N2 WILD COAST BIODIVERSITY OFFSET PROJECT

Offset Implementation Management Series

Report 2

Invasive Alien Plants Monitoring, Control and Eradication Plan

ADVENTURE PROVINCE
Eastern Cape
PARKS & TOURISM AGENCY

August 2020

Prepared by
Sigwela and Associates JV SG Environmental Empowerment
06 Epson Road, Sterling, East London
☎ (043) 735 1374 🖷 086 554 0950

SUBMISSION

The Offset Implementation Management Series has been submitted for approval by the Eastern Cape Parks and Tourism Agency:

Submitted for Approval By:

Name: Dr Ayanda Sigwela Position: Director of Sigwela and Associates Date: 17 August 2020	

Received By:

Name: Mr Sakhiwo Nombembe Position: Senior Manager, Stakeholder Engagement & Biodiversity Offsets, ECPTA Date: 8th September 2020	

Approved By:

Name: Mr Vuyani Dayimani Position: Chief Executive Officer, ECPTA Date: 13 October 2020	

EXECUTIVE SUMMARY

Since 1995, the Department of Environment, Forestry and Fisheries through its Working for Water programme has been in the forefront of managing invasive alien plants (IAPs). The management of these IAPs has a direct bearing on the availability of water resources in the country. Also, because IAPs compete with indigenous plant species, they affect biodiversity. The management of IAPs in the Biodiversity Offset Project is one of the mechanisms of improving the biodiversity value of the identified polygons. The management of IAPs needs to be systematic, following specific protocols. This IAPs Implementation Plan provides parameters and mechanisms that should form the basis of such implementation. It is from this that the ECPTA will develop operational plans for the management of IAPs (which includes monitoring, control, reduction of spread and clearing) within the Biodiversity Offset Project domain to fulfil the requirements of the N2 Wild Coast Road Biodiversity Offset Project. It is a higher-level plan upon which operational plans should be based. The framing of this implementation plan does not only focus on the aspect of clearing invasive alien plants, but also incorporates the social context and opportunities of capacity building. The information used in conceptualising this implementation plan is the data that was collected during the situational assessment of the Project. The situational assessment was a form of scoping intended to gain understanding into the situation on the ground.

It is recommended that, for this implementation to be effective, there is a need for partnerships with other entities clearing IAPs in the area. Partnerships with the communities is also necessary.

CONTENTS

ACRONYMS, ABBREVIATIONS AND TERMINOLOGY

APOs	Annual Plan of Operations
CARA	Conservation of Agricultural Resources Act (43 of 1983)
CBA	Critical Biodiversity Area
CEPF	Critical Ecosystem Partnership Fund
DAFF	Department of Agriculture, Forestry and Fisheries (National)
DEA	Department of Environmental Affairs (National)
DEFF	Department of Environment Forestry and Fisheries
DWS	Department of Water and Sanitation (National)
ECA	Environment Conservation Act (73 of 1989)
ECPTA	Eastern Cape Parks and Tourism Agency
EDRR	Early Detection and Rapid Response
EIP	Environmental Implementation Plan
EMP	Environmental Management Programmes
ESA	Ecological Support Area
FPA	Fire Protection Associations
GIS	Geographic Information System
IAP	Invasive Alien Plant
IASP	IAPs Programme
M&E	Monitoring and Evaluation
MPAH	Maputaland-Pondoland-Albany 'hotspot'
NBAL	Natural Biological Alien treatment units
NEMA	National Environmental Management Act (107 of 1998)
NEMBA	National Environmental Management: Biodiversity Act (10 of 2004)
NRM	Natural Resources Management
NVFFA	National Veldt and Forest Fire Act (101 of 1998)
OHS	Occupational Health and Safety
PMU	Project Management Unit
PPE	Personal Protective Equipment
RoD	Record of Decision
SANBI	South African National Biodiversity Institute
SANRAL	South African National Road Agency Limited
VAI	Value-Added Industries
WFW	Working for Water Programme

INTRODUCTION

SANRAL was issued with a Record of Decision (RoD) by the Department of Environmental Affairs (DEA) in 2010 for the construction of the N2 Wild Coast Road which extends 560 km between the Gonubie Interchange (near East London in the Eastern Cape) and the N2 Isipingo Interchange (south of Durban in KwaZulu-Natal). As one of the RoD conditions, SANRAL needed to establish a biodiversity offset for the residual impacts of the planned road. SANRAL commissioned the Eastern Cape Parks and Tourism Agency (ECPTA) to act as its Implementing Agent for the development of an Integrated Implementation Plan, and it is against this backdrop that the ECPTA has appointed a project management advisory team (Sigwela & Associates) to develop an Integrated Biodiversity Offset Implementation Plan, aligned to the approved RoD. Section 6.2.7 of the RoD outlines the requirements pertaining to a Biodiversity Offset Project. Furthermore, Section 6.2.7.2 of the RoD states that, prior to the commencement of any construction activities within the Greenfields sections:

> *"an invasive alien control programme must be drawn-up and submitted to DEA for approval. Implementation must be monitored, and measures to enforce implementation needs to form part of the programme".*

This Invasive Alien Plant (IAP) Management Plan forms part of the SANRAL N2 Wild Coast Road Biodiversity Offset Project.

Project Location

The N2 Wild Coast Road project will traverse a significant portion of the Maputoland-Pondoland-Albany Biodiversity Hotspot located in the Wild Coast region of the Eastern Cape and KwaZulu-Natal. Although the project is proposed for 560 km between the Gonubie Interchange (near East London in the Eastern Cape) and the N2 Isipingo Interchange (south of Durban in KwaZulu-Natal), the "greenfields" section for which the Biodiversity Offset Project needs to be implemented, is in the Wild Coast area north of the Mzimvubu River.

The ecosystem types that will potentially be impacted by the proposed N2 in the "greenfields" section, include the following: Pondoland Ugu Sandstone Coastal Sourveld, Pondoland Scarp Forest, Transkei Coastal Scarp Forest, Successional Thicket, Transkei Coastal Belt Dolerite and Shale Grassland, and several freshwater ecosystems including wetlands of the Indian Ocean Coastal Belt.

Owing to human land use requirements, land tenure restrictions and scattered settlements along the Wild Coast, the areas of continuously large tracts of land that can be set aside as potential offset sites, are limited. The offset sites were thus clustered around three areas that are either already under conservation or ideal for stewardship programmes (see Figure 1).

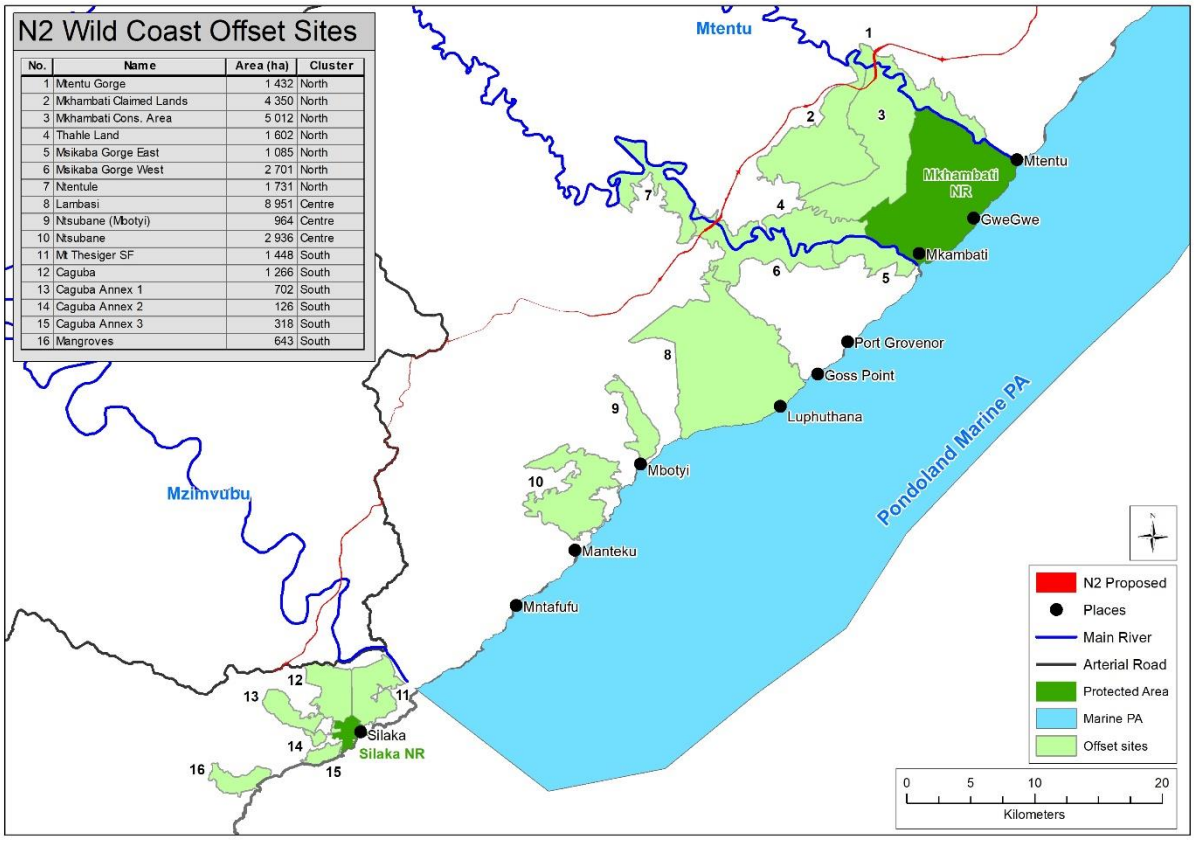


Figure 1 The current configuration of sites

- The **Northern Cluster** includes six sites slightly inland from the coast, mostly focused on the existing Mkambathi Nature Reserve. Of these, Msikaba Gorge, Mtentu Gorge, Ntentule, Cele Land, Thahle Land, Mkambati Claimed Land, and Mkambati Conservation Area are all immediately adjacent to each other and the Mkhambati Nature Reserve – leading to a very significant increase to the existing Nature Reserve.
- The **Central Cluster** is focused around the proposed Lambasi Community Reserve, which has unfortunately been hampered by a lack of resources and human capital; yet, it remains an ideal focal point for a cluster. It is a large portion of mostly pristine coastal grassland of outstanding conservation and tourism value. The cluster includes two related Ntsubane sites to the south.
- The **Southern Cluster** is focused around the existing Silaka Wildlife Reserve, incorporating the Mt Thesiger State Forest and then three heavily forested sites associated with the Caguba area. Further south is the outstandingly unique Mangroves site which has been included due to the very significant mangroves around the core estuary.

The sites have all been identified for their outstanding value for biodiversity conservation as well as their strategic potential to act as catalyst areas to improve the tourism industry of the Wild Coast. The ECPTA can use the leverage that they already have for tourism on the protected areas for potential growth to these annexed areas. Should these opportunities be taken up, the tourism industry has the potential to attract infrastructure investment and, ultimately, improve the livelihoods of local people.

Objectives of this plan

The overall aim of this IAP Implementation Plan is to provide a framework to guide the ECPTA when they develop operational plans for the management of IAPs (which includes monitoring, control, reduction of spread, and clearing) within the Biodiversity Offset Project domain to fulfil the requirements of the N2 Wild Coast Road Biodiversity Offset Project.

This section outlines the strategic objectives of this IAP Implementation Plan from which annual operational plans can be developed. It is an overarching document for the entire biodiversity offset planning domain which needs to be operationalised at a fine-scale during the implementation phase of the Biodiversity Offset Project. This plan will facilitate the prevention, early detection and control of IAPs in the biodiversity offset planning domain. This Implementation Plan has the following three key objectives:

1) **Environmental:** To protect the integrity and biodiversity of the planning domain through the identification, eradication, control and maintenance of IAPs.
2) **Social:** To create work opportunities for local people and to improve knowledge and skills in relation to IAP management.
3) **Financial:** To deliver socio-economic benefits through the beneficiation of biomass that results from cleared IAPs (value-adding activities).

To achieve these objectives, there is a need of effective coordination, collaboration and partnerships between all role players who are currently either clearing IAPs or mandated to do so, including:

- municipalities,
- traditional authorities,
- Natural Resources Management (NRM) unit of the Department of Environment Forestry and Fisheries (DEFF),
- Wildlands Trust, and
- ECPTA.

These objectives will be realised through an approach that includes the following aspects:

- Although this Implementation Plan is focused on activities within the biodiversity offset sites, it will need to leverage activities that occur in the surrounding areas, implementing integrated control measures to decrease invasions into the sites.
- The spread of IAPs should be contained and reduced within the biodiversity offset sites.
- There should be early detection and eradication of new IAP species or new occurrences of IAP species.
- The IAP infestations should be managed at maintenance levels using a combination of mechanical and biological control measures.
- There should be rehabilitating done on cleared areas and habitats.
- The introduction of new IAPs in the area should be prevented through screening for species introductions in partnership with different institutions and government departments.
- It is necessary to build capacity and partnerships to undertake these actions, including raising general awareness.
- There should be research, monitoring and evaluation of both IAPs and the effectiveness of management interventions.

The above are general objectives of this Implementation Plan which have been broken down to specific objectives, an indicated in Table 1 below.

High-level goals	Specific goals and dates	Outputs	Activities
To improve the biodiversity of the planning domain through the identification, eradication, control and maintenance of IAP species.	70% of the activities in priority catchments by 2023.	Ha of total area treated to maintain cleared areas, i.e. follow up (2 500 ha).	Sustainable (standard) control of terrestrial invasive alien plants.
			Sustainable control of non-invasive alien plants.
	Prevent, contain and reduce the density and distribution of established, invasive alien plant species by 90% in 2026.	Number of releases of biological control agents (500 points).	Mass rearing, systematic release and monitoring of biological control agents (especially Ntsubane outside the currently delineated polygon 2 000 ha).
	Reduce the spread by 20% per annum, and achieve the goal of zero spread by 2026.	Number of species identified, prioritised and treated according to species class.	Early detection of invasive alien plant species.
			Rapid response, eradicating populations of invasive alien species during early phase of establishment.
To create work opportunities for local people and improve knowledge and skills in relation to IAP management.	Provide 1 000 full-time equivalent jobs per annum.	A minimum of 5 contractors contracted to clear IAPs in three clusters.	Use of labour in clearing and application of herbicide.
	Provide one IAP training platform per quarter per annum.	Number of community training interventions per quarter.	Training of worker and interested people in the communities.
		Number of workshops attended by the majority of entities, agencies and active implementers in the Wild Coast per annum.	Establishment of a Wild Coast IAP Forum.
To deliver socio-economic benefits through the use of cleared IAP (value-adding activities).	Utilise 30% of IAP biomass removed by 2025.	Tons of biomass harvested.	Harvesting and primary processing of low-value high-volume products (e.g. biomass to energy charcoal, fire wood, and compost).
	Create jobs and skills in value-adding industries.	Ha cleared and harvested.	Harvesting and primary processing of high-value low-volume products (e.g. crafts, saw timber, and chemical extracts).
			Secondary processing of high-value low-volume biomass form clearing operations (e.g. eco-furniture, and eco-coffins).

Legislative Framework

The following key legislation is relevant to the management of IAPs in South Africa:

The Conservation of Agricultural Resources Act (43 of 1983)

The Conservation of Agricultural Resources Act (CARA) regulates and restricts the propagation, harbouring and sale of IAPs and weed species listed in a set of Regulations published in terms of the Act. CARA was revised in 2001 and is administered by the National Department of Agriculture, Forestry and Fisheries (DAFF). All listed IAPs are divided into three categories, which are now also listed under NEMBA and therefore not included herein. The weeds and invader plants listed in CARA are subject to different forms of management and control. While the old CARA regime is over 30 years old, it is yet to be repealed.

The National Environmental Management Act (107 of 1998)

The National Environmental Management Act (NEMA) embraces the notion of sustainable development as contained in the Constitution in that everyone has the right:

- *to an environment that is not harmful to their health or well-being; and*
- *to have the environment protected for the benefit of present and future generations through reasonable legislative and other measures.*

NEMA aims to provide for cooperative environmental governance by establishing principles for decision-making on all matters relating to the environment and by means of Environmental Implementation Plans (EIP) and Environmental Management Programmes (EMP). Principles contained in Section 2 of NEMA indicates (among others) that environmental management should ultimately aim to:

1) *place people and their needs at the forefront of its concern, and serve their physical, psychological, developmental, cultural and social interests equitably (anthropocentric principle)*
2) *ensure that development must be socially, environmentally and economically sustainable (sustainable development principle)*

The National Environmental Management: Biodiversity Act (10 of 2004)

The National Environmental Management: Biodiversity Act (10 of 2004), (NEMBA) is administered by the Department of Environmental Affairs (DEA). This Act is accompanied by a comprehensive set of *Alien and IAPs Regulations* and *Alien and IAPs Lists* which are subject to various management and control measures. The *Alien and IAPs Regulations* sets out the permitting process for any person wanting to undertake 'restricted activities' (importing, possessing, growing, breeding, conveying, moving, translocating, selling, buying, receiving, giving, donating, acquiring and disposing of any species).

NEMBA regulates all invasive organisms in South Africa, including a wide range of fauna and flora. Section 76 – (2) (a) states the following:

"All organs of state in all spheres of government must prepare an invasive species monitoring, control and eradication plan for land under their control, as part of their environmental plans in accordance with section 11 of the National Environmental Management Act.

(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."

Regulations published in Government Notices R.506, R.507, R.508 and R.509 of 2013 under NEMBA categorises and regulates the control of invasive and alien species as follows.

Category 1A (combat and eradicate)

Category 1a Listed IAPs 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.

1) *A person in control of a Category 1a Listed IAPs must:*
   a) *comply with the provisions of section 73(2) of the Act;*
   b) *immediately take steps to combat or eradicate listed IAPs in compliance with sections 75(1), (2) and (3) of the Act; and*
   c) *allow an authorised official from the Department to enter onto land to monitor, assist with or implement the combatting or eradication of the listed IAPs.*

If an IAP Management Programme has been developed in terms of section 75(4) of the Act, a person must combat or eradicate the listed IAPs in accordance with such programme.

SUMMARY: IAPs requiring compulsory control must be removed and destroyed. Any specimens of Category 1a listed species need, by law, to be eradicated from the environment. No permits for cultivation will be issued.

Category 1b (controlled)

Category 1b Listed IAPs are those species listed as such by notice in terms of section 70(1)(a) of the Act as species which must be controlled.

1) *A person in control of a Category 1 b Listed IAPs must control the listed IAPs in compliance with sections 75(1), (2) and (3) of the Act.*
2) *If an IAPs Management Programme has been developed in terms of section 75(4) of the Act, a person must control the listed IAPs in accordance with such programme.*

A person contemplated in sub-regulation (2) must allow an authorised official from the Department to enter onto the land to monitor, assist with or implement the control of the listed IAPs, or compliance with the IAP Management Programme contemplated in section 75(4) of the Act.

SUMMARY: IAPs requiring compulsory control as part of an IAP control programme should be removed and destroyed. These plants are deemed to have a high enough invasive potential that infestations can qualify to be placed under government sponsored IAP management programmes. No permits will be issued.

Category 2 (permitted on occasion)

Category 2 Listed IAPs 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.

