kakadu NATIONAL PARK

Environmental Impact Assessment (EIA)

Seed collection in Kakadu National Park

Kakadu Native Plants Pty Ltd

May 2017

INTRODUCTION

The Kakadu National Park (NP) Management Plan 2016-2026 is the key document which determines what activities are allowed in Kakadu NP and how they should be assessed. The Plan establishes different categories of action according to the degree of potential impacts (Section 9.5: Table 4 - Impact Assessment Procedures).

All proponents must refer to the full explanation of these categories and the impact assessment process in the EIA Guidelines before completing the following.

CATEGORY 1 ASSESSMENT
If your proposal involves an action considered likely to have

- no impact
- or no more than a negligible impact on the Park's environment and natural and cultural values
- and no impact on Bininj/Mungguy

► COMPLETE KAKADU NP'S PRELIMINARY CHECKLIST, NOT THIS FORM

Some examples of Category 1 activities:

- Minor capital works e.g. maintenance, replacement repairing or improving existing infrastructure in its present form.
- Regular/routine ongoing operations to implement prescriptions in the Kakadu NP Management Plan e.g. patrols, weed control or fire management.
- Seasonal opening/closing of visitor areas.
- Issuing permits for regular activities in accordance with the Kakadu NP Management Plan, e.g. land-based tours, camping, research.

CATEGORY 2 ASSESSMENT
If your proposal involves an action considered likely to have

- More than a negligible impact
- but a not a significant impact on the Park's environment and natural and cultural values
- More than a negligible but not a significant impact on Bininj/Mungguy.

►► AN EIA IS REQUIRED. COMPLETE THIS FORM. ALL SECTIONS OF THE FORM ARE TO BE COMPLETED UNLESS OTHERWISE SPECIFIED.

Some examples of activities requiring an EIA are:

- Moderate capital works e.g. new infrastructure or moderate expansion/upgrade of existing infrastructure.
- Rehabilitation of heavily eroded sites.
- Development for approved existing tourism activities that do not require major works e.g. small safari camps.
- Minor new operations or developments to implement prescriptions in the Kakadu NP Management Plan.
- Prescribed burns in areas comprising fire sensitive communities i.e. *Allosyncarpia ternate*, *Callitris intratropica, Pityrodia spp*, rainforest communities and sandstone heath communities.

CATEGORY 3 ASSESSMENT
If your proposal is considered likely to have

- A significant impact on the Park's environment and natural and cultural values
- And a significant impact on Bininj/Mungguy.

►►► A CATEGORY 3 ASSESSMENT IS REQUIRED.

BEFORE COMPLETING THIS FORM, ADVICE MUST BE OBTAINED FROM THE DIRECTOR OF NATIONAL PARKS (DNP) AS TO WHETHER IT SHOULD BE REFERRED AS A CONTROLLED ACTION UNDER THE ENVIRONMENTAL PROTECTION AND BIODVISERSITY CONSERVATION (EPBC) ACT.

Some examples of proposals requiring CATEGORY 3 ASSESSMENT are:

- Major capital works e.g. new major infrastructure or major expansion/upgrade of existing infrastructure
- Major new operations or developments to implement prescriptions in the Kakadu NP Management Plan.
- Major/long-term changes to existing visitor access arrangements
- Large-scale mine rehabilitation
- Expansion of the Jabiru township
- New types of commercial activities
- New or major expansion of Bininj living areas
- Impacts on threatened species or threatened environmental communities.

1 BACKGROUND INFORMATION

1.1 Proponent's Details

- Proponent's name: Peter Christophersen & Sandra McGregor, Kakadu Native Plants Pty Ltd (Include organisation and contact name if different)
- Phone number (business hours): 0419 824837
- Mobile number: 0419 824837
- Facsimile number:
- Postal address: PO Box 319, Jabiru NT 0886
- Email address: kakadunativeplants@hotmail.com
- ABN (if applicable): 37 125 747 140

1.2 **Location of the proposed action** (Insert map showing relation to Park boundary, access route, locality names, rivers and other key landscape features)

It is proposed that the seed collecting activities will be conducted in the shaded area of Kakadu National Park, shown in Figure 1, which is approximately 6,600 km^2 in area. The proposed activity (e.g. seed collection) is the same activity currently carried out by Kakadu Native Plants Pty Ltd under the existing Permit Number CKM 1046, issued 4 December 2012.

The plants that will be grown by Kakadu Native Plants Pty Ltd will be used predominantly in the planned revegetation of the Ranger Project Area (RPA). The objective is to close and rehabilitate the entire RPA, to form one final landform across the site that will blend with the surrounding landscape of Kakadu National Park. The total area of disturbance in the RPA to be rehabilitated is approximately 950 hectares. Kakadu Native Plants Pty Ltd has already supplied native plants for planting in Jabiru, Jabiluka, and ecological restoration of disturbed areas, and has been the source of native plants donated to the former Jabiru Town Council by Energy Resources of Australia (ERA).

The proposed seed collecting activities described in this permit application and supporting documentation, are to enable collection of a wide range of genetically diverse species, to facilitate locally sourced plants to be used in the RPA revegetation project.

The information provided in this environmental impact assessment (EIA) is supported by four documents as appended:

1. *Kakadu National Park Permit Application Form: Other Activities in Kakadu National Park*.
2. *Appendix A: Details of Proposed Activity*, which provides additional responses to address the permit application sections on the application form.
3. *Appendix B: Selection of the Seed Collection Zone*, which provides background information on the justification of the proposed area of seed collection. This Appendix also gives details of the "in principle" approval by the Gundjeihmi Aboriginal Corporation Board (GAC) that seed for the revegetation of the RPA should only be collected from within the Kakadu National Park.
4. Appendix C: Potential Impact Assessment, which assesses the potential impact of seed collection on Northern Territory and Commonwealth conservation listed flora and fauna species known to occur within the proposed seed collection zone. This assessment is made against *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). The assessment addresses the Commonwealth matters of national environmental significance (MNES) criteria, as it is the most comprehensive criteria available.

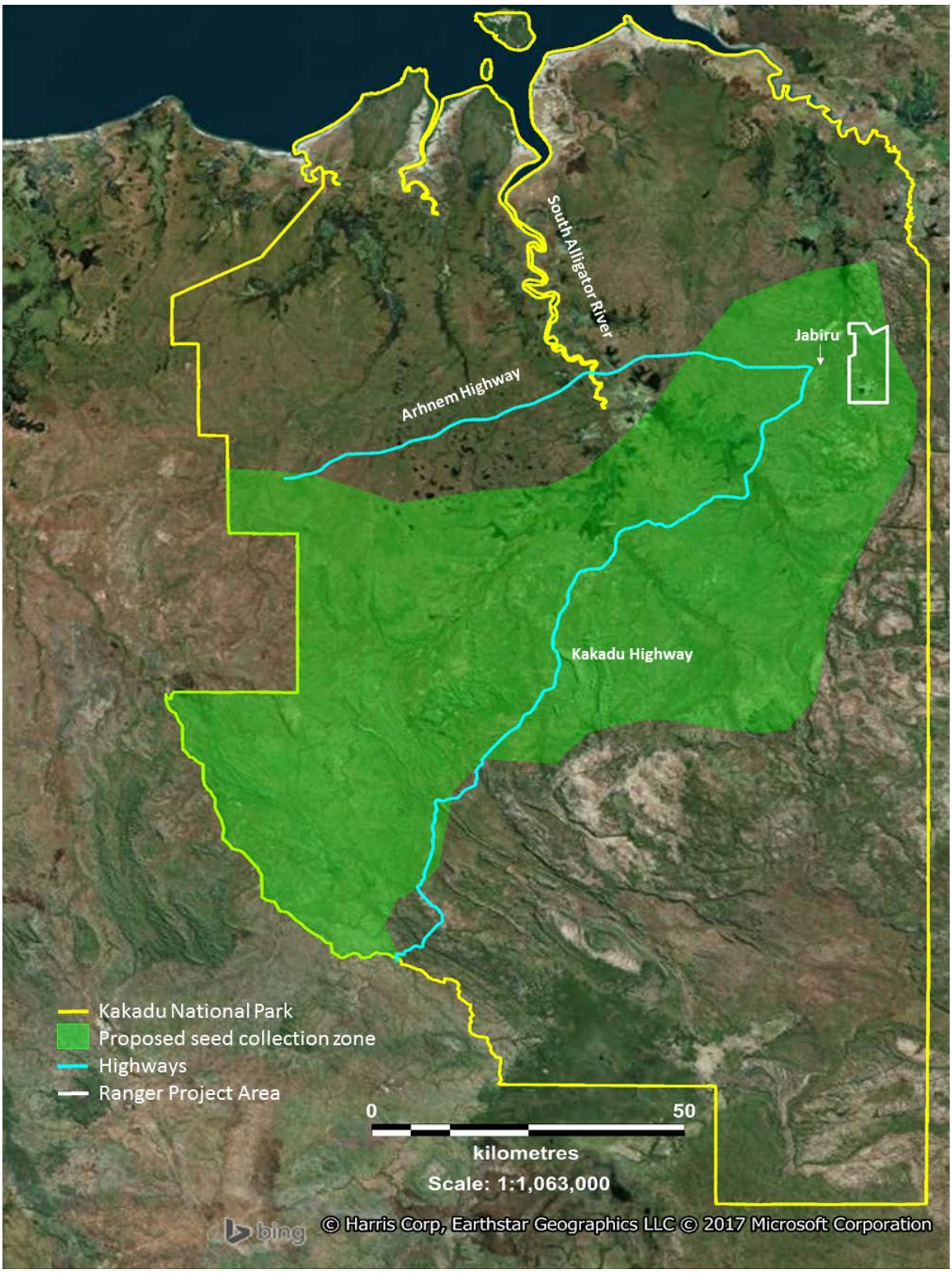

Figure 1: Map of Kakadu National Park showing the proposed seed collection zone (green), approximately 6,600 km^2

1.3 **Project description** (provide a comprehensive description of action or project including: area of site [hectares] or footprint [metres]; current use of the site if any; description of what is involved in the action; steps or stages of the action; what access routes will be used; who will carry out the work; how long the work will take; what machinery will be required for the work). Attach plans, diagrams or specifications as necessary.

