



GA Environment

ALIEN INVASIVE MANAGEMENT PLAN

**FOR THE PROPOSED SLURRY AND RETURN WATER PIPELINE FROM TGT 2 TAILINGS STORAGE
FACILITY (TSF) TO FREDDIE'S 9 TSF, ALLANRIDGE (WELKOM) IN THE FREE STATE PROVINCE**

DMRE REF: FS30/5/1/2/226MR

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Prepared for:

Harmony Gold Mining Company Limited

Randfontein Office Park
Cnr Main Reef Road and Ward Avenue
Randfontein
Gauteng
1759

Submitted to:

Department of Mineral Resources and Energy

The Strip Building 314
C/O Stateway & Bok Street,
Welkom
Free State
9460

Prepared by:

GA Environment (Pty) Ltd

P.O. Box 6723
Halfway House
Midrand
1685
Tel. No.: (011) 312 2537
Fax. No.: (011) 805 1950

e-mail: environment@gaenvironment.com

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PROJECT INFORMATION

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Applicant: Harmony Gold Mining Company Limited

Environmental Assessment Practitioner: GA Environment (Pty) Ltd.

Compiled by: Vukosi Mabunda: *MSc, Reg. EAP, Pri.Sci.Nat*

Approver: Reviewer: Nyaladzi Nleya: *BSc Hons, Pri.Sci.Nat*
Approver: Nkhensani Khandhela: *MSc*

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Original	Prepared by	Reviewed by	Approved by
Date: 25 November 2022	Name: Vukosi Mabunda	Name: Nyaladzi Nleya	Name: Nkhensani Khandhela
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1 INTRODUCTION

GA Environment (Pty) Ltd, has been appointed by Harmony Gold Mining Company (Harmony) to undertake a Basic Assessment and a Water Use Licence Applications process for the proposed construction a new slurry and return water pipelines from Target Tailings Storage Facility to Freddie's 9 Tailings Storage Facility (TSF). The Free State Operations have been mining the Vaal Reefs since approximately 1950. The Target Operations consist of Target Plant and the three shafts (Target 1, 2 and 3 Shafts). The associated supporting infrastructure includes the metallurgical plant which processes gold, the tailings storage facilities (TSF), waste rock dumps and the sewage treatment plant. Target 1 Shaft operations are at the depths of the underground workings of approximately 2500m below ground level. Operations at Target 2 Shaft ceased during 2009 and the underground workings have been flooded.

Infrastructure at this shaft has not been demolished as the old hostels are currently used to store core samples. Operations at Target 3 Shaft ceased in September 2014 and the shaft is currently under care and maintenance. This shaft continues to pump water from the underground workings to maintain safe operations at Target 1 Shaft, as these two shafts are connected via their underground workings. The Target Metallurgical Plant is situated south of Target 1 Shaft, where reef material from Target 1 Shaft and waste rock from the waste rock dumps at the shafts is processed. Harmony Gold Mining Company (Harmony) is proposing to construct a new slurry and return water pipeline from Target TSF to Freddie's 9 TSF to deposit tailings at the Freddie's 9 TSF as Target 1 and 2 TSF is reaching their final design height and are unserviceable.

The National Environmental Management Act 107 of 1998, as amended (NEMA) and the Environmental Impact Assessment Regulations 2014 (as amended) requires that listed activities follow an Environmental Authorisation (EA) process from the competent authority prior to commencing with the activity. Since the proposed pipelines will be transporting mining slurry and return water and deposit tailing and directly relate to the extraction and the primary processing of a mineral, the Department of Mineral Resources & Energy will be the competent authority for the environmental authorisation as stipulated in the Mineral and Petroleum Resources Development Act, Act 28 of 2000. Based on the triggered listed activities as indicated in the basic assessment report, a basic assessment process is required has been undertaken to determine any potential environmental impact that will emanate during the construction of the pipeline.

It must be noted that the Basic Assessment (BA) process was also triggered due to four listed activities that were applicable as the proposed construction of the pipeline will result in the clearance of indigenous vegetation and development of infrastructure within 32m and 100 metres of wetlands or watercourses. Some of the construction activities associated with the development of the pipelines will require the clearance of existing vegetation, thereby creating favourable conditions for weeds to invade the cleared areas. It is for such reasons that the compilation of the Alien Invasive Management plan has been undertaken to support the application. This document will provide the contractor, the Developer, and the ECO with guidelines on how to effectively manage alien invasive species throughout the proposed slurry and return water pipes. This plan must be implemented in conjunction with the approved EMPr as well as other management plans prepared for this proposed development (Rehabilitation Plan and Soil Erosion Management Plan). The exact details of the alien invasive management plan will depend on the extent of the site, working area conditions, available manpower, and the desired environmental compliance state of the site as stipulated in the EA and EMPr.

1.1 Site location

The existing slurry and return water pipelines are located in the Free State Province within the Lejweleputswa District Municipality (LDM), approximately 7 km north of Odendaalsrus, 3 km south of Allanridge and 26 km east of Wesselsbron. The proposed development site is located in Allanridge west of the Nyakallong Township. The proposed return water pipeline will be 8.3km long and the proposed slurry pipeline will be about 5.6km in length.

The proposed new pipeline starts from Freddie's 9 Dam at coordinates 27°50'31.66"S and 26°40'32.30" and heads northwest and to the immediate northeast of TGT 2 TSF. The end coordinates where the TGT 2 TSF ends are 27°47'32.23"S and 26°38'20.25"E (**Figure 1 and 2**). From this point, the proposed pipelines will be connected to the existing pipelines towards the Target Plant. The two pipelines will run parallel to each other along the proposed route. One of the pipelines will transport tailings from the Target Gold Plant to the existing Freddie's 9 TSF and the other will transport return water from Freddie's return water dam (RWD).

The proposed slurry pipeline of 5.6km will have a diameter of 300mm and an average flow rate of 93 ℓ/s and starts from TGT 2 TSF to the Freddie's 9 TSF. The proposed return water pipeline (8.3km) starts from Freddie's 9 Return Water Dam (RWD) and heads northwest to immediately northeast of TGT 2 TSF where it is connected to the existing pipelines towards the Target Plant. The return water pipe will have a diameter of 200mm and an average flow rate of 40 litres per second (ℓ/s). The two pipelines run parallel to each other along the proposed route as illustrated in Figure 1. One pipeline will transport return water from Freddie's return water dam (RWD) and the other pipeline tailings from Target Plant to Freddies TSF. The site locality is indicated in **Figure 1 and Figure 2**.