1) *Unless otherwise indicated in the Notice, no person may carry out a restricted activity in respect of a Category 2 Listed IAPs without a permit.*
2) *A landowner on whose land a Category 2 Listed IAPs occurs 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.*
3) *If an IAPs Management Programme has been developed in terms of section 75(4) of the Act, a person must control the listed IAPs in accordance with such programme.*

4) Unless otherwise specified in the Notice, any species listed as a Category 2 Listed IAPs that occurs outside the specified area contemplated in sub-regulation (1), must, for purposes of these regulations, be considered to be a Category 1 b Listed IAPs and must be managed according to Regulation 3.

Notwithstanding the specific exemptions relating to existing plantations in respect of Listed Invasive Plant Species published in Government Gazette No. 37886, Notice 599 of 1 August 2014 (as amended), 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.

SUMMARY: IAPs are regulated by area. A permit is required to: import, possess, grow, breed, move, sell, buy or accept as a gift any plants listed as Category 2 plants. No permits shall be issued for Category 2 plants to exist in riparian zones.

Category 3 (exempt or prohibited)

Category 3 Listed IAPs 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.

1) Any plant species identified as a Category 3 Listed IAPs that occurs in riparian areas, must, for the purposes of these regulations, be considered to be a Category 1b Listed IAPs and must be managed according to regulation 3.

If an IAP Management Programme has been developed in terms of section 75(4) of the Act, a person must control the listed IAPs in accordance with such programme.

SUMMARY: IAPs are regulated by activity. A permit is required to undertake any of the following restricted activities: import, possess, grow, breed, move, sell, buy or accept as a gift any plants listed as a Category 3 species. No permits will be issued for Category 3 plants to exist in riparian zones.

The National Veld and Forest Fire Act (101 of 1998)

The purpose of the National Veld and Forest Fire Act (NVFFA) is to prevent and combat veld, forest and mountain fires throughout South Africa and to provide institutions, methods and practices for achieving this purpose. Institutions include the formation of bodies such as Fire Protection Associations (FPAs) and Working on Fire.

The Act provides the guidelines and constitution for the implementation of these institutions, as well as their functions and requirements. It is, therefore, the responsibility of the proponent to ensure that he/she is a member of the local FPA for support with regards to fire management and protection.

The proponent is also responsible for implementing reasonable measures in order to prevent the spread of a fire to neighbouring properties. Every owner on whose land a veldfire may start or burn or from whose land it may spread must prepare and maintain a firebreak on his/her side of the boundary between his/her land and any adjoining land. The procedure in this regard and the role of adjoining owners and the Fire Protection Association are dealt with within this Act.

The Fertilizer, Farm Feeds, Agricultural Remedies and Stock Remedies Act (Act No. 36 of 1947)

This act regulates the use of herbicides and chemicals: contractors using herbicides need to have a valid Pest Control Operators License (limited weeds controller) according to the Fertilizer, Farm Feeds, Agricultural Remedies and Stock Remedies Act (Act No. 36 of 1947). This is regulated by the Department of Agriculture, Forestry and Fisheries.

Conceptual Approach

A vast body of literature exists that describes both the general and the specific aspects of IAPs and their control. It is not the aim of this report to repeat this, but rather to highlight those aspects that are relevant to the Project and the IAPs found at the offset sites. This Implementation Plan incorporates various IAP management ideas that have been conceptualised in the Wild Coast, specifically those generated by the Wild Coast Project. Many strategies for IAP management have been developed for various countries, institutions and purposes (e.g. GISP 2008). South African examples include the following:

- Working for Water Strategic Plan (WfW 2007)
- Cape Action for People and Environment's strategy (CAPE 2008)
- South African National Parks strategy for the Kruger National Park (Foxcroft 2004, 2005)
- Working for Water regional plan for the Eastern Cape (CSS 2008)
- Management Plans for both Silaka and Mkambati Nature Reserve
- CSIR report on invasive alien plant management in the ecosystems of the Wild Coast (Le Maitre & Forsyth 2010).

Policy level documents include the National Environmental Management: Biodiversity Act (Act No 10 of 2004) and the draft regulations on invasive and alien species, and the Conservation of Agricultural Resources Act (Act 43 of 1983) and its regulations concerning proclaimed invasive alien plants (2014).

IAP management and control is a long-term effort. Thus, IAP management should be aimed at a long-term success with the proponent ideally committing to a clearing and maintenance period of more than ten (10) years with initial clearing efforts occurring over the first five to ten years, followed by a period of maintenance.

The implementation approach targeting IAPs should have a landscape perspective even though the operations are done at a local scale. The context of this is that small projects done at a micro-scale are often unviable and have exorbitant transactional costs compared to a macro-programmatic approach. It is widely recognised that IAPs pose a significant threat not only to the long-term conservation of biodiversity and to human livelihoods and wellbeing, but also to ecological infrastructure and ecosystem services. A landscape approach in IAP management will yield better returns to ecological infrastructure and ecosystem services than micro, project-scale management.

Although the offset sites may not be declared formally as part of the protected area network, this Implementation Plan recognises that the ECPTA has a legal mandate to develop strategies and management plans to control IAPs and minimise the threat to biodiversity. The National Biodiversity Act (NBA, No. 10 of 2004) is one of the legislative frameworks that govern the ECPTA.

In summary, the control of IAPs is not limited in any manner by best practice information, legislation (see above), or policy or strategic insight.

WILD COAST PROJECT: OUTPUTS FOR INVASIVE ALIEN PLANT CONTROL FOR THE WILD COAST

The Logical Framework (Anon 2005) of the Wild Coast Strategy and Action Plan identifies the following activities and deliverables:

- Under Output 3.4: *Adaptive management planning systems for managed resource use protected areas are established*, the following activity is listed as the responsibility of the ECPB Eastern Region:
    - **Activity 3.4.2** *Development of an alien clearing program for state forests and the CCA* (chief issue is uncoordinated and inconsistent IAP control activity)
- Under Output 3.5: *Active Management interventions for managed resource use protected areas*, the following activity is listed as the responsibility of the ECPB Eastern Region:
    - **Activity 3.5.3** *Implementation of new alien control techniques in state forests and the CCA*

Key principles for successful IAP management and control include the following:

1. Take a **long-term view**, with a commitment of funding and resources for at least ten years; with initial clearing efforts occurring over the first five to ten years, followed by a period of maintenance. Without such long-term commitment, any attempts to deal with IAPs meaningfully will be unsuccessful.
2. Plan at a **landscape-scale** even though operations are done at a local-scale. Isolated, local-scale projects are often unviable and have relatively high transactional costs.
3. Consider the **full suite of factors** that are affected by IAPs, including biodiversity conservation, human livelihoods and wellbeing, ecological infrastructure and ecosystem services.
4. Ensure **consistency and coordination** within the regional approach of IAP management by building on and integrating any IAP initiatives already underway in the region, such as:
    a. Wild Coast Project
    b. Strategic Management Plans for Mkambati and Silaka Nature Reserves
    c. DEFF (NRM) projects
    d. Wildlands Trust
5. Have a strong focus on **beneficiation** when clearing IAP infestations. Although the primary goal of IAP management focuses on clearing infestations and rehabilitation, it is important to see value-added to the biomass that emerges from the clearing. DEFF (NRM) has developed innovative ideas of value-adding activities such as the following:
    a. Firewood
    b. Charcoal
    c. Compost
    d. Pellets for energy generation
    e. Secondary processing of high-value products such as coffins, eco-furniture and school desks.
6. Have an integrated multi-species approach that does not just focus on the more obvious woody species. Most species from which some of these value-adding activities can be implemented are hard woody plant species. However, there are soft wood or herbaceous species that also require clearing within the planning domain such as *Chromolaena odorata* (triffid weed), *Lantana camara* (lantana), *Caesalpinia decapatala* (Mauritius thorn), *Solanum mauritianum* (bugweed) and *Cestrum laevigatum* (inkberry).

Definitions

Within this Implementation Plan, the following definitions are maintained:

Invasive Alien Plant	A plant species not indigenous to a location, area or region, which has either been accidentally or intentionally introduced, and whose presence threatens habitats, ecosystems or other species resulting in harm to economic, environmental or human health.
Alien Species	A species that is not indigenous, or an indigenous species translocated outside its normal distribution range in nature, but that has not spread outside its normal range without human intervention.
Weed	Any plant, indigenous or alien, invasive or otherwise, which is growing where it is not desired.
Emerging weed	Plants with invasive tendencies already present outside of their natural distribution range, but not yet widely so. They often have horticultural value, but can impact negatively on natural ecosystems, biodiversity, livelihoods or human health if allowed to continue to expand to outside of their natural range and become naturalised.

Biodiversity Context

The Biodiversity Offset Project domain is in the Maputaland-Pondoland-Albany 'hotspot' (MPAH) (Myers 2003) that, despite its conservation significance, is considered poorly protected. The Biodiversity Offset Project provides an opportunity to strengthen, expand and improve conservation efforts towards securing the MPAH. The Biodiversity Offset Project domain has also been identified in the National Spatial Biodiversity Assessment (NBA 2018) as one of nine national priority areas for conservation action. Hence, this Implementation Plan is strongly focused on biodiversity conservation as IAPs are a key threat to the indigenous species because they often rapidly colonise new habitats and tend to outcompete indigenous species due to:

- a lack of natural pathogens,
- a resistance to local diseases, and
- highly competitive growth and colonising strategies.

An invasion is accompanied by changes in composition, structure and functionality of ecosystems that lead to land degradation and a variety of negative ecological, social and/or economic impacts, such as:

- loss of biodiversity,
- increased risk of fire,
- increased erosion,
- loss of wetland functioning,
- reduced on drainage line stability,
- reduced availability of water (including for human use/consumption), and
- reduced tourism potential.

The Wild Coast Strategy and Action Plan (2005) refers to IAPs as a significant threat to the Wild Coast biodiversity, especially its species-rich grasslands and diverse forest communities (Gelderblom et al. 2005). This is against the backdrop of the unique species and vegetation types of the Wild Coast being a major drawcard for both international and local tourists. Considering that tourism is the primary economic activity in the Wild Coast, the management of IAPs will have positive spinoffs for the local economy.

IAPs also pose a major threat to rural livelihoods. IAP infestation of grasslands causes loss of grazing potential as palatable grass species are replaced by non-palatable or even poisonous species such as *Chromolaena odorata*

(triffid weed), *Solanum mauritianum* (bugweed) and *Lantana camara* (lantana). These IAPs can also outcompete and replace grasses used by the community, such as thatch and medicinal plants and herbs. In forests, IAPs can smother the canopy trees (e.g. *Caesalpinia decapetala* (Mauritius thorn)), replacing or preventing access to useful forest products such as wood and medicinal plants. Some of IAPs can also have direct impacts on human health though allergic reactions or poisoning (e.g. some *Solanum* species).

INVASIVE ALIEN PLANT MANAGEMENT

This section provides a guide for the overall approach that should be adopted in managing existing IAP populations, preventing the establishment of new populations and monitoring invasion pathways that could lead to the introduction of new species or populations of species under management. This Implementation Plan suggests an integrated approach that includes a combination of control methods in a long-term, coordinated and systematic manner based on sound reasoning, careful planning and commitment to resource allocation. Without **all** these factors being operational, any attempt to control IAPs are likely to follow many other attempts in South Africa, which have proven futile and even counter-productive. This high-level Implementation Plan should therefore be translated into lower-level operational plans when the implementation phase of the Biodiversity Offset Project has been initiated. These operational plans should adhere to the minimum standards described in the following documents:

- Guidelines for monitoring, control and eradication plans as required by Section 76 of the National Environmental Management: Biodiversity Act, 2004 for species listed as invasive in terms of Section 70 of this Act (Department of Environment Affairs 2015).
- Specific operational standards are clearly articulated in the Working for Water programme (https://www.environment.gov.za/projectsprogrammes/wfw/)

The general intention of this Implementation Plan is to protect natural resources and prevent environmental degradation. This general goal is guided by past efforts, research, botanical insights, experience and an understanding of the affected environment. This Plan has been designed to be SMART (Specific, Measurable, Actionable, Realistic and Time-bound) to achieve its purpose and generate the desired ecological outcomes and environmental benefits. In conceptualising these SMART goals, this Plan has leaned heavily on the Working for Water Programme's comprehensive guidelines and best practice protocols and monitoring. It is not the intention of this report to duplicate these excellent resources, but rather to provide a summary of what needs to be done by the ECPTA to achieve success in IAP management.

Strategic Planning Approach

All IAP control plans require a strategic approach as opposed to a haphazard or random slash-and-burn approach toward the nearest or most obvious IAP infestation. Considerable research supports the notion that any approach that is not focused and systematic will be ineffective and wasteful, and often makes the IAP problem worse in the end. It is better rather not attempt IAP clearing than implement a process that is not strategic in approach.

The strategic approach in managing IAPs must take a landscape scale, such as per cluster in the Biodiversity Offset Project or within a quaternary catchment or even multiple catchments, depending on the nature of the invasion. The IAP management approach must include at least the following considerations:

- Early detection and eradication of new species, or new infestations of existing species.
- Containing and reducing the negative impacts through integrated control measures aimed at decreasing invasions to maintenance levels, including biological control and the rehabilitation of invaded areas and habitats.
- Building capacity and partnerships to undertake these actions, including raising general awareness.
- Research, monitoring and evaluation of invasive species and the effectiveness of management interventions.

Preventing Introductions

The best long-term approach to IAP control is to prevent the infestation of new areas by screening of applications for introductions for new species. This screening should consider whether the species pose a significant risk to

both or either biodiversity conservation and/or human livelihoods. Such an approach should be guided by risk-based assessments that integrate the potential for an area to be infested and the risk of high impacts due to the ecology of the IAP species likely to invade. The aim of this should be to minimise the opportunities of creating new IAP problems. Considering that this may go against the deliverables of some entities such as the forestry sector, this activity should be treated with caution. The introduction itself may not be problematic if managed appropriately, but runaway seedlings may present a problem. This means, the ECPTA should be involved in conceptualising monitoring protocols for all introductions into the area. Furthermore, the outcomes of monitoring activities implemented by forestry Environmental Control Officers should be shared with the ECPTA. This will provide the ECPTA with fore-warnings for potentially new invasions and likely operational interventions to be triggered. This might need developing and enforcing policies, laws and regulations; raising awareness; targeting likely pathways of introduction and supporting and guiding early detection.

Early Detection and Rapid Response

A national Early Detection and Rapid Response (EDRR) programme is used by the South African National Biodiversity Institute (SANBI), for the identification and control of newly established IAP species before their populations spread. Based on both practical experience and research, it is critical for the ECPTA to act promptly when there is evidence of a species is becoming invasive. The Working for Water programme has shown that even a short delay can result in a species becoming an established invader, which will be far more expensive to manage than if it had been subdued earlier. In this Biodiversity Offset Project, it would be of great advantage during the operational phase that representatives from SANBI (Invasive Alien Plant section) form part of the IAP management team. They could give input on the principles and practices that are adopted to increase the likelihood and success of early detection.

Likewise, any new infestation of existing species should be prioritised for action before they properly establish and start to damage the ecosystem. It is much cheaper and more successful to contain an emerging infestation where the ecosystem is still in reasonable condition than to clear an established one where the ecosystem requires rehabilitation.

Integrated Control Approach

Effective control of IAPs requires a landscape perspective where an integrated approach of complementary methods is used. This is especially true for the Biodiversity Offset Project domain where there is a wide diversity of IAPs. These methods would include mechanical, chemical and biological control measures. Depending on species type, species density and age class of the plant population, the operational plans should be tailor-made to fit local conditions.

Prioritisation

The problem of IAP management is often dauntingly large in terms of extent, intensity and cost. Thus, species and infestations should be prioritised for interventions. Without prioritisation, the scale of infestation will often overwhelm either the human or the financial resources to the point of paralysis. The general principles for managing IAPs as set out in the WfW standard operations procedure include the following:

- Initial clearing should always be accompanied by follow-up activities. Follow-up always takes precedence over the initial control of new areas; and failure to follow-up in time wastes the resources spent on the previous operation(s). This is important because some of the species found on the Wild Coast, notably *Chromolaena*, can re-sprout and produce seeds within 2–3 months of being treated. Follow-up has to be timed in such a manner to prevent this so the treatment unit (NBAL) must be followed-up at least two to three times within the first year. Resource planning has to allow for this.

- Control low-density invasions before dense invasions; this is because (a) controlling low-density areas removes invaders before they really suppress or displace the indigenous vegetation so that recovery of the natural vegetation is more rapid; and (b) a greater area can be treated per unit of resources.

- Control operations in riparian zones should, wherever possible, start from the top of a river system and progress downstream; this is because many riparian invaders are dispersed by water and move downstream. This is not possible where rivers have their headwaters well outside the protected area but can be done where the entire system is inside the protected area or only extends a short distance outside the protected area.

- Ensure that appropriate biocontrol agents are introduced unless they are already known to be present and effective. The longer the agents have to attack their target species the more effective they are; this, in turn, can reduce treatment costs, especially the follow-up, where seed feeders are used. This needs to be explicitly catered for in the initial APO and for subsequent years as specified by, and agreed upon by the WfW projects active in the Wild Coast.

- Ensure that control operations are integrated with other operations to ensure that the potential synergies are realised. The primary one in these protected areas is the management and use of fire. In general, fire can be a useful in conjunction with control operations, but it will not be sufficient on its own as the species that have invaded these areas are able to cope or even thrive with the fire regimes in the natural vegetation of these reserves (e.g. *Psidium guajava, Lantana camara*). Frequent fires may be useful in keeping some species from establishing in grasslands (e.g. *Chromolaena odorata*) (Goodall & Erasmus 1996; Goodall & Zacharias 2002) but reductions in fire frequency will allow such species to establish. Vegetation which burns less frequently, such as the forest fringe, is very vulnerable to invasion because of the generally lower fire frequencies.

- Ensure that treatment units (NBALs) that have been treated are revisited periodically after the treatment operations have ended. This is particularly important for containing reinvasions by aggressive colonisers and for species, such as *Chromolaena odorata* and *Solanum mauritianum*, which have persistent seed banks.

A prioritisation matrix such as in Figure 2 can be used to prioritise species (which IAP species to target), areas (which specific areas to clear) and timing (which areas need attention in the current management cycle).