The proposed activity involves seed collection of a wide range of plant species from a range of habitat types. The majority of the plant species identified for seed collection (Table 1) occur in lowland eucalypt woodland vegetation, with some species occurring in floodplains, lowland sandstone country and monsoon forest within the designated area of Kakadu National Park (see Figure 1). The proposed seed collection zone comprises 6,600 km^2, however, much of the collecting will be focused in plants within close proximity to existing roads. The larger seed collection zone enables collection of a wide range of genetically diverse, locally sourced plants for use in large-scale revegetation activities. Seeds will be collected by Peter Christophersen, Sandra McGregor and other staff members (including other Bininj) of Kakadu Native Plants Pty Ltd. Species to be collected are listed below (Table 1) and are a mixture of shrubs, palms and trees.

Variability in seasonal rainfall and fire frequency/intensity can make it difficult to predict annual quantities of seed to be collected. Therefore, Table 1 lists the total quantity (kg) of each species that will be collected to supply the plants across two planting phases on the RPA. However, it is highly unlikely that these quantities will be achieved for all species in one year due to logistical constraints associated with finding sufficient plants with ripe fruits/seeds before seeds are naturally dispersed. None of the species are conservation listed in the NT. In addition, a maximum of 20% of the available seed will be collected from a given population (up to the proposed maximum quantities in Table 1) and the same individual plants will not be collected from in consecutive years.

Seeds will be collected using a variety of techniques: seeds will primarily be collected directly from plants by hand, although some collection from the ground may occur. For trees, where seeds are out of reach, a long handled tree pruner or, exceptionally, a cherry picker will be used. Use of the cherry picker will be restricted to within close proximity of existing roads/access tracks. Collection will mainly occur from July to November when most species are in fruit. However, some species will require collection at other times of year, dependent on fruiting patterns. Seeds will often be collected from individuals with ripe fruits/seeds that are visible from existing tracks/roads. Other collecting will take place when individuals with ripe fruits/seeds are identified when out on country. When collecting takes place, location, quantity of seeds and identification of plant species will be recorded using a combination of Bininj regional knowledge and GIS for future reference, and to ensure that plants are protected from consecutive years' harvesting.

As outlined previously, the plants grown from these seeds, will be mainly used to revegetate the disturbed areas of the RPA. The objective is to close and rehabilitate the entire RPA, to form one final landform across the site which will blend with the surrounding landscape of Kakadu National Park. The total area of disturbance in the RPA to be rehabilitated is approximately 950 hectares. This project will involve greater quantities of potting mix being brought into the Park than at present. However, only sterilised, soilless-based potting mix of predominantly sand and coco-peat will be used in the propagation of seeds, eliminating the potential for the introduction/spread of pathogens/disease (see Appendix C).

Table 1: Target list of species and total quantity of seeds per species that would be collected to rehabilitate the RPA

Species	ERA phase 1 species	ERA phase 2 species	Growth form	Habitat type	Total quantity per species (kg)
Acacia aulacocarpa			Tree	Open forest/woodland	1
Acacia difficilis			Shrub/tree	Open forest	3
Acacia dimidiata			Shrub/tree	Open forest	3

Species	ERA phase 1 species	ERA phase 2 species	Growth form	Habitat type	Total quantity per species (kg)
Acacia hemignosta			Shrub/tree	Open woodland	25
Acacia latescens			Shrub/tree	Open forest	25
Acacia mimula			Shrub/tree	Open forest	25
Allosyncarpia ternata			Tree	Sandstone country	1,600 fresh fruits/seeds needed
Alphitonia excelsa			Tree	Open forest	1
Asteromyrtus symphyocarpa			Tree	Along streams/ around lagoons and swamps	2
Banksia dentata			Small tree	Lowland wetlands/open forest	2
Brachychiton diversifolius			Tree	Open forest/woodland	5
Brachychiton megaphyllus			Tree	Open woodland	5
Buchanania obovata			Tree	Open forest/woodland	10
Calytrix achaeta			Shrub	Sandstone country	5
Calytrix exstipulata			Shrub	Open forest/woodland	5
Coelospermum reticulatum (Pogonolobus reticulatus)			Shrub/tree	Open forest/woodland	1
Cochlospermum fraseri			Shrub/tree	Open forest/woodland	2
Corymbia bleeseri (Eucalyptus bleeseri)			Tree	Open forest/woodland	3
Corymbia chartacea			Tree	Open forest/woodland	3
Corymbia confertiflora (C. disjuncta)			Tree	Open woodland	3
Corymbia dichromophloia			Tree	Open woodland	3
Corymbia foelscheana (Eucalyptus foelscheana)			Tree	Open woodland	3
Corymbia latifolia (Eucalyptus latifolia)			Tree	Open woodland	3
Corymbia polysciada			Tree	Open woodland	3
Corymbia porrecta			Tree	Open forest/woodland	5
Corymbia dunlopiana (formerly *Corymbia setosa* subsp. *indeterminate)*			Tree	Open woodland	3
Erythrophleum			Tree	Open forest	80

Species	ERA phase 1 species	ERA phase 2 species	Growth form	Habitat type	Total quantity per species (kg)
chlorostachys					
Eucalyptus miniata			Tree	Open forest/woodland	7
Eucalyptus phoenicea			Tree	Sandstone country	5
Eucalyptus tectifica			Tree	Open woodland	1
Eucalyptus tetrodonta			Tree	Open forest/woodland	7
Eucalyptus tintinnans			Tree	Rises/low stony hills	1
Ficus racemosa			Tree	Monsoon vine thicket/monsoon forest	5 kg fresh fruits/seeds needed
Gardenia fucata			Shrub/tree	Sandstone country	1
Gardenia megasperma			Tree	Open forest/woodland	3
Grevillea decurrens			Tree	Open forest/woodland	12
Grevillea dryandri			Shrub	Sandstone country	2
Grevillea goodii			Prostrate shrub	Open forest/woodland	0.5
Grevillea pteridifolia			Tree	Open forest/woodland	5
Hakea arborescens			Tree	Open forest/woodland	7
Jacksonia dilatata			Shrub/tree	Sandstone country	1
Livistona humilis			Single stemmed palm	Open forest/woodland	15
Livistona inermis			Single stemmed palm	Sandstone country	15
Lophostemon lactifluus			Tree	Along streams/ around lagoons and swamps	5
Melaleuca argentea			Tree	Along streams	0.5
Melaleuca cajuputi			Tree	Along streams/ around lagoons and swamps	0.5
Melaleuca dealbata			Tree	Open forest/ around lagoons	0.5
Melaleuca leucadendra			Tree	Along streams/ around lagoons	0.5

Species	ERA phase 1 species	ERA phase 2 species	Growth form	Habitat type	Total quantity per species (kg)
				and swamps	
Melaleuca nervosa			Tree	Open forest/woodland	0.5
Melaleuca viridiflora			Tree	Streams/lagoons/ swamps	1
Owenia vernicosa			Tree	Open forest/woodland	13,793 fresh fruits/seeds needed
Pandanus spiralis			Tree	Open forest/woodland	17,777 fresh fruits/seeds needed
Persoonia falcata			Shrub/tree	Open forest/woodland	5
Petalostigma pubescens			Tree	Open forest/woodland	2
Petalostigma quadrioculare			Small tree	Open forest/woodland	72
Planchonia careya			Tree	Open forest/woodland	7.5
Stenocarpus acacioides			Shrub/tree		2
Sterculia quadrifida			Tree	Monsoon vine thicket/monsoon forest	1
Syzygium eucalyptoides subsp. *bleeseri*			Tree	Open forest/woodland	16,000 fresh fruits/seeds needed
Syzygium eucalyptoides			Tree	Open forest/woodland	1,600 fresh fruits/seeds needed
Syzygium suborbiculare			Tree	Open forest/woodland	10,526 fresh fruits/seeds needed
Terminalia carpentariae			Tree	Sandstone country	25
Terminalia ferdinandiana			Tree	Open forest/woodland	45
Terminalia pterocarya			Shrub/tree	Open woodland	10
Verticordia cunninghamii			Shrub	Open forest/woodland	1
Vitex glabrata			Tree	Monsoon vine thicket	1
Wrightia saligna			Shrub/tree	Open forest/woodland	5
Xanthostemon eucalyptoides			Tree	Along streams/ monsoon forest	1
Xanthostemon paradoxus			Tree	Open	10

Species	ERA phase 1 species	ERA phase 2 species	Growth form	Habitat type	Total quantity per species (kg)
				forest/woodland	

1.4 Project objectives and justification (include the reasons why the action is being proposed; and how it relates to existing facilities or proposed future initiatives as applicable)

Kakadu Native Plants Pty Ltd currently has a permit for collecting seeds and seedlings within Kakadu National Park for the purpose of suppling seeds and plants for use in Jabiru and its environs (Permit # CKM 1046).

Kakadu Native Plants Pty Ltd have developed considerable expertise in seed collecting and propagation of native plant species and have the necessary facilities for producing plants for sale. The company has already suppled native plants for planting in Jabiru, ecological restoration of disturbed areas and has been the source of native plants donated to the former Jabiru Town Council by Energy Resources of Australia Ltd (ERA). The focus of seed collecting activities for the purpose of revegetation on the RPA will contribute towards the long-term sustainability of this wholly Bininj owned business and inter-generational knowledge transfer. Further, the ecological restoration of the RPA with locally sourced seeds, will long-term, ensure similarity with surrounding Kakadu National Park, effectively expanding the adjacent savanna woodland habitat.

