturbed during the preceding ten years.
Invasive species	Alien species that sustain self-replacing populations over several life cycles, produce reproductive offspring, often in very large numbers at considerable distances from the parent and/or site of introduction, and have the potential to spread over long distances.

Listed alien species	All alien species that are regulated in South Africa under the National Environmental Management: Biodiversity Act, 2004 (Act No. 10 of 2004), Alien and Invasive Species (A&IS) Regulations, 2020.
Monitoring	The repetitive and continued observation, measurement and evaluation of environmental data to follow changes over a period of time to assess the efficiency of control measures
Native species (syn. indigenous species)	Species that are found within their natural range where they have evolved without human intervention (intentional or accidental). Also includes species that have expanded their range as a result of human modification of the environment that does not directly impact dispersal (e.g., species are still native if they increase their range as a result of watered gardens but are alien if they increase their range as a result of spread along human-created corridors linking previously separate biogeographic regions).
Problem plants	A problem plant is any plant, shrub or tree which has a negative environmental impact in a particular locality and result in the subsequent loss of biodiversity, and (potential) excessive water consumption. These species have not been listed or classified as alien (thus can include native species) or invasive plants by the current South African National Environmental Management: Biodiversity Act, 2004 (Act No. 10 of 2004) (NEMBA).
Weeds	A plant is a weed '*if, in any specified geographical area, its populations grow entirely or predominantly in situations markedly disturbed by man (without, of course, being deliberately cultivated plants*)' (Baker 1965); in cultural terms, weeds are plants (**not necessarily alien**) that grow in sites where they are not wanted and that have detectable economic or environmental impacts (Pyšek et al. 2004).

1 INTRODUCTION

Scientific Terrestrial Services (STS) CC was appointed to develop an Alien and Invasive Plant (AIP) Control and Management Plan (AIPCP) for Goedgevonden (GGV) Colliery and the Oogiesfontein (OFT) Colliery (Figure 1), to comply with Section 73(2) and 75 of the National Environmental Management Biodiversity Act, 2004 (Act No. 10 of 2004) (NEMBA) – See Box 1 below. The area targeted for the AIPCP covers the entire Mining Right Area (MRA).

GGV mine is in the process of amending their Environmental Management Plan (EMP) – encompassing both the GGV Colliery and the OFT Colliery operations. The MRA thus includes both active mining (i.e., authorised activities) and proposed future mining activities (both open cast and underground) and is further associated with non-mining activities such as agriculture. Figures 2 and 3 illustrate the proposed and authorised activities associated with the MRA.

BOX 1

NEMBA Section 73(2): A person who is the owner of land on which a listed invasive species occurs must-

a) notify any relevant competent authority, in writing, of the listed invasive species occurring on that land;
b) take steps to control and eradicate the listed invasive species and to prevent it from spreading; and
c) take all the required steps to prevent or minimise harm to biodiversity.

NEMBA Section 75: Control and eradication of listed invasive species

1) Control and eradication of a listed invasive species must be carried out by means of methods that are appropriate for the species concerned and the environment in which it occurs.
2) Any action taken to control and eradicate a listed invasive species must be executed with caution and in a manner that may cause the least possible harm to biodiversity and damage to the environment.
3) The methods employed to control and eradicate a listed invasive species must also be directed at the offspring, propagating material and re-growth of such invasive species in order to prevent such species from producing offspring, forming seed, regenerating or re-establishing itself in any manner.
4) The Minister must ensure the coordination and implementation of programmes for the prevention, control or eradication of invasive species.
5) The Minister may establish an entity consisting of public servants to coordinate and implement programmes for the prevention, control or eradication of invasive species.

This AIPCP is developed to ensure that the AIPs are adequately managed within the MRA at both the species level and the habitat level. The aim of the AIPCP is to aid the GGV and OFT operations to comply with national legislation and to reduce and/or control the subsequent spread of AIP species into the surrounding natural habitat, thereby promoting and increasing the habitat integrity and biodiversity associated with the MRA.

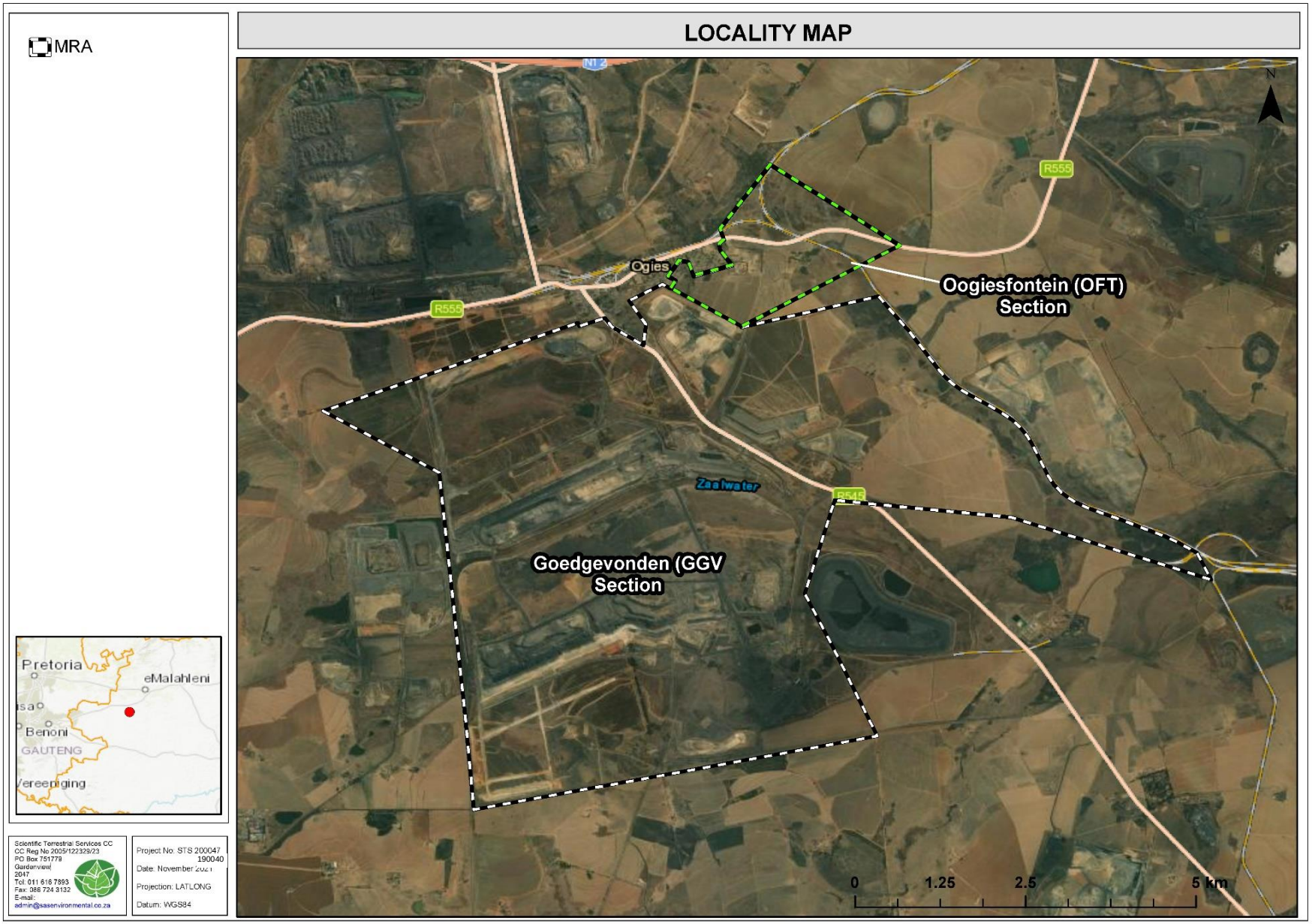

Figure 1: The MRA depicted on google satellite imagery. The OFT Section is indicated by the green outline.

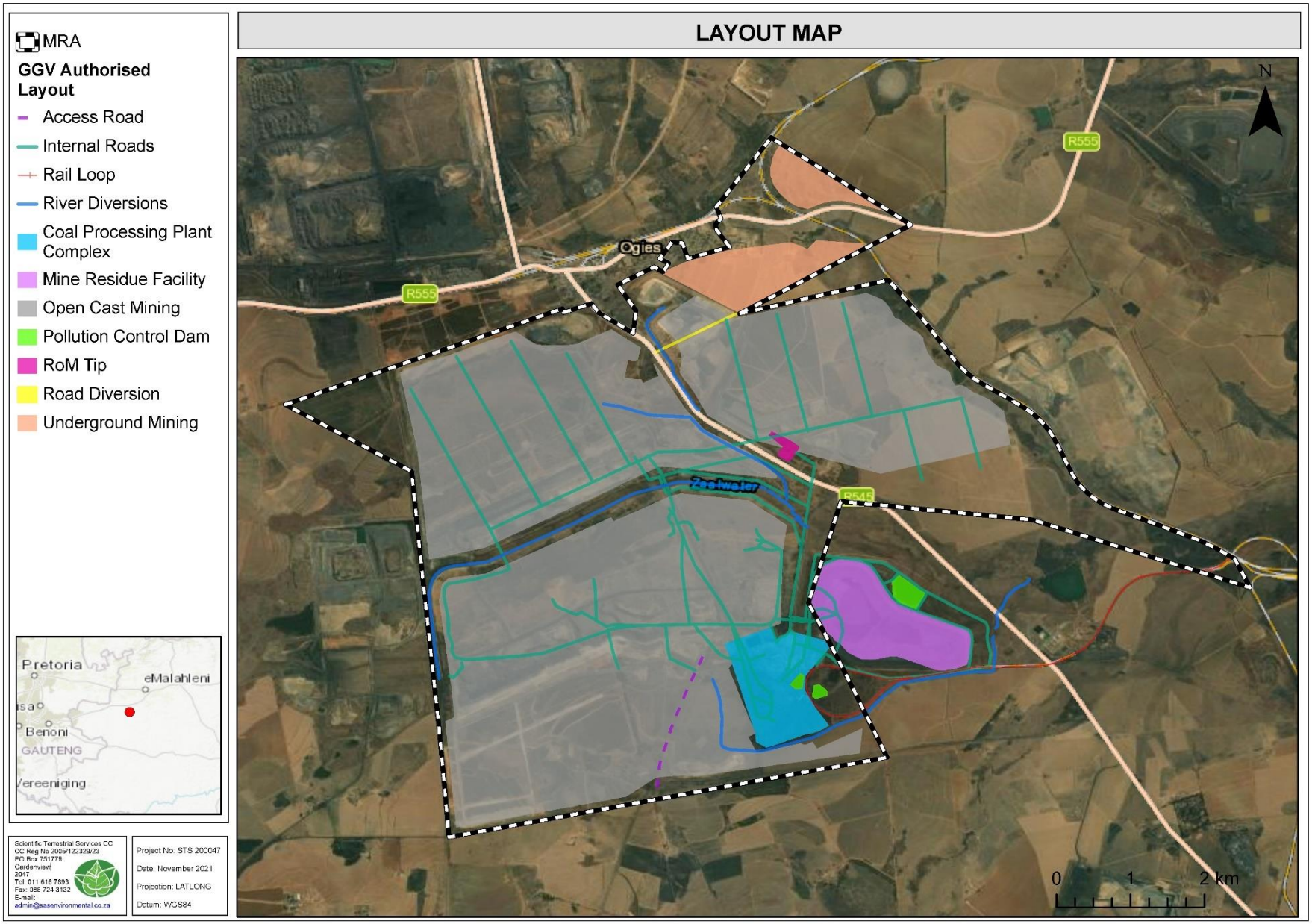

Figure 2: The authorised layout within the MRA in relation to the surrounding area.

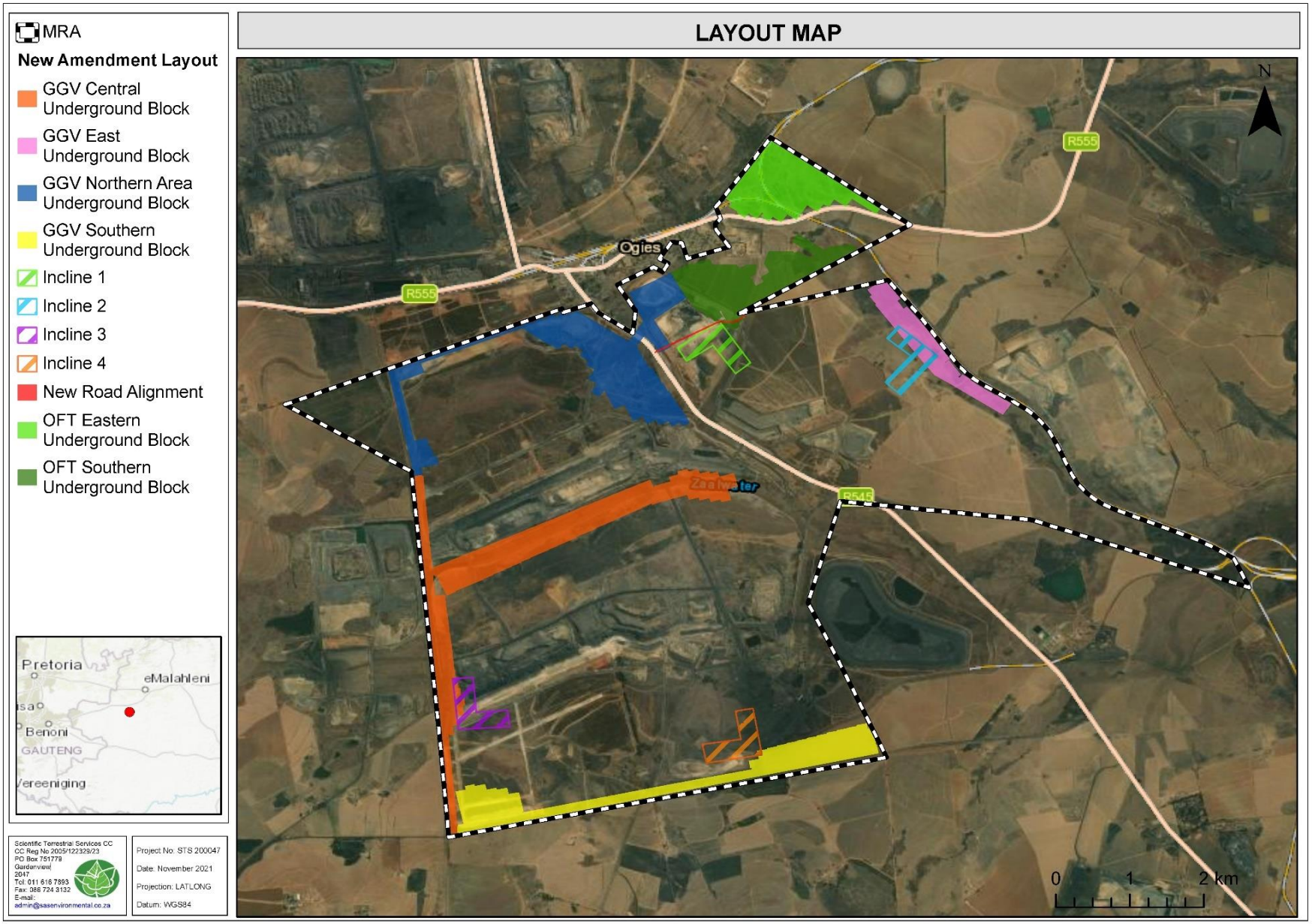

Figure 3: The new amendment layout proposed for the MRA in relation to the surrounding area.

1.1 Scope of Work

The AIPCP must be undertaken as per the guidelines for control and monitoring plans required by section 76 of the NEMBA for species listed as invasive (refer specifically to section 76(4) in Box 2). The scope of work, therefore, includes the below:

- Reviewing the legal framework (taking special note of the Critical Biodiversity Areas, Critical Ecosystems, and Watercourses affected by alien vegetation);
- Conducting a general field assessment;
- A detailed list and description of any listed species and problem plants occurring on the relevant property will be developed[1];
- A description and maps of the parts of that property that are infested with such listed invasive species and problem plants, including an assessment of the extent of such infestations;
- The current measures to monitor, control and eradicate such invasive species and problem plants;
- Measurable indicators of progress and success, and indications of when the control plan is to be completed; and
- A status report on the efficacy of previous control and eradication measures will be made if such information is available.