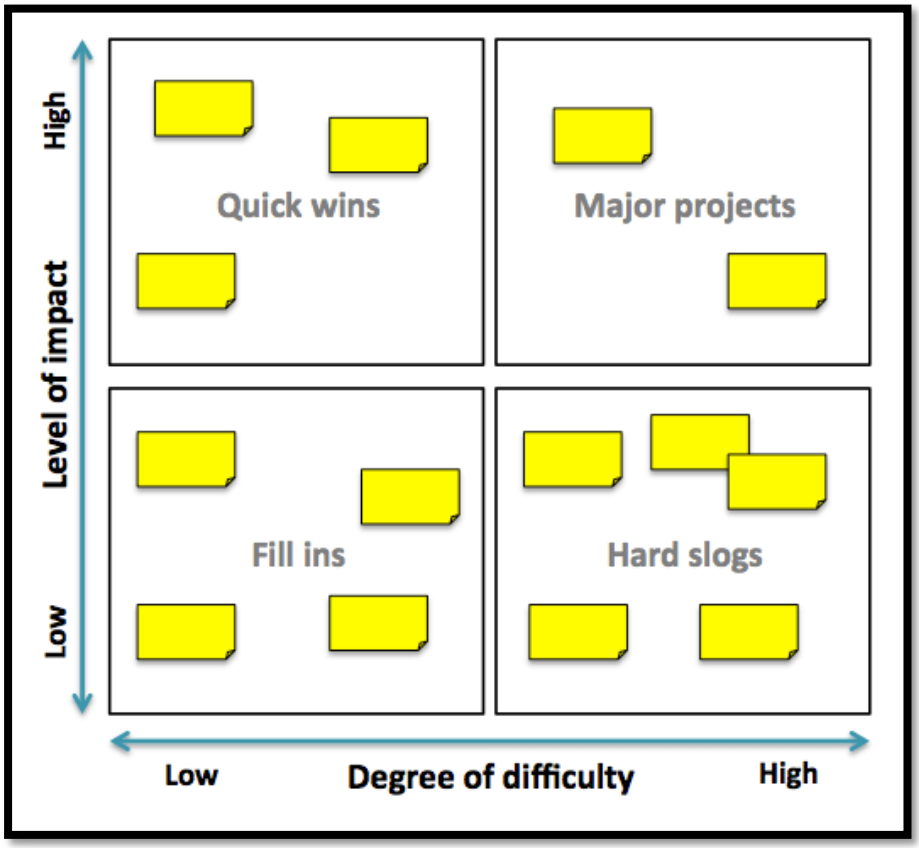


Figure 2. Prioritisation matrix for planning operations

In this prioritisation exercise, a landscape perspective should be maintained into which all lower-level operational plans need to fit. The prioritisation matrix will be an important decision-making tool to enable the ECPTA to work through different options to determine the best course of action. The proposed matrix has four boxes representing the different levels of impact and difficulty:

- **Major Projects** – those projects that will have a high impact but are going to be difficult to implement.
- **Quick wins** – those projects that will have a high impact and will be straightforward to implement.
- **Hard slogs** – those projects that will have a low impact and will be difficult to implement.
- **Fill ins** – those projects that will have low impact and will be easy to implement (these projects can be implemented in Year 1, as they will be a learning curve for both the implementers and the ECPTA).

Prioritisation should be done at the start of the project and then at regular intervals such as at the start of every management/budget cycle, and must consider the following criteria:

Spatial priority

1. **Land values** in terms of conservation (biodiversity and habitat), ecosystem services, arable or socio-economic values. For example, it may be important to prioritise clearing of riverine areas to improve water flow to a vulnerable downstream community.

2. **Risk of infestation** maps showing those areas prone to future infestation or rapid expansion, such as regularly disturbed areas around plantations or areas where vectors of seed dispersal may operate to a higher degree, such as road construction sites.

3. **Catchment location** as the dispersal of IAPs within a catchment is often downstream. That means upstream areas need to be prioritised for clearing before downstream areas are cleared.

4. **Infestation density**, with low density infestations being targeted first as this will rapidly reduce the overall spatial extent of the IAPs on site and confine the problem to smaller more easily managed localities. If a stand is too dense to remove in one go the edges of this should be controlled to prevent spreading. The complete clearing of this can then occur at a later stage when time and resource are available, and conditions of higher priority areas are acceptable.

5. **Key source populations**, for example, populations of wattle trees in an upper catchment will be an ongoing source of seeds that will re-infest any cleared downstream area. Typically, any 'upstream' area (in terms of gravity, water, wind and animal vectors) should be a high priority as seeds generally move downhill, downstream, downwind and along any route or regular stopping point that animals (domestic or wild) use, such as around kraals, along fences and livestock paths, etc.

6. **Proximity to labour**, especially in areas where there is no road access. It is ineffective to work in areas where significant resources (time, fuel, 4x4 vehicles) are needed just to commute to the site.

Species priority

1. **Potential rate of infestation**, based on the IAP species' life-history strategies. Those species whose life-history strategies lend themselves to rapid expansion and infestation must be prioritised, e.g. Black wattle, which produces thousands of easily-dispersed long-lived seeds, is a higher priority than prickly pear, which largely reproduces vegetatively.

2. **Severity of infestation** impacts. As different IAP species have different impacts on the values mentioned in point 1, those species that have the greatest impacts must be prioritised. For example, in grazing areas the highly toxic Lantana should be cleared due to the risk of livestock death. Or, in water security areas, 'thirsty' species such as black wattle should be prioritised. Or, in tourism areas and along hiking paths, IAPs such as bramble that are nasty to walk through, or are unsightly, should be prioritised.

Some of the most important invading species that need to be prioritised in the Wild Coast include:

- *Caesalpinia decapetala* (Mauritius thorn): aggressive invader; well-dispersed; it is able to invade both disturbed and relatively intact forests as well as grasslands; a vigorous sprouter after fire.

- *Solanum mauritianum* (bugweed): aggressive invader; able to invade disturbed forests and forest ecotones as well as grasslands with woody plant encroachment which provides bird perches; does not resprout after fire.

- *Cestrum laevigatum* (inkberry): an aggressive invader; very similar in its invasion ecology to bugweed; seed bank dynamics apparently unknown; invades grasslands and forest ecotones but not forest interiors as well as grasslands with woody plant encroachment which provides bird perches; does not resprout after fire.

- *Lantana camara* (lantana): an aggressive invader; very similar in its invasion ecology to bugweed; seed bank dynamics apparently unknown; able to invade a wide range of habitats; vigorous resprouter.

- *Chromolaena odorata* (triffied or paraffin weed): an aggressive invader; produces large quantities of wind dispersed which can cover considerable distances (kilometres); seed banks accumulate in the ground and seeds can persist for years; invades grasslands and forest ecotones but not forest interiors; established plants resprout vigorously after fire, saplings younger than one year killed by fire and fires at intervals of 3 years or less can keep *Chromolaena* out of grasslands.

- *Psidium guajava* (guava): an aggressive invader which produces abundant, edible fruit with large numbers of viable seeds; attracts birds, monkeys and other vertebrates capable of dispersing the seeds; invades grasslands, shrubby vegetation, woodlands and forest edges, essentially anywhere the seedlings can establish; even small plants are vigorous sprouters and it can persist even with frequent fires. The edible fruit of this species is used by local communities which may result in conflicts of interest about their control.

Timing or phasing priority

1. **Optimal effectiveness** must be considered to ensure that whatever resources (human and financial) are used to prevent the greatest proliferation of IAPs and minimise future work.

2. **Density of infestation** must be considered as it is better to prioritise less dense infestations as dense stands generally don't get worse, but less dense areas rapidly become thicker and harder to clear if left for even a few years.

3. **Seeding species/individuals** must be prioritised so that they are cleared first, BEFORE they are able release their seed.

Containment

Containment is the principle of controlling spread from demarcated areas of dense infestation or legal cultivation (e.g. forestry plantations). It is important to work in collaboration with Environmental Control Officers of the plantation companies to prevent escaping seedlings. The containment of dense stands of IAPs is used as a management strategy in situations where there are inadequate resources to eradicate a demarcated IAP infestation. Although the dense infestation may not be cleared, any spread of the infestation is dealt with. Projects of this nature can fit within the 'hard slogs' component of the prioritisation matrix.

Follow-up

Regular follow-up operations that ensure effective control and prevent re-invasion of cleared areas are necessary. IAP management is a long-term process and interventions cannot simply stop once initial clearing has been done, despite the temptation to move onto other sites to 'chase' an area-based target.

Follow-up control and maintenance should be conducted in cleared high-density areas before initial clearing is conducted in other lower-density areas IF it is not possible to do initial clearing for the entire site within the time required between initial and follow-up work. This will prevent initially cleared areas from becoming re-established and the initial work thus undone by the time control can finally get back to it. It is thus pertinent to rather do smaller areas properly than the entire site less so.

Post-clearing activities must include various long-term activities that complement the work already undertaken. The exact details of the follow-up operations will be determined by the Monitoring and Evaluation of the cleared sites as this will assess how much work, and what type of work, is needed for the follow-up.

Rehabilitation

Too often, a regional response to IAP infestations focuses on the eradication aspect and there is a long history in South Africa of large amounts of resources being wasted on eradication of IAPs without adequate investment into the other aspects of integrated control. Such imbalances always lead to the resources being wasted and the IAP infestation becoming worse. The same mistakes must not be made in the offset areas!

As many IAPs proliferate on disturbed sites, including those disturbed by initial clearing, one of the best ways to prevent IAPs from proliferating in an area is to ensure that damaged areas, or areas cleared of IAPs, which are

now by nature 'disturbed', are able to recover. Ongoing annual or even bi-annual maintenance clearing of emerging IAPs will give the indigenous plants a chance to re-establish. Rehabilitation typically involves a mix of active and passive rehabilitation of indigenous species using manipulated natural succession or active reseeding and planting. The natural plant density of a recovered area will play a role in reducing future proliferations through competition while limiting the extent and intensity of disturbance will reduce future ruderal seed germination. For most IAP clearing operations, rehabilitation simply involves creating a foundation for which natural regeneration of indigenous species can occur.

The initial goal of re-vegetation is to establish a short-term (2–5 years longevity) cover crop that stabilises both the soil and the diurnal temperature and light fluctuations to reduce the germination of IAP seeds.

On steep embankments, where larger trees have been removed and the soil is exposed, the trunks can be cut into lengths and pegged in series horizontally along the slopes using sections of cut branches as stakes. Only barren branches free of seeds should be utilised. Either this method or utilising more formalised silt screens and soil saver cloth, can be used on any cleared and barren piece of land if erosion is a risk or if indigenous species are struggling to re-establish.

Active restoration subsequent to clearing of IAPs is necessary to ensure the suppression of potential regeneration of seedlings. The recruitment of natural vegetation can provide a good cover and prevents IAPs to re-establish or re-colonise. Rehabilitation does not replace follow-up treatment. Failure to undertake the necessary follow-up treatments or to ensure that the treatments are effective (i.e. that chemical and mechanical treatments achieve a high kill rate) can potentially lead to ineffective control of IAP (Goodall & Zacharias 2002; Morris et al. 2008).

Environmental Awareness, Capacity Building and Partnerships

The ECPTA will not win the battle against IAPs in the biodiversity offset sites on its own. It is, therefore, necessary to build partnerships with many role players in the Project domain. Also, it is important to align and create synergies with those entities that are already working in the landscape. This will have a huge potential of reducing the costs and provide co-learning opportunities. A formulation of an IAP Forum would go a long way in ensuring synergy and capacity building within the biodiversity offset team, municipalities, other implementing entities in the project domain, and even the staff of local nature reserves. This must be a priority for the PMU when it starts.

Partnerships should be created with the local communities as a priority, as people from these communities may be the first line in the defence against IAP infestations. Not only can they alert the authorities to any emerging infestations, but they can be involved in clearing them in their areas. Environmental awareness and basic information such as educational leaflets, posters and basic training sessions should be provided to the local community so that they start to recognise the damage that IAPs inflict in their area and know how to respond.

How this plan links to the Annual Plan of Operations

DEFF's Working for Water programme has developed extensive standard operating procedures for implementing and managing clearing of IAPs (WfW 2007). These procedures are not focusing only on the clearing protocols but also on the basic set of reporting forms. This Implementation Plan is conceptualised according to these standards which cover the following steps:

- Project operational planning and administration
- Contract and treatment area administration
- Project contractor administration
- Management of transport, tools, equipment, stores, workshops

- Control methods, herbicides, use of fire, environmental awareness, health and safety
- Fire-fighting and protection
- Social development, employment, training, participation of workers
- Costing

This Implementation Plan provides a strategic implementation approach for the management of IAPs in the biodiversity offset polygons. It also highlights the current state of invasion status in each polygon or cluster of polygons. As indicated above, mapping needs to be refined at fine-scale level for translation into Annual Plans of Operations (APO). These APOs need to follow an adaptive management approach as indicated in Figure 3.

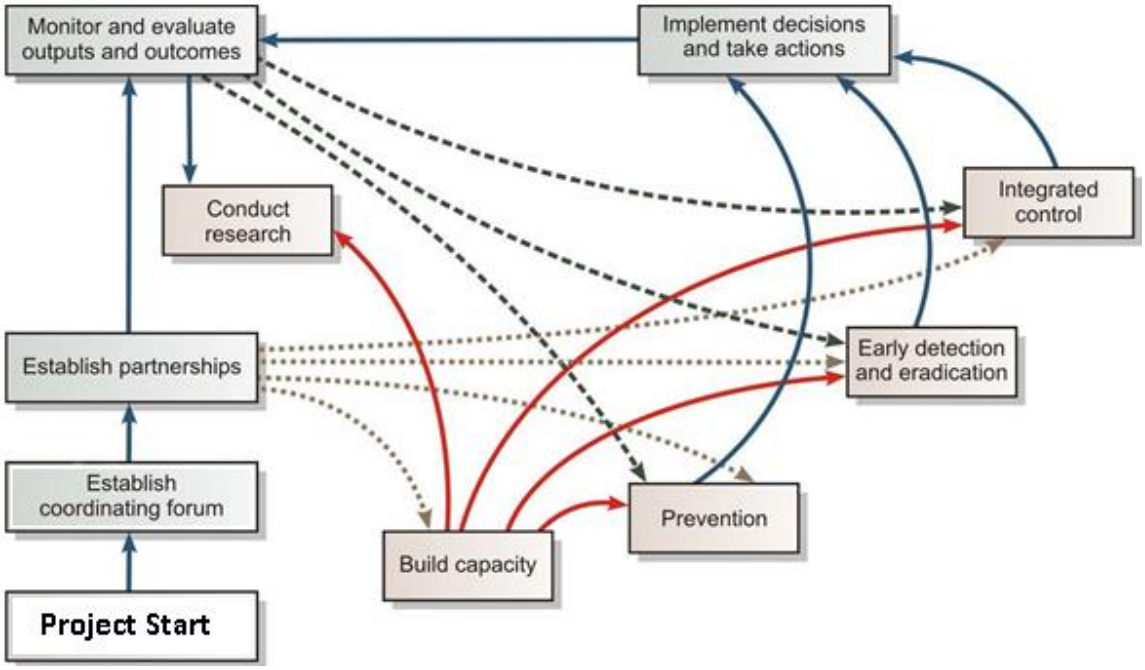


Figure 3: A flow diagram showing the steps to be followed and the sequence of activities and actions required to achieve the overall objective of a biodiversity offset IAP implementation plan. The broad solid arrows link the activities to outputs and outcomes and the dashed arrows show the feedback loop aimed at improving the execution of those key activities (Le Maitre & Forsyth 2010).

The APOs should also inform budgets, the number of person-days and other resources (e.g. equipment, chemicals and transport) that are available for control treatments. The APOs should follow the same format as done by WfW. The WfW mapping system uses NBALs (**N**atural **B**iological **A**lien) which are treatment units (polygons) planned for clearing. Each NBAL is assigned a code based on the quaternary catchment it is located in, the subdivision of that catchment and the number which shows the order they were established in. For synergy and future referencing, it is important that the IAP management approach in the Project domain follows or is aligned with the WfW protocol. This is important because WfW is already working in the area. The codes start with the name of the quaternary catchment in which the Project is situated, followed by a subdivision of that quaternary and then by the number of the area demarcated for the control operation. The code is used to track each treatment that is applied to an NBAL, when it was done, the resources required and the effectiveness of the treatment. Reporting on the APOs should be done both monthly and annually.

The following items only deal with the essential steps in executing and monitoring control treatments, for more details see WfW (2007).

The Polygon or Cluster Manager needs to ensure that the following essential steps are undertaken in executing and monitoring control treatments (these steps are as per WfW 2007):

1. Divide each biodiversity offset polygon into management units called NBALs:
    a. Begin with the top priority areas and select a management unit.
    b. Each NBAL size should be sized so that it would take about 315 person-days of work to clear based on the WfW norms (15 people working for 21 days).
    c. It should cover an area within which the invasions are similar (homogenous) to simplify the estimation of the inputs needed to clear it.
    d. The boundaries should be defined by natural features or otherwise clearly indicated.
    e. Identify sites where it is likely that rehabilitation may be needed and obtain input from the ECPTA's scientific services on suitable rehabilitation measures.
2. Identify biological control:
    a. Implementation of biocontrol is a top priority.
    b. Identify suitable sites with input from the regional WfW biocontrol implementation staff.
    c. Locate and mark the sites on the map showing the state of invasions in the Reserve.
3. Identify and demarcate special areas where IAPs should not be cleared (e.g. stands that are for communal use for harvesting firewood, fencing poles, etc.).
4. Develop the Annual Plan of Operations (APOs):
    a. Select management units and add them to the standard APO spreadsheet (an APO spreadsheet is attached as Appendix B for reference).
        i. Insert the NBAL number.
        ii. Add the data on the species, their densities and their size/age class in each NBAL.
        iii. Select the planned treatment phase (e.g. initial clearing, first follow-up).
        iv. Select the appropriate treatment (e.g. hand-pull, cut & fell, herbicide).
        v. Keep a running total of the person-days.
        vi. Repeat steps i-v until the person-days approximate the budget available for control treatments (i.e. excluding training and management overhead costs).
        vii. The system does not provide for rehabilitation at this stage, do not forget to include it.
        viii. Plan for one or more follow-up treatments within the same year where the species requires them (e.g. *Chromolaena odorata*). This can be done by re-entering the NBAL data and selecting the appropriate follow-up treatment.
    b. Check that there are still resources available to treat further NBALs, if not then that is the set of NBALs that can be treated for the year.
    c. Add the rest of the information needed to complete the APO for the year.
5. Submit the APO to management and scientific services to obtain their approval.
6. Implement the APO – Cluster Manager with the control team & team leader (contractor).
    a. Identify and mark out the NBALs on the site.
    b. Inspect the area with the clearing team (contractor):
        i. Get agreement on the resources required to execute the planned treatment.
        ii. Agree on the methods and standards to be applied.
        iii. Finalise and sign-off on the contract; include a map of the NBAL showing the features that demarcate it.
    c. Take fixed point photographs prior to commencing the treatment. These points should be permanently marked and the co-ordinates should also be recorded using a GPS.
    d. Monitor progress with the treatment and confirm that progress is as expected.

e. If it is not as expected, agree with the control team on how to remedy the situation, where necessary.
f. When the treatment has been completed, inspect the NBAL area to:
    i. Make sure the treatment has been completed as specified in the contract (there is a specific form to complete).
    ii. If the treatment does not meet the standard agree with the team (contractor) on what still needs to be done and ensure that it is done.
    iii. If the treatment meets the standard, complete the evaluation form and sign off.
    iv. Make a copy of the signed evaluation form for your own records and submit the original to the regional manager.
g. Select the next NBAL and repeat the steps above.

7. Monthly reporting
    a. Prepare monthly reports on the progress of the control operations.
    b. Ensure that all treatment information is captured for each NBAL.
    c. Document cases where clearing team performance does not meet expectations and reasons why this occurs.
8. Annual reporting
    a. Provide a summary of the progress, effectiveness of treatments, outcomes of corrective measures (where necessary) and any other relevant information.

MONITORING AND EVALUATION

Monitoring from a baseline

It will be extremely difficult to implement an effective IAP management programme without monitoring and evaluation (M&E). To assess the impact of the clearing activities, follow-ups and rehabilitation efforts, monitoring must be undertaken on an agreed frequency (i.e. monthly, quarterly or annual). Within those M&E protocols, learning should be built in so that an adaptive approach of implementation can be effected. This will introduce a flexible approach to the IAP management programme so that changing conditions can be addressed. The requirement of learning is necessary so that the approach to implementation can be improved based on accurate, comprehensive and reliable information obtained both from monitoring the effectiveness of IAP management interventions and from knowledge gained elsewhere. M&E should have objectives so that it is done according to specific standards.