1.5 Alternatives and preferred option (include alternative alignments, layouts, materials, work methods etc and brief explanation of why the preferred option was selected)

The **preferred option** is to continue to collect seed from within the proposed seed collection zone (Figure 1) within the park, for the following reasons:

(1) The activity supports the ongoing sustainability of an existing Bininj business and inter-generational knowledge transfer. Importantly, this business has had no measurable detrimental environmental impact on the floristic or fauna composition or ecology of the park.

(2) The activity supports the legislative requirements of the Ranger Environmental Requirements (see alternative 1 below) and the GAC Board preferred seed collection option.

(3) Seed collection from within the park maximises species adaptation to the current conditions of the Ranger mine, thereby providing a stable and contiguous landscape with Kakadu National Park.

(4) Seed collection from within the park provides sufficient genetic diversity to reduce inbreeding, promotes the plants' adaptive potential and increases the resilience of the revegetation areas against moderate changes in climate.

(5) The current and proposed seed collection activity meets the intent of Regulations 12.20 and 12.21 of the EPBC Regulations and Section 10.13 of the *Kakadu Management Plan 2016 – 2026* – i.e. to protect and maintain the genetic diversity of the native flora and fauna of the park.

(6) Kakadu Native Plants Pty Ltd and the proposed activity meets the provisions outlined under the joint management to provide *"… opportunities for Bininj/Mungguy to be involved in park management at all levels, establish businesses and preserve their culture for future generations."*

The two main alternatives to this proposal are to:

(1) Do nothing which would result in no locally sourced plant material being available for use in ecological restoration and revegetation of disturbed areas, such as the post-mining landscapes on the RPA. This approach would contravene clause 2.1 of the Ranger Environmental Requirements (ERs), which are issued under the section 41 of the Commonwealth *Atomic Energy Act 1953*, which states:

"… the company must rehabilitate the Ranger Project Area to establish an environment similar to the adjacent areas of Kakadu National Park such that, in the opinion of the Minister with the

advice of the Supervising Scientist, the rehabilitated area could be incorporated into the Kakadu National Park."

(2) Source plant material from outside Kakadu National Park. As outlined in Appendix B (attached), ERA has undertaken extensive provenance studies to identify the most appropriate source of seed for the revegetation of the RPA, in order to meet the ERs and its legal obligations. The outcomes of the provenance study were presented to the Alligator Rivers Region Technical Committee and the GAC Board, which has subsequently endorsed the collection of seed only from within the park.

As stated in the *Kakadu Management Plan 2016 – 2026*, sourcing plant material from outside the park for revegetation purposes has the potential risk of introducing pests within soil and potting mix or altering local genetic stock (see Section 10.13).

This approach would not conform to the request of the GAC Board to only source seed from inside the park, or the aspirations of the Kakadu Management Plan (Section 10.13).

1.6 Business plan (include source of funding; approval information if relevant; information about joint venture arrangements if relevant; list set-up costs and maintenance requirements separately)

Kakadu Native Plants Pty Ltd have a pre-existing seed collection and nursery business (that has operated for a number of years). The current permit number is CKM 1046. The setup costs for this proposal are negligible/nil.

Approval to continue this operation ensures the long-term sustainability of the business and ongoing transfer of inter-generational knowledge relating to various ecological processes and management of the landscapes of the park.

2 LEGISLATION, PLANNING AND POLICY CONSIDERATIONS

Kakadu NP is managed in a multi-layered legislative framework which includes international, national, regional, and park-specific considerations. In addition, policies are developed to assist in day-to-day park management.

This section of the EIA indicates whether the proposed action is:
(a) legally permissible within the legislative framework; and
(b) appropriate under existing park management policies.

The Kakadu NP Management Plan 2016-2026 is the key instrument for determining if an action is permissible in Kakadu NP. Other planning and policy documents should only be referred to as relevant. Complete the following sections by following the prompts and inserting text from the Management Plan or other relevant document (available on Department of Environment website – see EIA Guidelines), with an accompanying statement as necessary.

Is the Action Permissible and Appropriate under:	**YES**	**NO**
PARK-SPECIFIC CONSIDERATIONS: (to be completed by all proponents)		
KNP Management Plan 2016-2026 [1]		
Is the proposed action referred to specifically?		**X**
Are other general provisions of the plan relevant to the proposal?	**X**	
Refer below.		
Does Section 9.9 *Carrying out and authorising activities not otherwise specified* apply?	**X**	
Kakadu Native Plants Pty Ltd have been collecting seeds and selling plants in the Jabiru region for a number of years. The company has also been extensively involved in revegetation and ecological restoration projects for the former Jabiru Town Council, and for ERA on the RPA and at Jabiluka.		
Has the process under section *4.1 Making decisions and working together* been applied in relation to the proposal?	**X**	
Provide details		
Although seed collecting and plant propagation are not mentioned explicitly in the Management Plan, Kakadu Native Plants Pty Ltd is an existing Bininj business that has been collecting seeds in the park under an existing permit CKM 1046. The proposed activities are also consistent with the overall strategy contained in the Plan – see below:		
1. Section 5.3. *"If plant material is sourced from outside the park for revegetation purposes there is a potential risk of introducing pests within soil and potting mix or altering local genetic stock …"* (page 96)		
The further development of Kakadu Native Plants Pty Ltd will ensure the availability of locally sourced plant material for revegetation works in the park. The enhanced knowledge of propagating local plants will increase the diversity of species available for rehabilitation and ecological restoration projects, such as gravel pits (Section 5.3, page 96).		
2. Sections 10.5. *"Kakadu National Park includes the estate and the resource base of a number of Aboriginal clan groups and families and the park is a major contributor to their economic future. The ability for Bininj/Mungguy to derive benefit from enterprises established in the park is recognised in the IUCN management principles for the park."* (Page 165)		
The proposed activities by Kakadu Native Plants Pty Ltd are consistent with this over-arching aim, because Kakadu Native Plants Pty Ltd is a wholly Bininj owned		

[1] If not permissible under the Kakadu NP Management Plan, the action cannot be approved.

business which ensures that, *"Bininj/Mungguy are provided with training and development opportunities and gain social and economic benefits from the park."* (page 38). In addition, the proposed activities will be conducted in a sustainable manner as collecting will be conducted using current best practice guidelines for the collection of seeds of wild plant species. Specifically, no more than 20% of available seeds will be collected from a given population and the same plants will not be collected from in consecutive years (see **Appendix C**). 3. Section 1.5, *"… creating opportunities for Bininj/Mungguy to be involved in park management at all levels, establish businesses and preserve their culture for future generations."* (page 16) The proposed activities are consistent with this aspiration as they will involve considerable time spent on country by Peter Christophersen, Sandra McGregor and other Bininj staff members. This will help to maintain connections with traditional knowledge of plants and animals. The proposed activities are consistent with the further development of the pre-existing business in Jabiru and will contribute to the long-term sustainability of this business venture. Kakadu Native Plants Pty Ltd has also already acted as a source of local, native plants for Jabiru residents and has actively participated in weed control and subsequent replacement of removed of invasive plants with native species as part of the Weedy Time Bomb project, which is a collaboration between PAN, ERA, the former Jabiru Town Council (now West Arnhem Shire) and Gundjeihmi Aboriginal Corporation. Kakadu Native Plants Pty Ltd has also been responsible for growing plants that have been donated to Jabiru by ERA. Undertaking the long-term revegetation of the RPA will ensure an ongoing revenue stream for this Bininj business, and provide ongoing expertise in the collection and propagation of native plant species of the region, based on local indigenous knowledge.		
Memorandum of Lease between the Aboriginal Land Trusts and the Director of National Parks (specify which ALT lease applies) Does the proposal impact on the interests of Relevant Aboriginals? Does the proposal refer to Sickness Country in the south of the Park? Has an environmental evaluation been carried out for proposed development as required by the lease? **Provide details** The proposed activity impacts positively on Aboriginal interests since it is intended that seed material be collected in Aboriginal land within Kakadu National Park by a wholly-owned Bininj business. Consultation with other clans will be determined by the Northern Land Council via the Land Interest Reference (LIR) process.	**X**	**X** **X**
Kakadu National Park policies, management strategies or area plans e.g. weed management strategy, fire management plans, feral animal strategy, walking track strategy etc. KNP policies and procedures[2] Is the proposal consistent with the relevant strategy or policy? If not, provide justification. **Provide details** N/A. Seed collecting has no impact on fire management, feral animal management etc. Refer **Appendix C** for a comprehensive assessment of the potential impact of the proposed activity within the context of key threatening processes, etc.	☐	☐
KNP Board of Management resolutions		

Provide details N/A. This wholly owned Bininj business has been granted permits previously to collect native seed for commercial purposes with no measurable detrimental environmental impact being recorded on the floristic or faunal composition, or ecology of the park.	☐	☐