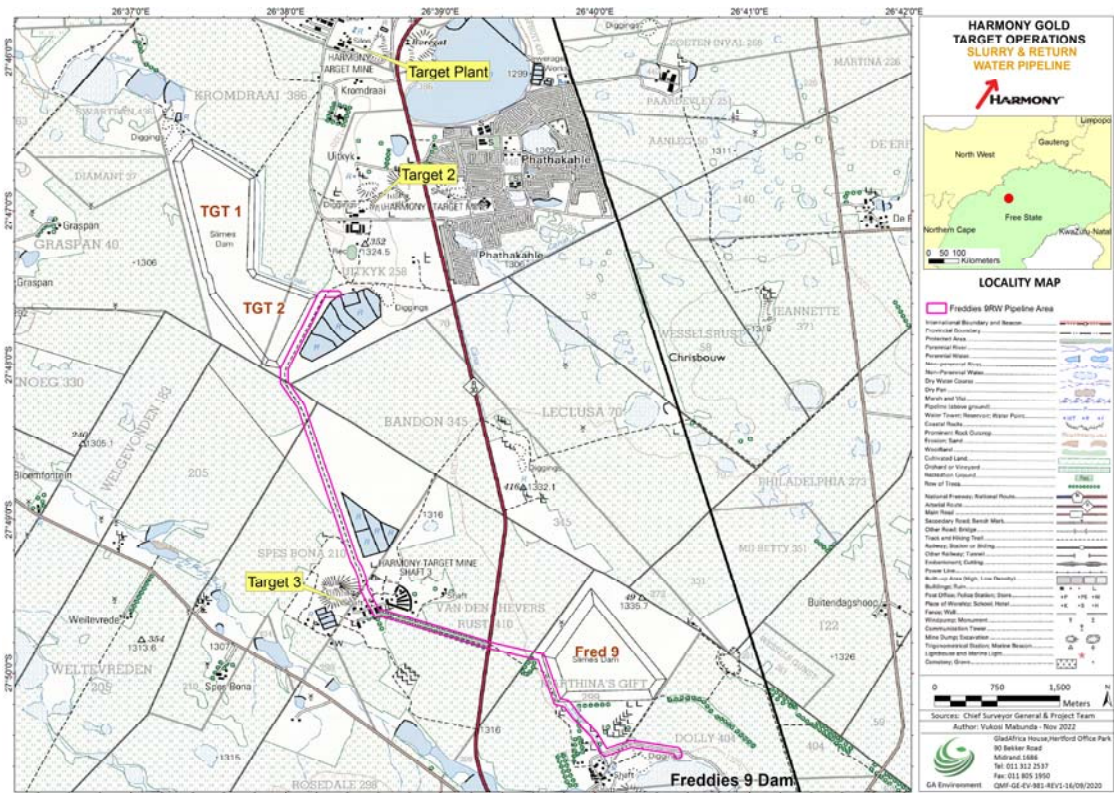


Figure 1: Locality map (topographical) of the slurry and return water pipelines

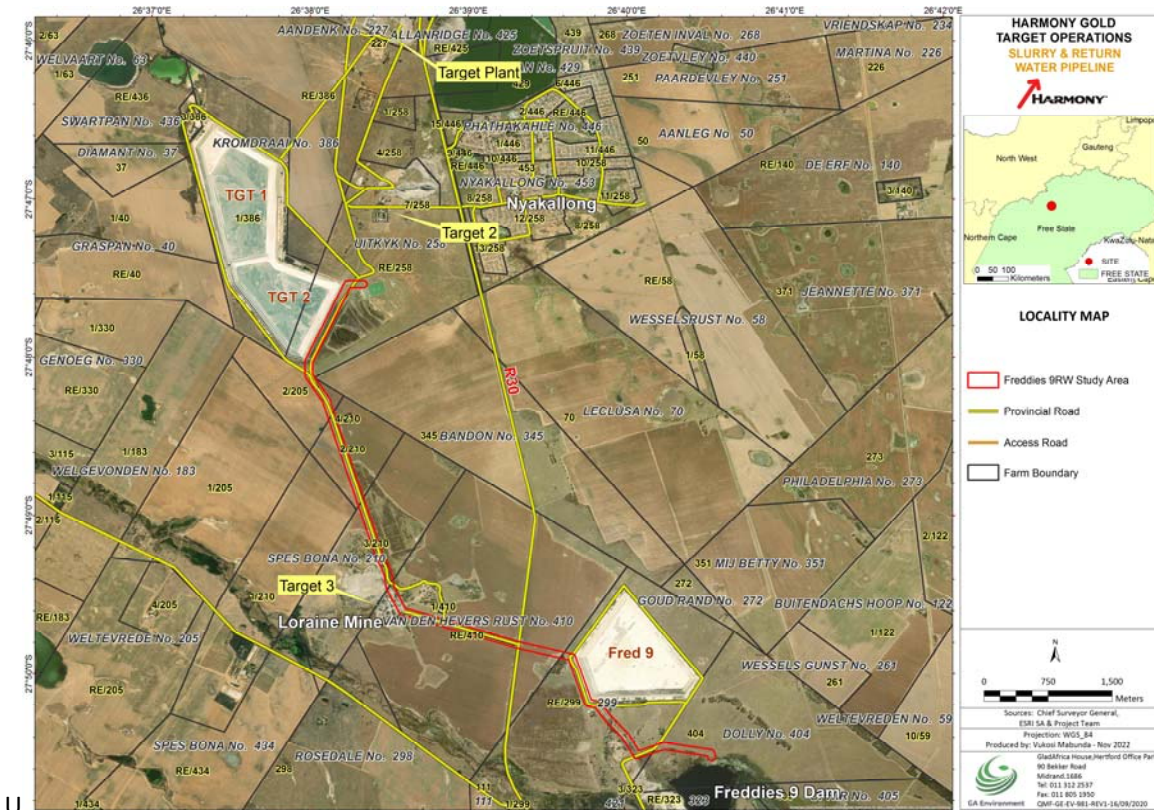


Figure 2: Locality map (orthophoto) of the slurry and return water pipelines

The two pipelines will be installed parallel to each other along the proposed route highlighted in **Figure 1** and **Figure 2**. One pipeline will transport return water from Freddies return water dam (RWD) and the other pipeline tailings from Target Plant to Freddies TSF. The pipes will be a flanged steel pipes installed above-ground on pre-cast concrete plinths and will cross underneath the R30 road through a culvert. A 3.5m wide access road, adjacent to the pipelines, will be cleared/graded to provide access for construction, maintenance and inspections.

1.2 Ecological setting

According to the information obtained from the Terrestrial Biodiversity Assessment Report undertaken by the Biodiversity Company (2022), the project area is situated within the Grassland Biome. In terms of vegetation structural composition, grasslands are characteristically dominated by grasses of the *Poaceae* Family (Mucina & Rutherford, 2006). The Grassland Biome in South Africa occurs mainly on the Highveld, the inland areas of the eastern seaboard, the mountainous areas of KwaZulu-Natal and the central parts of the Eastern Cape. The topography is mainly flat to rolling, but also includes mountainous regions and the Escarpment (Mucina & Rutherford, 2006). Major macroclimatic traits that characterize the Grassland Biome include:

- Summer to strong summer rainfall and winter drought; and
- Frost is common, and fog is found on the upper slopes of the Great Escarpment and seaward scarps (Mucina & Rutherford, 2006).