BOX 2

NEMBA Section 76(4): An invasive species monitoring, control and eradication plan must include-

a) a detailed list and description of any listed invasive species occurring on the relevant land;
b) a description of the parts of that land that are infested with such listed invasive species;
c) an assessment of the extent of such infestation;
d) a status report on the efficacy of previous control and eradication measures;
e) the current measures to monitor, control and eradicate such invasive species; and
f) measurable indicators of progress and success, and indications of when the control plan is to be completed.

[1] In this report, AIP species refer to both "listed species" (as listed under the NEMBA: Alien and Invasive Species Regulations, 2020) and "problem plants" (species which are not considered listed alien species in the current NEMBA Alien Invasive Species List (2020), but which still pose a significant threat to the biodiversity and ecosystem functionality of the MRA). Distinctions are made between the two categories where needed.

1.2 Legislative Requirements

The following legislative requirements were considered during the assessment:

- The Constitution of the Republic of South Africa, 1996[2];
- The Conservation of Agricultural Resources Act, 1983 (Act No. 43 of 1983) (CARA);
- The National Environmental Management Act, 1998 (Act No. 107 of 1998) (NEMA);
- The National Environmental Management: Biodiversity Act, 2004 (Act No. 10 of 2004) (NEMBA);
    - GN number R.1020: Alien and Invasive Species Regulations, 2020, in Government Gazette 43735 dated September 2020 as it relates to the NEMBA; and
    - GN number 1003: Legislation to come into force on the 1st of September 2021: Government Notice number 1003: Alien and Invasive Species Lists, 2020, in Government Gazette 43726 dated 18 September 2020, as it relates to the NEMBA.
- The National Water Act, 1998 (Act No. 36 of 1998) (NWA);
- The Mpumalanga Nature Conservation Act, 1998 (Act No. 10 of 1998) (MNCA); and
- The Occupational Health and Safety Act, 1993 (Act No. 85 of 1993) (OHSA).

The details of each of the above, as they pertain to this study, are provided in Appendix A of this report.

1.3 Assumptions and Limitations

The following assumptions and limitations are applicable to this report:

- This report only presents the initial control measures/guidelines and does not focus on follow-up or maintenance. Controlling AIPs is not a single occurrence, and follow-up control of all areas where AIPs have been cleared is essential for the project to be successful. This should be undertaken by the appointed contractor/mine personnel responsible for the implementation of the AIPCP, in order to monitor and control the re-establishment of seedlings;
- Additional AIP species not recorded during the initial or historic site assessments can emerge from time to time as seeds are dispersed (either naturally or by anthropogenic

[2] Since 1996, the Constitution has been amended by seventeen amendments acts. The Constitution is formally entitled the 'Constitution of the Republic of South Africa, 1996". It was previously also numbered as if it were an Act of Parliament – Act No. 108 of 1996 – but since the passage of the Citation of Constitutional Laws Act, neither it nor the Acts amending it are allocated act numbers.

means), and control methods would need to be adjusted accordingly. Information from previous studies[3] and field experience within the area were used in conjunction with the field assessment to make appropriate conclusions and recommendations;

- Due to the extent of the MRA, it was not possible to record exact abundances of AIP species; instead, and as per the request of the mine, priority areas were identified where higher densities and diversities of AIPs were recorded, which allows for a more flexible but efficient approach to AIP control. The field assessment thus involved assessing the natural areas within the MRA as well as transformed areas that were associated with active mining sites and agricultural fields; and
- Timing of AIP control is essential as it must be done during the growing season, preferably before the flowering season. If not done this way, follow-up control will be extended/prolonged.

2 AIPCP METHODOLOGY / APPROACH

As mentioned in the scope of work, in this report, AIP species refer to both “listed species” (as listed under the NEMBA: Alien and Invasive Species Regulations, 2020) and “problem plants” (species which are not considered listed alien species in the current NEMBA Alien Invasive Species List (2020), but which still pose a significant threat to the biodiversity and ecosystem functionality of the MRA). Distinctions are made between the two categories where needed.

The approach of the AIPCP follows the recommendations of NEMBA 76(4), the recommendations of the Department: Forestry, Fisheries and the Environment (DFFE)[4] as well as the DFFE Guideline document[5] of 2015 (Figure 4). The four steps followed in this AIPCP are detailed / explained in section 2.1 – 2.4.

[3] Previous botanical studies for the MRA:

- Botanical baseline survey of the Goedgevonden Colliery Expansion Area Mine Property (Ogies, Mpumalanga). Prepared by De Castro & Brits c.c. Ecological Consultants. February 2003. (Draft Report)
- Flora and Fauna survey of the proposed Xstrata Coal Oogiesfontein Project, Ogies (Mpumalanga). Prepared by Warren McCleland, Duncan McKenzie of De Castro & Brits c.c. Ecological Consultants. July 2009. (Draft Report V1)
- Goedgevonden Complex amendment to Environmental Impact Assessment and Management Programme. Revised April 2015. Prepared by Jacana Environmentals cc for Glencore Operations South Africa (Pty) Ltd

[4] See e.g., https://www.dffe.gov.za/projectsprogrammes/wfw/alienplantcontrol_managementplan

[5] Guidelines for Monitoring, Control and Eradication plans as required by Section 76 of the NEMBA for species listed as invasive in terms of Section 70 of this Act.

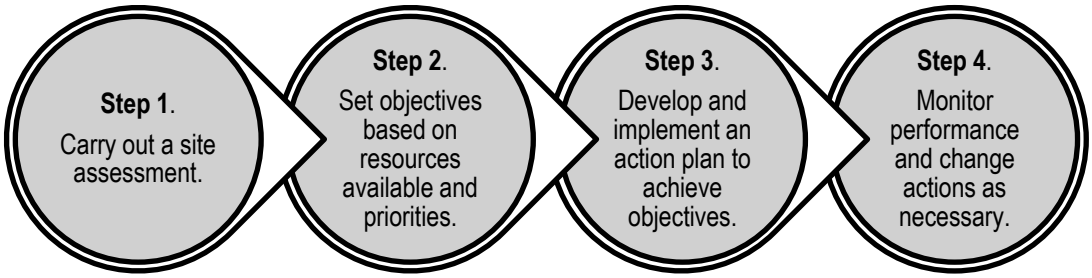

Figure 4: Approach followed for the Alien and Invasive Plant Control and Management Plan.

2.1 Carry out a site assessment

STS undertook a site investigation of targeted sections of the MRA on two separate occasions, namely 12th – 13th November 2020 and 12th – 13th October 2021 (spring).

During the site visits, all AIPs were recorded throughout the MRA as encountered, and priority areas requiring control were identified. The below approach was taken:

- To ensure a focused survey of the MRA, digital satellite imagery and previous studies were consulted prior the field investigation. The preparation for the field investigation included the identification of areas where previous studies have highlighted the presence of AIPs, as well as the identification of areas with increased disturbances where invasive species were anticipated to have proliferated (disturbance and land use are often the strongest drivers of AIP spread and proliferation);
- The survey of AIPs was conducted on foot where a walkthrough was undertaken of the site and specifically the targeted areas, including examining the corridors of disturbance where AIP species were expected to accumulate. All AIP species encountered during the site investigation were recorded and photographs of the specimens taken for record keeping and identification purposes.

2.2 Set objectives based on resources available and priorities

The objectives of the AIPCP includes:

- To ensure that AIPs are managed on site to reduce or completely eradicate their populations (where applicable) and to prevent AIPs from establishing in areas where they do not yet occur;
- To ensure that AIPs do not spread to areas outside of the MRA; and
- To recommend a monitoring programme to detect the presence of AIPs (early detection is key in AIP control) and to monitor the implementation and success of the AIPCP.

It should be noted that this report identifies areas and species of highest priority for control; however, it is the responsibility of the mine to determine available resources for control and to allocate such resources to best meet the performance indicators set out in this report (see section 2.3.4 and Appendix D).

2.3 Develop and implement an action plan to achieve objectives

Following the DFFE Guideline document[6], this section describes the approach taken for the development of the AIPCP upon completion of the site assessment.

2.3.1 Compilation of a comprehensive AIP list

A list of both invasive species and problem plants was compiled during the site assessments, with species recorded in previous assessments also incorporated into this list. For each species, the below data were recorded and is presented in this report (section 3.1):

- Scientific name and Common name(s), where available;
- NEMBA Category (distinguishing between species listed under 1a, 1b, 2 and 3);
- Whether the species is described in the Bromilow (2018) book of problem plants as a species of concern;
- Average abundance. No formal measurements were taken of the abundance of AIPs on site as this did not form part of the scope of work. Species abundance was estimated and categorised as high, medium or low;

[6] Guidelines for Monitoring, Control and Eradication plans as required by Section 76 of the NEMBA for species listed as invasive in terms of Section 70 of this Act.

- Prioritisation of control required for each species. Prioritisation was based on the species' invasive status (NEMBA category), its dominance within an area, as well as its potential to spread to new sites; and
- Environmental threats posed by each species based on site observations and available literature.

2.3.2 Defining Priority Areas

To allow for coherent management interventions, the MRA was divided into Priority Areas based on the priority of control required for AIPs at both the habitat and species level. For AIP priority areas, the density of AIP infestation is not the only contributing factor, but the sensitivity of the receiving environment, the likelihood for further spread to surrounding natural areas, as well as potential corridors such as roads is also considered.

AIP Priority Areas were broadly classified as follows:

- **High Priority**: Areas requiring immediate control. This includes i) areas where immediate control can significantly reduce further spread of AIPs, ii) areas of increased sensitivity where immediate control can drastically reduce impacts to sensitive areas that result from AIP proliferation (e.g., AIPs infestation in watercourses), and iii) areas of increased AIP abundance/dominance which hinders the establishment of indigenous flora;
- **Medium Priority**: Areas to be controlled once initial control of high priority areas have been undertaken. Although these might include areas of high-density AIP stands, immediate control is not required as the risk of further spread is not considered as likely as opposed to the risk of spread of AIPs associated with high priority areas. These areas also include sections where AIP abundance/dominance was noticeably lower than for High Priority areas; and
- **Low Priority**: Areas of low AIP density, or where AIPs consists of non-invasive species that do not pose a risk of spreading to new, uninvaded environments.

All information gathered is presented on a map to allow for easier planning of control operations. AIP priority areas must be amended and mapped as the AIPCP is updated.

2.3.3 Control Methods to be employed

A range of different management practices should be strategically combined to achieve the goals of the AIPCP;

- The strategic combination of all available and appropriate methods may optimise the prospect of achieving stated goals; and
- An overview of available species-specific control methods is provided in Section 3.1.1, with more detail on AIP Control Planning presented in Appendix B and C.

An AIPCP is a long-term management project. To ensure long-term success of the AIPCP, the management plan for alien vegetation must include the following three phases:

- Phase 1: Initial control;
- Phase 2: Follow-up control; and
- Phase 3: Maintenance control.

The scope of this report includes approaches and guidelines for **initial control**. Follow-up control and maintenance will be the responsibility of the mine and/or the maintenance team in consultation with a suitably qualified contractor.

2.3.4 Recommended Targets and Timeframes for the AIPCP

The DFFE 2015 Guideline recommends that the goals set out for the AIPCP should be "SMART", i.e.,

- **S**pecific (the nature and level of the performance required must be clearly identified);
- **M**easurable (the indicators chosen must be meaningful, easily understood and measurable);
- **A**ssignable (who will carry out the actions?);
- **R**ealistic (what can realistically be achieved, given the available resources?); and,
- **T**ime-bound (the timeframe for the achievement of goals must be clear).

2.4 Monitor performance and change actions as necessary

It is important that monitoring of the AIPCP as presented in Section 3.4 and Appendix E (Proposed Field Monitoring Form) be carried out to determine the efficiency of the plan and to determine the costs and the allocation of time and manpower for such an exercise. Methods to obtain this data could include fixed-point photography as a further means of documenting change. Annual monitoring of AIP must be performed to determine the extent of an infestation and to monitor if the AIP control program is efficient or not.

The monitoring of the AIPCP details the below:

- What is to be recorded about the listed invasive species and about the implementation of the management plan in the land parcel;

- How and how frequently these data are to be collected;
- How the data are to be stored, and how they are to be analysed; and
- The frequency of the analyses and their evaluation and feedback to the Managing Authority should also be recorded.

3 ALIEN INVASIVE PLANT CONTROL AND MANAGEMENT PLAN (AIPCP)

The MRA extends over approximately 4480 hectares (ha) and comprises various land uses such as agriculture and mining as well as natural systems such as wetlands and grasslands. Although only the eastern section of the MRA is currently associated with agricultural fields, most of the MRA was historically cultivated (refer to Figure 5 below) and therefore has a long association with AIP species.

The habitat associated with the MRA can be divided into (i) **transformed areas**, such as the actively mined areas and currently cultivated fields, (ii) **open veld areas**, including historically cultivated fields that have been left to recover without rehabilitation, as well as heavily grazed grasslands, (iii) **rehabilitated areas**, and (iv) **wetland habitat**, comprising areas of increased moisture split between natural wetlands (watercourses as per the NWA) and modified wetlands (not considered watercourses). The wetlands, natural grasslands and rehabilitated areas within the MRA generally had a low to medium abundance of AIPs. The agriculture fields, mining areas and built-up areas generally had a medium to high abundance of AIPs, with the highest abundance of AIPs observed within areas that were historically cultivated but never rehabilitated.

The subsequent sections provide the data collected for species (section 3.1) and habitats (section 3.2) during the field and background data investigations. These sections provide the control methods required at both the species level and the habitat level.

Figure 5: Historic (2006) and current (2021) land uses associated with the MRA.

3.1 Comprehensive list of AIPs and species-specific control measures

In total, 50 AIPs were recorded across the MRA, of which 15 species fall under NEMBA category 1b (control required – **Table 1**), two species under NEMBA category 2 (control only required if the species occurs on property without a licence – **Table 2**), and 32 species not listed. Of the species not listed under NEMBA, only 10 species are considered problem plants that require control (Table 3). The remaining 21 AIPs do not require control and are excluded from the AIPCP.

Species listed under Category 1b are presented first as these species are regarded as high priority species in the Regulations. The conditions of the regulations are as follows:

GN number R.1020: Alien and Invasive Species Regulations (2020): Chapter 3. Category 1b Listed Invasive Species

1) Category 1b Listed Invasive Species are those species listed as such by notice in terms of section 70(1)(a) of the Act as **species which must be controlled**.
2) A person in control of a Category 1b Listed Invasive Species must control the listed invasive species in compliance with sections 75(1), (2) and (3) of the Act.
3) If an Invasive Species Management Programme has been developed in terms of section 75(4) of the Act, a person must control the listed invasive species in accordance with such programme.
4) A person contemplated in sub-regulation (2) must allow an authorised official to inspect a property as provided for in terms of section 31K of the National Environmental Management Act and to monitor, assist with or implement the control of the listed invasive species, or compliance with the Invasive Species Management Programme contemplated in section 75(4) of the Act.
5) The Minister may require any person to develop a Category 1b Control Plan for one or more Category 1b species, which plan must be submitted to the Minister for approval, and such Control Plan must include the following:
    a) species identification;
    b) extent of invasion;
    c) control measures to be used;
    d) an action plan or schedule including time-frames for the clearing of each species;
    e) whether or not any species can be utilised as biomass; and

f) any other information which the Minister may require.

Table 1: All AIP species identified in the MRA and falling under NEMBA Category 1b.