INTERNATIONAL AGREEMENTS (complete only if relevant)		
RAMSAR Convention N/A. Seed collecting will not impact on the ecological character of wetlands (refer **Appendix C**, Section 4.6 for an assessment of potential impacts to RAMSAR wetlands).	☐	**X**
World Heritage listing Collection and use of natural resources are compatible with the aims of the UNESCO Convention Concerning the Protection of World Cultural and Natural Heritage (1972). For example, one aim is to give the *"…property a function in the life of the community…"* which seed collecting, the use of plants for local revegetation and income generation helps achieve. The proposed activity also provides a mechanism for the ongoing transfer of inter-generational knowledge relating to various ecological processes and management of the landscapes of the park.	☐	**X**
CAMBA (China-Australia Migratory Bird Agreement) and JAMBA (Japan – Australia Migratory Bird Agreement) N/A. Refer **Appendix C**, Section 4.3 for an assessment of potential impacts to migratory birds.	☐	**X**
Tri-Nation Wetlands Agreement N/A	☐	**X**
NATIONAL AND AUSTRALIAN GOVERNMENT CONSIDERATIONS (complete only if relevant)		
EPBC Act & EPBC Regulations **Is the proposal consistent with the objects of the Act?** Two objects of the EPBC Act are to: *"… to promote ecologically sustainable development through the conservation and ecologically sustainable use of natural resources"* (1)(a) and *"… to recognise the role of indigenous people in the conservation and ecologically sustainable use of Australia's biodiversity"* (1)(f). The current proposal is consistent with these over-arching objects of the Act because seed collection and plant propagation for ecological restoration are not only planned in an ecologically sustainable manner but also provide cultural, employment and financial benefits to Bininj, as well as giving Bininj the benefit of being able to restore country with locally sourced plant material. **Is the proposal consistent with the purposes and objectives of a national park as defined under the Act?** Regulations, Part 1 General administrative principles (5), outlines that any resource use in the reserve should be *"… based on the principle of ecologically sustainable use."* The proposed activities are for the sustainable harvest of seeds from within KNP using best practice seed collecting guidelines. Also, the seed will be propagated for use in the ecological restoration of the RPA, to ensure similarity with surrounding Kakadu National Park, effectively expanding the adjacent savanna woodland habitat. Schedule 8 of the EPBC Regulations, Part 2 Principles for each IUCN category 3(3.08) states: *"The aspirations of traditional owners of land within the reserve of zone, their continuing land management practices….and the benefit the traditional owners derive from enterprises established in the reserve or zone…should be recognized and taken into*	**X** **X**	

account." The proposed activities are consistent with this principle since Kakadu Native Plants Pty Ltd is a wholly Bininj owned business. **Is the proposed action specified in Section 354 of the Act?** The proposed action is covered by Section 354 (1)(a)&(f) in that it involves the taking and trading of native species (e.g. seed collection, propagation and commercial use of the plants for predominantly ecological restoration projects); also the proposed action is an established, commercial Bininj business: *"A person must not do one of the following acts in a Commonwealth reserve except in accordance with a management plan in operation for the reserve:* *(a) kill, injure, take, trade, keep or move a member of a native species; or* *(f) take an action for commercial purposes."* However, the proposed action is supported in the Kakadu Management Plan. For example, the proposed action has been permitted in the past in accordance with the intent of Section 10.1 of the Kakadu Management Plan (page 153) and Part 17 of the EPBC regulations, which *"… contains provisions for issuing and managing permits, including permit applications; preconditions to permits being issued; and the content of permits."* **Does the proposal relate to a "matter of national environmental significance (NES)" as defined under the Act? (Refer to list of NES matters in Appendix 1)** The proposal does not relate to MNES, since no negative effects on world heritage values or listed threatened species will arise from the proposed action. Also the proposed action does not involve the collection of any threatened/conservation listed plant species. However, the proponent recognises the MNES that are relevant to Kakadu National Park and has undertaken an assessment of potential impacts on all relevant MNES that occur within the proposed seed collection zone (see **Appendix C**). **Do specific provisions in the Regulations apply? eg use of genetic resources** Part 8A of the EPBC regulations (access to genetic resources) does not apply in the case of this proposal since the material will not be used for research and development.	**X**	**X** **X**
Australian Standards/Building Code of Australia Have the relevant Australian Standards been adopted and adhered to in the construction and design of the proposal? eg *Australian Standard for Walking Tracks, Building Code of Australia* N/A. This proposal does not include the construction of building / infrastructure etc.	☐	☐
Burra Charter (the *Australian ICOMOS Charter for Places of Cultural Significance*) Where the proposal involves non-Aboriginal heritage values, is it consistent with the guidelines of the Charter? N/A. The proposal does not involve non-Aboriginal heritage values.	☐	☐
National Strategies and Policies e.g. National Strategy for the Conservation of Australia's Biological Diversity; National Strategy for Ecologically Sustainable Development; National Forest Policy Statement; National Reserves System; Wetlands Policy of the Commonwealth Government of Australia. The proposed action is consistent with the National Strategy for Sustainable Development. The goal of the NSSD is: *"Development that improves the total quality of life, both now and in the future, in a way that maintains the ecological processes on which life depends."* In addition, the Core Objectives are:	**X**	☐

"• *to enhance individual and community well-being and welfare by following a path of economic development that safeguards the welfare of future generations* • *to provide for equity within and between generations* • *to protect biological diversity and maintain essential ecological processes and life-support systems"* This current proposal is consistent with both the overarching goal and the core objectives of the NSSD, by aiming to improve the current quality of life for Bininj through both financial and cultural means, via the sustainable harvest and propagation of plant material for predominantly ecological restoration projects. Not only will the proposed approach have potential medium-term financial benefits but it will also provide cultural benefits to Bininj through time spent on country. In addition, the provision of native plants may contribute towards wider community well-being, both now and into the future, by encouraging: (1) The growing of native plants as opposed to introduced and potentially invasive garden plants; and (2) The use of locally sourced native plants in landscape rehabilitation. The proposed activities are also ecologically sustainable because of the use of best practice seed collecting guidelines which recommend the collection of no more than 20% of the available seeds from a given plant population (e.g. Cochrane *et al.,* 2009). Also plants grown and used in the revegetation of the RPA will lead to the long-term establishment of a contiguous habitat with the surrounding park vegetation.		
Threatened Species Recovery Plans e.g. *Recovery Plan for Marine Turtles in Australia (2003).* Where the proposal involves a nationally listed threatened species, is it consistent with the provisions of the Recovery Plan? N/A. It is not proposed that the proponent will collect seeds of listed threatened species. Further and assessment of potential impacts to MNES is provided in **Appendix C**. Section 4.2, Table C5 addresses potential impacts to the recovery of a threatened species.	☐	**X**
Department of Environment policies and protocols (to be completed by KNP) eg eriss	☐	☐
NORTHERN TERRITORY LEGISLATION, STRATEGIES, POLICIES AND REGIONAL AGREEMENTS (complete only if relevant)		
Northern Territory Threatened Species List N/A. NT threatened plant species will not be collected as part of these activities. Threatened fauna will only be incidentally disturbed (if present at collecting sites) by time spent seed collecting on country. However this does not represent any greater impact to threatened fauna than other activities undertaken in the park. Refer **Appendix C** for an assessment of potential impacts on NT and Commonwealth conservation listed species, and other MNES.	☐	**X**
Northern Territory Aboriginal Sacred Sites Act N/A	☐	**X**
Northern Territory Bushfires Act N/A	☐	**X**
Northern Territory Weeds Management Act	☐	**X**

N/A		
OTHER (specify) N/A	☐	**X**

3 DESCRIPTION AND FEATURES OF THE EXISTING ENVIRONMENT

The environment of Kakadu NP includes physical, cultural, and social aspects so that a comprehensive description is needed to provide the context for the proposed action. Site-specific information, rather than generic information is needed as evidence of the proponent's familiarity with the site. The condition of the environment, including its conservation value needs to be described in order to assess what changes or impacts the proposed action may have.

Briefly describe the existing *'environment'* under the following headings as they are relevant to the proposal.

3.1 Natural heritage

a) Landforms and landscapes (include the physiographic unit of the subject area, names of regional features, unusual or outstanding landscape features)

Relative tectonic stability has led to features, within Kakadu National Park, of great antiquity. As a result of its great age (over 2,000 million years), much of the Park is characterised by land forms and soils that are deeply weathered, leached and infertile. Much of the landscape in the proposed seed collecting area is covered by lowland eucalyptus woodland communities.

The proposed action is confined to seed collecting conducted in an ecologically sensitive manner. This is similar to collection of bush tucker species by traditional owners, with collection conducted according to best practice guidelines used for seed collection elsewhere. Consequently, there will be no impact on landforms, landscapes, geology, hydrology, soils, etc (refer **Appendix C**, Section 4.7, Table C11).

b) Geology, geomorphology

By the diffuse nature of the proposed activities, it is not possible to provide a single description of the geology over which collection will take place. In addition, geology is not relevant to the proposed action since being on country has no impact on this feature of the existing environment (refer **Appendix C**, Section 4.7, Table C11).

c) Soils (include information on stability, erodibility etc)

By the diffuse nature of the proposed activities, it is not possible to provide a single description of the soils over which collection will take place although soils will generally be typical of the lowlands – shallow soils overlying ironstone. In addition, soil stability and erodibility are not relevant to the proposed action since being on country has no impact on this feature of the existing environment (refer **Appendix C**, Section 4.7, Table C11).

d) Hydrology and water flows (refer to rivers, creeks, wetlands and other catchment values and their conservation value; include information on seasonal flooding, presence of any built structures for visitor/management access, crocodile management, flood control etc)

Hydrology and flows are not relevant to the proposed action since being on country has no impact on this feature of the existing environment (refer **Appendix C**, Section 4.7, Table C11).

e) Vegetation (indicate the condition of the vegetation on site including weed infestations and how much of the site is cleared, provide names of the vegetation community(ies) present and their conservation value, include information about fire sensitivity and fire zoning under KNP policy if known, provide records of threatened and regionally significant flora species relevant to the site. NOTE: it is not necessary to list all pant species which occur).

It is not possible to give a single description of the vegetation in which the proposed activities will take place. However, eucalypt savanna woodland and lowland habitats occur in approximately 80% of Kakadu National Park. As previously listed in Table 1, most plant species identified for seed collection occur within lowland eucalypt woodland. Table 2 lists species of significance recorded in Kakadu National Park that are known to occur within the proposed seed collection zone. Table 2 is compiled from NT and Commonwealth spatial data sets.

Further information, including maps of where the species are known to occur within the seed collection zone are provided in **Appendix C**, Section 2.