On a fine-scale vegetation type, the project area is located within the Vaal-Vet Sandy Grassland. The Vaal-Vet Sandy Grassland vegetation type is restricted to the North-West and Free State Provinces, where it extends south of Lichtenburg and Ventersdorp, stretching southwards to Klerksdorp, Leeudoringstad, Bothaville and to the Brandfort area north of Bloemfontein. The ecosystem is characterised by a plains-dominated landscape with some scattered, slightly irregular undulating plains and hills. Mainly low-tussock grasslands are present with an abundant karroid element, where the dominance of *Themeda triandra* is an important feature (Mucina & Rutherford, 2006). Some of the invasive species recorded during the ecological assessment include *Eucalyptus camaldulensis* and *Salsola kali* (**Figure 3**).



Figure 3: Some of the invasive species *Eucalyptus camaldulensis*(left) and *Salsola kali*(right) (TBC, 2022)

Three habitat units are delineated for the project area: Transformed, Modified Sandy Grassland, and Seep Wetland (**Figure 4**). The Transformed habitat unit includes all areas that maintain very little to no functional vegetation, such as portions of cultivated land and areas utilised for roads and mining activity. Modified Sandy Grassland was found to occur in largely separated sections along the pipeline routes and

is characterised by overgrazed and disturbed fields dominated by pioneer species. These portions do however maintain a level of ecosystem functionality, particularly towards the south of the pipeline routes around Freddie's Dam, and they will be supportive of regular fauna activity. The seep wetland unit includes the three artificial wetland systems which intercept with the specified pipeline routes, as delineated and defined by the project freshwater assessment report (TBC, 2022). Although these systems were listed as 'Seriously Modified' by the wetland report, they maintain an important level of functionality which supports the local fauna species and encourages regular foraging in the area.



Figure 4: Illustration of the seep wetland unit and adjacent modified sandy grassland, habitat units (TBC, 2022)

According to Mucina and Rutherford (2006) Vaal-Vet Sandy Grassland vegetation type is classified as 'Endangered', with the national target for conservation protection being 24%, only very small parts are statutorily conserved in the Bloemhof Dam, Schoonspruit, Sandveld, Faan Meintjies, Wolwespruit and Soetdoring Nature Reserves. More than 63% has been transformed for cultivation (ploughed for commercial crops) and the rest is under strong grazing pressure from cattle and sheep. The vegetation type in the area is indicated in **Figure 5**.



Figure 5: Vegetation types within the study area (TBC, 2022)

The terrestrial biodiversity theme sensitivity as indicated in the screening report (compiled by the National Web based Environmental Screening Tool) was derived to be ‘Very High’. The completion of the terrestrial biodiversity desktop and field studies disputes the ‘Very High’ sensitivity presented by the screening tool report, as relevant to the proposed footprint areas. As discussed above, the proposed footprint area is largely degraded and as such it is assigned an overall sensitivity rating of ‘Very Low’ to ‘Low’. The screening report classified the animal species theme sensitivity as being of a ‘High’ sensitivity, and the plant species theme as ‘Low’. Following the field survey findings, both the animal and plant species themes should be classified as ‘Low’ sensitivity. This is due to the fact that the frequent occurrence of sensitive SCC is considered unlikely within the local habitats as they maintain only a low level of functionality. Summary of habitat types delineated within field assessment area of the project area is provided in **Table 1**.

Table 1: Summary of habitat types delineated within field assessment area (TBC, 2022)

Habitat	Conservation Importance	Functional Integrity	Biodiversity Importance	Receptor Resilience	Site Ecological Importance
Transformed	Medium	Low	Low	High	Very Low
Modified Sandy Grassland	Medium	Medium	Medium	High	Low
Seep Wetland (Artificial)	Medium	Medium	Medium	Medium	Medium

Important plant taxa are those species that have a high abundance, a frequent occurrence, or are prominent in the landscape within a particular vegetation type (Mucina & Rutherford, 2006). The following species are considered important in the Vaal-Vet Sandy Grassland vegetation type (d = dominant):

Graminoids: *Anthephora pubescens* (d), *Aristida congesta* (d), *Chloris virgata* (d), *Cymbopogon caesius* (d), *Cynodon dactylon* (d), *Digitaria argyrograpta* (d), *Elionurus muticus* (d), *Eragrostis chloromelas* (d), *E. lehmanniana* (d), *E. plana* (d), *E. trichophora* (d), *Heteropogon contortus* (d), *Panicum gilvum* (d), *Setaria sphacelata* (d), *Themeda triandra* (d), *Tragus berteronianus* (d), *Brachiaria serrata*, *Cymbopogon pospischilii*, *Digitaria eriantha*, *Eragrostis curvula*, *E. obtusa*, *E. superba*, *Panicum coloratum*, *Pogonarthria squarrosa*, *Trichoneura grandiglumis*, *Triraphis andropogonoides*.

Herbs: *Stachys spathulata* (d), *Barleria macrostegia*, *Berkheya onopordifolia* var. *onopordifolia*, *Chamaesyce inaequilatera*, *Geigeria aspera* var. *aspera*, *Helichrysum caespititium*, *Hermannia depressa*, *Hibiscus pusillus*, *Monsonia burkeana*, *Rhynchosia adenodes*, *Selago densiflora*, *Vernonia oligocephala*.

Geophytic Herbs: *Bulbine narcissifolia*, *Ledebouria marginata*.

Succulent Herb: *Tripteris aghillana* var. *integrifolia*.

Low Shrubs: *Felicia muricata* (d), *Pentzia globosa* (d), *Anthospermum rigidum* subsp. *pumilum*, *Helichrysum dregeanum*, *H. paronychioides*, *Ziziphus zeyheriana*.

Endemic Taxon: Herb: *Lessertia phillipsiana*.

According to the information taken from Terrestrial Biodiversity Assessment Report undertaken by the Biodiversity Company (2022), the proposed pipelines will affect existing natural vegetation and watercourses as tabulated in **Table 2** below.