Objective 1*: Regularly monitor the efficiency and cost-effectiveness of invasive plant control techniques and update the plan as required.*

Objective 2*: Maintain key baseline and monitoring information on the implementation of the invasive alien and invasive species control programme.*

M&E should also contribute to the improvement of effective management. The management should be adaptive in nature, so that there is a continuous improvement in the manner in which actions are taken. Effective control/management of IAPs cannot be precisely prescribed because there are too many variables that require continuous adaptation. Continuously obtaining data is key to this flexible approach. Without continuous reflection from M&E data, mistakes are bound to happen. With this information it will be possible to achieve the goals of this Implementation Plan.

There are different levels at which monitoring and evaluation of the control operations is carried out which include:

- Management Unit Control Plan level which assesses whether the overall progress on the clearing work is satisfactory when compared with the objectives that were set for this plan and with the targets set for the Annual Plan of Operations.

- The treatment unit (NBAL) level which assesses the effectiveness of the control treatments, that is, how well the individual contracts have been carried out.

The top level of reporting is based on aggregating the assessments done at the treatment unit level and comparing the summarised actual progress with the planned progress. Where there are deviations from the planned outcomes the reasons for these should be evaluated and appropriate remedial actions taken. **These assessments and actions are the responsibility of the Invasive Alien Plant Manager.**

Of all forms of management, the control of IAPs requires detailed and systematic M&E protocols. M&E needs to be applied both in the field and in management systems, and these are discussed below.

Monitoring is a measurement of change from a **baseline** situation. One of the first activities of the Project Management Unit (PMU) should be to establish accurate field-based baseline data for all the offset sites, focusing on the spatial (GIS) information of all IAP infestations in and around the site. This data should conform to the WfW minimum mapping requirements in terms of species identification, site conditions, age-density structures, and so on. The importance of this baseline assessment cannot be over-emphasised as without this data, it is impossible to plan and monitor properly.

Thereafter, monitoring should be done at several levels using a range of indicators, including the following:

- Photographic records must be kept of areas to be cleared prior to work starting and at regular intervals during the initial clearing activities. Similarly, photographic records should be kept of the area from immediately before follow-up clearing activities, and after. Rehabilitation processes/efforts must also be recorded.
- GIS mapping records should ideally be kept, recording progress each year in relation to the baseline.
- Records of daily operations should be kept, e.g. area/location cleared, number of labour units and amount of herbicide used. This will assist with planning as each site will require work, once or twice a year, for several years and of evaluating the costs against the benefits of the work.

Monitoring of any cleared area should run for a minimum of three years from the start of initial clearing. The cleared site(s) must, following the initial control phase, receive follow-up treatment no more than six months after the completion of initial clearing of the final management unit. Thereafter, the site must be revisited on a regular basis, every six months at a minimum, to monitor and record the regrowth and action any maintenance control measures necessary.

The recommended reporting frequency is summarised in the matrix below:

Table 1: Example of a Strategic Monitoring and Evaluation Matrix for IAP clearing and biomass beneficiation

Objectives	Key Performance Indicators	Tool	Baseline	Target	Reporting	Key Activities
Environmental						
To improve the biodiversity of the planning domain through the identification, eradication, control and maintenance of IAP species.	% of offset area with accurate field maps of IAP infestations	GIS mapping	0%	100%	Quarterly	Conduct IAP baseline mapping.
	% ha of IAP species eradicated	GIS mapping	100%	0%	Annually	Develop and implement an IAP Management Plan.
	% cleared area that has been rehabilitated to a natural ecosystem	GIS mapping	0%	100% of cleared area	Annually	Promote the planting of indigenous species.
Social						
To create work opportunities for local people.	# localised man-days worked	Timesheets	0%	1000 FTE per annum	Monthly	Employ local people to do all clearing and rehabilitation.
To improve the localised knowledge and skills in relation to IAP management.	# training interventions	Workshops	0	1 per quarter	Quarterly	Provide IAP training and development initiatives.
Financial						
To deliver socio-economic benefits through the beneficiation of biomass.	# Rand revenue generated from IAP biomass beneficiation	Financial Report	R0.00	TBC	Annually	Conduct a financial feasibility assessment. If feasible, implement accordingly.

DATA REQUIREMENTS

The strategic approach described above, with a strong emphasis on prioritisation, relies heavily on having good data. Without such data, any decisions will likely be inaccurate, and the exercise will be fruitless. The following data requirements are a minimum for reasonable decision-making capacity.

Species life-history and ecological data

It is important to know enough about each IAP species to allow for prioritisation and control methods to be designed. Considerable work has already been done by institutions such as the Plant Protection Research Institute, Agricultural Research Council and many academic organisations, so there is no shortage of information about the life-history, ecology, impacts, control methods and likely future under various climate change scenarios for every common IAP in the country. There are also several comprehensive books that summarise all this information, such as the recently published *Problem Plants and Alien Weeds of South Africa* (Bromilow 2018).

Mapping requirements

Infestation maps showing the spatial distribution of areas with known IAP infestations, noting the species mix, age-size classes, and density classes.

Figure 4. Example of IAP trees establishing on the edge of a secondary grassland

Such data is relatively easy to generate from desktop analysis of good quality aerial imagery ONLY for larger IAPs in contrasting ecosystems, as was done in this report for the offset sites. In other words, it is relatively easy to accurately map infestations of IAP trees in a grassland as they stand out from the matrix (e.g. Figure 4). It is much harder, if not impossible, to generate maps of IAP infestations in woody ecosystems such as forests or riverine

bush as the distinction between indigenous and invader is minimal, and it is too easy to make errors of omission or inclusion.

The only way for a good IAP map to be generated is by an experienced field ecologist doing baseline field work. This will allow for indistinct IAP species to be identified, such as invasive grasses in a grassland, or invasive trees in an indigenous forest. Without such baseline work, it is impossible to proceed accurately.

- **Mapping:** A suitably qualified and experienced person should survey the areas (polygons) that are to be cleared and have the IAPs which occur there identified and fine-scale mapping done (through GIS) accordingy to IAP species, density and size (layers).
- **Management units:** Once fine-scale mapping has been completed, its recommended to separate each area/polygon into practical management units (ha) using GIS. These are areas that often have easy to identify geographic boundaries and make management and monitoring in terms of alien plant control much more concise.
- The management units must be **prioritised** according to factors such as threat status and value. High priority units are chosen according to various factors including where the IAP threat is greatest due to the likelihood to spread and cause further problems, where the conservation concern is the greatest and where control in these areas will achieve the greatest total site and area benefit. For instance an area of sporadic though rapidly spreading invasive trees would be of higher priority than a dense area, as it is possible to be cleared much faster preventing more damage than the already dense area which is not likely to get much worse.
- Each management unit should be evaluated continually by the staff/contractor to map areas of special concern such as hazards, wetlands, bee hives, dense seedlings, etc. This information is invaluable for annually assessing progress and potentially updating plans and/or strategies. There is likey to be a training requirement here to upskill the staff/contractor to be able to do basic map work using a GPS and/or annotating hard copy maps.
- Management units can be created digitally if an area is small or well-known, but site visits are required for larger areas or unfamiliar locations to divide them into workable management units based on clearly-defined geographic features such as rivers, roads, cliffs, forest edge and fence lines.
- Each management unit should have a descriptor document that provides further insight into what to expect and how the invasion in the unit should be addressed. Contractors must read and understand the descriptor document before starting work in each unit. This document should be routinely updated, and revised versions saved following completion of any alien vegetation clearing phase.
- Appendix 4 includes an example of a Management Unit Descriptor Document.
- **Targets:** Once management units are established, annual IAP clearing targets need to be set by the PMU and agreed with the staff/contractor. These targets will form the basis of the management effectiveness monitoring (see above).

Clearing protocols and resource requirements

A key to prioritisation and strategic approaches is to understand how much and how long it will take to clear any one patch of IAPs. This step involves taking the infestation maps and calculating what will be required to clear it to the point that it is in the 'maintenance' phase. Such calculations require an understanding about the quantity of man-days, chemicals, equipment, finances and other resources that are needed for different clearing scenarios (based on the species, density, age-class data in the maps, and the proximity to road access and labour sources).

Considerable work has been done over decades by the various Working for Water and other such clearing programmes, so there are good spreadsheet models that can assist the ECPTA. The key to success here is having good underlying infestation maps and attribute data.

HUMAN RESOURCES

It is necessary to understand something of the socio-economic dynamics within the labour source areas as these dynamics can confound the best-planned programmes if they are not understood. It is vital to work through the local traditional leadership for any recruitment or sourcing of labour.

Clearing Teams

Clearing Teams need to be assembled (or contracted if they already exist). The exact structure of the Clearing Teams will depend on the nature of the work to be done, but other programmes recommend Clearing Teams comprising 12 people structured as follows:

1 x Team Supervisor/Driver
1 x Assist Supervisor (First Aider/OHS Representative)
4 x Chainsaw/Brushcutter Operators
6 x Clearing Operators

Training and Development

If members of the team does not have experience in specific aspects of the required clearing (i.e. either the species or the context) then it is important to identify the training needs for project workers and supervisors based on the nature of the area to be cleared, the target IAPs and identified clearing methods. This may include the following:

- IAP identification
- Safety training for use of specialised equipment such as chainsaws
- Specialised training for working in difficult or sensitive terrain

All necessary training must be completed prior to the start of the clearing activities.

See Appendix 3 for a Training Matrix Template.

Occupational Health and Safety

All work also needs to be done in accordance with The Occupational Health and Safety (OHS) Act and Regulations (85 of 1993) and a site- and task-specific Health and Safety Specification should be developed and implemented by a suitably qualified and experienced Health and Safety Practitioner. Key OHS considerations should include:

- Training certificates for all operators of machinery such as chainsaws, chippers, sprayers, etc.
- Approved method statements
- Registered/licenced vehicles
- Driver licence and training
- Provision of clean toilet facilities, eating facilities, fresh water, etc.
- Valid COID certificate/s and insurance
- Proper storage of fuels, herbicides, tools and equipment
- Fire prevention
- Suitable Personal Protective Equipment (PPE)

First Aider and OHS Representative Responsibilities

Responsibilities of the First Aider include the following:

- Managing the First Aid Kit
- Keeping record of all items issued from the First Aid Kit: the name of the person issued to, the item issued, and the date issued.
- Applying first aid when an injury occurs.
- Attending Health and Safety meetings when required.
- Reporting when stock is low in the First Aid Kit.

Responsibilities of the OHS Representative include the following:

- Recording all near misses as well as minor and major injuries.
- Reporting injuries.
- Reporting any unsafe act/condition in the workplace.
- Attending Health and Safety meetings when required.
- Speaking to workers regularly on healthy, safe working procedures and encouraging workers to report unsafe conditions.

Implementing Entities and Key Responsibilities

This section outlines the key entities who may be involved with the implementation of this IAP Management Plan.

Entities	Role
Client/Developer	To fund the project development, assume final acceptance and handover, and accept ultimate accountability.
Implementing Agent	To manage the project design and development on behalf of the Client/Developer.
Principal Contractor	To manage the implementation of the project.
Sub-Contractor/s	To implement parts of the project (for example, the IAP Management Plan).
Environmental Control Officer	To monitor, evaluate and report on implementation and compliance/conformance to the IAP Management Plan.

Equipment and Chemicals

The work plan should reflect the infestation and other data described above. This will determine the clearing methods required, which in turn will determine what equipment and chemicals will be needed. These should be procured and be on site before the work starts otherwise the team will be inactive and unproductive. The following components need to be considered:

- Vehicle/s and fuel (incl. Service & Maintenance)
- Chainsaws, brushcutters, bowsaws with maintenance tools and spares
- Herbicides, sprayers, spill kits, etc.

- Personal Protective Equipment (PPE) and First Aid Kits

BUDGETING

Good budgeting is a critical component of successful IAP control, and it is built upon all the data described above. Any plan to manage IAPs should have a section that unpacks the costs of all requirements, including labour, equipment, herbicides, PPE, etc. Furthermore, if a plan to clear IAPs on a given site is structured correctly, with regular follow-up events, the overall management costs will quickly decline.

If specialised IAP clearing contractors are to be used, it is important to compare quotations and qualifications/experience of several teams. If a team is not qualified or experienced, it is unlikely that they will implement effective IAP control.

Always do sufficient research into the types of IAP present. Large gum trees will require significantly more resources to clear than a few bugweed plants. As such, a survey to determine species density and distribution, together with a table that assigns approximate costs to clearing each type of IAP present, is essential.

In the example below, resources and training need to be included into the proposed annual budget forecast to be reviewed and approved by the ECPTA management (eThekwini Municipality 2013).

Draft Project Budgeting Table (Mechanised Control):				
No.	**Specifications**	**Quantity**	**Unit Cost**	**Total**
1	Staff Training			
2	Staff Person Days			
3	Personal Protective Equipment			
4	Application Equipment			
5	Mechanical Control Equipment			
Total Cost (per Month)				
Total (Per Year)				

Estimated Cost to Clear 1 Ha:	
Infestation Rate (mixed species)	**Cost (ZAR / Ha)**
Light	R3,357.52
Medium	R4,648.88
High	R8,633.60
Very high	R20,145.10

Estimated Area (m^2) Cleared Per Person Per Day:		
Control Method	**(m^2) Cleared/Person/Day**	**(m^2) Cleared/12-Person Team/Day**
Light (mechanical & chemical)	850–900	10,800
Medium (mechanical & chemical)	550–650	7,800
Heavy (mechanical & chemical)	250–350	4,200
Extra Heavy (mechanical & chemical)	100–150	1,800

A detailed budget template is included in Appendix 2.

CLEARING PROTOCOLS PER GROWTH FORM/INFESTATION TYPE

It is important that appropriate control methods are used when clearing IAPs. If the IAPs are to be removed by burning or bulldozing, specific authorisation is required from the DAFF before any burning or bulldozing takes place.

There is a variety of control measures available to clear IAPs and these are often used in concert, depending on the infestation attributes. Typically, methods will include:

- Mechanical Control: Direct removal of plants by human labour, using hand-pulling, machinery or hand tools.
- Chemical Control: Use of an appropriate herbicide to kill the plant and/or to prevent regrowth.
- Biological Control: Deliberate introduction of the IAPs natural enemies, including insects, mites, pathogens or fungi. This would only ever be done through the national programmes.

General Clearing Protocols

Identify the clearing methods that are best for the specific project site and target species, as well as the associated field equipment and personal protective equipment (PPE) required.

Herbicides: Identify the required herbicides for IAPs if chemical control is to be used. Only herbicides registered for use on the target species may be used.

Site Camp: A site camp may be set up to accommodate vehicles bringing workers onto the site, herbicide and equipment storage areas, and ablutions and changing areas for workers. The site camp must be located outside the sensitive natural areas, must not restrict access routes or points for local residents and businesses, and must not damage private property or community gardens. If the site camp is on private property, the land-owner must have given permission for use of this area.

Storage Area: A safe storage area for the herbicides must be established which is bunded to contain any leaking containers (i.e. herbicide should not be able to leak into the soil, any watercourse or wetland, stormwater drain, an area of natural vegetation or a human settlement area). Herbicide storage areas must be secured to ensure that children and animals cannot access the chemicals, and that the chances of theft are minimised.

Fire Breaks: Areas of IAPs that pose a fire risk to houses or infrastructure should be targeted as a priority. Creating an effective “fire break” is important where woody/fire prone IAPs are located in dense stands near settlements, powerlines, etc.

On-site Prioritisation

Slopes and Elevation

Start at the top or highest elevation and work down. Seeds spread faster downhill and it becomes easier for workers to tackle the further to reach places first. On gentle gradients, clearing should start from the outside of a work block and move inwards towards the centre, to contain potentially invasive plant material and seeds within a confined area.

Density

Clear less dense infestations first. Tackling dense stands will allow these less dense areas to become thicker and harder to clear later. Pick of the 'low hanging fruit' first to prevent future spread.

Waterways

Prevent seeds from entering rivers as this can spread the problem much further than terrestrial vectors.

Riparian areas

Riparian areas (rivers, streams, wetlands) are a priority when planning the phasing of IAP clearing work. However, clearing needs to start from the head of the catchment (or highest point in a valley) and move downstream/downslope to ensure that any potential sources of IAP seeds and other regenerative plant material are minimised/eliminated from upstream of the working area.

Wetlands

Moderate to low IAP infestations in wetland areas can be treated by implementing controlled burning at the beginning of autumn, followed by mechanical removal or herbicide application during mid-Spring. Please note, however, that as wetlands are protected by the National Water Act and the National Environmental Management Act, no heavy machinery may be used to remove IAPs in wetland areas without prior authorisation from relevant government departments.

Indigenous vegetation

Stands of or individual indigenous trees located amongst stands of IAPs, must be protected from damage during the IAP clearing process. If necessary, indigenous trees and vegetation can be cordoned off or marked using danger tape to assist workers to be constantly aware of what needs to be protected.

Infestation Type Protocols

Regrowth

Dense regrowth can arise after initial control operations and these are best controlled through chemical control. Knapsack or hand sprayers set to low pressure should be used to apply a foliar spray. In low-density regrowth areas, coppice regrowth can be spot sprayed with knapsack or hand sprayers, and any emergent saplings can be hand-pulled.

It is important to note that no chemical spray may be used within 32 m of a watercourse, and manual removal by hand or with mattocks is required.

Large Trees

Where there are large IAP 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 project, and the IAP trees are removed as late as possible in the project process, or once the indigenous trees are starting to become established. Note that this approach is not appropriate where the IAP trees are highly invasive and are a priority for removal. Furthermore, felling of large IAP 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.

IAP trees located away from any structures or roads can be ring-barked, poisoned and left standing rather than felled. They will slowly collapse over time and will be a wonderful habitat for birds such as woodpeckers and barbets. If trees are felled, particularly on slopes, then they should be felled across the slope to act as natural barrier lines against soil erosion.

Large, established woody species such as *Acacia cyclops* need to be felled with a chainsaw, bowsaw, handsaw or brushcutters; ensuring a clean horizontal cut with the stump less than 15 cm above ground level. Cut stumps must immediately (within 5 minutes of being cut) be treated with the appropriate herbicide and dye using a paintbrush, knapsack or hand sprayers fitted with a solid cone nozzle and set to low pressure.

It is important to note that no chemical spray may be used within 32 m of a watercourse, and **only** paint brushes can be used to apply herbicide onto the cut stumps within 32 m of a watercourse.

Saplings and Seedlings

Clear seeding species first. This will slow the spread of the IAPs thereby preventing further proliferations.

In low-density infestations, saplings and seedlings must be pulled out by hand or chopped just below soil level with a mattock, ensuring the roots are removed. Hand-pulling is preferable where possible as it disturbs the soil less and reduces the chances of re-infestation from seed. In instances where a mattock is used, the hole must be backfilled, smoothed over and ideally covered with a mulch layer from whatever dead material is lying nearby. In higher density infestations, brushcutters or pangas/slashers can be used to slash the infestation aiming for a clean horizontal cut less than 15 cm above ground level. Cut stumps must immediately (within 5 minutes of being cut) be treated with the appropriate herbicide and dye using a paintbrush, knapsack or hand sprayers fitted with a solid cone nozzle and set to low pressure.

It is important to note that no chemical spray may be used within 32 m of a watercourse, and **only** paint brushes can be used to apply herbicide onto the cut stumps within 32 m of a watercourse.