Scientific name	Common Name	Abundance	Environmental threats / known impacts	Prioritisation	Risk of spread / invasion
WOODY SPECIES					
Ailanthus altissima	Tree-of-heaven	Low. Individuals occurred sporadic and not in colonies	Competes with and has the potential to replace indigenous species.	High	High
Nicotiana glauca	Wild Tabaco	Medium-to-high in mined areas	Competes with pioneering indigenous species. Can form dense and extensive stands along watercourses after flooding this is of particular concern in conservation areas such as the Kruger National Park. Unpalatable and poisonous to domestic and wild animals.	High	High
Solanum elaeagnifolium	Silverleaf Nightshade	Medium, mostly within mined areas and agricultural fields	Forms dense spreading infestations which compete with crop plants. It is extremely difficult to eradicate as it has deep, spreading roots and the ability to regenerate from small root fragments. The plants are poisonous and unpalatable.	High	High
Tamarix ramosissima	Pink tamarisk	Medium-to-high in mined areas and historically cultivated sites. Medium density in rehabilitation areas and low density elsewhere	Competes with and replaces indigenous species. Dense stands could significantly reduce stream flow and groundwater reserves.	High	High
FORBS					
Argemone ochroleuca subsp. *ochroleuca*	White-flowered Mexican poppy	Medium-to-high in mined areas and agricultural fields (though patchily distributed). Low elsewhere	Prolific in disturbed sites and competes with agricultural crops and indigenous species. This plant contaminates crop seed, and the spiny fruits and leaf tips can adhere to the wool of sheep. The seeds and parts of the plant are poisonous to humans and livestock.	High	High
Campuloclinium macrocephalum	Pompom weed	Low at the time of the assessment (seasonal constraints may have limited the observation of this species on site)	It causes serious degradation of the veld, lowering the biodiversity and reducing the grazing capacity by being unpalatable to large herbivores.	High	High
Cirsium vulgare	Spear thistle, Scotch thistle	Medium in wetlands and historic agricultural fields. Low elsewhere	It causes heavy infestations that reduce the carrying capacity of the veld and can cause injury to man and animals.	High	Medium
Datura stramonium	Common Thorn Apple	High-to-medium in mined areas and currently cultivated fields. Medium in wetlands and historically cultivated areas. Low elsewhere	It competes with crops and indigenous species.	High	High
Phytolacca octandra	Forest inkberry	Medium in wetlands and mined areas	Phytolacca octandra contains phytolaccatoxin and phytolaccigenin, which are poisonous to mammals though they seldom graze it.	High	Medium

Scientific name	Common Name	Abundance	Environmental threats / known impacts	Prioritisation	Risk of spread / invasion
Solanum sisymbriifolium	Wild tomato, Dense-thorned bitter apple	Medium in current and historic agricultural fields and mined areas	Competes with crop plants and indigenous pioneering species. Poisonous.	High	High
Verbena bonariensis	Wild Verbena,	Medium in wetlands and historic agricultural fields	It is poisonous to livestock and invades roadsides, disturbed places, moist areas and grasslands.	High	High
Xanthium strumarium	Large cocklebur	High-to-medium in agricultural fields. Low elsewhere	Competes with crop plants and indigenous species along riverbanks. Its spiny burs adhere to the wool of sheep wool and becomes entwined in tails, manes and coats of domestic livestock, causing the animals much discomfort. The seedlings are particularly toxic to domestic livestock. It readily invades overgrazed pastures and spreads at the expense of the indigenous species.	Medium	Medium
GRAMINOIDS					
Arundo donax	Giant reed, Spanish reed	Low at the time of assessment	Competes with and replaces indigenous species. It forms very dense stands on riverbanks and in riverbeds which results in the narrowing of water channels, increased siltation and the exclusion of smaller and less vigorous riverbank species.	High	High
Cortaderia selloana	Common pampas grass	High in some wetlands and mined areas	It forms large clumps which displace smaller indigenous species.	High	High

GN number R.1020: Alien and Invasive Species Regulations (2020): Chapter 4. Category 2 Listed Invasive Species

1) Category 2 Listed Invasive Species are those species listed by notice in terms of section 70(1)(a) of the Act as species **which require a permit to carry out a restricted activity**[7] within an area specified in the Notice or an area specified in the permit, as the case may be.
2) Unless otherwise indicated in the Notice, no person may carry out a restricted activity in respect of a Category 2 Listed Invasive Species without a permit.
3) A person in control of a Category 2 Listed Invasive Species, or person in possession of a permit, **must ensure that the specimens of the species do not spread outside of the land or the area specified in the Notice or permit**.
4) Unless otherwise specified in the Notice, **any species listed as a Category 2 Listed Invasive Species that occurs outside the specified area contemplated in sub regulation (1), must, for purposes of these regulations, be considered to be a**

Category 1b Listed Invasive Species and must be managed according to Regulation 3.

5) Notwithstanding the specific exemptions relating to existing plantations in respect of Listed Invasive Plant Species, any person or organ of state must ensure that the specimens of such Listed Invasive Plant Species do not spread outside of the land over which they have control, or the specified area on such land, where any restricted activity is authorised in respect of any Listed Invasive Plant Species.

Table 2: All AIP species identified in the MRA and falling under NEMBA Category 2.

Scientific name	Common Name	Abundance	Environmental threats / known impacts	Prioritisation	Risk of spread / invasion
WOODY SPECIES					
Eucalyptus grandis [8]	Saligna gum, Rose gum	High in tree stands / scattered clumps, but low otherwise	It competes with and replaces indigenous species. Stands of trees along watercourses are likely to reduce stream flow.	High	Low
Pinus sp.[9]	Pines	High in clumps. Low elsewhere.	N/A at the genus level.	Low	Low
Populus × *canescens*	Grey poplar, Matchwood poplar	High in clumps, not proliferate elsewhere	Forms dense stands and thus outcompetes native species. Studies have shown that the water use of the poplar invasions is significantly lower than that of other riparian invasions.	High	High

The below tabulated species are not listed in the Regulations, but are considered problem plants that warrant control, especially in the context of the MRA.

[8] NEMBA 2020 **– [sections in blue are applicable to *Eucalyptus* species on site]**

a. Category 1b within- (i) riparian areas; (ii) a Protected Area declared in terms of the Protected Areas act; or, (iii) within a Listed Ecosystem or an ecosystem identified for conservation in terms of a Bioregional Plan or Biodiversity Management Plans published under the Act.

b. Not listed within Nama-Karoo, Succulent Karoo and Desert biomes, excluding within any area mentioned in (a) above.

c. **Category 1b in Fynbos, Grassland, Savanna, Albany Thicket, Forest and Indian Ocean Coastal Belt biomes**, but-

(i) **Category 2 for plantations, woodlots, bee-forage areas, windrows and the lining of avenues. (ii) Not listed within cultivated land that is at least 50 meters away from untransformed land,** but excluding within in any area in (a) above. **(iii)** Not listed within 50 meters of the main house on a farm, but excluding in (a) above. **(iv)** Not listed in urban areas for trees within a diameter of more than 400 mm at 1000 mm height at the time of publishing of this Notice, but excluding in (a) above.

[9] Most *Pinus* species fall under Category 2. Exempted for an existing plantation

Table 3: All AIP species identified in the MRA and falling under NEMBA Category 3 or that are listed as problem plants.

Scientific name	Common Name	Invasiveness	Abundance	Environmental threats / known impacts	Prioritisation	Risk of spread / invasion
WOODY SPECIES						
Agave americana	Spreading century plant	Not listed in Mpumalanga, but control is recommended as this species can become an aggressive problem plant	Low. Occurred as small clumps select few sections	The plant eventually forms dense almost impenetrable thickets and has properties that can cause injury to people and animals.	Medium	Medium
FORBS						
Bidens pilosa [10]	Common Blackjack	Not Listed but is considered a problem plant, described as being "extremely troublesome"	High within historically cultivated areas, medium in mined areas, current agricultural fields and wetlands, low elsewhere	Aggressive weed in South Africa but has not yet been determined to be invasive. Bidens pilosa is a hardy weed capable of invading a vast range of habitats including grassland, heathland, forest clearings, wetlands, plantations, streamlines, roadsides, pasture, coastal areas and agriculture areas	High	High
Chenopodium album	White Goosefoot	Not Listed but considered a problem plant in crop fields	Low-to-medium in wetlands and historic agricultural fields. Low elsewhere	Mostly associated with direct and indirect crop losses. Reports of mammalian losses have been documented outside of South Africa as this plant is poisonous to people and animals.	Medium	Medium
Conyza bonariensis	Flax-leaf fleabean	Not Listed but is considered a crop pest	High in historic agricultural fields and wetlands. Medium within the rehabilitation site. Low-to-medium elsewhere	Major weed in South Africa but not yet deemed invasive.	High	High
Conyza canadensis	Horseweed, Canadian horseweed, Canadian fleabane	Not listed. Considered a problem plant	Medium	Major weed in South Africa but not yet deemed invasive.	Medium	Medium
Cosmos bipinnatus	Cosmos	Not Listed but recognised as a crop weed that can become a nuisance	High in historic agricultural fields (might have been confused with *Bidens pilosa*). Medium in wetlands and low elsewhere	No serious impacts / threats to the environment recorded in South Africa.	Medium	High

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Scientific name	Common Name	Invasiveness	Abundance	Environmental threats / known impacts	Prioritisation	Risk of spread / invasion
Physalis viscosa	Sticky Ground Cherry	Not Listed but regarded a problem plant	Medium in general	Better recognised as a crop pest, however it was noted on site to be abundant in areas of increased disturbance, thus hampering native species from reestablishing in such areas.	Medium	High
Schkuhria pinnata	Dwarf Marigold,	Not Listed but recognised as a crop weed and has become a problem plant in Zimbabwe and further north in Africa	Low	Can be competitive.	Medium	Medium
Solanum nigrum	European black nightshade	Not Listed and not considered a significant problem plant within the MRA	Low	None recorded for South Africa yet.	Low	Low
Tagetes minuta	Khakiweed	Not Listed but considered a problem plant	High in current and historic agricultural fields and mined areas. Medium in wetlands and natural grasslands. Low elsewhere	Can be an aggressive weed of various habitats.	High	High

3.1.1 Control Guidelines at the species level

Methods to be used to control specific species during the implementation of the AIPCP are as follow (Coetzee, 2005):

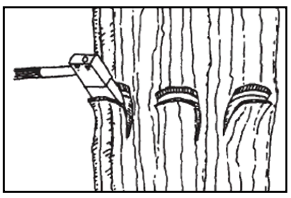
- Mechanical control which includes tree felling, ring barking and cut stump (refer to Table 4);
- Chemical control will entail using registered herbicides for a specific species, and one must adhere to the measurements on the product label. Avoid/Limit the use of chemical control methods within the watercourses and grassland, as this could contaminate water resources or have an adverse effect on indigenous flora; and
- A combination of chemical and mechanical control, where cut plants are treated with herbicide (Table 5).

Biological control or biocontrol methods involve the release of natural enemies that will reduce plant health and reduce population vigour to a level comparable to that of the natural vegetation (excluded from this report). More detail on the specific control methods and control phases is discussed in **Appendix B**.

In order to control AIP successfully, one must use a number of control methods as listed in this report. When using herbicides, one must adhere to the recommendations that are stated on the label of the specific product (Campbell, 2000), which must be applied by a suitably trained person or organisation. Furthermore, with herbicides/chemicals use, it must be applied by a suitably trained person or organisation. Control measures that disturb the soil or result in the clearance of AIP vegetation (e.g., hand pulling or cutting and removing) should be used with caution, especially in areas of high AIP infestation. Areas subjected to these control measures will require rehabilitation of the soil and rigorous follow-up and repeat control to ensure that reestablishment of the cleared species or establishment of other AIP species is prevented.

Table 4: Manual and Mechanised Methods of Clearing.

Risk to Ecosystem	Infestation density & plant size targeted	Required Tools	Reference Photograph
HAND-PULLING All seedlings Must be pulled out by hand. All root material should be removed to avoid re-sprouting of the plant.			
Safe to use throughout the subject property including watercourses as no chemicals are used. Hand pulling does create soil disturbance, but if the area is sparsely invaded such disturbances are unlikely to be ecologically damaging.	Low or sparse infestation. Aimed at seedlings and saplings: Plants that are small enough to be pulled out with roots intact.	No special tools required Gloves and spade optional.	

Risk to Ecosystem	Infestation density & plant size targeted	Required Tools	Reference Photograph
WRENCH PULLING A weed wrench is a manually operated, all-steel tool designed to remove woody plants by uprooting it.			
Safe to use throughout the subject property including watercourses as no chemicals are used. Wrench pulling does create soil disturbance, but if the area is sparsely invaded such disturbances are unlikely to be ecologically damaging.	Low or sparse infestation. Aimed at saplings: Plants that are small enough to be pulled out with roots intact.	A weed wrench	
RING-BARKING Removal of a ring of bark at least 25 cm wide and pull down to just below ground level. Ring barking interferes with the circulation of the tree and results in tree mortality.			
<u>Low</u> No contamination of watercourses with herbicides as these are applied directly to the tree.	Low or sparse infestation. Aimed at killing large / mature trees.	A cane knife or axe is used to remove the bark of the tree and cambium, in a horizontal band about 30 cm wide (about 50 cm from the ground)	
STRIP-BARKING			
<u>Low</u> No contamination of watercourses with herbicides as these are applied directly to the tree	Low or sparse infestation. Most effective for large / mature trees: The bark of large trees can be stripped completely, from waist height down to the base of the trunk.	Cane knife or axe. ***Herbicide, if used, should be applied to the stripped surface immediately after strip-barking. This is an effective but time-consuming method.*	
FRILLING *more cost-effective than ringbarking or strip-barking. The technique where an axe or cane knife is used to chip/cut around the base of a tree (±2 mm deep) in order to place herbicide into the cuts (cutting not to be as deep as to ringbark). Herbicide to be applied within 30 minutes from frilling.			
<u>Low</u> No contamination of watercourses with herbicides as these are applied directly to the tree	Low or sparse infestation. Most effective for mature trees: Small trees can be frilled by cutting an angled groove into the bark and cambium, right the way around the tree trunk.	Cane knife or axe, depending on how hard the bark and cambium layers of the tree are. Herbicide is then applied into the groove, which kills the tree as it seeps into the cambium tissue.	

Risk to Ecosystem	Infestation density & plant size targeted	Required Tools	Reference Photograph
CUT-STUMPING			
Low No contamination of watercourses with herbicides as these are applied directly to the tree. **Stumping can also imply the treatment of the remaining stump after felling with an appropriate herbicide.	Low or sparse infestation. Most effective for large / mature trees, but works on saplings too: Plants with a stem/ trunk diameter larger than 10 mm can be cut as low to the ground as possible with a saw or cane knife.	Saw or cane knife	
SLASHING			
Low No contamination of watercourses with herbicides as these are applied directly to the tree. ** *Care should be taken to prevent plant material and propagules from ending up in surrounding natural areas.*	Low or sparse infestation. The seed stalks/branches of annuals (plants that die each year after they set seed) can be slashed before the seeds have matured.	Slashed with a cane knife, mattock, bill hook or slasher before the seeds have matured. ***Costs are generally low for controlling annuals in this way, as no herbicide is required*.	
BRUSH-CUTTER			
Possible pollution caused by bar oil.	Dense stands can be cleared. Popular for controlling low-growing thickets of AIPs.	Heavy duty motorised brush-cutters that are usually powered by a small two-stroke engine.	
CHAINSAW			
Possible pollution caused by bar oil[11].	Dense stands can be cleared. For felling large trees and can be used to cut logs and branches into shorter lengths. ***Common target species for felling include large specimens of Syringa, Pine, Gum and Wattle*.	A chainsaw	

[11] Bar oil is designed to stick to the chain and bar of a chainsaw

Table 5: Manual and Mechanised Methods of clearing, with the application of herbicide (taken from Safe and Effective Herbicide Use: A handbook for near-water applications. Online available at: http://www.epa.sa.gov.au/files/477387_pesticide_water.pdf

Picture reference	Method	Type of Weed	Equipment Required	Notes
	Foliar Spray	Herbs, Bulbs, Woody weeds	Knapsack Vehicle mounted tank Herbicide mix	Ensure herbicide is being applied at the right concentration and rate to cover the foliage of the pest plant with fine droplets and avoid run-off. A flat-fan nozzle and low pump pressure will assist in reducing spray drift.
	Cut and Swab	Woody weeds, Shrubs and Trees	Saw, chainsaw, loppers Herbicide mix Bush / sponge for herbicide application	Ensure herbicide is applied quickly to cut stump (usually within 30 seconds). Apply during active growing period of plant for best results Do not apply herbicide to the point of run-off.
	Frill and Paint	Shrubs and Trees	Axe, hatchet Herbicide mix Brush for herbicide application	Frill trunk thoroughly and treat major surface roots where visible. Expose sapwood and apply herbicide immediately. For deciduous species, apply herbicide during active growth period.
	Drill and Fill	Shrubs and Trees	Drill Application bottle, injection gun Herbicide	Drill to sapwood only and apply herbicide to drill hole immediately. Drill and fill major surface roots where appropriate. For deciduous species, apply herbicide during active growth period.
	Scrape and Paint	Woody weeds	Knife or sharp blade Paintbrush, sponge, applicator bottle Herbicide	Scrape main or major stems of the plant. Apply herbicide immediately after scraping.
	Wick Wipe	Herbs, Bulbs and Rushes	Knapsack Vehicle-mounted tank Wick applicator Herbicide mix	Cover foliage thoroughly. Apply herbicide during active growth period.