Table 2: Desktop assessment of the floral ecological setting of the study area (TBCs, 2022)

Aspect	Relevant	Applicability
Provincial Conservation Plan	Yes	The pipelines overlaps with CBAs
Ecosystem Threat Status (NBA, 2018)	Yes	The pipelines falls within an Endangered Ecosystem (Vaal-Vet Sandy Grassland)
Ecosystem Protection Level (NBA, 2018)	No	The pipelines do not transact Protected Areas
South African Inventory of inland Aquatic Ecosystems, 2018	Yes	Several wetland features occur nearby
National Freshwater Priority Areas, 2011	Yes	Several wetland features occur nearby, none of which are Freshwater Priority Areas
South African Protected and Conservation Areas Database, 2021	No	No SAPAD or SACAD Areas occur within 10km of the site
National Protected Areas Expansion Strategy, 2017	No	The project does not overlap with any NPAES priority focus areas
Import Bird and Biodiversity Areas, 2015	No	No Important Bird and Biodiversity Areas occur nearby
Strategic Water Source Areas, 2021	No	There are no Strategic Water Source Areas in the region

Based on the ecological assessment, there are no portion of the pipelines that represents intact Vaal-Vet Sandy Grassland vegetation, and the areas listed as Irreplaceable CBAs by the provincial conservation plan exist in a modified state due to the heavy grazing of the areas, the invasion of alien species, and the additional related effects of nearby agricultural and mining activity. No SCC flora or fauna were recorded

during the field survey; however, it is noted that certain SCC fauna may move through the area infrequently due to the abundance of wetland systems in the region. In addition, the completion of the terrestrial biodiversity assessment led to a disputing of the ‘Very High’ classification for the terrestrial biodiversity theme sensitivity as allocated by the National Environmental Screening Tool. The proposed pipelines area has instead been assigned an overall sensitivity of ‘Very Low’ to ‘Low’, because of the significant levels of historical environmental disturbance that have taken place within and immediately adjacent to the proposed development footprint.

The Free State Province Biodiversity Plan classifies areas within the province based on their contributions to reaching the conservation targets within the province. These areas are primarily classified as either Critical Biodiversity Areas (CBAs) or Ecological Support Areas (ESAs). As shown in **Figure 6** and according to the Free State Province Biodiversity Plan, the pipelines overlap with CBA: Irreplaceable areas, as well as ESA2 areas. These high-level CBA sites represent areas that are irreplaceable, or near irreplaceable, for meeting biodiversity targets. There are no or very few other options for meeting biodiversity targets for the features associated with these areas (SANBI, 2017). Appropriate land-uses for these areas are generally limited to low-impact conservation and game farming activities. ESA2 areas are generally regarded as degraded Ecological Support Areas that are still considered important for supporting nearby CBA areas.

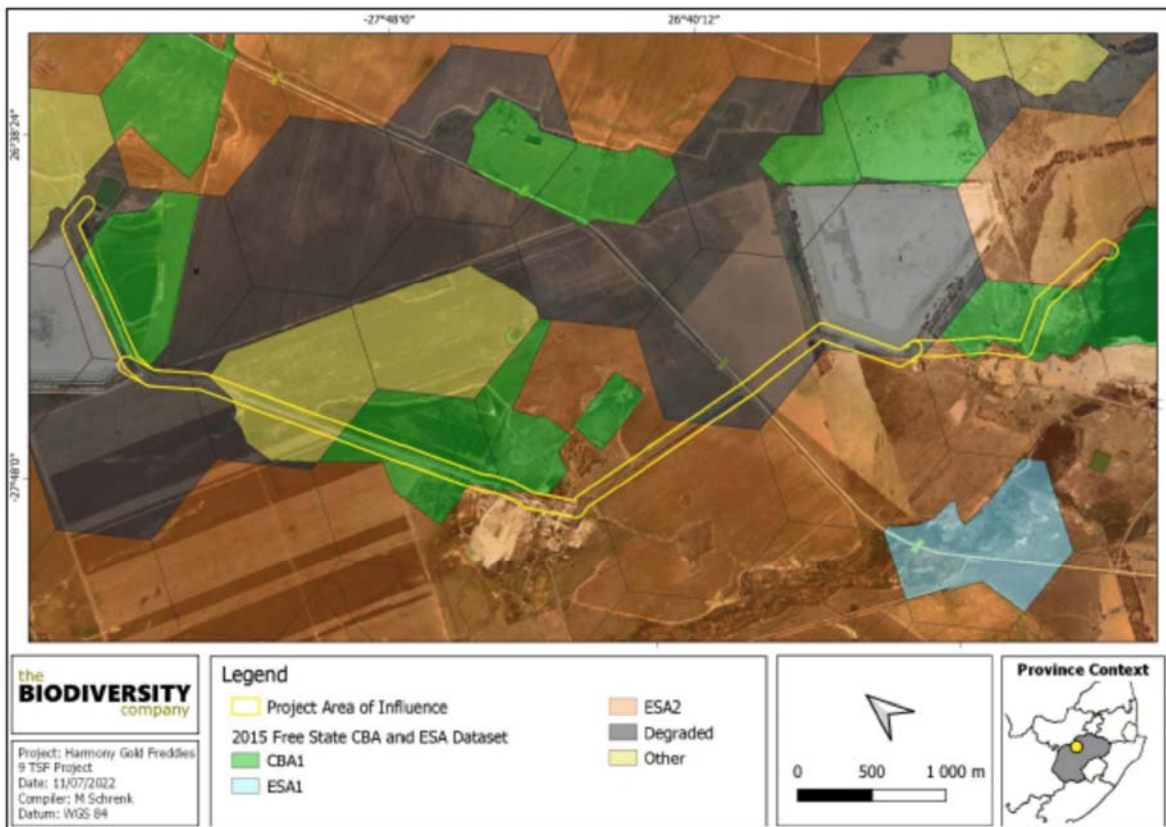


Figure 6: Site Conservation plan (TBC, 2022)

Based on the Plants of Southern Africa (BODATSA-POSA, 2019) database, over 620 plant species have the potential to occur within the pipeline routes and its surroundings. Of these species, none are listed as being Species of conservation concern (SCC).

1.3 Definition of Alien Invasive Species

Alien invasive species are simply defined as plants, animals, pathogens and other organisms that are exotic, non-indigenous or non-native to an ecosystem, and which may cause economic or environmental harm or adversely affect human health. They spread aggressively, and which threaten indigenous ecosystem functioning and biodiversity, www.environment.com. Invaders and weed species are plants that invade natural or semi-natural habitats; especially areas disturbed by humans and are commonly known as environmental weeds. Weeds that invade severely disturbed areas are known as ruderal and agrestal weeds. Most of these weeds are annuals colonising waste sites and cultivated fields. These weeds only persist on recently disturbed areas and seldom invade established areas.

Alien and invasive floral species lead to degradation of the ecological integrity of an area, which in turn may lead to, amongst others, a decline in and potential local extinction in indigenous species diversity, an ecological imbalance and the decreased productivity of grazing land (Bromilow, 2010). According to Brimlow, alien invasive species tend to out-compete the indigenous vegetation; this is since they are vigorous growers that are adaptable and able to invade a wide range of ecological niches. Alien invasive floral species must be controlled in terms of the Alien and Invasive Species Regulations (2014).