Table 2: Plant species recorded from Kakadu National Park (2017) considered as threatened under the *Environment Protection and Biodiversity Conservation Act 1999* and/or the *Territory Parks and Wildlife Conservation Act* (adapted from Woinarski 2004)

Family	Scientific name	Status as at 2017		Kakadu significance	Occurrence within the collection area
		Northern Territory	C'wealth		
MIMOSACEAE	*Acacia* sp. Graveside Gorge	CE	CE		No records of occurrence within the seed collection zone.
RUTACEAE	*Boronia laxa* [1]	NT	not listed	High	Restricted to Mt Brockman area and the western Arnhem Land Plateau. Occurs in 14 locations on the eastern perimeter of the seed collection zone (Appendix C, Figure C1).
RUTACEAE	*Boronia quadrilata* [1]	VU	VU	High	No records of occurrence within the seed collection zone.
RUTACEAE	*Boronia rupicola* [1]	NT	not listed	High	Known only from eight populations around Mt Brockman and near Nabalerk. Occurs at several sites on the eastern perimeter of the seed collection zone but restricted to vertical sandstone surfaces (Appendix C, Figure C1). Seed collection will not take place on vertical surfaces or within habitat where this species occurs.
RUTACEAE	*Boronia suberosa* [1]	NT	not listed	High	Grows only on sandstone cliff faces on the Arnhem Plateau (Appendix C, Figure C1). However, seed collection will not be undertaken in escarpment areas.

Family	Scientific name	Status as at 2017		Kakadu significance	Occurrence within the collection area
		Northern Territory	C'wealth		
RUTACEAE	*Boronia verecunda* [1]	NT	not listed	High	No records of occurrence within the seed collection zone.
RUTACEAE	*Boronia xanthastrum* [1]	NT	not listed	High	Two populations known to occur in western Arnhem Land. The extent of occurrence for this species is considered to be approximately 5 760 km^2. Occurs at one site within the seed collection zone (Appendix C, Figure C1).
MYRTACEAE	*Calytrix inopinata* [1]	NT	not listed	High	No records of occurrence within the seed collection zone.
CYCADACEAE	*Cycas armstrongii* [1]	VU	not listed	Low	No records of occurrence within the seed collection zone.
ORCHIDACEAE	*Dienia montana* (*Malaxis latifolia*)	VU	not listed	Moderate - high	No records of occurrence within the seed collection zone.
ELAEOCARPACEAE	*Dubouzetia australiensis* [1]	NT	not listed	Low - moderate	No records of occurrence within the seed collection zone.
GLEICHENIACEAE	*Gleichenia dicarpa*	NT	not listed	Moderate	No records of occurrence within the seed collection zone.
STERCULIACEAE	*Helicteres sphaerotheca* [1] (referred to as *Helicteres* D21039 *linifolia*) (Cowie, 2011)	VU	not listed	High	No records of occurrence within the seed collection zone.
DILLENIACEAE	*Hibbertia tricornis* [1]	VU	not listed		Recorded only from the Mt Brockman outlier of the Arnhem Land escarpment on sandy areas on sandstone escarpment. Occurs in 4 locations on the perimeter of the seed collection zone (Appendix C, Figure C1). However, seed collection will not be undertaken in escarpment areas.
MALVACEAE	*Hibiscus brennanii* [1]	VU	VU	High	Known from only one population in west Arnhem Land. Grows in sandstone gullies and cliffs. Occurs on the perimeter of the seed collection zone (Appendix C, Figure C1). However, seed collection will not be

Family	Scientific name	Status as at 2017		Kakadu significance	Occurrence within the collection area
		Northern Territory	C'wealth		
					undertaken in escarpment areas.
MYRTACEAE	*Lithomyrtus linariifolia*	VU	not listed		Occurs in sandstone woodland or shrubland of western parts of the west Arnhem Land plateau. Occurs at 1 site within the seed collection zone (Appendix C, Figure C1).
PONTEDERIACEAE	*Monochoria hastata*	VU	not listed	Low - moderate	No records of occurrence within the seed collection zone.
EUPHORBIACEAE	*Sauropus filicinus*	DD	not listed	High	A short pendulous shrub growing from sandstone cliff faces. Occurs from four locations within the seed collection zone (Appendix C, Figure C1). However seed collection will not be undertaken along cliff faces.
LENTIBULARIACEAE	*Utricularia subulata*	NT	not listed	Moderate	No records of occurrence within the seed collection zone.
	[1] Endemic [2] Conservation listed post 2004				
	Status: CE: Critically endangered, DD: Data deficient, EN: Endangered, LC: Least concern, NT: Near threatened, VU: Vulnerable				

None of the conservation listed plant species known to occur within the seed collection zone will be impacted by the action – seeds will not be collected from any of these species. It is not possible to identify which species may be present at individual collecting sites as these specific locations are currently unknown and will differ between years (although they will be constrained by the area in Figure 1). Collection sites will differ between years because they are constrained both by sites not having been burnt in the year of collection (few seeds remain in such sites) and by the presence of fruiting individuals with ripe seeds at the point of natural dispersal. Furthermore, as these sites will be dispersed over an area of 6,600 km^2 it is not possible to provide specific comments on the condition of vegetation, presence of weeds etc.

Finally, seeds will be collected from 9 species known to occur in lowland sandstone country. Sandstone encompasses all communities that occur on the sandstone of the Arnhem plateau and its outliers. Sandstone country is topographically diverse and therefore provides a wide diversity of habitats supporting spinifex grassland, woodland and rainforest. Many species in sandstone country are fire-sensitive.

f) Fauna and fauna habitat values (provide records of threatened, migratory, and regionally significant fauna species within a radius relevant to the site, include the conservation status of each recorded species, describe habitat values present on the site relevant to each recorded species, include information about non-native species and their use of the area as relevant)

Table 3 lists faunal species of significance recorded in Kakadu National Park that are known to occur within the proposed seed collection zone. Table 3 is also compiled from NT and Commonwealth spatial data sets. The action will not impact on habitat values for these species since the action is limited to seed collection from native plant species that are abundant and common within the

designated collection habitats (see Table 1). Further information including maps of where the species are known to occur within the seed collection zone are provided in **Appendix C**, Section 2.

Table 3: Fauna species recorded from Kakadu National Park (2017) considered as threatened under the Environment Protection and Biodiversity Conservation Act 1999 and/or the *Territory Parks and Wildlife Conservation Act* (adapted from Woinarski 2004)

Scientific name	Common Name	Conservation status as at 2017		Kakadu significance	Occurrence within the collection area
		Northern Territory	C'wealth		
REPTILES					
Caretta caretta	Loggerhead turtle	EN	EN	Low	No records of occurrence within the seed collection zone.
Chelonia mydas	Green turtle	LC	VU	Low – moderate	No records of occurrence within the seed collection zone.
Glyphis sp.A.	Speartooth shark	EN	CE	Moderate – high	No records of occurrence within the seed collection zone.
Glyphis sp. C.	Northern river shark	EN	EN	Uncertain	No records of occurrence within the seed collection zone.
Acanthopsis hawkei [2]	Plains death adder	VU	VU		Known to occur on the cracking soils on floodplains of the Adelaide, Mary and Alligator Rivers. However the likely distribution of *A. hawkei* is extensive, covering over 50% of Kakadu National Park (Appendix C, Figure C2). Occurs in the seed collection zone.
Bellatorias obiri [1]	Arnhemland egernia	EN	EN	High	Occurs mainly on the perimeter of the seed collection zone but restricted to the escarpment (Appendix C, Figure C2). However, no seed collection will be undertaken in escarpment areas.
Diplodactylus occultus [1]	Yellow-snouted gecko	VU	EN	Moderate	No records of occurrence within the seed collection zone.
Lepidochelys olivacea	Olive ridley	VU	EN	Low – moderate	No records of occurrence within the seed collection zone.
Morelia oenpelliensis [1]	Oenpelli python	VU	not listed	High	Occurs mainly on the perimeter of the seed collection zone but restricted to the escarpment (Appendix C, Figure C2). However, no seed collection will be undertaken in escarpment areas.
Natator depressus	Flatback turtle	DD	VU	Moderate	No records of occurrence within the seed collection zone.
Pristis clavata	Dwarf sawfish	VU	VU	Low – moderate	No records of occurrence within the seed collection zone.
Pristis pristis	Freshwater sawfish, largetooth sawfish, river sawfish, leichhardt's sawfish, northern sawfish	DD	VU	Low – moderate	No records of occurrence within the seed collection zone.
Varanus mertensi	Mertens water monitor	VU	not listed		A semi-aquatic monitor seldom seen far from water, occurring across a broad geographic range, In the NT it has been recorded across most of the Top End and the Gulf Region. Occurs in the seed collection zone

Scientific name	Common Name	Conservation status as at 2017		Kakadu significance	Occurrence within the collection area
		Northern Territory	C'wealth		
					(Appendix C, Figure C2).
Varanus mitchelli	Mitchell's water monitor	VU	not listed		A semi-aquatic and arboreal water monitor that inhabits margins of watercourses, swamps and lagoons. Occurs in the seed collection zone (Appendix C, Figure C2).
BIRDS					
Amytornis woodwardi [1]	White-throated grasswren	VU	VU	High	Known to occur in the seed collection zone (Appendix C, Figure C2). However seed collection will not occur along the sandstone massif of the western Arnhem Land.
Epthianura crocea tunneyi [1]	Yellow chat	VU	EN	High	Known to occur within the seed collection zone (Appendix C, Figure C2); mainly occurs within a small number of sites on the Adelaide River to the East Alligator River.
Erythrotriorchis radiatus	Red goshawk	VU	VU	Low - moderate	Occurs in the seed collection zone (Appendix C, Figure C2). However Kakadu comprises only a small proportion of this range and total population.
Erythrura gouldiae	Gouldian finch	EN	EN	Moderate	Occurs in the seed collection zone (Appendix C, Figure C2).
Falcunculus (frontatus) whitei	Northern/crested shrike-tit	NT	VU	Low	Known to occur at two sites within the seed collection zone (Appendix C, Figure C2).
Geophaps smithii smithii [1]	Partridge pigeon	VU	VU	Moderate	Occurs in the seed collection zone (Appendix C, Figure C2).
Limosa lapponica [2]	Bar-tailed godwit	VU	CE		Occurs predominantly in the coastal areas of all Australian states.
Tyto novaehollandiae kimberli	Masked owl	VU	VU	Uncertain	Known to occur in the seed collection zone (Appendix C, Figure C2). However very little information is known about the distribution, population size and trends in population.
MAMMALS					
Antechinus bellus [2]	Fawn antechinus	VU	EN		The only species of Antechinus found in the savanna woodland and tall open forest of the Top End of the NT. Occurs in the seed collection zone (Appendix C, Figure C2).
Conilurus penicillatus	Brush-tailed rabbit-rat	EN	VU	Moderate – high	Occurs in the seed collection zone (Appendix C, Figure C2).
Dasyurus hallucatus	Northern quoll	CE	EN	Uncertain	Occurs in the seed collection zone (Appendix C, Figure C2).
Hipposideros diadema inornata [1]	Arnhem leaf-nosed bat	VU	EN	High	Limited distribution within the Kakadu escarpment an adjoining western edge of the Arnhem Land