3.1.1.1 General control methods for AIPs

The following general AIP control measures are recommended for the various growth forms of the targeted species:

General control of woody species**:**

- The best control method is determined by size of the plant:
  - Seedlings: Hand pulling, hoeing or foliar spray.
  - Saplings: Hand pulling, hoeing, foliar spray, basal stump treatments or cut-stump treatments.
  - Mature trees: Ring barking, frilling or partial frilling, basal stem treatments, cut-stump treatments, stem injections or ecoplugs.
- *Special conditions for invasive tree clearing within natural areas*:
  - Should any listed alien plants present on site be trees or bushes greater than 1.5 m tall they should be very carefully removed, and the ground immediately reseeded/revegetated.
  - Alternatives:
    (a) Where there are large alien trees which provide aesthetic appeal or some other useful function (windbreak or slope stabilisation), a phased approach to their removal is recommended whereby indigenous trees are planted below/around the alien trees at the start of the control project, and the alien trees are removed as late as possible in the clearance process, or once the indigenous trees have become established.

    ***Note that this approach is not appropriate where the alien trees are highly invasive and are a priority for removal. Furthermore, felling of large alien trees in areas where one needs to avoid damaging the emerging indigenous trees that have been planted can be difficult and expensive – so careful planning is required.*

    (b) Within wetland or river systems, the impacts on the freshwater resource caused by clearing vegetation can be reduced by avoiding the excavation of tree species, making sure the stump and roots remain. Thus, it could be beneficial to cut the trees to a low level where water is still permitted to flow over it, limiting erosion potential as the roots continue to stabilise the soils. Regular follow up control should be implemented, where all new shoots that might form from the stump are regularly removed, and the stump treated to limit new shoots from forming.

General control methods for herbaceous plants[12]

- Manual removal: Immature, broad-leaved herbaceous weeds can be removed easily with a hoe or spade. However, if the weeds have seed heads they must be gathered up, put in garbage bags or waste drums, transported and disposed of at a licensed waste disposal facility.
- Foliar spray: Broad-leaved weeds that are green and actively growing can be killed by foliar spraying with herbicides such as those used to maintain road verges. Preventing re-establishment will require follow-up control and revegetating the area with native grasses and shrubs.

General control methods for alien grasses[13]

- Burning: Not recommended as burning can stimulate alien grasses and lead to in-effective management. Burning is also not a good management option for mining areas due to health and safety risks.
- Hand clearing: Not recommended for dense infestations as hand clearing / pulling can lead to significant soil disturbance and, consequently, promoting the establishment of alien grasses or other pioneer alien species.
- Mowing: Effective for dense stands of annual grasses if performed where grasses are in flower and seed has not yet set. This approach will require follow-up control.
- Chemical control: Most effective method of controlling alien grasses. Pre-emergent systemic herbicides are most effective. Chemical control to be restricted to registered herbicides only and **not within 32 m of a watercourse**.

3.1.1.2 Species-specific Control Measures

Species-specific control measures are presented below for i) species that have registered herbicides (Table 6) and ii) species without registered herbicides (Table 7).

[12] Dr Sue Milton, 2016. Alien Listed alien plants Assessment and Management Guidelines.

[13] CapeNature. FACT SHEET: A landowner's guide to alien grasses and the prevention of their spread.

Table 6: Control options (as provided by Working for Water Alien Species and Herbicide List V2.9 AIP species). Hand pull only refers to seedlings (Campbell, 2000). Care Must me given as to not use herbicides containing Glyphosate close to water bodies. Refer to Marer (1999) for use of safe methods for herbicides.

Scientific Name	Herbicide registration status	Size class	Treatment method	Herbicide	Trade name	Dosage (mℓ / g)
Agave americana	Registered	All	Stem inject	MSMA 720 g/L SL	MSMA	10000
Argemone ochroleuca	Registered	Young	Foliar spray	Glyphosate (as isopropylamine salt) 180 g/l SL	Glyphosate 180	150
Campuloclinium macrocephalum	Registered	Young	Foliar spray	Metsulfuron methyl 600g/kg WP	Climax, Brushoff	25
Cirsium vulgare	Registered	Young	Foliar spray	Clopyralid 90 + Triclopyr (as amine salt) 270 g/L SL	Confront, Astra	75
Cortaderia selloana	Registered	Young	Foliar spray	Glyphosate (as sodium salt) 500g/kg WG	Glyphosate 500, Kilo, Muscle up	500
Datura stramonium	Registered	Young	Foliar spray	2.4D (as dimethylamine salt) 480g/L SL	2.4-D amine	150
Eucalyptus grandis	Registered	Seedling	Hand pull	No herbicide needed.		
		Adults	Integrated	Adult trees can be cut down but must be followed up with herbicide application.		
Populus canescens	Registered	Young	Lopping / Pruning	Imazapyr 100 g/L SL	Chopper, Hatchet	500
Solanum elaeagnifolium	Registered	Young	Foliar spray	Fluroxypyr 200 g/L EC	Tomahawk	2500
Solanum sisymbriifolium	Registered	Young	Foliar spray	Triclopyr (as butoxy ethyl ester) 480 g/L EC	Garlon, Triclon	50
Tamarix ramossisima	Minor use	All	Integrated	Refer to: Global Invasive Species Database (2021) Species profile: *Tamarix ramosissima*:. http://www.iucngisd.org/gisd/species.php?sc=72		
Verbena bonariensis	Registered	Young	Foliar spray	Glyphosate (as isopropylamine salt) 360 g/L SL	Springbok	300
Xanthium strumarium	Registered	Young	Foliar spray	2.4D (as dimethylamine salt) 480g/L SL	2.4-D Amine	150

Table 7: Control methods for species excluded from the Working for Water Alien Species and Herbicide List V2.9 AIP species.

Scientific Name	Herbicide registration status	Size class	Treatment method	Herbicide	Trade name	Dosage (mℓ / g)
Ailanthus altissima	None	Seedling	Hand pull	No herbicide needed. Hand-pulling must ensure the entire taproot is removed.		
		Adult	Integrated approach	Once a taproot has established, physical control alone will not prove successful. The Cabi website recommends: - Cut stump with chemical application treatment such as the gyphosate herbicide - Stem-injection of herbicide - Foliar spray method using glyphosate or triclopyr for large thickets of seedlings can be used only if the risk to non-target species is minimal		
Arundo donax	Registered, but not recommended	All	Integrated	Bromilow (2018) recommends that if physical methods are employed, it must be ensured that all rhizomes are removed to prevent resprouting. Glyphosate is registered for use on this species. Best approach is to: 1) Cut plants down to the ground level and preferably use burning methods as well 2) Regrowth to be sprayed with systematic herbicides once the plant has reached 1-2 m. 3) Thorough follow-up required. See also Global Invasive Species Database (2021) Species profile: *Arundo donax*. http://www.iucngisd.org/gisd/species.php?sc=112		
Bidens pilosa	None	All	Hand pull Post-emergence herbicides	Bromilow (2018) recommends that for both physical and chemical control should aim to prevent seeding so to reduce the seedbed. The Cabi website also lists both physical and chemical control as methods of control. For physical control the site recommends "persistent mowing, hoeing and hand pulling in order to prevent seed production". For chemical control, the use of "the use of herbicides such as glyphosate-trimesium, oxyfluorfen, atrazine, 2,4-D glyphosate, pendimethalin, metribuzin, diuron, paraquat, nicosulfuron, and simazine" have been recorded. However, both Bromilow (2018) and Cabi mentions that some biotypes of *Bidens pilosa* have developed resistance to certain herbicides. As such, physical control is recommended where chemical control reaches its limits.		

Scientific Name	Herbicide registration status	Size class	Treatment method	Herbicide	Trade name	Dosage (mℓ / g)
Chenopodium album	None	All	Hand pull Post- and pre-emergence herbicides	Bromilow (2018) states that hand-weeding and cultivation should be successful in the control of *Chenopodium album* populations. As for chemical control, both pre- and post-emergence broadleaf herbicides have proven successful; however, the addition of a wetting agent may be required due to the waxy surface of the seedlings.		
Conyza bonariensis	None	All	Shallow cultivation Pre- and post-emergence herbicides	Pre-emergence herbicides are recommended for the control of *Conyza* species (Bromilow, 2018). Where shallow cultivation and post-emergence herbicides will be applied, it must be done before the plant forms a rosette. **Resistance to glyphosate has been recorded for *Conyza bonariensis*. Cabi physical control: "*C. bonariensis* establishes from a small seed and the initial rosettes are readily destroyed by tillage. Once established, however, the plant becomes more difficult to control mechanically. Soil solarization is surprisingly ineffective (Silveira et al., 1988)[14]."		
Conyza canadensis						
Cosmos bipinnatus	None	All	Cultivation and broadleaf weed herbicides	Hand-weeding is possible but highly labour-intensive. Preferred method of control is thus cultivation and/or broad-leaf weed herbicides (Bromilow, 2018).		
Nicotiana glauca	None	Young (preferred) Adult	Several	The Global Invasive Species Database (ISSG)[15] recoded both physical and chemical control as successful methods: Physical: "Hand pull or dig out seedlings and young plants." Bromilow (2018) emphasizes the importance of controlling the species while young/small and before it flowers. Cabi further states that "For larger more established shrubs, a weed wrench or other woody weed extractor should be used. Care must be taken to remove the entire crown to prevent re-sprouting.". Chemical: "Cut large plants and treat the stumps with herbicide. In South Africa the plants are cut, and stumps treated with 2,4,5-T (Cronk & Fuller 2001, in PIER 2007)."		
Physalis viscosa	None	All	Chemical	Physical control as well as herbicide use is problematic for this species and has proven unsuccessful numerous times. The best approach according to Bromilow (2018) is to make use of "spotspray with systematic, non-selective herbicides or with triclopyr."		

[14] Silveira HL, Caixinhas ML, Leitao A, Gomes R, 1988. Evolution of actual and potential weed flora after soil solarisation. VIIIe Colloque International sur la Biologie, l'Ecologie et la Systematique des Mauvaises Herbes, Paris, France: A.N.P.P., Vol. 1:59-69.

[15] Global Invasive Species Database (2021) Species profile: Nicotiana glauca. Downloaded from http://www.iucngisd.org/gisd/species.php?sc=1453 on 13-11-2021.

Scientific Name	Herbicide registration status	Size class	Treatment method	Herbicide	Trade name	Dosage (mℓ / g)
Phytolacca octandra	None	All	Chemical and Physical	Hand-pull or use of glyphosate as a foliar spray.		
Schkuhria pinnata	None	All	Chemical and Physical	The species is susceptible to pre- and post-emergence herbicides. For physical control, hand-pulling or cultivation has proven successful but only if executed before the "onset of seeding" (Bromilow, 2018).		
Solanum nigrum	None	All	Hand-pull Cultivation Pre- and post-emergence herbicides	Bromilow (2018) indicates that this it is easy to remove and control this species with both physical and chemical control methods. For physical control, both hand-pulling and cultivation has proven successful. The Cabi site further mentions that controlling these species with physical methods should be carried out before the plant flowers for best and quickest results. The species is susceptible to most conventional pre- and post-emergence herbicides.		
Tagetes minuta	None	All	Hand-pull Cultivation Pre- and post-emergence herbicides	Several approaches can be taken, but an integrated approach will be best. Physical: Both Bromilow (2018) and the Cabi site mentions that hand-pulling or mechanical cultivation is an easy approach "but this should be done before the flowers form to prevent the return of viable seeds to the soil". Chemical: Susceptible to most pre-emergence herbicides but care must be taken to avoid herbicide leaching into the soil.		

3.1.2 General Health and Safety Requirements for AIP clearing

All personnel to be provided with the appropriate Personal Protective Equipment (PPE) for clearing of AIPs and/or encroaching indigenous vegetation. The use of PPE by staff controlling AIPs in the field is required by law. The PPE specifications differ for the different types of control. Mechanised control includes the use of a chainsaws and brush-cutters and will therefore require slightly different PPE from someone using manual control (cane knife, slasher, knapsack sprayer, etc.). Tables 8 – 10 below specify the minimum required PPE for AIP clearing.

Table 8: PPE for manual control.

Item	Specification
Overall	100% cotton, two-piece overalls are the best for absorbing perspiration; they last longer and are cooler. However, various cotton/polyester blends are available and suitable.
Rubber gloves	Standard rubber gloves for fieldwork are sufficient. Wrist length gloves are preferable over elbow length gloves for a warm climate.
Leather gloves	Standard wrist length leather gloves are appropriate.
Safety boots	(with/without steel cap) long run. Gumboots or standard safety boots, which support the ankles, are acceptable. Steel toecaps are recommended for workers working with hand tools or with large trees.
Hat – (hardhat/ wide brim hat)	If working with large trees, on steep gradients or if any other safety risks may be present, then wearing a hardhat is advisable. Alternatively, a wide brim hat can be used to protect the worker from the sun.
Safety glasses	Large, clear safety glasses, which allow air to pass through, are acceptable. Glasses with elastics, (e.g., welding glasses) are not acceptable as they tend to fog when a person perspires.
Face mask	A face mask which covers the nose and mouth is essential when mixing herbicides and for foliar spraying.
Raincoat	A raincoat is necessary in case workers are caught in the rain or can be worn early morning to avoid getting wet from dew.
Face mask	A face mask which covers the nose and mouth is essential when mixing herbicides and for foliar spraying.

Table 9: PPE for mechanised control.

Item	Specification
Chainsaw safety pants	Standard safety chainsaw and long pants that provide protection against the chainsaw.
Leather gloves	Standard wrist length, leather gloves.
Safety boots with steel cap	Steel toecaps are essential for safety of the workers. Safety boots, not gumboots, are to be worn as they provide support around the ankle.
Hardhat	A hardhat with a visor and earmuffs is necessary for all mechanised control.
Safety glasses	Chainsaw safety glasses provide total cover around the eye area, thus preventing wood chips, stones, etc. entering.
Raincoat	A standard two-piece raincoat. However, it is better not to use mechanised control when it is raining.

Table 10: PPE for chemical control.

Suitable protective clothing must be available and use thereof is compulsory.	- Goggles or face shield to protect the eyes; - Chemical-resistant gloves to protect hands; - Overalls to protect legs, arms, torso and groin; - Respirator with filter cartridges to prevent inhalation of herbicide vapour or mist rubber or PVC boots to protect feet washable or chemical-resistant hat to protect head and scalp; and - PVC apron for use during mixing.
	NB Adequate hygiene aids must be readily available e.g., plentiful water, soap, towels and eye wash.