1.4 Scope and Objectives of the alien and invasive plant management plan

The purpose of the Alien Invasive Management Plan (AIMP) is to implement avoidance and mitigation measures to reduce the impact of the slurry and return water pipeline site and on the sensitive biodiversity. This plan must be used and read in conjunction with the EMPr.

1.5 Details of Environmental Assessment Practitioner

Table 3: Report compiler information

	Compiler
Company Name:	GA Environment (Pty) Ltd
Contact person:	Mr. Vukosi Mabunda
Postal Address:	P. O Box 6723, Midrand, 1685
Telephone Number:	(011) 312 2537
Fax Number:	(011) 805 1950
E-mail:	vukosim@gaenvironment.com or environment@gaenvironment.com

This Alien Invasive Management Plan was prepared by **Mr Vukosi Mabunda** a Registered Environmental Assessment Practitioner (EAP) employed by GA Environment. Mr. Vukosi Mabunda is a current Geographic Information Systems (GIS) Specialist and Environmental Assessment Practitioner with 4 years' working experience. Vukosi is a Registered Environmental Assessment Practitioner with the Environmental Assessment Practitioners Association of South Africa (EAPASA). He is one of the few dual registered professionals with SACNASP as a Professional Geospatial Scientist and Professional Environmental Scientist. Vukosi has dual professional background in Geographic and Environmental Sciences with a Master of Science Degree in Geography.

1.6 Key role players and responsibility matrix

For the Alien and Invasive Management plan (AIMP) to be successfully implemented, all the role players involved in the project need to co-operate. For this, role players must clearly understand their roles and responsibilities, they must be professional, and they must form respectful and transparent relationships and maintain open lines of communication. The key role players for the rehabilitation phase and the post rehabilitation monitoring phases are as follows:

- Developer;
- Engineer;
- Contractor;
- Environmental Control Officer; and
- Environmental Assessment Practitioner.

The functions and responsibilities of each of these role players are outlined in **Table 4**.

Table 4: Functions and responsibilities of the project team for the implementation of the Rehabilitation Plan

ROLE	PHASE OF INVOLVEMENT	RESPONSIBILITIES
Developer <i>Harmony</i>	Construction, Rehabilitation and Operational phases	<ul style="list-style-type: none"> • Appointing project team; and • Ensuring that the AIMP, is circulated to the project team. • Ensuring overall compliance with the rehabilitation plan
Project Engineer <i>To be appointed</i>	Construction, Rehabilitation and Operational phases	<ul style="list-style-type: none"> • Ensuring that the Contractor undertakes all construction, operational and maintenance activities in line with the AIMP, • Ensuring that all non-compliances, environmental or otherwise are actioned by the Contractor.
Contractor <i>To be appointed</i>	Construction, Rehabilitation and Operational phases	<ul style="list-style-type: none"> • Implement the AIMP, • Addresses all areas of concern raised by the Consulting Engineer or Environmental Control Officer during construction, operational and maintenance
Environmental Control Officer <i>To be appointed</i>	Construction, Rehabilitation and Operational phases	<ul style="list-style-type: none"> • Ensuring that the Contractor undertakes all co activities in line with the AIMP • Undertaking of Environmental Audits and circulating reports to the project team

ROLE	PHASE OF INVOLVEMENT	RESPONSIBILITIES
<p>Environmental Assessment Practitioner</p> <p><i>GA Environment (Appointed by Harmony Gold Mining Company Limited)</i></p>	<p>Environmental Authorisation</p>	<ul style="list-style-type: none"> • The definition of an Environmental Assessment Practitioner (EAP) in Section 1 of NEMA is “the individual responsible for the planning, management and coordination of environmental impact assessments, strategic environmental assessments, environmental management plans or any other appropriate environmental instruments introduced through regulations”. • The Environmental Assessment Practitioner is generally responsible for undertaking environmental processes necessary to authorise the project activities proposed. The Developer can also appoint the Environmental Assessment Practitioner to act as an Environmental Control Officer during the post-construction or rehabilitation phase of the project to ensure the environment is remediated as far as possible.

2 ALIEN INVANSIVE MANAGEMENT PLAN

The compilation of AIMP aims at managing and controlling potential aliens. This AIMP acts as a guideline to be applied by all contractors and other role players involved in the project. The AIMP is an evolving guideline that needs to be updated or adapted as progress is made in terms of the control of alien invasive species within the project area, and successes and failures of procedures identified.

As per the Terrestrial Biodiversity Assessment Report undertaken by the Biodiversity Company (2022), it is the substantive opinion that the proposed development continues, provided that all mitigation and rehabilitation measures presented within this report and the project specific EMPr be strictly implemented and subsequently monitored. However, the ecologist recommended that the following be implemented prior to the construction phase beginning:

- Prevent the further loss and fragmentation of vegetation communities within the CBA areas in the vicinity of the pipeline route.
- Reduce the negative fragmentation effects of the development and enable the safe movement of faunal species;
- Prevent the direct and indirect loss and disturbance of floral and faunal species and communities (including any potential Species of Conservation Concern nearby); and
- An Alien and Invasive Plant Species Management Programme should be drafted for the entire study area. This recommendation is in line with the requirements stipulated within the NEM:BA (Act no. 10 of 2004) and its Alien and Invasive Species Lists (2016) Regulations, which put the responsibility of the control and maintenance of alien and invasive species on the designated land proponent/owner.

2.1 Applicable Legislation

The Conservation of Agriculture Resources Act No. 43 of 1983 (CARA) Regulations have been superseded by the National Environmental Management: Biodiversity Act, 2004 (Act no. 10 of 2004) – Alien and Invasive Species (AIS) Regulations which became law on 1 October 2014, www.arc.agric.za/arc-ppri/weed. These Regulations call on landowners and sellers of land to assist the Department of Environmental Affairs now Department of Forestry, Fisheries and the Environment (DFFE) to conserve indigenous fauna and flora. Non-adherence to the Regulations by a landowner or seller of land, can result in a criminal offense punishable by a fine of up to R5 million (in case of 2nd offence, R10 million) and / or a period of imprisonment of up to 10 years.

According to these regulations, alien species (birds, animals, insects, and plants), are categorised as Invasive species; and Prohibited species. According to the classification of these species, certain invasive species must be controlled and eradicated, while others require a permit to be obtained. The only currently active legislation on weeds and invasive plants in South Africa forms part of the Conservation of Agricultural Resources Act, 1983 (Act No 43 of 1983) (CARA). Regulations 15 and 16 under this Act, which concern problem plants, were amended during March 2001. CARA is currently (2011) in the process of being revised. In brief, the following key legislation is thus applicable:

- National Environmental Management: Biodiversity Act (10/2004): Alien and Invasive Species Regulations, 2014
- Section 151(1) of the National Water Act 36 of 1998;
- Section 28 of the National Environmental Management Act, 107 of 1998;
- Section 31A of the Environment Conservation Act, 73 of 1989;
- Municipal by-laws and the National Veld and Forest Fire Act 101 of 1989; and
- The present legislation forms part of the Conservation of Agricultural Resources Act, 1983 (Act No 43 of 1983) (CARA). Regulations 15 and 16 under this Act, dealing with problem plants, were amended during March 2001.