Scientific name	Common Name	Conservation status as at 2017		Kakadu significance	Occurrence within the collection area
		Northern Territory	C'wealth		
					plateau. Occurs in the seed collection zone (Appendix C, Figure C2).
Isoodon auratus auratus	Golden bandicoot	EN	VU	Uncertain	No records of occurrence within the seed collection zone.
Macroderma gigas	Ghost Bat	not listed	VU		Occurs across a broad range of habitats including rainforests, arid zones near rock outcrops, throughout the tropical savanna and mangroves. The species roosts in caves, mines, and rock clefts. Occurs in the seed collection zone (Appendix C, Figure C2)
Mesembriomys gouldii [2]	Black-footed tree-rat	VU	EN		Occurs in tropical woodlands and open forests in coastal areas in the NT. Occurs in the seed collection zone (Appendix C, Figure C2)
Mesembriomys macrurus	Golden-backed tree-rat	CE	VU	Uncertain	No records of occurrence within the seed collection zone.
Petrogale concinna	Nabarlek	EN	VU		Largely restricted to rocky areas (sandstone or granite), especially on steep slopes, with large boulders, caves and crevices. Occurs in the seed collection zone (Appendix C, Figure C2).
Phascogale (tapoatafa) pirata [1]	Northern Brush-tailed Phascogale	EN	VU	Moderate – high	Occurs in the seed collection zone (Appendix C, Figure C2).
Saccolaimus saccolaimus nudicluniatus	Bare-rumped sheath-tail bat	DD	CE	Uncertain	No records of occurrence within the seed collection zone.
Xeromys myoides	False water-rat water mouse	DD	VU	Uncertain	No records of occurrence within the seed collection zone. Seed collection will not occur within known habitat – e.g. mangrove forests, freshwater swamps and floodplain saline grasslands.
Zyzomys maini [1]	Arnhem rock-rat	VU	VU	High	Endemic to the sandstone massif of western Arnhem Land. Restricted to areas with large sandstone boulders or escarpment with fissures and cracks in monsoon forests. Known to occur at one location on the north-eastern edge of the seed collection zone (Appendix C, Figure C2).
[1] Endemic [2] Conservation listed post 2004					
Status: CE: Critically endangered, DD: Data deficient, EN: Endangered, LC: Least concern, NT: Near threatened, VU:					

Scientific name	Common Name	Conservation status as at 2017		Kakadu significance	Occurrence within the collection area
		Northern Territory	C'wealth		
Vulnerable					

g) Dangerous fauna (include information about risk and current management measures for crocodiles and buffaloes in the area)

Because of the varied nature of the areas in which seed collection would take place, it is not possible to be prescriptive regarding risks associated with dangerous fauna during seed collection. The risk of interactions with dangerous fauna are no different to those experienced by Bininj being on country for customary purposes. To mitigate risks associated with both buffalo and crocodile, a Take 5 risk assessment will be conducted on the day of collection to assess the possible level of threat posed in each area. When in the vicinity to water bodies that may hold crocodiles, a designated croc spotter will be used.

3.2 Aboriginal cultural heritage (to be completed by NLC)

a) Bininj/Mungguy interests (identify clan or family group who speak for Country in this part of Kakadu NP)

b) Bininj/Mungguy cultural heritage values (include sacred sites, other cultural sites and/or landscape features; indicate cultural heritage values which are specifically referred to in the Kakadu NP leases, indicate cultural constraints if known)

c) Bininj/Mungguy customary use values (include plant and animal species or other resources specific to the site which are used by Bininj/ Mungguy)

3.3 Non-Aboriginal cultural heritage (include listed and unlisted sites, identify conservation value of sites and adopted management regime if assessed)

N/A

3.4 Community

(a) Visitor use (describe nature and scale of visitor use, include season, include type and numbers of tour operators, include type and number of vehicles, include information on visitor management as relevant)

No visitors to the Park will be involved/associated with the seed collecting or propagation activities.

b) **Existing infrastructure** (include access routes, toilets and visitor facilities, services, park management works; include condition of all built structures)

N/A this permit is to harvest native seeds.

c) Education and scientific values (include research and/or monitoring action, refer to permits as relevant)

Through the detailed collection of seed harvesting records, it is possible that seasonal impacts (including the impact of climate change) on fruiting phenology will be identified.

In addition, information on the seed germination requirements of many NT plant species is simply unknown. This ongoing activity and the associated propagation work will add to the established knowledge base and expertise on seeds from this region.

Further, this action would provide Bininj with opportunities to improve both indigenous and scientific understanding of local plants, and subsequent ecological restoration of disturbed areas.

d) External stakeholders (identify relevant stakeholders e.gg Northern Territory Government, Bushfires Council, leaseholders, neighbouring landowners, interest groups, etc)

N/A

e) Aesthetic values (include scenic and amenity values)

The provision of native plant species to revegetate the RPA will result in a positive impact on the aesthetics of the surrounding area by establishing a contiguous habitat with surrounding vegetation.

The collecting activities themselves will have no impact on the aesthetics of the vegetation.

4 REFERENCES, AND BIBLIOGRAPHY

Atomic Energy Act 1953. http://www.comlaw.gov.au/Details/C2008C00313

Christophersen, P & McGregor, S (2009). *Kakadu National Park Environmental Impact Assessment (EIA): Seed collection in Kakadu National Park and the sale of plant material both inside and outside of Kakadu National Park*. June 2009.

Cochrane, A, Crawford, AD & Offord, CA (2009) Chapter 3: Seed and vegetative material collection. In: Offord, CA & Meagher, PF (eds.) *Plant Germplasm Conservation in Australia strategies and guidelines for developing, managing and utilising ex situ collections*. Australian Network for Plant Conservation in partnership with Australian Seed Conservation and Research.

Department of Land Resource Management (2017). NT Species_Atlas_Fauna dataset. https://nt.gov.au/environment/environment-data-maps/environment-data-requests. Spatial data package downloaded February 2017.

Department of the Environment & Energy (2017). National Strategy for Ecologically Sustainable Development. http://www.environment.gov.au/about-us/esd/publications/national-esd-strategy. Viewed online: March 2017.

Department of the Environment & Energy (2017). *Species of National Environmental Significance.* Species of National Environmental Significance (public grids) GIS data: http://www.environment.gov.au/fed/catalog/search/resource/details.page?uuid=%7B337B05B6-254E-47AD-A701-C55D9A0435EA%7D. Spatial data package downloaded February 2017.

Director of Parks (2016). *Kakadu National Park Management Plan 2016-2026.* https://www.environment.gov.au/system/.../kakadu-management-plan-2016-2026.pdf. Viewed online: March 2017.

Environment Protection and Biodiversity Conservation Act 1999. http://www.austlii.edu.au/au/legis/cth/consol_act/epabca1999588/s3.html.

Environment Protection and Biodiversity Conservation Regulations 2000. https://www.legislation.gov.au/Details/F2016C00914.

Woinarski, J (2004). Threatened plants and animals in Kakadu National Park: a review and recommendations for management. Report to Parks Australia North. Project # NHTKNP01, September 2004; p 185. https://denr.nt.gov.au/__data/assets/pdf_file/0020/255062/2004WoinarskiJ.ThreatenedplantsandanimalsinKakaduNationalPark.pdf. Viewed online: March 2017.

5 NATURE AND EXTENT OF THE LIKELY IMPACTS OF THE ACTION

This section is one of the most critical of the EIA and must be completed by all proponents. Its purpose is to describe the likely impacts of actions on Kakadu NP (as Commonwealth land) and actions taken by the Commonwealth according to the requirements of the EPBC Act.

Proponents must briefly describe the possible impacts likely to occur as a result of the action including consideration of the extent, size, scope, intensity and duration (refer to Guidelines).

A rating is also needed to categorise impacts as:
- low (or negligible), medium or high adverse impact, OR
- positive impact,

taking into account any mitigation measures that have been specified. Boxes should also be marked as N/A where the prompts are not applicable. These ratings made by the proponent for individual aspects of the proposed action, will help KNP staff determine whether or not there will be a significant impact from the action overall (refer Section 6.0).

5.1 NATURAL HERITAGE

Physical and chemical impacts during construction and operation

	IMPACT RATING (N/A, low, medium or high adverse OR positive)	**DESCRIPTION OF IMPACT** taking into account the receiving environment, proposed mitigation measures and proposed monitoring
1. Is the action likely to impact on soil quality or land stability?	N/A	Seeds will often be collected from individual plants with ripe fruits/seeds that are visible from existing access tracks/roads. Collection is highly intermittent and random across the seed collection zone; undertaken by a small team, thereby reducing the likelihood of causing subsidence, instability or substantial erosion (refer **Appendix C**, Table C11).
2. Is the action likely to affect a waterbody, watercourse, wetland or natural drainage system?	N/A	The proposed seed collection zone (Appendix A, Figure 1) does not include any practices that will impact on water resources (refer Appendix C, Table C11).
3. Is the action likely to change flood or tidal regimes or be affected by flooding?	N/A	The proposed seed collection zone (Appendix A, Figure 1) does not include any practices that will impact on flood or tidal regimes (refer Appendix C, Table C11).
4. Does the action involve the use, storage or transport of hazardous substances or the use of chemicals which could be released to the environment?	N/A	This EIA is in support of a seed collection of permit.
5. Does the action involve the generation or disposal of gaseous, liquid or solid waste or emissions?	N/A	This EIA is in support of a seed collection of permit.