Established Shrubs 1 m–2 m

Where IAP shrubs such as *Lantana camara* or *Senna didymobotrya* are taller than 1.5 m, the size must be reduced by means of cutting back with loppers, pangas/slashers or brushcutters. Only once the overall size of the plant is reduced, attempts can be made to remove the entire plant (including the rootstock) by hand or with a mattock. The hole must be backfilled and smoothed over. This should only occur on flat areas not susceptible to erosion. If this method is not possible, the stem must be cut using an appropriate tool, ensuring a clean horizontal cut with the stump less than 15 cm above ground level. Cut stumps must immediately (within 5 minutes of being cut) be treated with the appropriate herbicide and dye using a paintbrush, knapsack or hand sprayer fitted with a solid cone nozzle and set to low pressure.

It is important to note that no chemical spray may be used within 32 m of a watercourse, and **only** paint brushes can be used to apply herbicide onto the cut stumps within 32 m of a watercourse.

Small shrubs less than 1 m tall

In low density infestations small shrubs should be manually removed by hand or with mattocks. The remaining hole must be backfilled and smoothed over. In dense and extensive infestations foliar application of suitable herbicide should be applied with knapsack sprayers on windless days (less than 15 km/h). Knapsack or hand sprayers set to low pressure can be used, but not within 32 m of a watercourse. In areas within close proximity to watercourses, manual removal by hand or with mattocks is required.

Herbaceous Aliens

Low density infestations of young and small shrubs should be removed manually. In dense and extensive infestations foliar application of suitable herbicide should be applied with knapsack sprayers on windless days (less than 15 km/h). Knapsack or hand sprayers set to low pressure can be used, but not within 32 m of a watercourse. In areas within close proximity to watercourses, manual removal by hand or with mattocks is required.

Post-Clearing Protocols

Soil Erosion

To avoid the threat of soil erosion when clearing dense infestations of IAPs on steeper slopes, work should progress horizontally along the contours. IAPs should be cut in bands of approximately 3 m wide along the slope contour; the cut material should then be rolled back so that it forms a "frill" along the band. This will help slow down water run-off. A 2 m swath of uncut material should be left before starting on the next 3 m wide band. As the cut bands start to revegetate, work on the uncut bands can begin.

Disposal

Disposal of the cut IAP material needs to be carefully considered. Options may include: burning on site (note this comes with serious risks that need to be managed); chipping and composting (note that this is not appropriate if the plant material contains seeds); use of the woody biomass for charcoal manufacture (local SMME opportunity); use of the cut material to generate electricity (if there are facilities available for this); or transportation of the material to a garden refuse or landfill site for disposal. Regardless of the disposal method selected, it must meet all legal requirements and must not create a risk for local residents and infrastructure. Also note that burning of some types of IAPs stimulates seed release (e.g. Pine trees) or rapid seed germination (e.g. Black Wattle).

Value-added industries

Since the Working for Water programme has been the main driver of the clearing of IAPs in South Africa, they are the ones who came up with the concept of Value-Added Industries (VAI). As its name indicates, this industry was conceptualised to derive added value from the IAP clearing programme. Once economic benefits are derived, the clearing programme can become profitable and sustainable. Moreover, the clearing of IAPs provides many opportunities for community beneficiation from the waste biomass material. This industry is based on conversion of cleared biomass into a range of possible uses and opportunities that could be capitalised on, including the following:

- bio-energy (electricity and heat/cooling)
- various bio-fuels including woodpellets and briquettes, wood-chips, torrefied woodpellets, torrefied wood-chips, lump charcoal, charcoal briquettes, bio-oil and bio-syncrude
- biomaterials such as mulch, compost, biochar, timber, lumber and composite wood products
- biochemicals such as nanocrystalline cellulose, activated carbon, biopesticides, cosmetics, food and feed additives, and medicines
- fencing droppers, building poles, eco-coffins, wattle screens, garden and interior décor, fencing, wooden flash drive cases, charcoal, lampshades, basket-ware and gasification and/or pellet production for electricity generation

With the addition of these range of possible uses, there can be extra employment opportunities more than what is created through the clearing programme itself. Furthermore, VAI may reduce the net cost of clearing, and sometimes reduce the environmental risk associated with biomass material in-field, particularly those risks associated with fire and flood.

The following broad activities are what would be required for VAIs:

- Harvesting and primary processing of low-value, high-volume products (e.g. biomass to energy, charcoal, firewood, compost)
- Harvesting and primary processing of high-value, low-volume products (e.g. crafts, saw timber, chemical extracts)
- Secondary processing of low-value, high-volume biomass (e.g. generating energy from biomass, wood composites)
- Secondary processing of high-value, low-volume biomass (e.g. production of crafts, eco-furniture, eco-coffins)

Another option of a VAI that can be explored as an SMME opportunity, is the production of biochar. Biochar is used as a mechanism of "locking" the carbon content of the cleared woody material and putting it back into the soil, thus increasing its availability for use by indigenous plants. If the cleared woody material can be charred and that char used in land restoration activities, this will improve the net carbon gain in degraded landscapes. Biochar is the carbon-rich product produced when biomass (such as wood) is heated in a closed container with little or no available air.

Several IAP clearing programmes (such as Working for Water) have supported job creation initaitives linked to the collection of waste biomass material since 1995. Products such as fencing droppers, building poles, eco-coffins, wattle screens, garden and interior décor, fencing, wooden flash drive cases, charcoal, lampshades, basket-ware and gasification and/or pellet production for electricity generation represent some of the opportunities that could be capitalised on.

The potential sustainability and viability of VAIs varies significantly due to several factors that need to be considered, including:

- Felling method (hand sawing, chain sawing, mechanised felling)
- Extraction costs, which in turn are influenced by a combination of biophysical factors:
    - Steepness
    - Roughness (rocky terrain – generally lower production and higher costs)
    - Wetness
    - Extraction distance and road density
- Transport costs from the extraction depot to the factory
- Piece volumes (pole sizes)

It is important to note that VAIs are not the primary responsibility of the ECPTA/the PMU, but should rather be offered to the local business community. The PMU is responsible for creating an enabling environment to facilitate the establishment of SMMEs in the area, including those associated with VAIs.

CURRENT IAP STATUS PER CLUSTER

The following descriptions of IAP infestations per cluster are based on the results of three mapping exercises. First, mapping from aerial imagery. Second, spatial mapping done by the DEFF's NRM contractors currently implementing on-the-ground clearing of IAP in the Project domain. These contractors provided their shape files to be included in the map production of the current Project. Third, a ground truthing exercise was undertaken during detailed field assessments. It is accepted that at a fine-scale level, there might be gaps or areas that have been missed in this mapping exercise. During the operational phase of the Project, these gaps may be filled. It is thus essential that the list of IAPs likely to be found in the area (Appendix A) is updated during the operational phase. This can only be done once there is confirmation of the site boundaries.

Northern Cluster

The Northern Cluster of sites, comprising the various extensions to the Mkambati Nature Reserve, the Msikaba Gorge and the Ntentule area, are all dominated by grasslands, making it feasible to map IAP tree stands that are encroaching into the area. These are important conservation areas for the endangered Pondo-Ugu Sandstone Coastal Sourveld, and wetlands that surround and sustain the Mkhambati Nature Reserve.

The area is also used extensively for grazing by the local communities and is thus a vital part of the local socio-economic dynamic.

The area stands out as a current tourism node with a lot of potential to expand, due to its scenic beauty, beaches, hiking oportunities and existing tourism infrastructure.

There is a large, and expanding, timber plantation right in the centre of the expansion area. This plantation has a long history of poor management and acts as a source of IAP tree seeds in the area (see Figure 5). That said, the overall extent of woody IAPs in this cluster is relatively low (see Table 2).

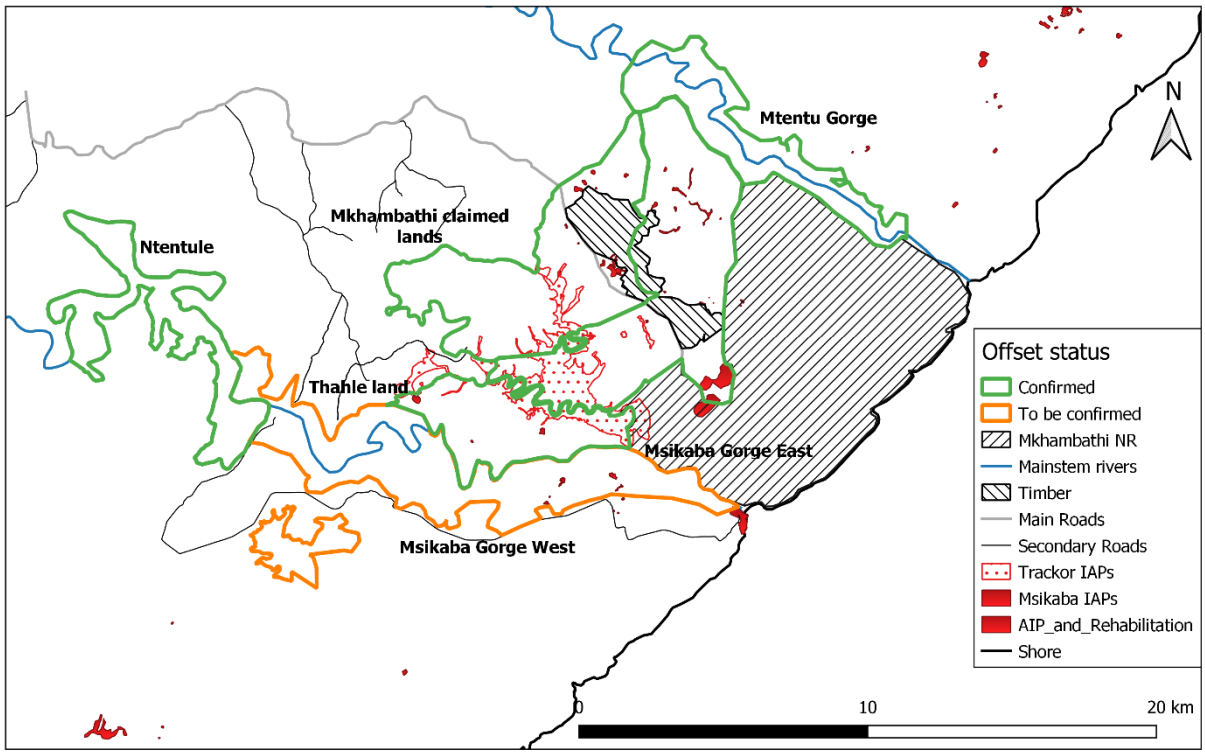


Figure 5. Map showing the IAP infestations and timber of the Northern Cluster

Table 2. The areas of woody IAPs per site in the Northern Cluster

Offset Site	Offset area (ha)	Woody IAPs (ha)
Gobodweni	1,435	2.1
Mkambati Claimed Lands	4,350	1,038.2
Mkambati Cons. Area	4,930	33.55
Msikaba Gorge	1,100	36.18
Thahle Land	1,580	11.01

Relative to the total area, the proportion of woody IAP infestation is very low: <60 ha out of 13 395 ha, a total of less than 10%. This is a classic example of where intervention is urgently needed to remove these IAP stands before they expand and put seed into other areas. In terms of prioritisation, the Northern Cluster stands out as a very high priority, and it is possible to achieve 100% clearing in the first year. The fact that the local people also want a conservation area in this cluster is an added factor contributing to this prioritisation.

Sappi has recently planted large areas in this cluster with timber. The potential of runaway seedlings from these stands of timber is a serious threat. It is imperative that the plantations in the area be properly delineated and the management be held accountable for clearing any escaping IAPs over their boundaries. Co-working with Sappi's Environmental Control Officer will be of strategic importance. Specific actions are summarised in Table 3.

Table 3. The IAP implementation goals for the Northern Cluster

Relevant IAP activities	
Prevention	Any areas of soil disturbance, particularly those associated with old fields, road verges, construction sites, eroded areas and sand mines should be highlighted as risk areas.
Early detection/Rapid response	The area within 5 km of the plantations should be assessed as a priority for any escaping woody IAPs. The entire area needs to be properly assessed for the full complement of IAPs prior to implementation.
Eradication	The relatively small size of the woody IAP infestations means it is possible to achieve a 100% initial clearing in the first year of implementation.
Containment	A buffer zone around the plantations must be assessed every six months for emerging seedlings. Any roads leading to the plantations and sand mines must be assessed similarly.
Follow-up	Assuming the infestations are eradicated, each one must be properly mapped and scheduled for follow-up on an annual basis.
Rehabilitation	Each infestation that is cleared must be rehabilitated to natural grassland. The initial focus should be on stabilising the soil and achieving a mulch layer or cover crop to prevent re-infestation through seed germination.
Baseline Data (2020)	
Total Area Invaded (ha)	13 385 ha
IAP Species Composition:	*Acacia mearnsii*, *Eucalyptus* sp *Acacia longifolia* and *Caesalpinia decapetala*
IAP Coverage (ha)	1 120 ha (woody IAPs only)
IAP Coverage (%)	8.4 %
IAP End-Project Target (2028)	0 ha
Annual IAP Eradication	50 % per annum

Central Cluster

The Central Cluster is focused around the 8 950 ha Lambasi Community Reserve, which has unfortunately been hampered by a lack of resources and human capital; yet, it remains an ideal focal point for a cluster. It is a large portion of mostly pristine coastal grassland of outstanding conservation and tourism value***. Specifically***, it comprises large, contiguous areas of relatively pristine Pondo-Ugu Sandstone Coastal Sourveld and over 200 ha of Pondoland Scarp Forest as well as intact Coastal Belt Wetlands.

Table 4. The areas of woody IAPs per site in the Central Cluster

Offset Site	Offset area (ha)	Woody IAPs (ha)
Lambasi		74,06
Ntsubane including Mbotyi		680,41

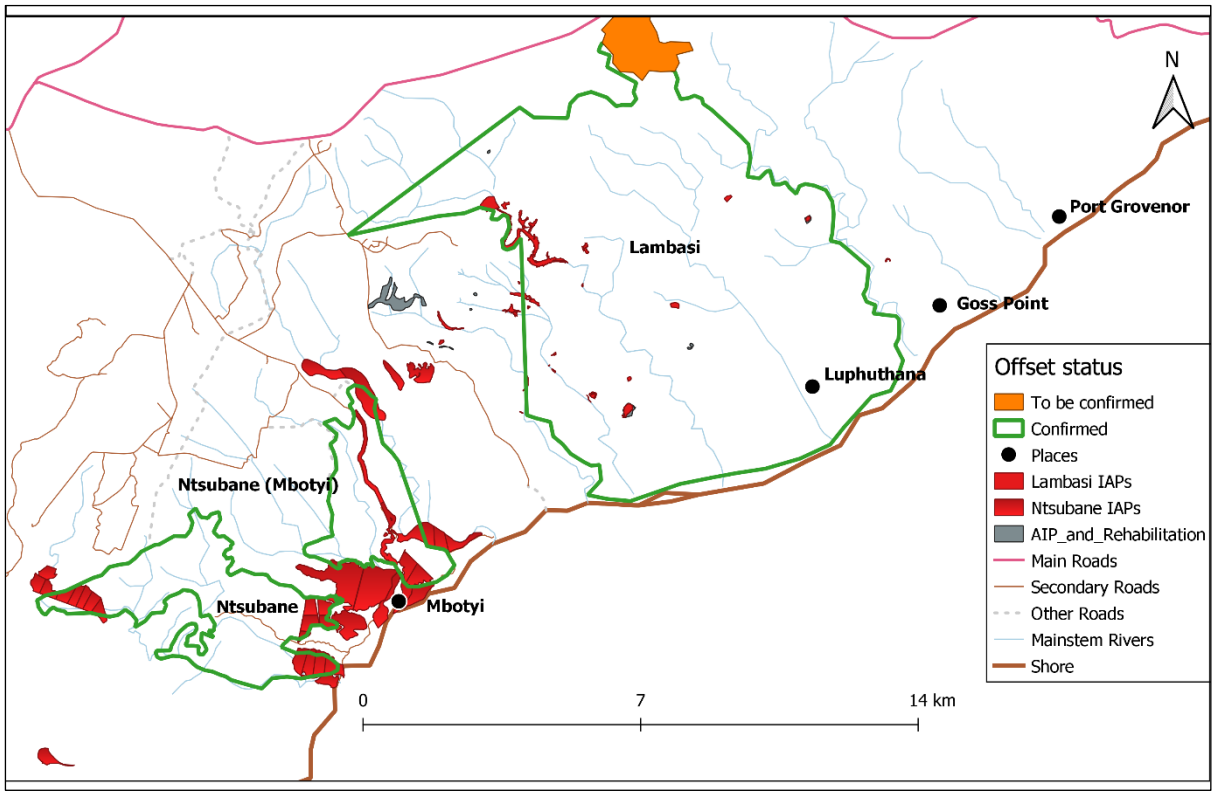


Figure 6. Map showing the IAP infestations and timber of the Central Cluster

There are three woody IAP infestations that comprises a total of 754.47 ha (0.6%). As with the Northern Cluster, this data is based on aerial imagery interpretation and is not verified by field work.

Although Lambasi is currently in very good condition, the neglected commercial forestry and tea plantations to the north and west of area, as well as uncontrolled sand mining and tourism development pose a massive threat to the integrity of the Nature Reserve. There is a high risk that IAPs will invade from these source areas.

The cluster also includes two related Ntsubane sites to the south ***(Ntsubane – 2 935 ha and Ntsubane Mbotyi – 965 ha)*** although these are largely forested with small patches of grasslands in them. The inaccessibility of the Ntsubane forests and the inability to distinguish IAPs from indigenous woody vegetation using aerial imagery means there is almost no data available for these sites. This emphasises the need for detail field work to assess the state of IAPs in these areas.

According to the CEPF project that worked in the area[1], The Ntsubane forest complex, Pondoland north, is the largest remaining indigenous forest complex on the Wild Coast. It includes critical ecosystems highlighted in the Maputo-Pondoland-Albany corridor. It is under ever-increasing threat as a result of IAP infestation and human activities which take the form of forest clearing for ever-expanding community settlements and their increased agricultural needs, deforestation for construction needs, unsustainable harvesting practices for medicinal and traditional craft purposes, and unmanaged and illegal access by users and poachers.

The Ntsubane forests are relatively degraded due to long-term effects of slash-and-burn type agriculture and unsustainable harvesting. Such disturbances are highly likely to result in further intense IAP infestations, which thrive in a disturbed environment.

Table 5. The IAP implementation goals for the Central Cluster

Relevant IAP activities:	
Prevention	Any areas of soil disturbance, particularly those associated with old fields, road verges, construction sites, eroded areas and sand mines should be highlighted as risk areas.
Early detection/Rapid response	The area near the tea and timber plantations in the north and west should be assessed as a priority for any escaping woody IAPs. The entire area needs to be properly assessed for the full complement of IAPs prior to implementation. Forest margins that are close to settlements or areas of human activity must be prioritised for assessment. Each forest patch should be assessed for historic and current disturbance patches (particularly old slash-and-burn fields), and for any path, track or road that penetrates the forest.
Eradication	The relatively small size of the woody IAP infestations in the grasslands means it is possible to achieve a 100% initial clearing in the first year of implementation. An eight-year programme of eradicating IAPs in and around the forest patches should be initiated.
Containment	A buffer zone around the plantations must be assessed every six months for emerging seedlings. Any roads leading to the plantations and sand mines must be assessed similarly.
Follow-up	Assuming the infestations are eradicated, each one must be properly mapped and scheduled for follow-up on an annual basis.
Rehabilitation	Each infestation that is cleared must be rehabilitated to natural grassland or forest. The initial focus should be on stabilising the soil and achieving a mulch layer or cover crop to prevent re-infestation through seed germination.
Baseline Data (2020)	
Total Area (ha)	12 850
IAP Species Composition:	*Lantana camara, Cestrum laevigatum, Solanum mauritianum, Ricinus communis, Chromolaena ordorata, Ipomoea spp, Psidium guajava* and *Acacia mearnsii, Caesalpinia decapetala, Acacia longifolia*
IAP Coverage (ha)	754.47 ha
IAP Coverage (%)	5.9 %

[1] 2014 Collaborative Approach to Ntsubane Forest Complex Management & Sustainable Livelihoods (Wild Coast)

IAP End-Project Target (2028)	0 ha
Annual IAP Eradication	30 % per annum

Southern Cluster

The Southern Cluster includes two confirmed sites (the 1 480 ha Mount Thesiger State Forest and the 1 355 ha Caguba Forest), and an additional four sites (the three Caguba Annex's of 700 ha, 126 ha & 320 ha respectively, and the 640 ha Mangroves) that still have to be confirmed either by the communities or SANRAL (see Figure 7).