2.1 Principles to ensure effective management of alien invasive

Invasive alien plant species are difficult to control. Methods should be used that are appropriate for the species concerned, as well as to the ecosystem in which they occur. When performing the controlling methodology for weeds and invaders, damage to the environment must be limited to a minimum. The methodology must be performed for at least three growing seasons to ensure the seed bank is depleted. Continual monitoring will be needed for seeds that are likely to be blown in from adjacent areas. The clearing of vegetation for the slurry and return water pipelines and associated infrastructure will leave bare patches of soil, thereby enhancing the colonisation by ruderal weeds (mostly annual weeds) or declared alien species that will prohibit the natural succession during rehabilitation activities. Such soil disturbances (as well as the inappropriate handling of topsoil) could enhance the establishment or spread of invasive adjacent to the development. The following must be included when addressing invasive species in the area:

- Alien control programs are long-term management interventions and should include a clearing plan which includes follow up actions for rehabilitation of the cleared area.
- Alien problems at the site should be identified during preconstruction surveys (should there be indications) of the development footprint.
- The clearing plan should then form part of the preconstruction reporting requirements for the site.
- The plan should include a map showing the alien density also indicating potential alien species in each area.
- Lighter infested areas should be cleared first to prevent the build-up of seed banks.
- Collective management and planning with neighbouring landowners may be required as seeds of alien invasive species are easily dispersed across boundaries by wind and the movement of people and livestock.
- All clearing actions should be monitored and documented to keep track of which areas are due for follow-up clearing.
- Chemical mechanism of alien invasive plant control should be avoided unless necessary.
- Alien and invasive plant species must be cleared on site and re-vegetated by planting indigenous vegetation, where feasible.

- The mitigations highlighted in the Rehabilitation report must be considered in instances where applicable.

2.2 Declared Weeds and Invader Plants Categories

Declared weeds and invaders have the tendency to dominate or replace the canopy or herbaceous layer of natural ecosystems, thereby transforming the structure, composition and function of natural ecosystems. The National Environmental Management: Biodiversity Act, 2004 (Act no. 10 of 2004) – Alien and Invasive Species (AIS) Regulations lists about 383 invasive plant species into four categories that must be managed, controlled or eradicated from areas where they may cause harm to the indigenous environment. These four categories of problem plants are as follows:

- **Category 1** plants may not occur on any land other than a biological control reserve and must be controlled or eradicated. Therefore, no person shall establish, plant, maintain, propagate or sell/import any category 1 plant species. These plants may no longer be planted or propagated, and all trade in these species is prohibited.
- **Category 1B** - Invasive species which must be controlled and wherever possible, removed and destroyed. Any form of trade or planting is strictly prohibited.
- **Category 2** plants are plants with commercial application and may only be cultivated in demarcated areas (such as biological control reserves) otherwise they must be controlled. These plants pose a threat to the environment but nevertheless have commercial value. These species are only allowed to occur in demarcated areas and a land user must obtain a water use license as these plants consume large quantities of water.
- **Category 3** plants are ornamentally used plants and may no longer be planted, except those species already in existence at the time of the commencement of the regulations (30 March 2001), unless they occur within 30 m of a 1:50 year floodline and must be prevented from spreading. These plants have the potential of becoming invasive but are considered to have ornamental value. Existing plants do not have to be removed but no new plantings may occur, and the plants may not be sold.

Based on the findings of Terrestrial Biodiversity Assessment Report undertaken by the Biodiversity Company (2022), the indigenous vegetation within the area was characterised by short pioneer grasses such as *Eragrostis* spp., *Aristida* spp., and *Cynodon dactylon*, as well as the shrubs *Gomphocarpus fruticosus* and *Asparagus laricinus* which are typical of disturbed areas surrounding mines and cultivated land. Several *Vachellia karroo* and *Searsia leptodictya* trees were also observed. Exotic herbs and shrubs were noted as being dominant across many areas of the landscape, including species such as *Tagetes minuta* and *Bidens pilosa*, as well as the **category 1b invasives** *Eucalyptus camaldulensis*, *Tamarix ramosissima*, *Salsola kali*, *Arundo donax*, and *Xanthium strumarium*.

In general, invasive alien plant control relies on four main methods - *manual*, *mechanical*, *chemical* and *biological* control. Long-term success of any programme is best achieved through a combination of these. This is called an integrated control approach. For the purpose of this report, a three-phase control programme presented in a section that follow must be considered in order to manage the alien invasive.

2.2.1 Alien invasive management plan (*Three-phased Control Programme*)

As mentioned, different species require different clearing methods such as manual, chemical or biological methods or in combination. During construction, mechanical methods should be encouraged as the main form of control, together with the judicious use of herbicides. The preferred clearing methods for most alien species can be obtained from the DWS Working for Water Website <http://www.dwaf.gov.za/wfw/>. For any alien eradication programme to be successful, a three-phased control approach that should be followed and is briefly presented as follows:

- **Initial control** - Initial control requires an “aggressive” remedial approach with the aim to drastically reduce the number of alien invader vegetation to acceptable and manageable levels.
- **Follow-up control** - Follow-up control is vital to control any re-growth or new seedlings. Follow-up control methods may occur as soon as re-growth or seedlings are and
- **Maintenance control** – this approach involves the continual monitoring of the alien vegetation on a regular (preferably bi-monthly) basis to identify any re-growth or seedlings. It is expected that the infestation densities will have been reduced dramatically by this stage and that only individual specimens may appear from time to time. It is preferred that any alien re-growth be removed manually to exclude the unnecessary use of chemicals

Such a three-phased control programme may consider the use of a combination of chemical and mechanical control options. Chemical control of alien plants is not recommended especially as the site is located within a protected environment. Chemicals control must be considered as the last option and if required should only be applied by qualified personnel. It is usually preferable to use manual clearing methods where possible, although such methods may create additional disturbance which may stimulates alien invasion and may also be ineffective for many woody alien invasive species. Should herbicides be considered, all care must be taken to prevent contamination of any water bodies. Where herbicides are to be used, the impact of the operation on the natural environment should be minimised by implementing some of the following measures:

- Equipment should be washed where there is no danger of contaminating water sources and washings carefully disposed.
- To avoid damage to indigenous or other desirable vegetation, products should be selected that will have the least effect on non-target vegetation.
- Coarse droplet nozzles should be fitted to avoid drift onto neighboring vegetation.
- No spraying of herbicides should take place in windy conditions or during wet conditions.
- The appropriate health and safety procedures should also be followed regarding the storage, handling and disposal of herbicides.
- For all herbicide applications, the following guidelines should be followed: Working for Water: Policy on the Use of Herbicides for the Control of Alien Vegetation <http://www.dwaf.gov.za/wfw>
- Only herbicide registered for use on target species may be used. It is a high priority of any eradication programme that makes use of herbicides or power equipment to implement the correct safety procedures and to prevent chemical spillages. Strictly follow the specified treatment concentrations for the relevant herbicides as specified by the product label. Always ensure that all staff members are

properly trained and make them wear protective clothing when working with herbicides or other equipment (e.g. handsaws).