3.2 AIP Priority Areas

Successful plant invasions are most likely if (i) the alien plant has the necessary characteristics to make it invasive in a novel environment and (ii) the environment is susceptible to being invaded (Vicente et al. 2013). As such, to determine priority areas, firstly the invasiveness of the species was examined as per section 3.1 (based on site observations, NEMBA category and available literature), thus targeting AIP management at the species level. Priority areas, however, were determined at the **habitat level**, examining the susceptibility[16] of a site to become invaded (including factors such as availability of dispersal pathways, sensitivity of the environment, and current level of infestation).

The MRA was divided into three categories of control priority, i.e., high, medium and low. Most of the MRA obtained either a **high** or **medium** priority score, whereas only a small section was regarded to be of **low** priority for control.

Where AIPs were particularly abundant, e.g., within historically cultivated fields, a high priority was assigned (Figure 6a). High priority areas further included sections where AIPs were not always necessarily abundant, but the AIPs that were present were either invasive in term of their NEMBA listing (1b or 2) or the invaded habitat is regarded to be either a facilitator of spread (e.g., roads in Figure 6b) or are highly susceptible to invasions due to e.g., the presence of sensitive habitat (e.g., watercourses, Figure 6c). The rehabilitated areas (Figure 6d) had a medium to low abundance of AIPs, however, this site is regarded important for the control of AIPs so that it can meet the closure requirements of the mine. As such, the rehabilitated areas were included as High Priority areas despite having lower AIP abundances.

Example photos of High Priority areas are provided in the below figure.

[16] The susceptibility of the novel habitat to invasion is also an important factor, since it can either inhibit or provide the ideal conditions for the alien to thrive (Rejmánek et al. 2005).

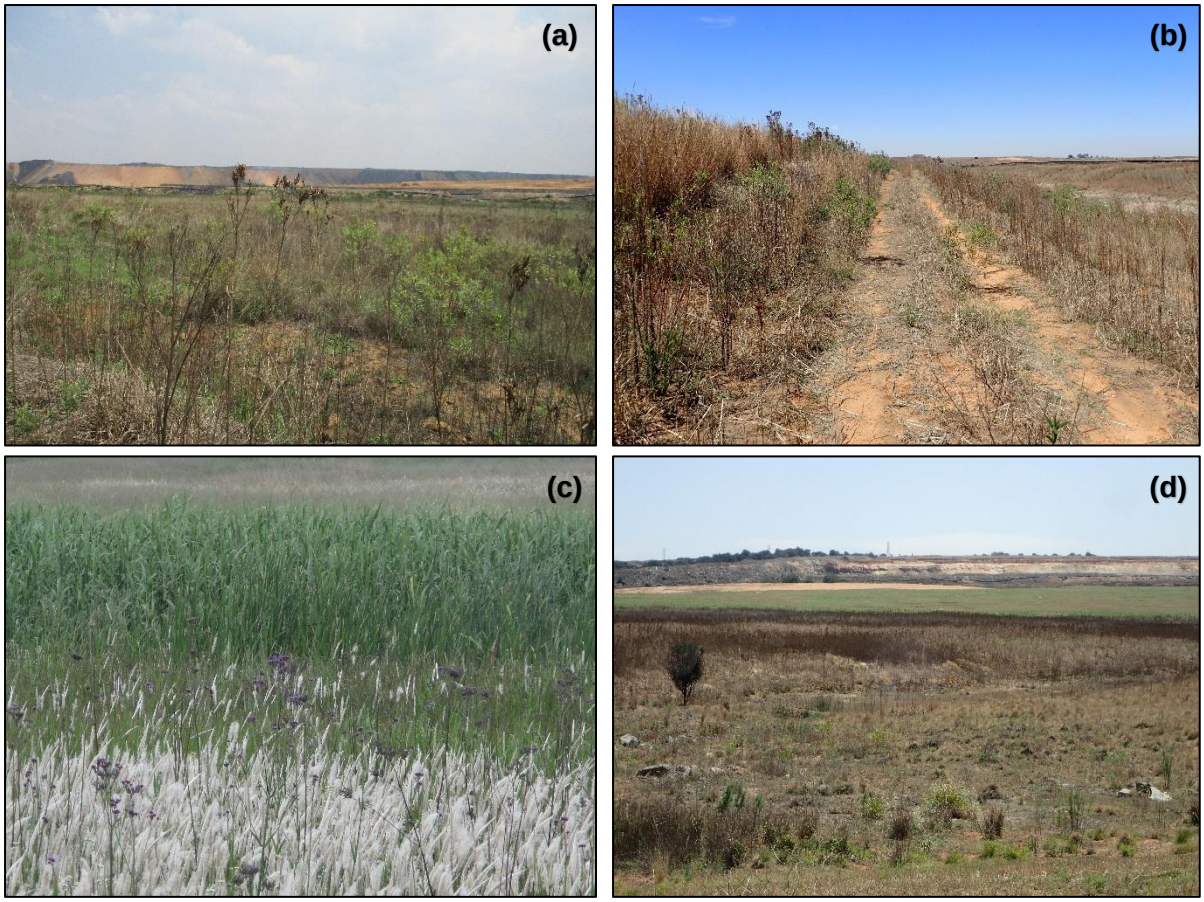


Figure 6: Example photos of areas considered of high priority for targeting AIPs as part of the AIPCP. These include areas with high abundances of AIPs (a), habitat serving as corridors of spread (b) and those susceptible to become invaded (c), as well as areas of conservation or environmental importance (e.g., rehabilitated areas in (d)).

Medium priority areas were associated with either moderate abundances of AIPs or lower diversities of invasive species. Medium priority areas included the actively mined sites as well as the currently cultivated fields (Figure 7). Only the heavily grazed grasslands and the existing plantations were classified as Low Priority areas due to the absence of invasive species and/or the absence of an abundance of AIPs. The AIP tree stands were examined utilising historic aerial photography and Google satellite imagery and it was evident that there was no indication of these stands spreading to nearby natural habitat. Where the AIP tree stands occur within 30 m of a natural watercourse, these should be regarded as a category 2 invaders and hence, AIP stands within the natural wetlands were grouped under High Priority areas. Those forming part of existing plantations or within 50 m of a farmstead, or as part of windrows, were grouped under Low Priority areas.

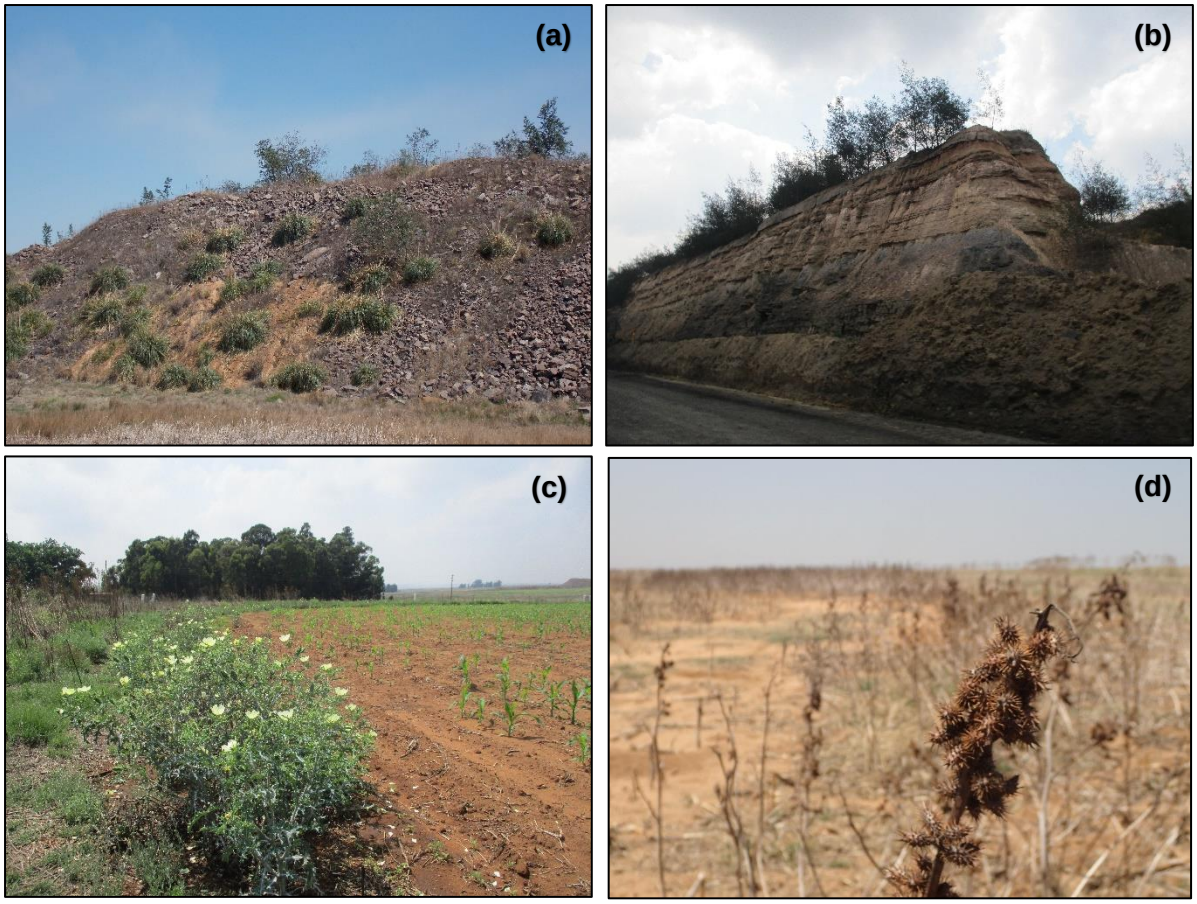


Figure 7: Example photos of Medium Priority areas (a-b = mined areas, c-d = agricultural fields). Despite generally associated with low to medium AIP abundances, the AIPs that are present are typically considered serious invaders.

Table 11 below tabulates the Priority Areas as identified within the MRA and provides additional justification for their priority classification. Refer to Figure 8 for a depiction of the Priority Areas within the MRA.

Table 11: AIP Priority Areas for targeting AIP species that were identified within the MRA.

Priority	Area	Justification
HIGH	AIP Tree Stands within watercourses	- The stand of *Populus x canescens* within the far eastern section of the MRA is of highest concern. Stands of *Acacia mearnsii* should also be prioritised.
	Historically cultivated areas left unrehabilitated	- **High abundance and dominance of AIPs**. These areas have been subjected to AIPs for years and without any active rehabilitation of the habitat post-cultivation, pioneer and opportunistic AIPs have invaded extensively with very few native species present. - **Linkage to dispersal corridors.** Historically cultivated areas are linked to either mine roads or wetland habitat (be it natural or modified). Linear features and water systems facilitate the spread of species, thus allowing the ongoing spread of AIPs not only within the MRA but to neighbouring properties as well. - **Source population**. Given the sheer number and diversity of AIPs within these areas, further exacerbated by the extended association with AIPs and dispersal corridors, these areas are important source populations and have built up a seed bank that would likely need long-term, ongoing management.

	Rehabilitated areas and Topsoil Stockpiles	- **Important/ significant habitat**. As part of the post-closure[17] requirements for rehabilitation, alien vegetation management is essential to ensure the post-closure rehabilitation goals are met: "Disturbed areas will be rehabilitated to arable standard as far as practicably possible, and as a minimum to grazing standards (300 mm depth).". The presence of AIPs will hamper these attempts and result in increased cost-related problems down the line. - **Source population**. During the site assessment, it was noted that the Topsoil Stockpiles were covered with a medium abundance of AIPs. As such, using the topsoil for rehabilitation will thus further spread these species and hamper any AIP management and control that have already been implemented. Costs will be much higher than necessary in the long-term.
	Watercourses	- **Important/ significant habitat**. As mentioned previously, watercourses are corridors along which species disperse and should be managed to prevent ongoing movement and dispersal of AIPs within the MRA and to neighbouring properties. - **Cumulative impacts**. Many of the AIPs recorded within the MRA pose threats to biodiversity and agriculture. As such, their dispersal along watercourses must be prevented seeing that the MRA and the surrounding areas are associated with habitat of biodiversity significance as well as agricultural practices.
MEDIUM	Actively mined areas and currently cultivated fields	- **Medium abundance of AIPs**. These areas are fully transformed and actively used for mining and agricultural practices. As such, there is little opportunity for AIPs to become highly abundant in these areas. However, these are simultaneously associated with increased disturbances and therefore provides ideal conditions for the establishment of AIPs. This was particularly evident along the edges of these areas where AIPs were more abundant. - **AIP invasiveness**. The species recorded in these areas were not only problem plants but mostly included listed AIPs (category 1b and 2). - **Linkage to dispersal corridors.** Extensive road networks surround and traverse these areas, facilitating the spread of AIP propagules to other areas.
LOW	AIP Tree Stands	- Existing plantations do not need clearance and for the remaining *Eucalyptus* stands, no indications were present that they are increasing in size or extent.
	Natural Grasslands	- **Low AIP abundance**. Some listed AIPs were recorded in the grasslands, however, as a whole, the AIPs in the grasslands pose the smallest threat to AIP spread.

[17] Goedgevonden Complex amendment to Environmental Impact Assessment and Management Programme. Section 2: Environmental Management Programme. Regulation 51. Revised April 2015.

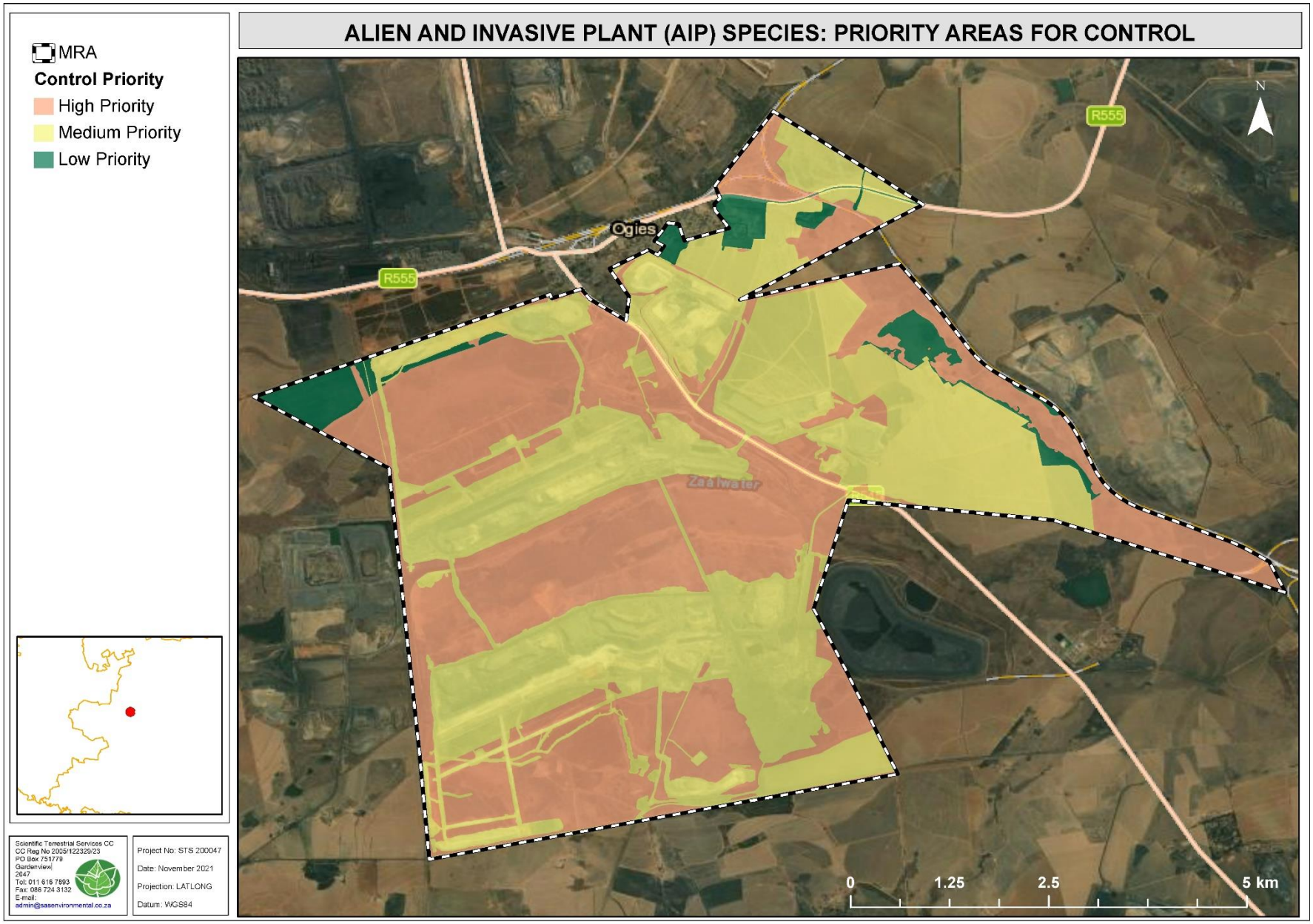


Figure 8: Priority Areas for the AIPs associated with the MRA.