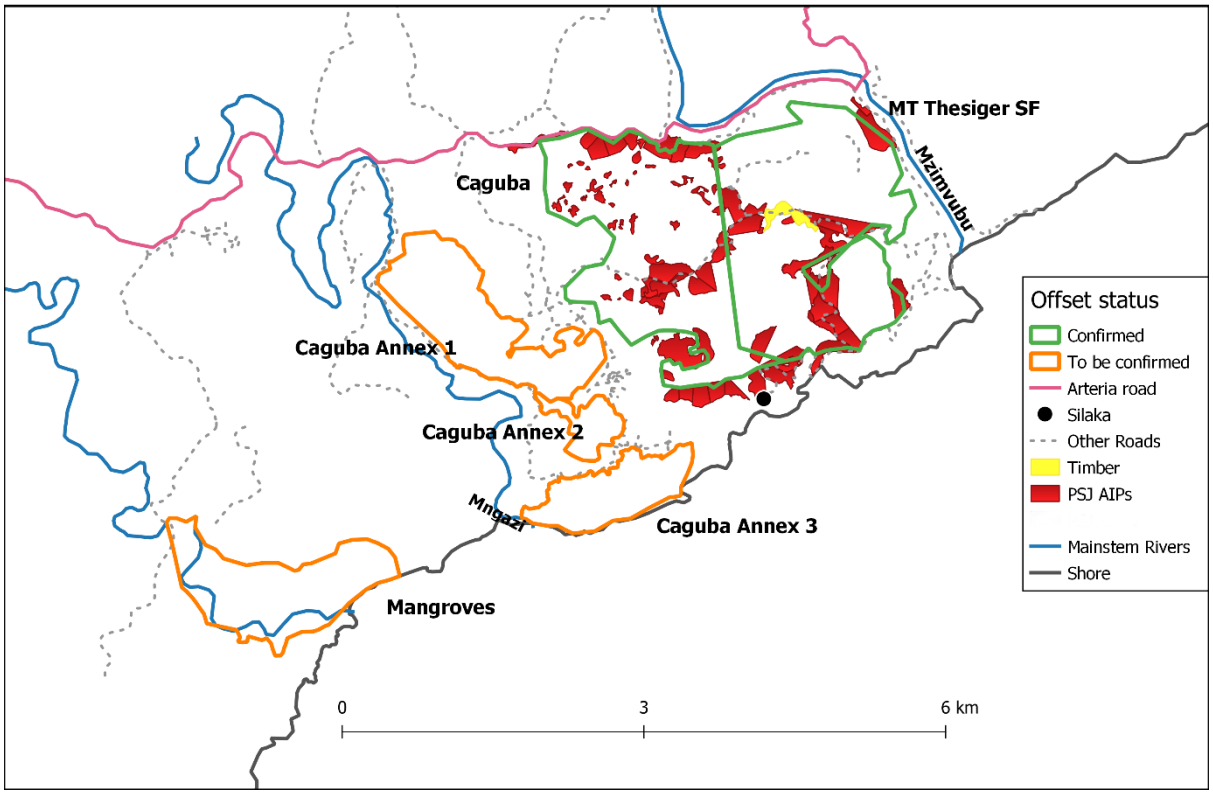


Figure 7. Map showing the IAP infestations and timber of the Southern Cluster

These sites are dominated by large, contiguous mosaics of Transkei Scarp Forest, successional thicket and Transkei Coastal Belt vegetation. These forests are of national conservation value and have been subject to several regional conservation initiatives such as the intiatives for "Pondoland National Park".

Table 6. The IAP implementation goals for the Southern Cluster

Relevant IAP activities:	
Prevention	Any areas of soil disturbance, particularly those associated with old fields, road verges, construction sites, eroded areas and sand mines should be highlighted as risk areas.
Early detection/Rapid response	The entire area needs to be properly assessed for the full complement of IAPs prior to implementation. Forest margins that are close to settlements or areas of human activity must be prioritised for assessment.

	Each forest patch should be assessed for historic and current disturbance patches (particularly old slash-and-burn fields), and for any path, track or road that penetrates the forest.
Eradication	The relatively small size of the woody IAP infestations in the grasslands means it is possible to achieve a 100% initial clearing in the first year of implementation. An eight-year programme of eradicating IAPs in and around the forest patches should be initiated.
Containment	A buffer zone around the plantations must be assessed every six months for emerging seedlings. Any roads leading to the plantations and sand mines must be assessed similarly.
Follow-up	Assuming the infestations are eradicated, each one must be properly mapped and scheduled for follow-up on an annual basis.
Rehabilitation	Each infestation that is cleared must be rehabilitated to natural grassland or forest. The initial focus should be on stabilising the soil and achieving a mulch layer or cover crop to prevent re-infestation through seed germination.

Baseline Data (2020)	
Total Area (ha)	4 625
IAP Species Composition:	*Lantana camara, Cestrum laevigatum, Solanum mauritianum, Ricinus communis, Chromolaena ordorata, Ipomoea spp, Psidium guajava* and *Acacia mearnsii*
IAP Coverage (ha)	364,8 ha
IAP Coverage (%)	7.9 %
IAP End-Project Target (2028)	0 ha
Annual IAP Eradication	30 % per annum

References

CAPE 2008. https://www.sanbi.org/biodiversity/science-into-policy-action/mainstreaming-biodiversity/cape-programme/.

CSIR. 2008. The development of protocols for the monitoring and evaluation of benefits arising from the Working for Water Programme. Report No. CSIR/NRE/ECO/ER/2008/0066/C, Natural Resources and the Environment. Stellenbosch: CSIR.

Foxcroft, L.C. 2004. An adaptive management framework for linking science and management of invasive alien plants. *Weed Technology* 18: 1275–1277.

Foxcroft, L.C. 2005. Alien species in Kruger National Park. Over-arching policy document, version 1. Unpublished report, South African National Parks.

GISP. 2008. Tackling invasive species globally: Global Strategy 2008–2010. Nairobi, Kenya: Global Invasive Species Programme (GISP).

Goodall, J.M. & Zacharias, P.J.K. 2002. Managing *Chromolaena odorata* in subtropical grasslands in KwaZulu-Natal, South Africa. Proceedings of the Fifth International Workshop on Biological Control and Management of *Chromolaena odorata*, Durban, South Africa, 23–25 October 2000. In: Zachariades, C., Muniappan, R. & Strathie, L.W. (eds), pp. 120-127. Pretoria: ARC-PPRI.

Le Maitre, D. & Forsyth, G. 2010. Invasive alien plant management in the ecosystems of the Wild Coast: Risk assessment of alien plant invasion and development of an invasive alien plant strategy for the Wild Coast. CSIR Report No: CSIR/NRE/ECO/ER/2010/0011/C. Stellenbosch: CSIR.

Mogobozi, M.P., Somers, M.J. & Dippenaar-Schoeman, A. 2008. Spider responses to alien plant invasion: the effect of short- and long-term *Chromolaena odorata* invasion and management. *Journal of Applied Ecology* 45: 1189–1197.

Morris, T.L., Witkowski, E.T.F. & Coetzee, J.A. 2008. Initial response of riparian plant community structure to clearing of invasive plants in Kruger National Park, South Africa. *South African Journal of Botany* 74: 485–494.

WfW. 2007. The Working for Water Programme Strategic Plan 2008–2012. Cape Town: Working for Water Programme.

APPENDIX A: LIST OF INVASIVE ALIEN SPECIES CHARACTERISTIC OF THE PROJECT AREA

IAP management and control methods vary according to site and species-specific factors such as plant type, age, density along with the specific location, terrain and project requirements. While general techniques offer broad direction on methodologies specific for density, size and age of species, it is important that these follow the species-specific control measures recommended.

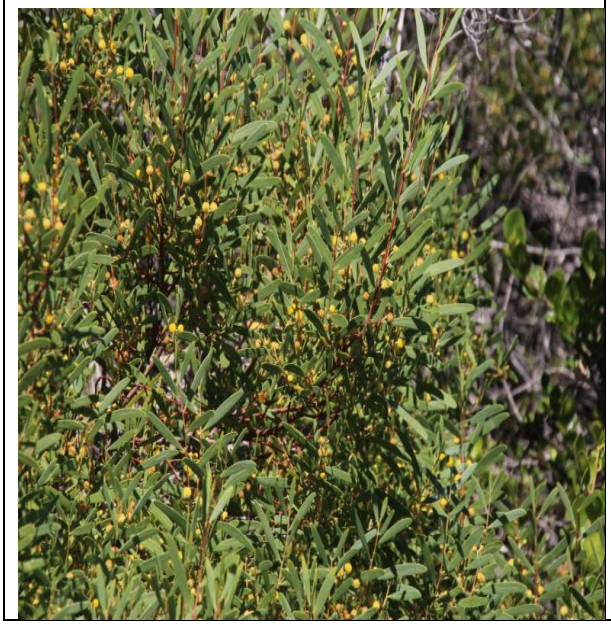
The following list depicts those likely to be problematic on the various sites and offers advice into their specific management and project specific priority according to likelihood for proliferation and resultant degradation (Type 1 being highest priority and Type 3 being least priority). Photo credits: Unless noted otherwise, below images were copied from IAPs South Africa (www.invasives.org.za) to assist with identification in the field.

Acacia baileyana

SPECIES NAME	COMMON NAME	CATEGORY
Acacia baileyana	Bailey's wattle	CARA 2002 – Category 3 NEMBA – Category 3
CONTROL METHODS (CM)	Manual: Hand pulling of seedlings or saplings. Grubbing, hoeing or digging out of young plants up to 2 m. Chemical: Foliar spray seedlings (Confront super 50ml/10l). Felling and cut stump treatment of young and mature trees (Timbrel 300ml/10l). Bio Control: Seed feeder (Melanterius maculatus).	
SOURCE FOR CM	WfW & NCC Environmental Services (Pty) Ltd	
ESTIMATED % COVER	N/A	
LOCALITY NOTES	This invader can transform sites and is often found alongside roads and watercourses.	
PRIORITISATION	Type 1	

Acacia cyclops

SPECIES NAME	COMMON NAME	CATEGORY
Acacia cyclops	Rooikrans	CARA 2002 – Category 2 NEMBA – Category 1b
CONTROL METHODS (CM)	Manual: Hand pulling of seedlings or saplings. Grubbing, hoeing or digging out of young plants up to 2 m. Chemical: Foliar spray seedlings (Confront super 75ml/10l). Felling and cut stump treatment of young and mature trees (Timbrel 300ml/10l). Alternate Garlon 4 and Diesel (1/4th). Bio Control: Indigenous field mice eat the seeds. Rooikrans seed weevil. Flower galler (Dasineuradielsi rubsaamen). Seed feeder (Melanterius servulus).	
SOURCE FOR CM	WfW & NCC Environmental Services (Pty) Ltd	
ESTIMATED % COVER	N/A	
LOCALITY NOTES	Often found near the coast and rocky outcrops and ridge lines. Tends to infest primarily coastal dunes; banks of watercourses, occasionally water edges; can colonise shallow water. It does not coppice when cut low enough to the ground.	
PRIORITISATION	Type 1	



Acacia saligna

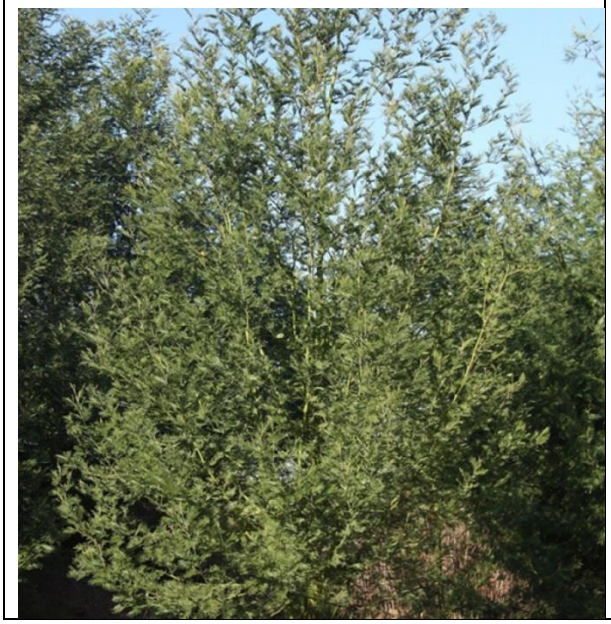
SPECIES NAME	COMMON NAME	CATEGORY
Acacia saligna	Port Jackson's Willow	CARA 2002 – Category 2 NEMBA – Category 1b
CONTROL METHODS (CM)	Manual: Hand pulling of seedlings or saplings. Grubbing, hoeing or digging out of young plants up to 2 m. Chemical: Foliar spray seedlings (Confront super 75ml/10l). Felling and cut stump treatment of young and mature trees (Confront super 200ml/10l). Alternate Garlon 4 and Diesel (1/4th). Bio Control: Gall rust fungus (Uromycladium tepperianum). Seed feeder (Melanterius compactus).	
SOURCE FOR CM	WfW & NCC Environmental Services (Pty) Ltd.	
ESTIMATED % COVER	N/A	
LOCALITY NOTES	Terrestrial but can also be found on banks of watercourses, occasionally water edges; can grow in shallow water and is a resprouter (coppices) that can invade and transform areas.	
PRIORITISATION	Type 1	

Acacia longifolia

SPECIES NAME	COMMON NAME	CATEGORY
Acacia longifolia	Long-leaved wattle	CARA 2002 – Category 1 NEMBA – Category 1b
CONTROL METHODS (CM)	Manual: Hand pulling of seedlings or saplings. Digging out of immature trees up to 2 m. Felling and stump cut to ground level of large mature trees. Chemical: Foliar spray of seedlings (confront super 100ml/10l). Young trees cut stem and treat (Timbrel 300ml/10l). Adult trees cut stump and treat (Timbrel 300ml/10l). Bio Control: Bud galling wasp (Trichilogaster acaiaelongifoliae). Seed feeding weevil (Melanterius ventralis).	
SOURCE FOR CM	WfW	
ESTIMATED % COVER	N/A	
LOCALITY NOTES	It favours wetter areas and rapidly becomes dense totally transforming the landscape.	
PRIORITISATION	Type 1	

Acacia mearnsii

SPECIES NAME	COMMON NAME	CATEGORY
Acacia mearnsii	Black wattle	CARA 2002 – Category 2 NEMBA – Category 2
CONTROL METHODS (CM)	Manual: Hand pulling of seedlings or saplings up to 40 cm. Digging out of immature trees up to 2 m. Care must be taken to remove the roots or the tree can resprout from these. Felling used for large mature trees. Ring-barking of 10 cm width in large plants. Chemical: Foliar spray of seedlings (Confront super 50ml/10l). Cut stem and stump treatment of young and older plants (Confront super 200ml/10l). Bio Control: Stump fungus (Cylindrobasidium laeve) applied to freshly cut stumps. Seed weevil (Melanterius maculates).	
SOURCE FOR CM	WfW & BioNET-EAFRINET & NCC	
ESTIMATED % COVER	N/A	
LOCALITY NOTES	Invaders of indigenous bush, watercourses and roadsides.	
PRIORITISATION	Type 1	



Ageratum conyzoides

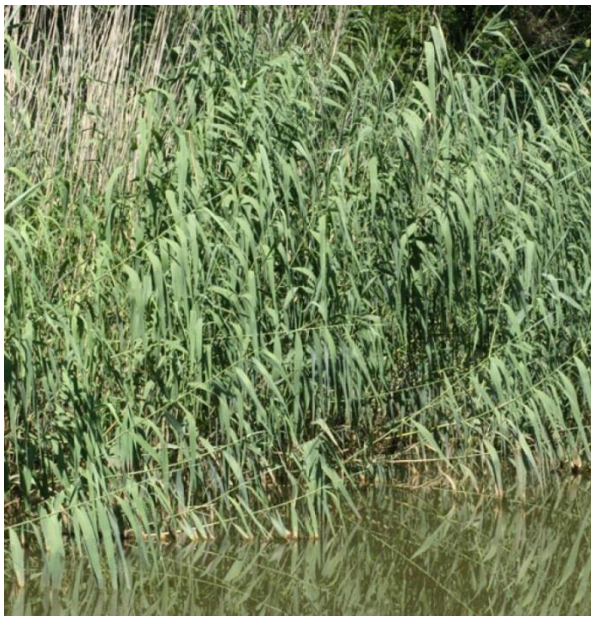
SPECIES NAME	COMMON NAME	CATEGORY
Ageratum conyzoides	Invading ageratum	NEMBA – Category 1b
CONTROL METHODS (CM)	A small weedy, and shallow rooted species which are best controlled manually or with post-emergent herbicide. With the use of herbicide being discouraged on this project, it is suggested that mechanical control be implemented as the primary method of control. In areas where plants are on steep embankments or the density is high enough to create a risk of soil disturbance, foliar applied herbicide can be used. Note: The windblown seeds can irritate the eyes of those manually removing plants. As such appropriate PPE must be worn.	
SOURCE FOR CM	Bromilow (2001) & BioNET-EAFRINET	
ESTIMATED % COVER	N/A	
LOCALITY NOTES	Widespread species, especially in moist areas.	
PRIORITISATION	Type 2	

Argemone mexicana

SPECIES NAME	COMMON NAME	CATEGORY
Argemone Mexicana (Pale) and Argemone ochroleuca (yellow)	Yellow & white flowered Mexican poppy	CARA 2002 – Category 1 NEMBA – Category 1b
CONTROL METHODS (CM)	Manual: Individual plants can be dug up or hand pulled. Do not break off the plant as the roots will regrow or the stems coppice. Do not cut the plant as it will coppice. It needs to be completely removed or chemically killed. Herbicides: As infestations are often dense a post emergent, non-residual, foliar herbicide needs to be applied (Tumbleweed 300ml/10l).	
SOURCE FOR CM	Bromilow (2001) & BioNET-EAFRINET & NCC	
ESTIMATED % COVER	N/A	
LOCALITY NOTES	Often found on disturbed soil piles and wet areas such as dried out depressions.	
PRIORITISATION	Type 1	

Arundo donax

SPECIES NAME	COMMON NAME	CATEGORY
Arundo donax	Spanish reed	NEMBA – Category 1b
CONTROL METHODS (CM)	Physical removal must include the total removal of the rhizomes as plants can regrow from pieces left in the soil. This can be a combination of cutting stems and digging up roots with shovel or pick axe. In areas where plants are on steep embankments or the density is high creating a risk of soil disturbance or erosion as a result of uprooting the plants can, in these instances, be treated with herbicide. The plant should first be cut down to ground level then the lush regrowth treated with a foliar systemic herbicide when the plant has reached a height of 1–2 m. Thorough follow-up treatments are required for effective long-term control. Herbicides can also be applied as a foliar spray (most effective when applied after flowering) or as a concentrated solution applied directly to freshly cut stems which is the recommended option.	
SOURCE FOR CM	Bromilow (2001) & BioNET-EAFRINET	
ESTIMATED % COVER	N/A	
LOCALITY NOTES	Riparian species but able to grow even in largely terrestrial conditions.	
PRIORITISATION	Type 1	