With regard to manual labour, hand pulling is most effective with small (30 cm), immature or shallow rooted plants. This method is mostly preferred especially in sensitive areas. Mitigation to ensure maintain environmental standards that may be considered include the following:

- It is important that records in the form of site photographs be kept for all steps that are during the removal and management of aliens, should these be required by the Competent Authority during close out.
- Once the vegetation clearance and soil preparation processes commence, conduct weekly walkthrough of the proposed development area as well as a minimum 50 m perimeter around the area, in order to identify all seedlings of any alien invasive species which might start to germinate and establish.
- Physically remove all identified alien invasive species seedlings from the soil by manually pulling them out with as much as possible of their root systems still intact.
- Place all removed alien invasive species seedlings in a metal drum or any other suitable containing unit and close the drum/containing unit in order to isolate the seedlings.
- Place the closed drum/containing unit on a concrete slab or any other suitable impermeable surface in direct sunlight in order to isolate the alien invasive species seedlings from any natural vegetation and prevent spreading of materials.
- Leave the closed drum/containing unit in direct sunlight for a minimum period of one week in order for all alien invasive species seedlings and materials to adequately dry out and die.
- Once all alien invasive species seedlings and materials have adequately dried out and died, remove the material from the drum/containing unit and place the materials in a minimum 1m deep hole which is isolated from any natural vegetation for disposal at nearby registered, landfill site.

2.2.2 Integrated Alien species Control Strategies

An integrated control strategy uses a combination of control options for a number of species during a particular situation. This approach is based on ranking the study site into priority areas for control. Therefore, high priority areas should be controlled first. As a general rule, maintenance control should consider areas with low infestations first and then move to areas of higher infestation since control of these areas will be rapid and cost-effective. Also, the direction of control should be in a downstream direction, meaning that initial control should start upstream and terminate downstream. In addition, control measures should aim to remove alien infestation from the edge of a grove or patch to prevent any further spread.

2.3.2.1 Control Zones

It is known that clearing of vegetation in preparation for construction that will leave bare patches of soil, thereby enhancing the colonisation by alien species that will prohibit the natural succession during rehabilitation activities. Such soil disturbances (as well as the inappropriate handling of topsoil) could

enhance the establishment or spread of *alien species* to natural systems adjacent of the development. At least one working day and at least one group is required to control alien vegetation identified from the control zone as this is a footprint development.

The control team members will be responsible for applying foliar spray. When appointing this method, certain precautions such using it on rain free days or dew falls must be observed. Spraying in windy weather must be avoided as the spray may encounter non-target plants.

As the project is a linear development within reduced working area (pipeline area), it is anticipated that initial control will take shorter hours to complete than extensive, longer and larger developments. Follow-up control will commence within a week or latest two weeks after initial control was completed and anticipated to be completed within a day. However, in the event of very little re-growth, follow-up control should be postponed for at least another month. Should re-growth be vigorous, a second follow-up treatment may be necessary.

The following management actions are aimed at reducing soil disturbance during the construction phase of the development, as well as reducing the likelihood that alien species will be brought onto site or otherwise encouraged.

2.3 Monitoring and Auditing

The re-emergence of aliens can simply be monitored as part of the internal and external auditing requirements that may come as a condition in the Environmental Authorisation. Monitoring of alien invasives can simply be undertaken as follows:

- Undertaking follow-up inspections are required in order to establish whether follow-up operations are required.
- It is preferable to follow up on an area and remove all seedlings or treat resprouting plants, rather than treat a new area.
- Post rehabilitation monitoring plan is used to ensure that critical aspects of rehabilitation are monitored.

Table 5: Specifications for monitoring (Construction and Post Monitoring)

Environmental Aspect	Description	Frequency and record keeping method
Planning Phase		
Alien removal plan	The Contractor must submit a plan 14 days before site establishment for review by the Engineers and ECO if required	<ul style="list-style-type: none"> • Once off, 14 days before site establishment • ECO and Contractors 's Environmental file
Alien removal plan approval	The Engineers/ECO must approve Alien removal plan before site establishment	<ul style="list-style-type: none"> • Once off, before site establishment

Environmental Aspect	Description	Frequency and record keeping method
<p>Site control</p>	<p>The construction must remain demarcated with appropriate fencing or hazard tape. These areas are no-go areas (this must be explained to all staff) that must be excluded from all development activities</p>	<ul style="list-style-type: none"> • Daily, as and when necessary • Bi weekly inspection for the first 2-3 weeks after establishment of vegetation
	<p>Alien vegetation regrowth must be controlled throughout the entire site during the construction period</p>	<ul style="list-style-type: none"> • Daily, as and when necessary
<p>Approval of clearance</p>	<p>The ECO is to approve all vegetation clearance prior to clearing commencing for the proposed development</p>	<ul style="list-style-type: none"> • Daily, as and when necessary • Weekly inspection for the first 2-3 weeks after establishment of vegetation
<p>Management of vegetation clearance</p>	<p>Only vegetation within the development footprint may be cleared and must take place as construction progresses on site. Mass clearing is not allowed unless the entire cleared area is to be rehabilitated immediately.</p>	<ul style="list-style-type: none"> • Weekly inspection for the first 2-3 weeks after establishment of vegetation • Photographic record
<p>Herbicide Management</p>	<p>Cleared areas that have become invaded with alien invasive species can be sprayed with appropriate herbicides provided that these are such that they break down on contact with the soil. Residual herbicides should not be used. Such must be undertaken by a qualified specialist Pesticides may not be used. Herbicides may be used to control listed alien weeds and invaders only.</p>	<ul style="list-style-type: none"> • Weekly inspection for the first 2-3 weeks after establishment of vegetation • Photographic record
<p>Management and Control Alien vegetation</p>	<p>Surveys for alien species should be conducted weekly until end of construction. All aliens identified should be removed from site.</p>	<ul style="list-style-type: none"> • Weekly inspection for the first 2-3 weeks after establishment of vegetation • Photographic record
	<p>Care must be taken to avoid the introduction of alien plant species to the site and surrounding areas. (Particular attention must be paid to imported material such as building sand or dirty earth-moving equipment.)</p>	<ul style="list-style-type: none"> • Weekly inspection for the first 2-3 weeks after establishment of vegetation • Photographic record
	<p>Clearing activities must be contained within the affected zones and may not spill over into demarcated No Go areas.</p>	<ul style="list-style-type: none"> • Weekly inspection for the first 2-3 weeks after establishment of vegetation • Photographic record
<p>Access control</p>	<p>Alien vegetation regrowth must be controlled throughout the entire site during the construction period</p>	<ul style="list-style-type: none"> • Weekly inspection for the first 2-3 weeks after establishment of vegetation • Photographic record