3.2.1 Stages for Effective Control of AIP species within Priority Areas

The AIPCP will be most effective if it proceeds in phases. The three most important phases to consider during the implementation of the AIPCP includes:

- Phase 1: Initial control.
  Drastically reducing an existing alien plant population can be achieved by following the guidelines for invasive species listed in terms of Section 70 of the NEMBA and as required by section 76 of this Act (DEA Biosecurity, 2015). For this AIPCP, the development of the Initial Control Phase followed the guidelines and important aspects recommended by the DEA Biosecurity (2015);
- Phase 2: Follow-up control.
  Control of seedlings, root suckers and coppice growth. Mechanical and chemical control of AIPs are effective short-term solutions. Rigorous follow-up control is needed to sustain an AIPCP over the medium term. The aim is to deplete the seed bank and specific tactics for seed bank management can be employed. Follow-up control should be done on a minimum of 2-3 follow-ups per growing season, especially within the first year of control; and
- Phase 3: Maintenance control.
  Sustain low alien plant numbers with biannual to annual control. Continuous monitoring and maintenance of all areas where AIPs have been removed should continue for the life of the opencast activities, with an additional five years post-closure to combat re-sprouting, and as an effort to deplete the existing alien species seedbank. It is very difficult and often expensive to completely eradicate alien species, which is why there is a need to maintain a control program over several years.

Based on the Priority Areas provided in Figure 8, it is recommended that the AIP priority areas be subdivided into control "**Control Blocks (CBs)**" during the implementation of the AIPCP by the appointed contractor/ mine personnel responsible for the implementation. Vegetation units and roads can be used as boundaries for the CBs (refer to Figure 9 for an example). The CBs must be illustrated on a map and rated according to the AIP infestation from high to low. The following criteria can be used to determine the CBs (Coetzee, 2005):

- Using different sensitivity areas and severity of AIP as control "Blocks" (Figure 9 and 10 as examples). This is the preferred and recommended approach; or
- Divide the whole MRA into identical sized control "Blocks" irrespective of the sensitivity of the areas and severity of AIP.

Figure 9: Example of the Control Block (CB) approach to AIP management and clearing with the focus on priority areas.

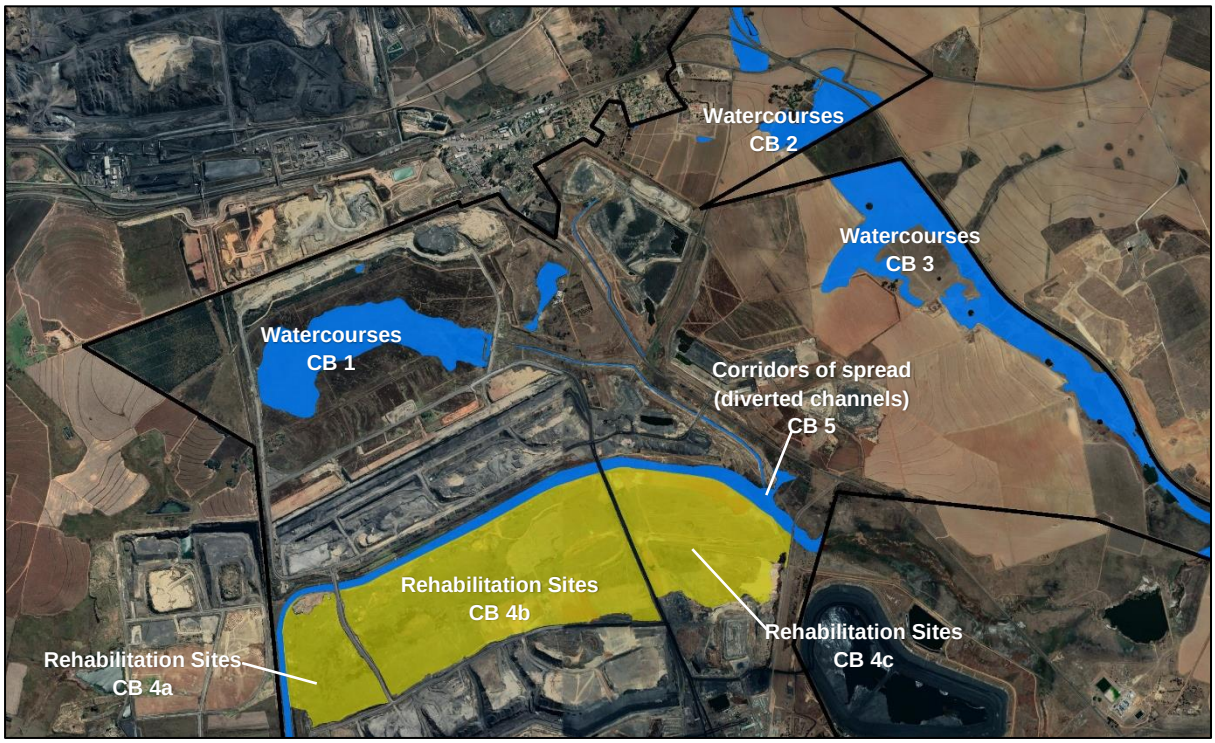


Figure 10: Example of the Control Block (CB) approach to AIP management and clearing with the focus on sensitive habitat.

To best achieve the objectives set out in this report, it is recommended that control of AIPs within the areas of High Priority must be targeted first, moving on to the Medium Priority Areas thereafter. Upon completion of initial control, follow-up control measures should be tackled in early spring before the rainy season starts (i.e., before flowers mature and set seed) to reduce the potential for flowers to mature and set seed; however, species-specific control times should be considered first. The boundary around the priority areas is also important to monitor throughout the year to limit the spread and escape of AIPs to natural areas. The following guidelines must be used for different stages of control. For further detail, refer to Appendix B and C within this report:

- Stage 1: High Priority areas with dense infestation must be controlled by working from the centre and the outer edges, and moving toward each other;
- Stage 2: Sparsely infested areas within High and Medium Priority areas must be cleared concurrently;
- Stage 3: Scattered individuals adjacent to dense infestations should be controlled, while edges of dense infestation must be prevented from extending and spreading further; and
- Stage 4: Small isolated infestations must be cleared, starting with young, less dense sections to control the invasion and prevent the build-up of seed banks.

3.3 Recommended Targets and Timeframes for the AIPCP

Following the “SMART” approach, the below list provides the recommended targets and timeframes for the implementation of the AIPCP. It should be noted that the recommendations will be restricted by available manpower and funding. As such, this should merely be seen as a guideline and the ECO should make use of the form in Appendix C to populate their own targets and timeframes which will fit into the mine’s budget.

- **Specific Goal**: Clearance of all priority AIPs.
- **Measurable Goal**: AIP cover reduced to less than 10% of current occupied area.
- **Assignable Goal**: ECO and relevant contractors. See section 5.5 of this report.
- **Realistic Goal**: Clearance of all AIPs within the Low and Medium Priority areas by the end of the AIPCP, with 90% of AIPs cleared and actively managed within the High Priority areas on an ongoing basis.
- **Time-bound Goal**: The overarching goal is to reduce the canopy cover of Listed Invasive Plant Species in the relevant area by 25% of its initial value by the end of year 1 of implementation, by 50% of this initial value by the end of Year 2, by 70% by the end of Year 3, and by 90% by the end of Year 4.

It is recommended that by the end of the 1st year of implementation the SMART approach be re-evaluated to see what was achievable and what was not.

3.4 Monitoring Requirements

It is important that monitoring of the AIPCP be carried out to determine the efficiency of the plan and to determine the costs and the allocation of time and manpower to such an exercise (DEA Biosecurity 2015). Principles that should be followed as part of the monitoring of the AIPCP are presented in Table 12 below. Refer to Appendix E for a proposed field form to be used during monitoring activities.

Table 12: Maintenance activities & monitoring.

AIM:	Implementing maintenance activities and monitoring the re-emergence of AIP species.	**MOTIVATION**	There will always be some measure of regeneration of the cleared AIPs after the initial clearing work has been done. Appropriate follow-up work is thus essential and should be conducted regularly. If follow-up clearing is not done, the progress made in the initial clearing exercise will be lost within a few years as the AIPs become re-established. Additionally, to assess the impact of the clearing activities, follow-up and rehabilitation efforts, monitoring must be undertaken.
MAINTENANCE & MITIGATION MEASURES			
1	Monitoring of each of the AIP Priority Area should include the following (Refer to Appendix E): - Name or number of the AIP Priority Area; - Global Positioning System (GPS) location of the AIP Priority Area; - Date of assessment; - Description of the issues associated with each AIP Priority Area, e.g., vegetation clearing required and/or debris and runoff damage; and - Priority of the maintenance tasks.		
2	The following principles should be followed to ensure adequate future management - After the implementation of initial control methods, the identified alien communities should be assessed in monthly intervals for a period of three months after the initial treatment to control any species that may re-sprout. Thereafter an annual assessment of the alien vegetation stands should take place after the spring flush of each year but prior to seed formation. The annual assessment should include: • Re-mapping (where applicable) of the extent of each alien vegetation community (AIP Priority Area). The areas mapped should then be compared to mapping done in the previous season. This will aid in determining if mitigation within each community is effective. • Determination of dominance by biomass and recruitment within each alien vegetation community. To identify any dominant species that may become a threat to the natural vegetation.		
3	Preventing new AIPs from establishing is more cost-effective than implementing continual clearing programs. Consequently, un-invaded areas must be protected from invasion through the establishment of indigenous vegetation in disturbed or cleared areas.		
4	All areas disturbed within watercourses should be monitored for erosion and incision.		
5	Maintenance schedule to be strictly followed: - Monitoring and maintenance of emerging alien vegetation and the re-emergence of seedlings to take place annually. Remove by hand-pulling as far as possible.		

6	All disturbed areas (where AIPs have been removed (especially where large infestations have been cleared), or as a result of mining activities) should be re-vegetated with an indigenous grass species mix, in consultation with a botanist / horticulturist, ensuring that only indigenous grasses, herbs and shrubs are used.
7	An active campaign for controlling invasive species must be implemented within disturbed zones to ensure that it does not become a conduit for the propagation and spread of invasive plants.
8	Photographs of the site should be taken to assist the process of monitoring the impact of the clearing programme.
9	Liaison with surrounding stakeholders, and the local municipality to control upstream and surrounding nodes of seed production should be undertaken.

3.5 Roles and Responsibilities

The Environmental Control Officer (ECO) or Environmental Manager is the person responsible for the monitoring of the implementation of the AIPCP during all phases of the AIP control activities and for reporting on the degree of compliance. The ECO/ Environmental Manager is mandated to do the following:

- Ensure that all contractors/ subcontractors/ employees are fully aware of their environmental responsibilities. This should take the form of an initial environmental compliance-training program in which requirements of the AIPCP will be explained;
- Monitor AIPCP activities on a regular basis to ensure that there is minimal environmental impact;
- Ensure that there is a mechanism available for Interested and Affected Parties to raise concerns and a mechanism to ensure that all such concerns are addressed;
- The ECO/ Environmental Manager has the authority to stop works if, in his/her opinion, there is/may be a serious threat to or impact on the environment caused directly by the vegetation management operations;
- Review or amend the AIPCP as necessary, and inform the relevant parties of the changes; and
- Conduct an environmental audit and a review of management and rehabilitation measures on an annual basis.

The Contractor must ensure that the conditions of the AIPCP are adhered to. Should the Contractor require clarity on any aspect of the AIPCP the Contractor must contact the ECO/ Environmental Manager for advice.

The ECO/ Environmental Manager must conduct monthly audits during the growing season and establish whether the measures in the AIPCP are applied, where after the ECO/ Environmental Manager reports to the responsible person for environmental oversight. The

responsible person for environmental oversight must ensure that the control plan is implemented and that suitable penalties are in place for non-conformance to the management plan by contractors. The ECO/ Environmental Manager should be the designated authority to issue a stop work order if severe non-compliance is taking place by the contractor.

Points below serve as a summary of the responsibilities of the Contractor:

- The contractor/s, in this case, refers to any contractor/s on site, including the building contractor/s and sub-contractors and vegetation management contractors;
- Such contractor/s will take full responsibility for each of his/her employees and any penalties imposed; and
- It is the responsibility of the contractor/s to ensure that they adhere to the AIPCP.

3.6 Training and Awareness

3.6.1 Training of AIP Control Workers

AIP Control workers must receive basic training in environmental compliance, including minimisation of disturbance to the environment within the MRA, as well as fauna and flora with a no-poaching policy, no animal or plant introduction policy, management of waste and prevention of water pollution.

3.6.2 Contractor Performance

Initially the objective will be to control AIP within the MRA, and once this has been achieved, new objectives must be clearly defined and implemented.

4 CONCLUSION

With the implementation of the AIPCP procedures outlined in this report, the potential negative impacts on the receiving environment may be reduced to acceptable levels. The information gathered through AIP monitoring programs will assist in a better understanding of controlling AIPs and the effect of AIPs on the receiving environment.

Factors considered with respect to the implementation of these plans include the following:

- Integration into management systems, Biodiversity Action and Management Plans and Environmental Management Plans;
- Identification and liaison with stakeholders and neighbouring properties, especially with respect to AIP and erosion control action plans;
- Available budget and manpower for the implementation and removal of AIPs; and
- Individuals responsible for the implementation of the AIPCP should undergo the required training, or it should be ensured that a qualified contractor is appointed for the implementation.

Controlling AIPs within the MRA is of the utmost importance. In this regard, species-specific control methods have been identified and summarised in this report to assist with targeting AIPs at the species level. However, when AIP management is planned, controlling AIPs at the habitat level is the best and most efficient way to ensure a successful outcome. In this regard, AIP Priority Areas were identified in this report, ranging from High to Low priority throughout the MRA. It is recommended that High Priority areas and High Priority species be targeted first, moving on to Medium Priority areas and species, with Low Priority areas and species to be targeted last. Figures 11 - 12 depict the priority areas and priority species.

It is of the utmost importance that the recommendations in this document be updated, based on an annual review of the AIPCP, which must guide future management and should be implemented to ensure the success of the AIPCP. Evidence must be recorded and filed to form part of the annual audit of the progress of the AIP

High Priority AIPs to be targeted:

Acacia mearnsii
Ailanthus altissima
Argemone ochroleuca subsp. *ochroleuca*
Arundo donax
Bidens pilosa
Chenopodium album
Cirsium vulgare
Conyza bonariensis
Conyza canadensis
Cortaderia selloana
Cosmos bipinnatus
Datura stramonium
Physalis viscosa
Phytolacca octandra
Populus × canescens
Schkuhria pinnata
Solanum elaeagnifolium
Solanum nigrum
Solanum sisymbriifolium
Tagetes minuta
Tamarix ramosissima
Verbena bonariensis
Xanthium strumarium

Figure 11: High priority areas with the priority AIPs to be targeted in these areas. Species in green are of lower priority.