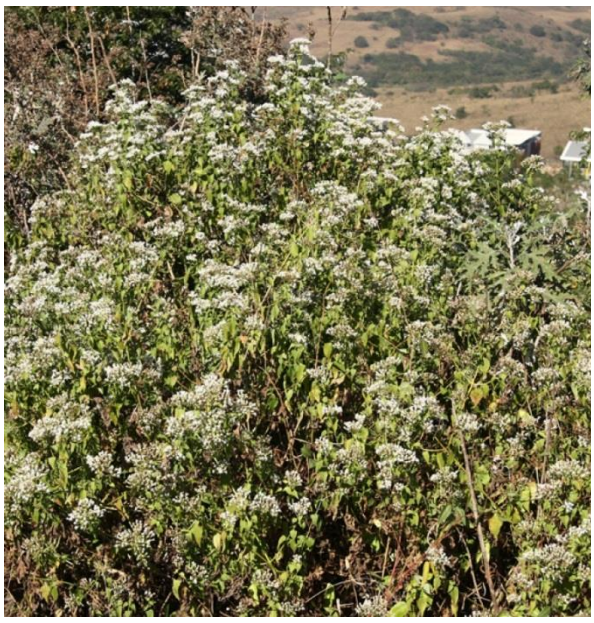


Atriplex nummularia

SPECIES NAME	COMMON NAME	CATEGORY
Atriplex nummularia	Old man's saltbush	CARA 2002 – Category 2 NEMBA – Category 2
CONTROL METHODS (CM)	Manual: Digging up and hand pulling of the plant.	
SOURCE FOR CM	NCC	
ESTIMATED % COVER	N/A	
LOCALITY NOTES	Can inhabit salty pans especially areas around kraals.	
PRIORITISATION	Type 3	

Chromolaena odorata

SPECIES NAME	COMMON NAME	CATEGORY
Chromolaena odorata	Triffid Weed	NEMBA – Category 1b
CONTROL METHODS (CM)	Various herbicides such as Roundup or Chopper (foliar and cut stump) have been used with good effect. However, young plants can be easily uprooted/pulled out by hand. Older or large plants can be slashed/cut down to first reduce the mass and ease of access to the stump. When manually or mechanically controlling Chromolaena odorata it is essential to dig out the roots, otherwise the plant will coppice. Note that control of this weed is difficult and costly because it is capable of vigorous regrowth from stem coppice, root suckers and seed. Therefore, it is essential to remove or completely kill all of the plant to avoid this. In areas on steep embankments or where the alien density is high creating a risk of soil disturbance or erosion as a result of uprooting the foliar or cut stumps application can be implemented. As with all cut stump treatment herbicide must be applied onto the cut stump to ensure the plant is killed.	
SOURCE FOR CM	Bromilow (2001) & BioNET-EAFRINET	
ESTIMATED SITE % COVER	N/A	
LOCALITY NOTES	Tolerant of most habitats and often found in remnant forest patches and riparian vegetation.	
PRIORITISATION	Type 1	



Caesalpinia decapetala

SPECIES NAME	COMMON NAME	CATEGORY
Caesalpinia decapetala	Mauritius thorn	NEMBA – Category 1b
CONTROL METHODS (CM)	This tree species can be controlled by physical removal of saplings by hand pulling or digging. Larger plants can be cut down and the root ball either dug up or treated with herbicide painted onto the stem to prevent coppicing. In areas where plants are on steep embankments or the density is high enough to create a risk of soil disturbance from uprooting foliar applied herbicide can then be used.	
SOURCE FOR CM	Bromilow (2001) & BioNET-EAFRINET & ARC	
ESTIMATED % COVER	N/A	
LOCALITY NOTES	Commonly found along river banks and moist areas.	
PRIORITISATION	Type 1	

Camuloclinium macrocephalum

SPECIES NAME	COMMON NAME	CATEGORY
Camuloclinium macrocephalum	Pom-pom weed	NEMBA – Category 1b
CONTROL METHODS (CM)	The entire plant including the rhizome from which it sprouts must be entirely removed in the case of low density infestations. There is no point in removing the upper parts of the plant as this will only stimulate more shoots to develop. In dense infestations, herbicides should be applied onto actively growing plants at least 0.5 m tall. The selective, broadleaf herbicides Picloram and Metsulfuron methyl are both registered on pompom weed and will not affect veld grasses. Non-selective herbicides should never be used to control pom-pom weed in the veld or along grassy road reserves.	
SOURCE FOR CM	Bromilow (2001) & ARC	
ESTIMATED % COVER	N/A	
LOCALITY NOTES	Recorded in a few locations throughout the site.	
PRIORITISATION	Type 1	

Datura ferox

SPECIES NAME	COMMON NAME	CATEGORY
Datura ferox	Thorny apple	NEMBA – Category 1b
CONTROL METHODS (CM)	Manual: It can be removed by digging it up, ensuring that the roots are removed to prevent regrowth. Herbicides: Post-emergence herbicide is effective and can be applied as a foliar application in dense stands (Tumbleweed 300ml/10l).	
SOURCE FOR CM	Bromilow (2001) & BioNET-EAFRINET	
ESTIMATED % COVER	N/A	
LOCALITY NOTES	One of the first species to emerge on disturbed sites such as roadsides. Often found on wet areas such as dried out depressions.	
PRIORITISATION	Type 1	

Echium plantagineum

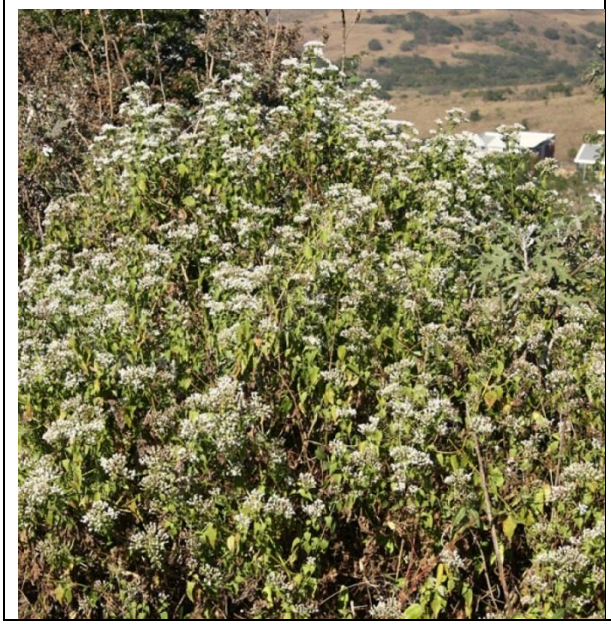
SPECIES NAME	COMMON NAME	CATEGORY
Echium plantagineum	Patterson's curse	CARA 2002 – Category 1 NEMBA – Category 1b
CONTROL METHODS (CM)	Manual: Low density infestations can be dug up. Chemical: Foliar spray (Mamba DNA 200ml/10l) Bio Control: Leaf mining moth (Dialectica scalariella) an insect slightly bigger than a mosquito has been trialled in Australia. The caterpillar stage of the moth feeds inside the leaves, producing tunnels and chambers which damage the leaf.	
SOURCE FOR CM	WfW	
ESTIMATED % COVER	N/A	
LOCALITY NOTES	Invaders of indigenous bush, watercourses and roadsides but does better in disturbed areas than it does in areas with established native vegetation.	
PRIORITISATION	Type 1	

Eucalyptus species

SPECIES NAME	COMMON NAME	CATEGORY
Eucalyptus species	Gum tree	CARA 2002 – Category 2 NEMBA – Category 1b
CONTROL METHODS (CM)	Manual: Seedlings and saplings can be removed by hand pulling or digging up. Herbicides: Larger plants need to be cut down and the root ball either dug out or the stem treated with herbicide to kill it (Timbrel 450ml/10l).	
SOURCE FOR CM	WfW & NCC & SANBI	
ESTIMATED % COVER	N/A	
LOCALITY NOTES	Found in commercial plantations with escapees favouring riparian areas generally further away from the coast.	
PRIORITISATION	Type 2	

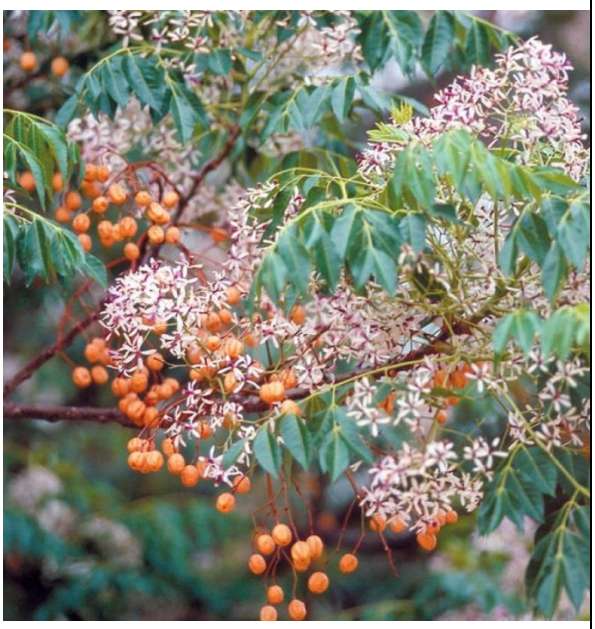
Lantana camara

SPECIES NAME	COMMON NAME	CATEGORY
Lantana camara	Tick-berry	CARA 2002 – Category 1 NEMBA – Category 1b
CONTROL METHODS (CM)	Manual: Hand pulling of seedlings or saplings is effective as the plant is removed relatively easily. Grubbing or hoeing of small patches also effective. Cutting is ineffective as plant coppices unless the stem is treated. Chemical: A foliar spray on regrowth is generally more effective than cut stump treatment. Note that foliar application on large, uncut bushes is expensive and not very successful and as such should only be done on large plant regrowth in instances where the stumps cannot/should not be manually removed. (Chopper 200ml/10l). It is noted that chemical control is often cheaper and can result in less disturbance resulting in higher biodiversity than mechanical control and as such, due diligence must be given to density considerations and when to employ mechanical or chemical control. Bio Control: Flower galler (Aceria lantanae Cook). Leaf miner (Calycomyza lantanae). Leaf sucker (Falconia intermedia). Leaf feeder (Hypena laceratalis Walker). Leaf miner (Octotoma scabripennis Guerin-Meneville). Leaf miner (Ophiomyia camarae Spencer). Seed miner (Ophiomyia lantanae). Leaf & flower sucker (Teleonemia scrupulosa Stal). Leaf miner (Uroplata girardi).	
SOURCE FOR CM	Bromilow (2001) & BioNET-EAFRINET & NCC	
ESTIMATED % COVER	N/A	
LOCALITY NOTES	Often found in wetter areas and spreads by seed.	
PRIORITISATION	Type 1	



Melia azedarach

SPECIES NAME	COMMON NAME	CATEGORY
Melia azedarach	Syringa	NEMBA – Category 1b in KZN
CONTROL METHODS (CM)	Being a large tree species, the seedlings can be removed by hand but this can be difficult for larger plants as *Melia azedarach* reproduces vegetatively from both root and stem suckers and the seedlings can often be connected to the larger plant. Melia coppices strongly and as such if cut down physical removal of the stump and roots is effective but laborious resulting is further soil disturbance. Ring-barking and stripping usually stimulate coppicing and the development of root suckers and as such, is not recommended. Larger trees should thus be cut down and a basal stem treatment employed with herbicide painted onto the stem and cut stump. When employing basal stem treatment, the tree must not be cut too close to the ground ensuring adequate surface coverage for the basal treatment. Herbicide (Garlon 4) painted onto the stem up to a height of 25 cm above the soil surface should suffice.	
SOURCE FOR CM	Bromilow (2001) & BioNET-EAFRINET	
ESTIMATED % COVER	N/A	
LOCALITY NOTES	Often found near rivers, remnant forest patches and cliffs where birds deposit seeds.	
PRIORITISATION	Type 2	



Mimosa pigra

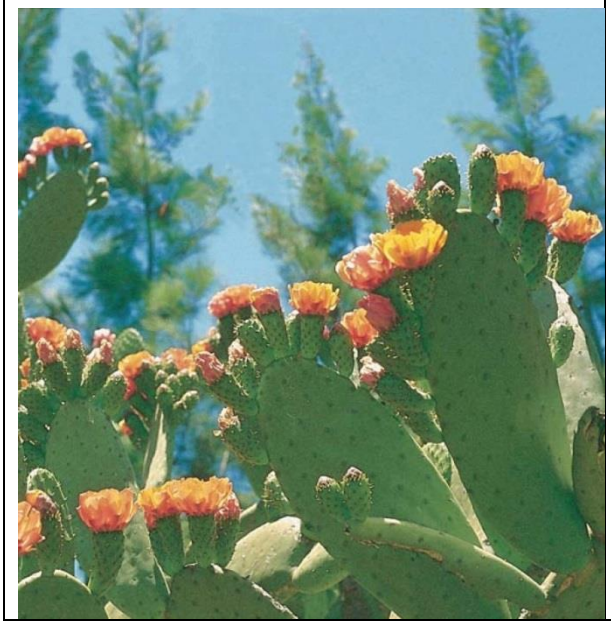
SPECIES NAME	COMMON NAME	CATEGORY
Mimosa pigra	Shy plant	NEMBA – Category 1b
CONTROL METHODS (CM)	Seedlings and saplings can be removed by hand. Larger plants need to be cut down and the root ball either dug out or the stem treated with herbicide to kill it. In areas where plants are on steep embankments or the density is high enough to create a risk of soil disturbance, foliar applied herbicide can be used. Follow-up treatments are necessary as mechanical and chemical management will not prevent the germination of many seeds in the seedbank which can persist for several seasons/years and will need to be addressed during following seasons.	
SOURCE FOR CM	BioNET-EAFRINET	
ESTIMATED % COVER	N/A	
LOCALITY NOTES	Generally found in disturbed areas.	
PRIORITISATION	Type 1	

Myoporum insulare

SPECIES NAME	COMMON NAME	CATEGORY
Myoporum insulare	Manatoka	CARA 2002 – Category 3 NEMBA – Category 3
CONTROL METHODS (CM)	Manual: Hand pulling of seedlings or saplings. Grubbing, hoeing or digging out of young plants up to 1 m. Chemical: Foliar spray seedlings or cut stump treatment of young and mature trees.	
SOURCE FOR CM	Meyer (2007)	
ESTIMATED % COVER	N/A	
LOCALITY NOTES	The tree can spread through vegetative reproduction where root runners radiate from mature trees just below the soil surface and shoots appear a distance away. Young trees very often pop up where *A.cyclops* has been removed as seeds are brought in by birds that perch on the *A.Cyclops* and are then germinated by the increased sunlight.	
PRIORITISATION	Type 2	

Opuntia ficus-indica

SPECIES NAME	COMMON NAME	CATEGORY
Opuntia ficus-indica	Prickly Pear	CARA 2002 – Category 1 NEMBA – Category 1b
CONTROL METHODS (CM)	Manual: Digging up and hand pulling of the plant. Disposal must ensure no fragments are left behind or scattered elsewhere as these will sprout. Chemical: Stem injection. Bio Control: Cochineal	
SOURCE FOR CM	BioNET-EAFRINET	
ESTIMATED % COVER	N/A	
LOCALITY NOTES	Noted in one location being the old quarry near the site entrance where it appears to have been dumped. The source material is however likely to be from the area and with the prevalence of livestock on site it is possible for them to act as seed vectors. The plant favours semi-arid and rocky locations and spreads vegetatively through broken branches which fall on the ground and set root, seeds as well as through animals eating and dispersing seeds in their droppings.	
PRIORITISATION	Type 2	



Pennisetum clandestinum

SPECIES NAME	COMMON NAME	CATEGORY
Pennisetum clandestinum	Kikuyu grass	NEMBA Category 1b in protected areas and wetlands in which it does not already occur.
CONTROL METHODS (CM)	Manual: In low density infestations this grass species can be hand pulled by the roots. Dense infestations are incredibly difficult to eradicate by means of mechanical control, and this will result in soil disturbance. In these cases, and only on new infestations, herbicide approved for usage in wetlands can be used. Herbicides: Spray with Roundup while grass is actively growing (not when dormant) and follow up spray any regrowth after 4 months. The plant is particularly sensitive to Glyphosate.	
SOURCE FOR CM	NCC & Bromilow (2001)	
ESTIMATED % COVER	N/A	
LOCALITY NOTES	Kikuyu is often associated with raised fill/disturbed areas and as such removal or rehabilitation of these will reduce invasion opportunities. The inclusion of hard paths/roads/firebreaks provides a hard management edge from which to manage invasion and also reduces to some extent root spread.	
PRIORITISATION	Type 3	

Pennisetum setaceum

SPECIES NAME	COMMON NAME	CATEGORY
Pennisetum setaceum	Fountain grass	CARA 2002 – Category 1 NEMBA – Category 1b
CONTROL METHODS (CM)	Manual: In low density infestations this grass species can be dug up with picks. Debris, especially debris with inflorescences, should be bagged and removed from the site to prevent spread. Dense infestations are incredibly difficult to eradicate by means of mechanical control, and this will result in soil disturbance. In these cases, herbicide can be used. Herbicides: Foliar spray with Roundup.	
SOURCE FOR CM	USDA & NCC	
ESTIMATED % COVER	N/A	
LOCALITY NOTES	Often found in dense stands colonising the sides of roads.	
PRIORITISATION	Type 1	

Psidium guajava

SPECIES NAME	COMMON NAME	CATEGORY
Psidium guajava	Guava	NEMBA – Category 3
CONTROL METHODS (CM)	Psidium guajava has a strong root system and is known to withstand many foliar herbicides. It coppices when cut and produces vigorous root suckers. Ring-barking, bark-stripping and felling can encourage root sucker development and thereby a greater density of the infestation. It is best controlled by total removal of the roots. As such, small plants must be removed manually. Larger plants can be uprooted but it is labour intensive and creates further soil disturbance. As such it is recommended that larger trees be cut down and a basal bark herbicide treatment applied to the cut stump and stem. When employing basal stem treatment, the tree must not be cut too close to the ground ensuring adequate surface coverage for the basal treatment. Herbicide painted onto the stem up to a height of 25 cm above the soil surface should suffice.	
SOURCE FOR CM	Bromilow (2001) & BioNET-EAFRINET	
ESTIMATED % COVER	N/A	
LOCALITY NOTES	Often found emerging on grassy embankments and hillsides.	
PRIORITISATION	Type 3	

Ricinus communis

SPECIES NAME	COMMON NAME	CATEGORY
Ricinus communis	Castor-oil plant	CARA 2002 – Category 2 NEMBA – Category 2
CONTROL METHODS (CM)	Manual: Small plants (0.1–0.5 m) can be slashed. Medium sized plants (1–1.5 m) can be physically uprooted. Large plants can easily be controlled by chopping them out and treating the cut stump with herbicide. Herbicides: Herbicides can be effective as cut stump treatments or basal bark applications (painting herbicide onto the bark) as the weed is generally sensitive to herbicide (Chopper 300ml/10l). Ricinus communis can be controlled through cultivation and mowing and as such in grassed road verges which will be periodically mowed this will become an effective form of control.	
SOURCE FOR CM	Bromilow (2001) & BioNET-EAFRINET	
ESTIMATED % COVER	N/A	
LOCALITY NOTES	Often in large stands on disturbed soil such as wood rows and soil piles.	
PRIORITISATION	Type 1	