6. Will the action involve the emission of dust, odours, noise vibration or radiation in the proximity of housing or other sensitive locations?	N/A	The proposed seed collection activity does not include any practices that involve emissions, vibration or radiation within proximity of residences or sensitive locations.
Biological impacts		
1. Is any vegetation to be cleared or modified?	Negligible/ positive	Vegetation will not be cleared as part of the proposed action. The proposed action will have positive effects on vegetation within the Park by providing locally sourced plants for rehabilitation. Based on available evidence there is negligible risk of the proposed action modifying vegetation patterns. Seed collecting may reduce seeds available for natural seedling recruitment. However, we believe this risk is minimal because: 1. Most plant species produce extremely high quantities of seeds For example, in the absence of fire, *Eucalyptus miniata* and *E. tetrodonta* produce ca. 430,000 and 200,000 seeds per hectare per year, respectively (Setterfield, 1997). For these two species this is equivalent to ca. 27 and 8 kg per hectare per year, respectively. Consequently, based on maximum collection limits of 15 kg per year for these species (Table 1), this equates to less than 0.000001 % of the seed of these species that is potentially available in Kakadu National Park (based on a total available area of 1.8 million ha). 2. Many tree species in the Park are adapted to the incipient fire regime by re-sprouting/ suckering which reduces reliance on recruitment from seeds. Consequently, for tree species in regularly burnt areas, natural seedling recruitment is a rare event as a result of fire related mortality (Setterfield, 2002): in this context seed collection is unlikely to have any impact. 3. In areas that are subjected to either early or late fires, it has been reported that for *E. miniata* and *E. tetrodonta*, seed production (seed fall) is reduced by between 62 and 98% (Setterfield, 1997). Since approximately 55-63% of the Park burns each year (Lehmann et al., 2008; Russell-Smith et al., 1997) this means that between 34.1 and 61.7% of the potential seed yield of these species is lost each year from the park. These potential seed losses resulting from fire which is both a beneficial and long-term feature of the landscape in Kakadu are vastly in excess of the quantities proposed to be collected as part of this action. Recent fire records support these earlier fire data, indicating that the average percentage of the park burnt per year during the 10 year timeframe 2005 – 2010,

		inclusive was 56.1% or 10,681.4 km^2 (NAFI 2015). Nonetheless the risk of impacts on vegetation composition will be kept to a minimum by using best practice seed collecting guidelines (e.g. Cochrane *et al.,* 2009). Specifically, these guidelines recommend that no more than 20% of available seed be collected from each population. In addition, Cochrane *et al.,* (2009) recommend that since the risk of any impact on vegetation is increased by multi-year seed collecting from the same populations, the seed take should be reduced in such cases. To reduce this potential multiplication of risk, we propose only collecting from particular trees/ populations in alternate years. This will be ensured by keeping complete records for quantities of seed, locations of seed collection and species collected in each year.
2. Is the action likely to introduce weeds, increase weed distribution or otherwise impact on existing weed infestations?	Negligible	There is a negligible risk of weed seeds being spread by vehicles / clothing etc., during seed collecting. This will be mitigated by inspecting vehicles / clothes etc., between each collecting location.
3. Will the action affect fire sensitive vegetation communities?	Positive	The collection and propagation of species from fire sensitive communities ensures that these species are available for rehabilitation projects in the event of large scale fires in fire sensitive communities.
4. Is the action likely to affect a vegetation community or flora species of conservation significance?	N/A	Seeds of no NT/EPBC listed species will be collected.
5. Does the action have the potential to endanger, disturb or permanently displace native fauna?	N/A	Seed collecting does not present a threat to native fauna. Furthermore, the same site will not be repeatedly visited for seed collection on multiple consecutive days.
6. Is the action likely to affect threatened or regionally significant fauna?	N/A Positive	Seed collecting does not present a threat to native fauna. Furthermore, the same site will not be repeatedly visited for seed collection on multiple consecutive days. Long term, the provision of local, native plant species to revegetate the RPA will result in a positive impact by establishing a contiguous habitat with surrounding vegetation.
7. Is the action likely to affect habitat values for threatened or regionally significant fauna?	N/A Positive	Habitat values for such species will be unaffected as no vegetation will be cleared / disturbed. Refer **Appendix C**, Section 4 for an assessment of potential impacts of the proposed action on the habitat values for threatened or regionally significant fauna. Long term, the provision of local, native plant species to revegetate the RPA will result in a positive impact by establishing a contiguous

		habitat with surrounding park vegetation.
8. Is the action consistent with any applicable Recovery Plan or threat abatement plan for listed or threatened fauna?	N/A	
9. Is the action likely to have an impact on migratory fauna species or their habitat?	N/A	The proposed action will not impact on migratory fauna. Furthermore, the same site will not be repeatedly visited for seed collection on multiple consecutive days. (Refer **Appendix C**, Section 4 for an assessment of potential impacts of the proposed action on migratory fauna species or their habitat.)
10. Is the action likely to have an affect on dangerous fauna?	N/A	This action may result in incidental interactions with dangerous fauna. However, the risk will be minimised by conducting a risk assessment when entering an area that includes looking for signs of buffalo. In areas where crocodiles may occur a designated croc spotter will used.
11. Is the action likely to introduce feral animals, change their distribution or otherwise impact on feral populations?	N/A	
5.2 ABORIGINAL CULTURAL HERITAGE (to be completed by KNP in consultation with NLC)		
1. Will the action affect places of significance or other cultural value of importance to Traditional Owners?		
2. Is the action likely to affect bush resources or access to bush resources which are used by Traditional Owners?		
3. Will the action affect a listed sacred site?		
4. Will the action affect an area subject to a Native Title Claim?		
5.3 NON-ABORIGINAL CULTURAL HERITAGE		
1. Will the action alter or disturb places or built structures which have cultural heritage significance?	N/A	Non-Aboriginal cultural heritage sites will not be disturbed.
5.4 COMMUNITY		
Visitors		
1. Is the action likely to affect visitor access routes to or within the Park?	N/A	
2. Is the action likely to affect visitor services within the Park?	Positive	Long term, the provision of local native plant species to revegetate the RPA will result in a

		positive impact by establishing a contiguous habitat with surrounding park vegetation. It may also have educational benefits regarding the ecological re-establishment of a disturbed area. This activity will continue to provide valuable local expertise in the seasonal collection and propagation of local native plants.
3. Is the action likely to have an impact on the safety of visitors, Traditional Owners or staff?	N/A	
Existing Infrastructure		
4. Is the action likely to affect services or infrastructure for people who reside in Jabiru?	N/A	
5. Is the action likely to affect services or infrastructure for people who reside elsewhere in the Park?	N/A	
6. Is the action likely to affect camping grounds or other visitor infrastructure?	N/A	
Aesthetics		
7. Does the activity affect a site(s) of importance to the broader community for their recreational or other values or access to these values?	N/A	No sites of importance to the broader community will be affected.
8. Will the action affect the visual or scenic landscape?	N/A Positive	There will be no negative impact on the scenic landscape as vegetation modification will be limited to collecting seeds. Conversely, seed collected and propagated for use on the RPA will, long term, result in a positive impact by establishing a contiguous habitat with surrounding park vegetation.
Economic impacts		
9. Is the action likely to have an impact on employment for Bininj/Mungguy?	Yes, positive	Kakadu Native Plants Pty Ltd has employed 6 Bininj staff (4 full-time and 2 on a casual basis) and this number is likely to increase with an expansion in activities into the dedicated revegetation of the RPA. In addition, Kakadu Native Plants Pty Ltd is a wholly Bininj owned business.
10. Will the action affect economic factors within the Park?	Yes, positive	The proposed action will contribute towards employment and revenue generation within the Jabiru region.
Scientific and Education Value		
11. Will the action impact on research priorities or activities?	Negligible	Given the low seed collecting rates planned and the use of best practice seed collection guidelines there should be no impact on research priorities.
12.Will the action impact on education priorities or activities?	Positive	It may also have educational benefits regarding the ecological re-establishment of a disturbed area. This activity will continue to provide

		valuable local expertise in the seasonal collection and propagation of local native plants.
Stakeholder Interests		
13. Will the action impact on other relevant Aboriginal people within the Park?	Positive	There may be employment opportunities for other Aboriginal people in the Park.
14. Will the action impact on other relevant Aboriginal people outside of the Park?	Positive	Kakadu Native Plants Pty Ltd provides a successful business role model for Aboriginal people.
15. Will the action impact on other stakeholders?	N/A	

5.5 MATTERS OF NATIONAL ENVIRONMENTAL SIGNIFICANCE (these matters are determined by the EPBC Act and should be completed only if relevant by referring to Appendix 1)

	DESCRIPTION OF IMPACT (taking into account the receiving environment and proposed mitigation measures)	**SIGNIFICANT IMPACT** (Yes / No)
1.Listed threatened species and communities	No listed threatened species will be collected. Refer **Appendix C**.	No
2. Listed migratory species	Listed migratory species will not be disturbed. Refer **Appendix C**.	No
3. World Heritage	The proposal will not impact on the world heritage values of the Park that relate to cultural criteria. In relation to natural criteria, there is no risk of the collecting activities impacting on "ecological processes" given the adoption and enhancement of current best practice in seed collecting. Refer **Appendix C**	No
4. RAMSAR Wetlands of International importance	RAMSAR wetlands will not be affected. Refer **Appendix C**.	No

6.0 SUMMARY OF ENVIRONMENTAL IMPACTS (do not complete this section if you completed Section 5.5)

This section requires a synthesis of the findings of Section 5.1 to 5.4.

The purpose of the Overall Impact Rating column is to allow for an assessment of the cumulative impact associated with each category and therefore, rapid identification of which aspect(s) of the environment of the Park could experience a significant impact as the result of the proposed action. To fill out this column, consider all impacts in each individual section and provide an overall assessment of the likely impacts as low, medium, or high.