Priority AIPs to be targeted:

Acacia mearnsii
Agave americana
Ailanthus altissima
Argemone ochroleuca subsp. *ochroleuca*
Arundo donax
Bidens pilosa
Cirsium vulgare
Conyza canadensis
Cortaderia selloana
Datura stramonium
Nicotiana glauca
Physalis viscosa
Phytolacca octandra
Pinus sp.
Populus × canescens
Schkuhria pinnata
Solanum sisymbriifolium
Tagetes minuta
Tamarix ramosissima
Verbena bonariensis
Xanthium strumarium

Figure 12: Medium priority areas with the priority AIPs to be targeted in these areas. Species in green are of lower priority.

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APPENDIX A: LEGISLATIVE FRAMEWORK

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

The NEMA (Act 107 of 1998) provides the framework and principles for sustainable development and sets national norms and standards for integrated environmental management (Section 24) where all spheres of Government and all organs of State must co-operate, consult and support one another. Section 28 of the Act also imposes a duty of care and remediation of environmental damage on any person who causes, has caused or may cause significant pollution or degradation of the environment.

National Environmental Management Biodiversity Act, 2004 (Act No. 10 of 2004) (NEMBA)

The objectives of this act are (within the framework of NEMA) to provide for:

- The management and conservation of biological diversity within the Republic of South Africa and of the components of such diversity;
- The use of indigenous biological resources in a sustainable manner;
- The fair and equitable sharing among stakeholders of the benefits arising from bio prospecting involving indigenous biological resources;
- To give effect to ratified international agreements relating to biodiversity which are binding to the Republic;
- To provide for co-operative governance in biodiversity management and conservation; and
- To provide for a South African National Biodiversity Institute (SANBI) to assist in achieving the objectives of this Act.

This act alludes to the fact that management of biodiversity must take place to ensure that the biodiversity of the surrounding areas is not negatively impacted upon, by any activity being undertaken, in order to ensure the fair and equitable sharing among stakeholders of benefits arising from indigenous biological resources.

Government Notice Number R. 1020: Alien and Invasive Species Regulations, 2020 (In Government Gazette 43735), Including Government Notice Number 1003: Alien and Invasive Species Lists, 2020 (In Government Gazette 43726) as it Relates to the NEMBA

NEMBA is administered by the Department of Environmental Affairs and aims to provide for the management and conservation of South Africa's biodiversity within the framework of the NEMA. In terms of alien and invasive species. This act in terms of alien and invasive species aims to:

- Prevent the unauthorised introduction and spread of alien and invasive species to ecosystems and habitats where they do not naturally occur,
- Manage and control alien and invasive species, to prevent or minimise harm to the environment and biodiversity; and
- Eradicate alien species and invasive species from ecosystems and habitats where they may harm such ecosystems or habitats.

Alien species are defined, in terms of the National Environmental Management: Biodiversity Act, 2004 (Act no 10 of 2004) as:

(a) A species that is not an indigenous species; or
(b) An indigenous species translocated or intended to be translocated to a place outside its natural distribution range in nature, but not an indigenous species that has extended its natural distribution range by natural means of migration or dispersal without human intervention.

Categories according to NEMBA (Alien and Invasive Species Regulations, 2017):

- **Category 1a**: Invasive species that require compulsory control;
- **Category 1b**: Invasive species that require control by means of an invasive species management programme;

- **Category 2**: Commercially used plants that may be grown in demarcated areas, provided that there is a permit and that steps are taken to prevent their spread; and
- **Category 3**: Ornamentally used plants that may no longer be planted.

Restricted activities (GN R598 National Environmental Management: Biodiversity Act 10 of 2004)

The following activities, applicable to this development project, are defined as restricted activities:

- The spread, or allowing the spread, of any specimen of a listed invasive species; and
- Releasing any specimen of a listed invasive species.

Exempted Alien Species (R.509 National Environmental Management: Biodiversity Act No. 10 of 2004)

Species that are exempted from the provisions of section 65 of NEMBA include:

- Dead specimens of alien species;
- Alien species legally introduced to South Africa prior to the Regulations coming into effect, and which are not on the National List of Invasive Species, including species imported for agricultural purposes; and
- Alien species that are also indigenous species, including those regulated in terms of the Threatened and Protected Species (TOPS) Regulations promulgated under NEMBA; and
- Alien species that are regulated in terms of the Conservation of Agricultural Resources Act (CARA; Act 43 of 1983) as weeds and invader plants.

Conservation of Agricultural Resources Act, 1983 (Act 43 of 1983) (CARA)

Removal of the alien and weed species encountered in the application area must take place in order to comply with existing legislation (amendments to the regulations under the CARA, 1983 and Section 28 of the NEMA, 1998). Removal of species should take place throughout the construction and operation, phases.

The National Water Act, 1998 (Act No. 36 of 1998) (NWA)

The objective of the NWA (Act 36 of 1998) act is to provide for fundamental reform of the law relating to water resources; to repeal certain laws; and to provide for matters connected therewith.

The central guiding principles for the protection, use and management of water resources were identified as sustainability and equity. These principles recognise:

- the basic human needs of present and future generations;
- the need to protect water resources;
- the need to share some water resources with other countries; and
- the need to promote social and economic development through the use of water.

The NWA indicates that watercourses, including wetlands and riparian areas, should be protected.

Occupational Health and Safety Act, 1993 (Act No. 85 of 1993) (OHSA)

The Occupational Health and Safety Act (OHSA; Act 85 of 1993) was administered by the Department of Labour and aim to provide:

- Health and safety of persons at work and for the health and safety of persons in connection with the use of plant and machinery;
- Protection of persons other than persons at work against hazards to health and safety arising out of or in connection with the activities of persons at work; and
- Establish an advisory council for occupational health and safety, which must provide for matters connected therewith.

The Mpumalanga Nature Conservation Act, 1998 (Act No. 10 of 1998) (MNCA)

The Mpumalanga Nature Conservation Act, 1998 (Act No. 10 of 1998) (MNCA) provides for the protection of indigenous plants. Subject to the provisions of this Act, no person shall:

- Pick, be in possession of, sell, purchase, donate, receive as a gift, import into, export, or remove from the Province, or convey:
  - A specially protected plant; or
  - A protected plant.
- Pick any indigenous plant:
  - On a public road;
  - On land next to a public road within 100m measured from the centre of the road;
  - Within an area bordering any natural watercourse, whether wet or dry, up to and within 50m from the high watermark on either side of the natural watercourse; or
  - In a Provincial Park, a site of Ecological Importance or a Protected Natural Environment.

The below schedules were applicable for the floral and faunal assessments (Part B and C):

- Schedule 1: Specifically Protected Game (Section 4 (1) (a));
- Schedule 2: Protected Game (Section 4 (1) (b));
- Schedule 4: Protected Wild Animals (Section 4 (1) (d));
- Schedule 7: Invertebrates (Section 35 (1));
- Schedule 11: Protected Plants (Section 69 (1) (a)); and
- Schedule 12: Specifically Protected Plants (Section 69 (1) (b)).

APPENDIX B: CONTROL METHODS AND PHASES

Initial Control Phase

Integrated Strategies to Control Alien Trees

Control of standing trees (Campbell, 2000):

- **Basal bark:** Recommended herbicide is mixed with diesel as carrier and applied to the basal part of the stem;
- **Strip bark:** Bark is stripped from stem at waist height to ground level;
- **Hand pull:** Saplings and seedlings must be pulled out by hand and regrowth should also be controlled by hand pulling, or foliar spray;
- **Frill:** Use a cane knife and make frills into the stem. Herbicide must be applied (1-2mm per frill) and must be done in 30min after frilling;
- **Foliar spray:** Foliar spray application of specific herbicides; and
- **Soil application:** Herbicide is applied to the soil by means of foliar spray of specific herbicides and taken up by the plant's roots.

Fell trees – control stumps

Trees should be felled and as soon as the trees are down, the stumps need to be treated with a registered herbicide mix with suitable dye listed in Table 5 in this report and applied with a paintbrush, hand sprayers or knapsack sprayers. A low pressure must be used when using the hand- and knapsack sprayers, and a solid cone nozzle, e.g. CE1 or TG1. Wood needs to be removed and areas must be revegetated with grass species occurring naturally in the area (Campbell, 2000).

The following equipment must be used to cut trees and saplings:

- Chainsaw;
- Bow saw;
- Brush cutter;
- Cane knife; and
- Trolley mounted roll saw, e.g. "Bosvreter".

NB: The height of the cut stump must not exceed 15cm.

- **Methods for controlling trees:**
  - Cut stump treatment;
  - Total stump treatment; and
  - Using herbicide plugs.

- **Methods for controlling coppice, saplings and seedlings:**
  AIP infestation can comprise of different growing forms, and some of the growth forms cannot be utilised. These plants need to be cut with a brush cutter and the stumps need to be treated with herbicide that was mixed with a dye to show where treatment was applied. Foliar spray of the coppice tends to be the most effective method to use.

Placement of disposed wood is very important because if a fire breaks out, the brushwood can increase the intensity of the fire. When the fire intensity is too high, soil structure will be broken down and seedbanks in the soil will also be destroyed and bare patches of sterilized ground will be formed. The best practice is to use the branches to control erosion, create habitat or chip and remove for compost, bricketing or even as a fuel source. The utmost care must be taken to prevent any seeds of AIPs from spreading when using branches as brush packing.

Integrated Strategies to Control Alien Shrubs

- **Alien shrubs that are less than 1m tall (Campbell, 2000):**
  - Registered herbicide must be used for foliar application;
  - Selective broadleaf herbicide that will not negatively impact on grass must be used when foliar application is done. When grass is not present, a selective or non-selective registered herbicide can be used;
  - Whenever dense seedling growth that are of uniform height are present, a flat fan nozzle with knapsack must be used; and
  - Seedling growth that is of uneven height (root suckers, short saplings, and coppice growth) a cone nozzle must be used.
- **Alien shrubs that are taller than 1m (Campbell, 2000):**
  - Shrubs that are taller than 1m must be reduced by using a brush cutter or cane knives; and
  - Mechanical uprooting of shrubs is not always a preferred method because the soil is disturbed, and this increases the risk of alien vegetation infestation. Erosion is also promoted by this activity, and soil loss will occur. Mechanical uprooting can be done in areas that have a dense grass cover, as the roots of the grass will keep the soil intact. After uprooting the soil must be levelled and, if grass seeds are present, some grass seeds must be placed on these areas to promote grass regrowth.

Integrated Strategies to Control Alien Herbs (Milton, 2016)

Mechanical Control

Obstructive / encroaching indigenous vegetation or AIP species are to be manually or mechanically removed as far as possible. In order to prevent chemical contamination of the watercourses, chemical control should be avoided.

- **Manual removal:**
  - Immature, broad-leaved herbaceous weeds can be removed easily with a hoe or spade; and
  - Should the weeds have seed heads they must be gathered up, put in garbage bags or waste drums, transported and disposed of at a licensed waste disposal facility.

Chemical Control: taken from Safe and Effective Herbicide Use: A handbook for near-water applications. Online available at: https://www.epa.sa.gov.au/files/477387_pesticide_water.pdf:

Where manual removal consistently fails to reach control targets of AIP species and chemical control is deemed necessary, the following considerations are important:

- Prior to using herbicides in a watercourse or its edge, ensure you have considered all non-chemical options. If there is no alternative, then ensure that appropriate herbicide and application techniques are selected for the site as per herbicide label information and the Working for Water Herbicide guideline;
- **Pre-emergent herbicides are not suitable for watercourse use** – These herbicides are typically applied before the pest plant germinates and are often residual in the soil for long periods. They are generally not considered to be safe for use near waterbodies and are not recommended for use due to their persistence in the environment;
- **Selective herbicides** are designed to act on only one type of pest plant. Generally, selective herbicides will control either broadleaf species, grasses or woody weeds. These herbicides are useful when the focus may be on controlling a particular weed species. These herbicides may persist as residues in the environment and only registered herbicides for targeted species should be used;

- **Non-selective herbicides, if applied correctly, could have a minimal impact on the environment**. These herbicides are designed to be applied directly to the target pest plant, either through being sprayed onto foliage or applied directly to the cambium layer;
- If herbicide use is deemed necessary, the time of herbicide application needs to coincide with a time when rainfall, and t run-off, is likely to be low so to minimise impacts on aquatic life; and
- Preventing re-establishment will require follow-up control and revegetating the area with native grasses and shrubs.

Integrated Strategies to control alien grasses:

- **Burning**: Not recommended as burning can stimulate alien grasses and lead to in-effective management.
- **Hand clearing**: Not recommended for dense infestations as hand clearing / pulling can lead to significant soil disturbance and, consequently, can promote the establishment of alien grasses or other pioneer alien species.
- **Mowing**: Effective for dense stands of annual grasses if performed where grasses are in flower and seed has not yet set.
- **Chemical control**: Most effective method of controlling alien grasses. Pre-emergent systemic herbicides are most effective. Use within the riparian zone or a watercourse is however not recommended.
- Chemical control to be restricted to registered herbicides only.

Ongoing Control Phase

Follow up Control (Campbell, 2000)

Follow-up control is essential to control AIP saplings, seedlings and coppice regrowth in order to achieve and sustain the progress that was made with the initial control work. If the follow-up control phase is neglected, the AIP infestation will likely re-emerge and will be more severe and denser than before the control proses started. It is essential to sustain the follow-up phase because it will prevent alien seedlings from suppressing planted grasses.

Follow up treatment control must use the following methods:

- Chemical control methods: Only use registered herbicides to control any AIP species. Instruction on the herbicide labels must be followed carefully. Chemical control within watercourses to be avoided at all cost;
- Mechanical control methods; and
- Biological control methods that are available.

Control Methods for Dense Regrowth (Campbell, 2000)

After initial control operations, dense regrowth may arise, because of re-sprouting in the form of stump coppice, seedlings and root suckers. Below are the recommendations to combat dense regrowth:

- **Chemical control / foliar application:**
  - Plants that are less than 1m in height must be controlled by foliar application;
  - Dense seedling growth must be controlled with knapsack sprayers with a flat fan nozzle;
  - If grass is present, the use of a registered selective herbicides must be used as to not harm the grass, and if grass is not present a registered non-selective or selective herbicide can be used; and
  - Suitable dye must be used at all times as to limit over- or under spray of areas.

- **Mechanical control:**
  - Areas with dense stands of seedlings should not be uprooted or hoed out unless active revegetation with correct species will be done, as these areas will result in soil disturbance and will in return promote flushes and germination of AIP seedling growth; and
  - When stump density is high, plants should be cut with brush cutters and the top growth must be removed. Stumps will start to coppice, and foliar spray must be used to control the coppice regrowth.

- **Biological control:**
  - As a rule, biological agents are only released within dense infestations of AIPs, as this will ensure that the biological agent will have enough food and will also increase the chances of establishment;
  - Unfavourable climatic factors (too wet or drought) can play a major role in biological agents not establishing in the area;
  - Dispersal of agents between infested areas can also be problematic and the need of separate introduction might be required for each separate site;
  - It is of utmost importance that any biological agent that is released on dense infestation must be noted during the AIP survey, as this will affect the AIP control program; and
  - Areas where a biological agent is established, and nursery areas may not be sprayed with herbicide. Areas where biological agents are released must be mapped and record must be kept of these sites

Control Methods for Low-medium Density Regrowth (Campbell, 2000)

Neglecting to control low-medium density regrowth will result in densification and spreading and will result in a more costly to control situation. Low- medium density areas must be controlled, and these methods are considered:

- **Chemical control:**
  - Cut stump method must be used and stumps must be cut up to a height of 15cm and must be sprayed within an hour of cutting the plant with a registered herbicide. Herbicide must be applied with knapsack sprayers set to a low pressure, using cone nozzles e.g. TG1 or CE1. Hand sprayers can also be used to apply herbicide. A suitable dye must be used to prevent any stumps from not being treated. Only the cut surface must be treated with herbicide and the side of the stumps must not be treated; and
  - Foliar spray can be applied to regrowth that is up to the height of 1m. Herbicide must be applied using knapsacks with solid cone nozzle and must be mixed with a suitable dye as to prevent over- or under spraying of treated areas.
- **Mechanical control:**
  - Seedlings can be removed from wet soil by hand pulling. Gloves can be used to protect hands during the operation.