Rivinia humilis

SPECIES NAME	COMMON NAME	CATEGORY
Rivinia humilis	Bloodberry	NEMBA – Category 1b
CONTROL METHODS (CM)	This perennial herb sometimes has a woody base and growing up to 1 m high can be mechanically removed through hand pulling or first cutting back the growth then digging up the stump and roots of larger specimens. In areas where plants are on steep embankments or the density is high enough to create a risk of soil disturbance foliar applied herbicide can then be used.	
SOURCE FOR CM	ISSA (http://www.invasives.org.za)	
ESTIMATED % COVER	N/A	
LOCALITY NOTES	Often found in remnant natural bush patches.	
PRIORITISATION	Type 1	

Schinus terebinthifolius

SPECIES NAME	COMMON NAME	CATEGORY
Schinus terebinthifolius	Brazilian pepper tree	NEMBA – Category 1b in KZN
CONTROL METHODS (CM)	Although large and established root systems are difficult to remove, this plant responds well to physical methods of control. As such, small saplings should be manually removed and large species cut down and a basal stem treatment employed with herbicide painted onto the stem and cut stump. When employing basal stem treatment, the tree must not be cut too close to the ground ensuring adequate surface coverage for the basal treatment. Herbicide painted onto the stem up to a height of 25 cm above the soil surface should suffice.	
SOURCE FOR CM	Bromilow (2001)	
ESTIMATED % COVER	N/A	
LOCALITY NOTES	Generally found in wooded or sheltered cliff areas.	
PRIORITISATION	Type 3	

Senna didymobotrya

SPECIES NAME	COMMON NAME	CATEGORY
Senna didymobotrya	Peanut butter cassia	CARA 2002 – Category 3 NEMBA – Category 3
CONTROL METHODS (CM)	Manual: Small plants can be hand pulled and large plants cut as close to the root ball as possible to reduce the chances of coppicing. Chemical: No herbicide is registered for the foliar control of this species making manual control the only option. Cut stems must be treated with herbicide (Chopper 500ml/10l).	
SOURCE FOR CM	Bromilow (2001)	
ESTIMATED % COVER	N/A	
LOCALITY NOTES	Tolerant of dry conditions.	
PRIORITISATION	Type 3	

Senna septemtrionalis

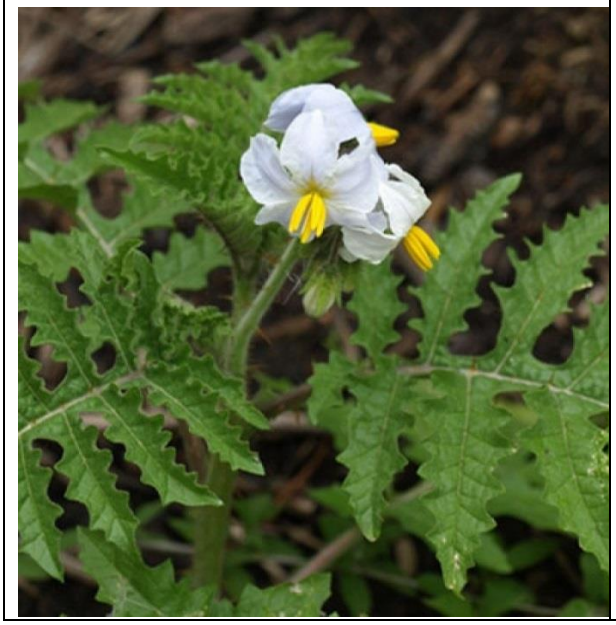
SPECIES NAME	COMMON NAME	CATEGORY
Senna septemtrionalis	Arsenic bush	NEMBA – Category 1b
CONTROL METHODS (CM)	Seedlings and saplings can be removed by hand. Slashing of larger plants induces vigorous regrowth and as such the entire plant needs to be cut down and the root ball either dug out or the stem treated with herbicide to kill it.	
SOURCE FOR CM	NCC	
ESTIMATED % COVER	N/A	
LOCALITY NOTES	Often found in remnant forest patches.	
PRIORITISATION	Type 2	

Sesbania punicea

SPECIES NAME	COMMON NAME	CATEGORY
Sesbania punicea	Red sesbania	NEMBA – Category 1b
CONTROL METHODS (CM)	Seedlings and saplings can be removed by hand. Slashing of larger plants induces vigorous regrowth and as such the entire plant needs to be cut down and the root ball either dug out or the stem treated with herbicide to kill it.	
SOURCE FOR CM	NCC	
ESTIMATED % COVER	N/A	
LOCALITY NOTES	Variable	
PRIORITISATION	Type 2	

Solanum sisymbrifolium

SPECIES NAME	COMMON NAME	CATEGORY
Solanum sisymbrifolium	Dense-thorned bitter apple	CARA 2002 – Category 1 NEMBA – Category 1b
CONTROL METHODS (CM)	Manual: Hand pulling or digging up of the plant. Chemical: Chemical control methods in South Africa have not been effective at controlling this plant (Hill & Hulley 1995). Bio Control: Gratiana spadicea tortoise beetles have been released as biological control agents.	
SOURCE FOR CM	USDA	
ESTIMATED % COVER	N/A	
LOCALITY NOTES	This species mainly grows in disturbed areas such as waste areas, roadsides, fence rows and drainage canals.	
PRIORITISATION	Type 1	

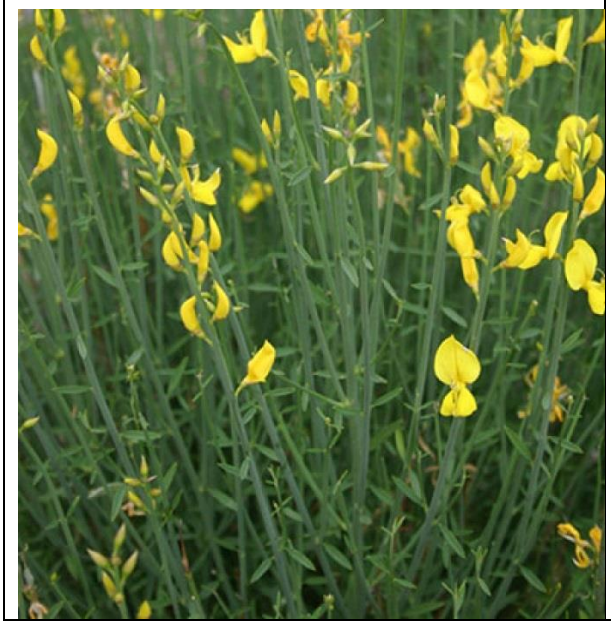


Solanum mauritianum

SPECIES NAME	COMMON NAME	CATEGORY
Solanum mauritianum	Bugweed	CARA 2002 – Category 1 NEMBA – Category 1b
CONTROL METHODS (CM)	Manual: Small plants up to 1.5 m can be uprooted manually. Larger plants can be cut down close to the ground and the stumps either dug out or treated with herbicide. Herbicides: Any cut stumps must be treated with herbicide or the plant will coppice. Basal bark (painting herbicide onto the bark), along with ringbarking are also effective methods of killing this specie. Young plants foliar spray (Garlon 50ml/10l), Adult plants cut stem treatment (Chopper 200ml/10l) or Adult plants basal stem paint (Garlon & diesel 2000ml/10l). Bio Control: Leaf sucker (Gargaphia decoris). Note: When mechanically cleared, the clouds of hairs that are dislodged contain toxins that have been blamed for respiratory problems in workers clearing these plants and as such appropriate PPE must be worn.	
SOURCE FOR CM	Bromilow (2001) & BioNET-EAFRINET & ARC	
ESTIMATED % COVER	N/A	
LOCALITY NOTES	Large numbers of seedlings often emerge under trees that have been killed by chemical means, from seeds that are unaffected by the herbicide. This makes follow-up treatments essential. Often found in wetter areas and depressions.	
PRIORITISATION	Type 1	

Spartium junceum

SPECIES NAME	COMMON NAME	CATEGORY
Spartium junceum	Spanish broom	CARA 2002 – Category 1 NEMBA – Category 1b
CONTROL METHODS (CM)	Manual: Plants are best controlled through physical uprooting. Bio Control: Stem galler (Aceria spartii).	
SOURCE FOR CM	Bromilow (2001)	
ESTIMATED % COVER	N/A	
LOCALITY NOTES	Often occurs in wetter areas of sites and along fence lines.	
PRIORITISATION	Type 1	



Verbena bonariensis

SPECIES NAME	COMMON NAME	CATEGORY
Verbena bonariensis	Wild verbena	NEMBA – Category 1b
CONTROL METHODS (CM)	Manual removal of the plant through hand pulling and digging is recommended. In areas where plants are on steep embankments or the density is high enough to create a risk of soil disturbance foliar applied broadleaf herbicide can then be used. Older plants are not as susceptible to herbicide and should therefore be manually removed.	
SOURCE FOR CM	Bromilow (2001) & BioNET-EAFRINET	
ESTIMATED % COVER	N/A	
LOCALITY NOTES	Disturbed places, moist areas and grassland embankments.	
PRIORITISATION	Type 1	

APPENDIX B: APO TEMPLATE (EXAMPLE FOR ONLY 3 MONTHS)

Written APO

Management Unit Name

Financial Year **2020/21**

		APR		MAY		JUN	
TOTAL AREA + PERSON DAYS	**Per month**	**Area**	**PD**	**Area**	**PD**	**Area**	**PD**
	Initial	0,0	0	0,0	0	0,0	0
	Follow-up	0,0	0	0,0	0	0,0	0
	Maintenance	0,0	0	0,0	0	0,0	0
	Rehabilitation	6,8	1092	6,8	1092	6,4	1040
	Fire break & Burn	0,0	0	0,0	0	0,0	0
	TOTAL	**6,8**	**1092**	**6,8**	**1092**	**6,4**	**1040**
	Cumulative totals	**Area**	**PD**	**Area**	**PD**	**Area**	**PD**
	Initial	0,0	0	0,0	0	0,0	0
	Follow-up	0,0	0	0,0	0	0,0	0
	Maintenance	0,0	0	0,0	0	0,0	0
	Rehabilitation	6,8	1092	13,5	2184	19,9	3224
	Fire break & Burn	0,0	0	0,0	0	0,0	0

	TOTAL		6,8	1092	13,5	2184	19,9	3224
NUMBER OF WORKING DAYS	**Per month**		**Planned**	**Cumulative**	**Planned**	**Cumulative**	**Planned**	**Cumulative**
			21	21	21	42	20	62
NUMBER OF TEAM MEMBERS	**Per month**		13		13		13	
ESTIMATED EMPLOYMENT	**Per month**		52		52		52	
	Average for year		52					
ESTIMATED NUMBER OF CONTRACTS	**Per month**		4		4		4	
	Cumulative		4		8		12	
OPERATIONAL TRANSPORT	**Rate per day (Apr-Sep)**	**Rate per day (Oct-Mar)**	**Calendar Days for Transport**	**Cost for Transport**	**Calendar Days for Transport**	**Cost for Transport**	**Calendar Days for Transport**	**Cost for Transport**
2x4 Vehicle	**R 230,80**	**R 230,80**	84	R 19 387	84	R 19 387	80	R 18 464
4x4 Vehicle	**R 258,30**	**R 258,30**	0	R 0	0	R 0	0	R 0
	Total		**84**	**R 19 387**	**84**	**R 19 387**	**80**	**R 18 464**
	Cumulative total		84	R 19 387	168	R 38 774	248	R 57 238

HERBICIDE REQUIREMENTS	Cost per Litre	Litres Required	Total Cost	Litres Required	Total Cost	Litres Required	Total Cost
Triclopyr (ester)	R 0,00	0	R 0	0	R 0	0	R 0
Triclopyr (salt)	R 0,00	0	R 0	0	R 0	0	R 0
Glyphosate 360	R 0,00	0	R 0	0	R 0	0	R 0
Glyphosate 500	R 0,00	0	R 0	0	R 0	0	R 0
Glyphosate 680	R 0,00	0	R 0	0	R 0	0	R 0
Imazapyr	R 0,00	0	R 0	0	R 0	0	R 0
MSMA	R 0,00	0	R 0	0	R 0	0	R 0
Fluroxypyr	R 0,00	0	R 0	0	R 0	0	R 0
Glyphosate Trimesium	R 0,00	0	R 0	0	R 0	0	R 0
Picloram	R 0,00	0	R 0	0	R 0	0	R 0
Metsulfuron	R 0,00	0	R 0	0	R 0	0	R 0
Triclopyr + Clopyralid	R 0,00	0	R 0	0	R 0	0	R 0
Wetter	R 0,00	0	R 0	0	R 0	0	R 0
Dye	R 0,00	0	R 0	0	R 0	0	R 0
	Total		R 0		R 0		R 0

CUMULATIVE HERBICIDE REQUIREMENTS & COSTS							
	Triclopyr (ester)	0	R 0	0	R 0	0	R 0
	Triclopyr (salt)	0	R 0	0	R 0	0	R 0

	Glyphosate 360	0	R 0	0	R 0	0	R 0
	Glyphosate 500	0	R 0	0	R 0	0	R 0
	Glyphosate 680	0	R 0	0	R 0	0	R 0
	Imazapyr	0	R 0	0	R 0	0	R 0
	MSMA	0	R 0	0	R 0	0	R 0
	Fluroxypyr	0	R 0	0	R 0	0	R 0
	Glyphosate Trimesium	0	R 0	0	R 0	0	R 0
	Picloram	0	R 0	0	R 0	0	R 0
	Metsulfuron	0	R 0	0	R 0	0	R 0
	Triclopyr + Clopyralid	0	R 0	0	R 0	0	R 0
	Wetter	0	R 0	0	R 0	0	R 0
	Dye	0	R 0	0	R 0	0	R 0
	Total		R 0		R 0		R 0

APPENDIX C: TRAINING MATRIX

The below training matrix outlines the courses, some of which are compulsary, and other beneficial to the project and employees' performance.

Courses	Duration	General Worker / Herbicide Applicator	First Aider	OHS Rep	Chainsaw/Brushcutter Operator	Supervisor	Project Manager
Compulsory Courses							
Basic First Aid	+- 4 Days (renewed every 2 years)		√			√	√
OHS Representative	+- 3 Days			√		√	√
Pest Control Officer (PCO)	TBC					√	√
Chainsaw Operator	+- 3 Days (annual refresher)				√	√	
Brushcutter Operator	+- 2 Days (annual refresher)				√	√	
Basic Firefighting	1 Day	√	√	√	√	√	√
Enabling Courses							
Induction Training	1 Per Person	√	√	√	√	√	√
Herbicide Application Training	1 Per Person	√	√	√	√	√	
Invasive Alien Plant Identification	1 Per Chainsaw Operator	√	√	√	√	√	√
Additional Courses							
Incident Investigation	1 Day			√		√	√
COIDA Training	3 Day					√	√
Basic Ecological Principles	3 Day	√	√	√	√		
HIV/AIDs Awareness	1 Day	√	√	√	√		
Basic Health Care	1 Day	√	√	√	√		
Personal Finance Management Skills	3 Day	√	√	√	√		
Banking Skills	1 Day	√	√	√	√		

APPENDIX D: MANAGEMENT UNIT TEMPLATE (EXAMPLE)

Management Unit 1_V03_June 2021			
Priority Site	1		
Size	53 ha		
Motivation	The combined area is large. However, due to the limited IAPs encountered on site such as size can be managed as a unit.		
Threats	IAPs are most threatening on disturbed sites due to their ability to take advantage of the exposed ground and associated sunlight, space and nutrient/water availability and thereby establish, outcompete and produce viable seed much faster than indigenous species. Accordingly, this unit is the most disturbed of the entire property and at risk of IAP proliferation with high numbers of IAPs present. Two rivers that run through the unit are not yet invaded but are at risk which will spread IAPs further downstream if this occurs.		
Level of Importance	High Priority – Threat of invading rivers and further IAP spread into nearby conservation area.		
IAP Species	*Acacia Cyclops*	Low shrub to small tree, proliferates through seed dispersal.	5%
	Opuntia ficus-indica	Small to medium succulent like shrub, proliferates through vegetative reproduction and seed dispersal through livestock.	0-5%
Overall Density	5%		
Land Use(s)	Cattle farming. On the easterly side the land is a national conservation area.		
Vegetation	The westerly side of the area is almost denuded of all vegetation while the eastern side has low to mid height scrubby bush covering the hillside.		
Previous Control	Sporadic hand pulling of isolated woody species. No previous plan in place and work conducted on an ad-hoc basis.		
Site Access & Terrain	Access in and around the central mine area is possible via vehicle while ascending the eastern ridge line will need to occur on foot.		
Soil	Crumbly loam		
Rehabilitation	In the conservation area the IAP density is so minimal that no damage requiring rehabilitation will be caused as a result of IAPs or their control. Due to water scarcity, seeding would be ineffective in any case and natural procession of indigenous vegetation would occur over cleared areas without external intervention.		
Recommended Methodology	Hand pulling of small *Acacia cyclops* while larger specimens can receive cut-stump treatment. Picking up and removal of *Optunia* is recommended.		
Notes	This area has the most IAPs encountered within the property albeit in very small quantities. Within the central mine vicinity sporadic *Acacia cyclops* can be found.		

APPENDIX E: EQUIPMENT CHECKLIST

Personal Protection Equipment	
Manual Control	
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)	Investing in a good quality safety boots might save you in the 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 brimmed 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 brimmed 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.
Mechanical Control	
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 are 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.

General Equipment		
Control Method	**Quantity**	**Specifications**
Funnel	1 Per Team	Industrial funnel, wide neck, not bigger than 25 litre container opening
Measuring Jug	1 Per Team	Enough to measure herbicide quantities (millilitres)
Sharpening Stone	2 Per Team	Standard sharpening stone with handle for sharpening cane knives and slashes.
25 litre Container	2 Containers Per Team	Transparent, plastic 25 litre containers with screw-on lids (for drinking water).
Tarpaulin/Basin	1 Tarpaulin/Basin Per Team	Non-leak tarpaulin (2m x 2m), or plastic basin to catch spills.
Soap, Bucket & Towel	1 Soap, Bucket & Towel Per Team	Soap bar, 5 litre bucket with handle and hand towel.
First Aid Kit	1 Per Team	Standard first aid kit customised for field use.
Fire Beaters	2 Per Team	Optional, but useful in areas where fires could ignite.
Cane Knife	1 Per Person (+ 1 Spare)	Cane knife with short plastic handle and broad blade end.
Handheld Sprayer	1 Per Person (+ 1 Spare)	1.5 litre sprayer of reputable brand with replacement parts.
16 Litre Sprayer	1 Per Person (+1 Spare)	16 litre sprayer of reputable brand with replacement parts.
Chainsaw, Maintenance Tools & Spares	1 Per Chainsaw Operator	Reputable brand with maintenance tools and spares. Ideally with access to regular servicing.
Brushcutter, Maintenance Tools & Spares	1 Per Brushcutter Operator	Reputable brand with maintenance tools and spares. Ideally with access to regular servicing.
Herbicides Spill Kit	1 Per Herbicide Storage Area	Bucket, sand and broom.