Environmental Aspect	Description	Frequency and record keeping method
Post Construction (Rehabilitation)		
Rehabilitation	Revegetation with indigenous, locally occurring species should take place in areas where natural vegetation is slow to recover or where repeated invasion has taken place	<ul style="list-style-type: none"> • Once off, post construction
	No alien species should be cultivated onsite. If vegetation is required for aesthetic purposes, then non-invasive, water-wise locally occurring species should be used.	
	Cleared sites will thus have to be constantly monitored, and as soon as a seedling can be identified as alien invasive species, these must be pulled out by hand.	<ul style="list-style-type: none"> • Monthly, post construction

3 CONCLUSIONS AND RECOMMENDATIONS

Any land management programme in South Africa will inevitably include an alien plant control program. Alien control programs are essential to protect valuable resources such as economically viable agricultural land, surface and ground water, biodiversity and the beautiful landscapes of our country. An alien control program however requires a high level of commitment, coordination between landowners and authorities, professional planning and implementation and a good dose of common sense. Competent land managers are essential for cost effective and professional implementation programmes. The guidelines provided are compiled from a wide source and will hopefully provide insight to land managers in order for financial and human resources to be effectively used in an integrated control programme.

4 REFERENCES

- 1) Bromilow C. (2010) *Problem Plants and Alien Weeds of South Africa*, Briza Publications.
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- 4) Mucina, L. & Rutherford, M.C. (eds) 2006. *The vegetation of South Africa, Lesotho and Swaziland*. Strelitzia 19. South African National Biodiversity Institute, Pretoria.
- 5) The Biodiversity Company. 2022. *The Terrestrial Ecology Compliance Statement for the Proposed Harmony Gold Freddies 9 TSF Project*.

APPENDIX 1: DESCRIPTION OF VEGETATION TYPE

a) Vaal-Vet Sandy Grassland (Gh10)

VT 50 Dry *Cymbopogon–Themeda* Veld (47%), VT 48 *Cymbopogon–Themeda* Veld (sandy) (24%) (Acocks 1953). LR 37 Dry Sandy Highveld Grassland (74%) (Low & Rebelo 1996).

Distribution North-West and Free State Provinces: South of Lichtenburg and Ventersdorp, stretching southwards to Klerksdorp, Leeudoringstad, Bothaville and to the Brandfort area north of Bloemfontein. Altitude 1 220–1 560 m, generally 1 260–1 360 m.

Vegetation & Landscape Features Plains-dominated landscape with some scattered, slightly irregular undulating plains and hills. Mainly low-tussock grasslands with an abundant karroid element. Dominance of *Themeda triandra* is an important feature of this vegetation unit. Locally low cover of *T. triandra* and the associated increase in *Elionurus muticus*, *Cymbopogon pospischilii* and *Aristida congesta* is attributed to heavy grazing and/or erratic rainfall.

Geology & Soils Aeolian and colluvial sand overlying sandstone, mudstone and shale of the Karoo Supergroup (mostly the Ecca Group) as well as older Ventersdorp Supergroup andesite and basement gneiss in the north. Soil forms are mostly Avalon, Westleigh and Clovelly. Dominant land type Bd, closely followed by Bc, Ae and Ba.

Climate Warm-temperate, summer-rainfall climate, with overall MAP of 530 mm. High summer temperatures. Severe frost (37 days per year on average) occurs in winter. See also climate diagram for Gh 12 Vaal-Vet Sandy Grassland (Figure 8.23).

Important Taxa Graminoids: *Antheophora pubescens* (d), *Aristida congesta* (d), *Chloris virgata* (d), *Cymbopogon caesius* (d), *Cynodon dactylon* (d), *Digitaria argyrograpta* (d), *Elionurus muticus* (d), *Eragrostis chloromelas* (d), *E. lehmanniana* (d), *E. plana* (d), *E. trichophora* (d), *Heteropogon contortus* (d), *Panicum gilvum* (d), *Setaria sphacelata* (d), *Themeda triandra* (d), *Tragus berteronianus* (d), *Brachiaria serrata*, *Cymbopogon pospischilii*, *Digitaria eriantha*, *Eragrostis curvula*, *E. obtusa*, *E. superba*, *Panicum coloratum*, *Pogonarthria squarrosa*, *Trichoneura grandiglumis*, *Triraphis andropogonoides*. Herbs: *Stachys spathulata* (d), *Barleria macrostegia*, *Berkheya onopordifolia* var. *onopordifolia*, *Chamaesyce inaequilatera*, *Geigeria aspera* var. *aspera*, *Helichrysum caespitium*, *Hermannia depressa*, *Hibiscus pusillus*, *Monsonia burkeana*, *Rhynchosia adenodes*, *Selago densiflora*, *Vernonia oligocephala*. Geophytic Herbs: *Bulbine narcissifolia*, *Ledebouria marginata*. Succulent Herb: *Tripteris aghillana* var. *integrifolia*. Low Shrubs: *Felicia muricata* (d), *Pentzia globosa* (d), *Anthospermum rigidum* subsp. *pumilum*, *Helichrysum dregeanum*, *H. paronychioides*, *Ziziphus zeyheriana*.

Endemic Taxon Herb: *Lessertia phillipsiana*.

Conservation Endangered. Target 24%. Only 0.3% statutorily conserved in the Bloemhof Dam, Schoonspruit, Sandveld, Faan Meintjies, Wolwespruit and Soetdoring Nature Reserves. More than 63% transformed for cultivation (ploughed for commercial crops) and the rest under strong grazing pressure from cattle and sheep. Erosion very low (85.3%) and low (11%).

References Louw (1951), Morris (1973, 1976), Bredenkamp & Bezuidenhout (1990), Kooij et al. (1990b, 1992), Bezuidenhout et al. (1994a).

APPENDIX 2: Alien Species Encountered within the Study Area*Table 6: Alien Invasive Species Encountered Within the Study Area (TBC 2021)*

Species	English Name	Alien Category
<i>Eucalyptus camaldulensis</i>	River Red Gum	Cat. 1b
<i>Tamarix ramosissima</i>	Salt cedar	Cat. 1b
<i>Salsola kali</i>	Prickly saltwort	Cat. 1b
<i>Arundo donax</i>	Giant reed	Cat. 1b
<i>Xanthium strumarium</i>	Rough cocklebur	Cat. 1b