APPENDIX C: ALIEN AND INVASIVE PLANT CONTROL PLANNING

Principles of the AIPCP

To assist in achieving the objectives of the AIPCP, a set of principles were applied, which contributed to the formulation of action plans and specific management measures. The principles of the AIPCP are:

- Minimising impacts by limiting aspects of an action which could lead to environmental damage;
- Rectifying impacts through rehabilitation, restoration, etc. of the affected environment;
- Minimising impacts by optimising processes, structural elements and other design features;
- Provide ongoing monitoring and management of environmental impacts of a mine and documenting of any digressions/good performances; and
- The AIPCP, once approved for implementation by the relevant authorities, should be incorporated into the Environmental Management Plan (EMP) which is a legally binding document that all parties involved, as listed in Appendix C, must be informed about. AIPs can be very difficult to control and review of the AIPCP Must be done every two years in order to adapt the program as to ensure the AIPCP is up to date.

The following points are essential aspects to be avoided in order for an AIPCP to be successful (Coetzee, 2005):

- **Poor planning**: Occasional treatment by workers when time is available. AIP control is set out as a low priority and little to no consideration is given;
- **Impractical approach**: AIP control starting with densely infested AIP instead of lightly infested areas that are easier to control and more cost-effective;
- **Inflexible approach**: Not adapting methods of controlling AIP to changing weather or local conditions;
- **Improper use of control methods**: AIPs are not killed when treated, the herbicide that is used is incorrect and/or wrongly applied, as well as wrong application of control method in a season;
- **No control follow-up**: Areas that were treated are not revisited to treat any new growth or seedlings;
- **Absence of guidance**: Landowners are not always informed on how to get rid of AIP on their land. Workers that carry out the control methods do not always have the right training to do so and also received very little guidance; and
- **Not understanding the cost involved of control method**: Inexperience with AIP control methods usually result in inadequate financial planning.

Gathering of information (Campbell, 2000)

- The subject property/ AIP Priority area Must be divided into specific control areas. Use man-made or natural boundaries to specify specific areas e.g. roads, fences. Each area Must be numbered to simplify record keeping;
- A detailed AIP survey Must be performed in each numbered area, and the following information Must be recorded:
  - AIP species that are present during the survey and their specific growth form e.g. herb, shrub and trees, including any coppice present;
  - Density of infestation Must be recorded in an estimation of percentage (%) cover:
    - 0-5% Scattered infestation;
    - 5-25% Sparse;
    - 25-50% Medium;
    - 50-75% Dense;
    - 75-100% Very dense;
  - These areas Must be ranked Low, Medium or High priority for control of AIP and rehabilitation. The following criteria Must be used to rank the area according to importance: Threat to biodiversity, carrying capacity and water yield; and
  - Suitable grass species for the specific land use Must be determined and grass naturally occurring in the area Must be used to rehabilitate the area.

Planning all Aspects of the Control Program (Campbell, 2000)

- All required resources Must be listed for each priority area e.g. equipment, herbicide, labour;
- Each area Must be evaluated and the correct registered herbicide for the AIP occurring in the specific area Must be used;
- Cost calculations Must be performed for each area and addressed according to priority; and
- Long-term AIP control funds Must be secured, as the success of the entire program will depend on it. Rehabilitation is a big factor and long-term commitment Must be secured, as neglecting to rehabilitate will increase the chance of AIP re-infestation.

During the planning phase, the points below Must be considered, and available funds Must be used optimally in order to effectively control AIPs:

- The following should be considered for the AIP control program to be successful:
  - Budget to estimate the cost of equipment and chemicals;
  - Transport and labour; and
  - AIP control programs are very expensive, and it is of utmost importance that cost, and planning estimates are done correctly, and that funding is used effectively.
- Goals and objectives for the project Must be clear so that the AIPCP can be shaped around other programs and help to achieve control of AIPs;
- The AIPCP Must be motivated in such a way as to keep it a long-term project, as it is of utmost importance that follow-up treatment is budgeted for and undertaken. This will ensure the success of the AIPCP within the priority areas;
- The control plan Must be developed in such a way as to ensure that:
  - Annual input into the program is low; and
  - The level of impact of AIP on the environment is low;
- AIP control can be divided into phases, namely, initial control and follow-up control. The initial control is usually the most costly but, as the follow-up control is implemented, the cost of control is reduced until only a minimal cost is used at the maintenance level of control; and
- It is of utmost importance that the follow-up operations are budgeted and planned for, as neglecting to initiate and maintain a follow-up program will result in a denser infestation of AIPs after initial control. Follow-up operations Must also be done on a minimum of two to three follow-ups after initial control, especially during the first growing season, so as to control any coppice, saplings and seedlings that may be present. Follow-ups Must be done for a minimum period of five years to ensure that new infestation of AIPs do not occur and to ensure the success of the AIPCP.

Implement Annual Alien and Invasive Control Plan (Campbell, 2000)

- An Annual Operation Plan (AOP) Must be implemented for areas that are of high priority. The following Must be included into the budget for the specific resources e.g. equipment, herbicide and labour. Care Must be taken not to control too large of an area at a time. The following is an approximate indication of how much of the budget Must be dedicated to each aspect:
  - 75% Must be used to follow-up control and also rehabilitation of the previous year's work;
  - 20% Must be used to control new areas; and
  - 5% will be for an emergency e.g. loss of planted grass, mass seed regeneration or coppice.
- Timetables Must be created for the control operations. Care Must also be taken to include the time when operations fall behind due to unfavourable weather or labour strikes; and
- The plan Must be set out in such a way that it should be flexible enough as to adjust it, so progress is made.

Record Keeping (Campbell, 2000)

- It is of utmost importance to keep records of all AIP control because it will set a baseline to compare to during the control phase;
- Records of labour days, herbicide volume and equipment used per site Must also be kept in order to ensure operations are kept within budget; and
- Sound record keeping will also ensure that the progress made with the control phase will be monitored. Feedback from the record-keeping can be used to update and amend the budget for the follow-up control operations to control the regrowth of AIP.

APPENDIX D: PROPOSED FIELD FORM FOR MEETING TARGETS AND TIMEFRAMES

Priority	Target Area	Specific Goal	Measurable Goal	Assignable Goal	Realistic Goal	Time-bound Goal
High	AIP Tree Stands within watercourses					
	Historically cultivated areas left unrehabilitated					
	Rehabilitated areas and Topsoil Stockpiles					
	Watercourses					
Medium	Actively mined areas and currently cultivated fields					
Low	AIP Tree Stands					
	Natural Grasslands					

APPENDIX E: EXAMPLE OF THE PROPOSED FIELD FORM FOR REPORT CONTENT

Date:					**Photo(s) of infestation:**
Name of recorder:					
MANAGEMENT UNIT DESCRIPTION AND INFORMATION					
Priority Area name:					
Priority Area number	**High 1**				
GPS location:					
AIP control present:	**YES**		**NO**		
AIP regrowth (Recruitment) present (where applicable):	**YES**		**NO**		
Description of Infestation:	(Species, Diversity, Abundance, Density, Extent, level of recruitment and trends.)				

Recommendations / Notes		
Overall Alien Plant Management Priority	High	The majority of the AIPs recorded at the culvert was present in relatively dense stands and threaten to disrupt the flow through the culvert if not managed. The clearance of species falling under NEMBA Category 1b are given a high priority despite being present in low quantities – by law required to be removed The AIP cover consists mainly of herbaceous species, thus manual and mechanical clearing is suitable.

ALIEN AND INVASIVE PLANTS: INSPECTION SHEET						
Check box	**Species Name**	**Common Name**	**NEMBA Category**	**CARA Category**	**Estimated cover (High /Medium /Low)**	**Priority (High /Medium /Low)**
SHRUB SPECIES						
X	*Sesbania bispinosa*	Spiny sesbania	NL	NL	**Medium**	**Low**
X	*Tecoma stans*	Yellow bells	1b	1	**Low**	**High**
HERBACEOUS SPECIES						
X	*Bidens pilosa*	Common Blackjack	NL		**Low**	**High**
	Tagetes minuta	Khakiweed	NL	NL		
	Verbena bonariensis	Wild verbena, Tall verbena	1b	1b		

X	*Xanthium strumarium*	Large cocklebur	1b	1b	**High**	High
	Hibiscus trionum	Bladder hibiscus	NL	NL	**Low**	Medium
	Flaveria bidentis	Smelter's bush	1b	NL	**Medium**	Medium
SUCCULENT SPECIES						
	Agave americana	Spreading century-plant	NL	NL		
X	*Opuntia ficus-indica*	Sweet Prickly Pear	1b	1		
GRASS SPECIES						
	Cortaderia selloana	Pampas Grass	1b	1	**Medium**	High
Additional AIP species found on site						
	Pennisetum clandestinum	Kikuyu Grass	1b	NL		

APPENDIX F: Details, Expertise And Curriculum Vitae of Specialists

1. (a) (i) Details of the specialist who prepared the report

Christien Steyn	MSc Plant Science (University of Pretoria)
Nelanie Cloete	MSc Botany and Environmental Management (University of Johannesburg)

1. (A). (ii) The expertise of that specialist to compile a specialist report including a curriculum vitae

Company of Specialist:	Scientific Terrestrial Services		
Name / Contact person:	Nelanie Cloete		
Postal address:	PO. Box 751779, Gardenview		
Postal code:	2047	Fax:	086 724 3132
Telephone:	011 616 7893		
E-mail:	Nelanie@sasenvgroup.co.za		
Qualifications	MSc Environmental Management (University of Johannesburg) MSc Botany (University of Johannesburg) BSc (Hons) Botany (University of Johannesburg) BSc (Botany and Zoology) (Rand Afrikaans University)		
Registration / Associations	Professional member of the South African Council for Natural Scientific Professions (SACNASP) Member of the South African Association of Botanists (SAAB) Member of the International Affiliation for Impact Assessments (IAIAsa) South Africa group Member of the Grassland Society of South Africa (GSSA)		

Company of Specialist:	Scientific Terrestrail Services		
Name / Contact person:	Christien Steyn		
Postal address:	PO. Box 751779, Gardenview		
Postal code:	2047	Fax:	086 724 3132
Telephone:	011 616 7893		
E-mail:	christien@sasenvgroup.co.za		
Qualifications	MSc (Plant Science) (University of Pretoria) BSc (Hons) Plant Science (University of Pretoria) BSc (Environmental Sciences) (University of Pretoria)		
Registration / Associations	Registered Professional Scientist at South African Council for Natural Scientific Professions (SACNASP) Member of the South African Association of Botanists (SAAB) Member of the Botanical Society of South Africa (BotSoc)		

1. (b) a declaration that the specialist is independent in a form as may be specified by the competent authority

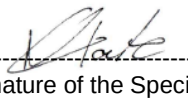
I, Christien Steyn, declare that -

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

Signature of the Specialist

I, Nelanie Cloete, declare that -

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



Signature of the Specialist

SAS ENVIRONMENTAL GROUP OF COMPANIES – SPECIALIST CONSULTANT INFORMATION

CURRICULUM VITAE OF CHRISTIEN STEYN

PERSONAL DETAILS

Position in Company	Floral Ecologist
Joined SAS Environmental Group of Companies	2018

MEMBERSHIP IN PROFESSIONAL SOCIETIES

Member of the South African Association of Botanists (SAAB)
Member of the Botanical Society of South Africa (BotSoc)
Professional member of the South African Council for Natural Scientific Professions (SACNASP)

EDUCATION

Qualifications

MSc (Plant Science) (University of Pretoria)	2017
BSc (Hons) Plant Science (Invasion Biology) (University of Pretoria)	2014
BSc Environmental Science (University of Pretoria)	2013

AREAS OF WORK EXPERIENCE

South Africa – Gauteng, Mpumalanga, North West, Limpopo, KwaZulu-Natal, Northern Cape, Free State

KEY SPECIALIST DISCIPLINES

Biodiversity Assessments

- Terrestrial Ecological and Biodiversity Scoping Assessments
- Terrestrial Ecological and Biodiversity Screening Assessments
- Floral Assessments
- Input into Terrestrial Rehabilitation Plan design with the focus on the re-establishment of vegetation
- Floral Rescue and Relocation Plans
- Alien and Invasive Control Plan (AICP)
- Alien and Invasive Plant Identification and awareness training
- Terrestrial Monitoring
- Protected Tree and Floral Marking and Reporting
- Desktop Studies, Mapping and Background Information Research

Training

- Practical Plant Identification, including Herbarium Usage and Protocols
- Vegetation Classification and Mapping: Use of Geographic Information System for understanding vegetation pattern and biodiversity conservation.
- Introduction to Statistics for Biologists: Applications of plant ecology principles in plant conservation, i.e., species distribution modelling, alien plant invasions, conservation planning
- Plant Functional Trait Course: Hands-on, field-based exploration of plant functional traits, along with experience in the usage of plant traits data in climate-change research and ecosystem ecology

SAS ENVIRONMENTAL GROUP OF COMPANIES – SPECIALIST CONSULTANT INFORMATION

CURRICULUM VITAE OF NELANIE CLOETE

PERSONAL DETAILS

Position in Company	Senior Scientist, Member Botanical Science and Terrestrial Ecology
Joined SAS Environmental Group of Companies	2011

MEMBERSHIP IN PROFESSIONAL SOCIETIES

Professional member of the South African Council for Natural Scientific Professions (SACNASP – Reg No. 400503/14)
Member of the South African Association of Botanists (SAAB)
Member of the International Affiliation for Impact Assessments (IAIAsa) South Africa group
Member of the Grassland Society of South Africa (GSSA)
Member of the Botanical Society of South Africa (BotSoc)
Member of the Gauteng Wetland Forum (GWF)

EDUCATION

Qualifications

MSc Environmental Management (University of Johannesburg)	2013
MSc Botany (University of Johannesburg)	2007
BSc (Hons) Botany (University of Johannesburg)	2005
BSc (Botany and Zoology) (Rand Afrikaans University)	2004

Short Courses

Certificate – Department of Environmental Science in Legal context of Environmental Management, Compliance and Enforcement (UNISA)	2009
Introduction to Project Management - Online course by the University of Adelaide	2016
Integrated Water Resource Management, the National Water Act, and Water Use Authorisations, focusing on WULAs and IWWMPs	2017

AREAS OF WORK EXPERIENCE

South Africa – Gauteng, Mpumalanga, North West, Limpopo, KwaZulu-Natal, Northern Cape, Eastern Cape, Free State
Africa - Democratic Republic of the Congo (DRC)

KEY SPECIALIST DISCIPLINES

Biodiversity Assessments

- Floral Assessments
- Biodiversity Actions Plan (BAP)
- Biodiversity Management Plan (BMP)
- Alien and Invasive Control Plan (AICP)
- Ecological Scan
- Terrestrial Monitoring
- Protected Tree and Floral Marking and Reporting
- Biodiversity Offset Plan

Freshwater Assessments

- Desktop Freshwater Delineation
- Freshwater Verification Assessment
- Freshwater (wetland / riparian) Delineation and Assessment
- Freshwater Eco Service and Status Determination
- Rehabilitation Assessment / Planning
- Plant species and Landscape Plan

Legislative Requirements, Processes and Assessments

- Water Use Applications (Water Use Licence Applications / General Authorisations)
- Environmental and Water Use Audits
- Freshwater Resource Management and Monitoring as part of EMPR and WUL conditions