The Sensitive Aspects column should not duplicate the findings of Section 5 above, but be used to highlight features which may require special attention.

CATEGORY OF IMPACT	Overall impact rating	Nature of key impacts	Sensitive aspects
Physical & chemical			
Biological			
Aboriginal cultural heritage			
Non-Aboriginal cultural heritage			
Community			

7.0 CONSULTATION (to be completed by PA)

7.1 Traditional Owners (include date of consultations concerns, and requests for changes to proposal as relevant; attach NLC/Kakadu NP consultation records and Board Minutes if available)

7.2 External Stakeholders

8.0 CONCLUSION OF ENVIRONMENTAL IMPACT ASSESSMENT
(to be completed by KNP)

Complete one of the following:

☐ The proposal is likely to have no impact or no more than a negligible impact on the Park's environment and natural and cultural values and on Bininj.

RECOMMENDATION -The proposal is recommended for approval.

☐ The proposal will have more than a negligible impact but not a significant impact on the Park's environment and natural and cultural values or on Bininj and does not affect a matter of national environmental significance.

RECOMMENDATION -The proposal is recommended for approval (subject to conditions) by the Director and the Board.

☐ The proposal is not likely to have a significant impact on the Park's environment and natural and cultural values, or a significant impact on Bininj/Mungguy but is not supported.

RECOMMENDATION - The proposal is recommended for refusal by the Kakadu Board of Management for the following reasons:

The Board's reasons for refusal will be forwarded to the Director of National Parks who will consider whether or not the proposal should be referred under the EPBC Act.

☐ The proposal will have, or is likely to have, a significant impact on the Park's environment and natural and cultural values, and a significant impact on Bininj/Mungguy

RECOMMENDATION - CATEGORY 3 ASSESSMENT is required. The Director of National Parks will consider whether or not the proposal should be referred under the EPBC Act.

☐ The proposed action involves a Matter of National Environmental Significance under the EPBC Act but a decision about whether or not there is a significant impact has not been determined.

RECOMMENDATION - The proposal is to be referred to the Kakadu NP Board of Management, for advice prior to referral to the Director of National Parks for determination of whether the action constitutes a controlled action under the EPBC Act.

☐ The proposed action is likely to have a significant impact on a Matter of National Environmental Significance under the EPBC Act.

RECOMMENDATION - The proposal is to be referred to the Kakadu NP Board of Management for advice, prior to referral to the Director of National Parks for determination of whether the action constitutes a controlled action under the EPBC Act.

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9 Endorsement of the Conclusion & Recommendation in 8
(to be completed by KNP)

The Conclusion and Recommendation ticked in Section 8.0 above is supported/not supported as follows:

POSITION	**DECISION** **Supported/Not supported ***	**SIGNATURE/DATE**
KNP Work Unit supervisor (if not the author of the EIA) eg Chief Ranger		
Relevant Manager (Operations/TVS/CHBM)		
KNP Planning Officer (if relevant)		
Park Manager		
Assistant Secretary PA JMB (as needed)		
Director of National Parks (as needed)		

*** provide comments as necessary** (eg considerations which should be included in conditions, reasons why the proposal should be forwarded to the Assistant Secretary etc)

APPENDIX 1 - Significance Test of NES Values (complete this section and transcribe the results to the table in Section 5.5)

This section allows an assessment of whether the proposed action will have a significant affect on the following matters of national environmental significance (NES) under the EPBC Act:

- listed threatened species and communities (each species must be addressed separately so as to provide a thorough assessment of the potential impacts of the proposal);
- listed migratory species;
- RAMSAR wetlands of international importance; and
- World Heritage.

(The following matters of NES are not relevant to Kakadu NP: the Commonwealth marine environment, National Heritage places, and nuclear actions).

Listed threatened species and ecological communities

a) In the case of **extinct-in-the-wild species**, state whether the action will
   - o adversely affect a captive or propagated population or one recently introduced/reintroduced to the wild
   - o or interfere with the recovery of the species or its reintroduction into the wild.

☐ **Yes** **X No**

Refer **Appendix C**, Sections 4.1, 4.2 and Table C5 for a comprehensive assessment of potential impacts against the key threatening processes listed above.

Explanation:

b) In the case of **critically endangered or endangered species** will the action lead to:
   - o a long-term decrease in the size of a population,
   - o reduce the area of occupancy of the species,
   - o fragment an existing population into two or more populations,
   - o adversely affect habitat critical to the survival of a species,
   - o disrupt the breeding cycle of a population,
   - o modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline,
   - o result in invasive species that are harmful to a critically endangered or endangered species becoming established in the habitat,
   - o introduce disease that may cause the species to decline or interfere with the recovery of the species.

☐ **Yes** **X No**

Explanation:
Refer **Appendix C**, Sections 4.1, 4.2 and Table C5 for a comprehensive assessment of potential impacts against the key threatening processes listed above.

c) In the case of **vulnerable species** will the action lead to:
   - o a long term decrease in the size of an important population of a species,
   - o reduce the area of occupancy of an important population,
   - o fragment an existing important population into two or more populations,
   - o adversely affect habitat critical to the survival of a species,
   - o disrupt the breeding cycle of an important population,

- o modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline,
- o result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat,
- o introduce disease that may cause the species to decline,
- o or interfere substantially with the recovery of the species.

☐ **Yes** **X No**

Explanation:
Refer **Appendix C**, Sections 4.1, 4.2 and Table C5 for a comprehensive assessment of potential impacts against the key threatening processes listed above.

d) In the case of **critically endangered and endangered ecological communities** will the action:
- o reduce the extent of an ecological community,
- o fragment or increase fragmentation of an ecological community, for example by clearing vegetation for roads or transmission lines,
- o adversely affect habitat critical to the survival of an ecological community,
- o modify or destroy abiotic (non-living) factors (such as water, nutrients, or soil) necessary for an ecological community's survival, including reduction of groundwater levels, or substantial alteration of surface water drainage patterns,
- o cause a substantial change in the species composition of an occurrence of an ecological community, including causing a decline or loss of functionally important species, for example through regular burning or flora or fauna harvesting,
- o cause a substantial reduction in the quality or integrity of an occurrence of an ecological community, including, but not limited to:– assisting invasive species, that are harmful to the listed ecological community, to become established,
- o or – causing regular mobilisation of fertilisers, herbicides or other chemicals or pollutants into the ecological community which kill or inhibit the growth of species in the ecological community
- o or interfere with the recovery of an ecological community.

☐ **Yes** **X No**

Explanation:
Refer **Appendix C**, Section 4.1 for an assessment of potential impacts against the key threatening processes listed above.

Listed Migratory Species

e) In the case of **Listed Migratory Species** will the action:
- o substantially modify (including by fragmenting, altering fire regimes, altering nutrient cycles or altering hydrological cycles), destroy or isolate an area of important habitat for a migratory species;
- o result in an invasive species that is harmful to the migratory species becoming established in an area of important habitat for the migratory species;
- o or seriously disrupt the lifecycle (breeding, feeding, migration or resting behaviour) of an ecologically significant proportion of the population of a migratory species.

☐ **Yes** **X No**

Explanation:
Refer **Appendix C**, Section 4.3 and Table C6 for a comprehensive assessment of potential impacts against the key threatening processes listed above.

World Heritage

f) In the case of **World Heritage Properties**[3] will the action cause
- one or more of the World Heritage values to be lost;
- one or more of the World Heritage values to be degraded or damaged; or
- one or more of the World Heritage values to be notably altered, modified, obscured or diminished.

☐ **Yes** **X No**

Explanation:
Refer Appendix C, Sections 4.4, 4.5 and Tables C7 and C8 for a comprehensive assessment of potential impacts against the key threatening processes listed above.

RAMSAR Wetlands of International Importance

(g) An action is likely to have a significant impact on the ecological character of a declared Ramsar wetland if there is a real chance or possibility that it will result in:
- areas of the wetland being destroyed or substantially modified;
- a substantial and measurable change in the hydrological regime of the wetland, for example, a substantial change to the volume, timing, duration and frequency of ground and surface water flows to and within the wetland;
- the habitat or lifecycle of native species, including invertebrate fauna and fish species, dependant upon the wetland being seriously affected;
- a substantial and measurable change in the water quality of the wetland – for example, a substantial change in the level of salinity, pollutants, or nutrients in the wetland, or water temperature which may adversely impact on biodiversity, ecological integrity, social amenity or human health; or
- an invasive species that is harmful to the ecological character of the wetland being established (or an existing invasive species being spread) in the wetland.

☐ **Yes** **X No**

Explanation:

Refer Appendix C, Sections 4.6, Tables C9 and C10 for a comprehensive assessment of potential impacts against the key threatening processes listed above.

[3] Note - For a full description of significant impacts on World Heritage Properties refer to EPBC Act Policy Statement 1.1 Significant Impact Guidelines.

APPENDIX A: DETAILS OF PROPOSED ACTIVITY
KAKADU NATIVE PLANTS PTY LTD

Mr Peter Christophersen
Kakadu Native Plants Pty Ltd
PO Box 319
JABIRU NT 0886

APPENDIX A: DETAILS OF PROPOSED ACTIVITY

9 Activity Description

The proposed activity is to support the revegetation activities occurring at the Ranger Project Area (RPA), which require the use of local native plant species (Refer **Appendix B**, for background and context to this activity). The total area of disturbance on the RPA to be rehabilitated by January 2026 is approximately 950 ha.

The proposed activity involves seed collection from a wide variety plant species (**Table 1**) across a range of habitat types, including predominantly lowland eucalypt woodland vegetation, and some seed collection across floodplains, lowland sandstone country and monsoon forest, within the designated area of Kakadu National Park (KNP).

Seed collection to support the revegetation of the RPA will be collected from the green shaded area shown on **Figure 1**, and represents an area of approximately 6,600 km^2. The size of the area is based on the feedback from the GAC board in 2015, and enables collection of a wide range of genetically diverse species, to facilitate locally sourced plants to be used in the RPA revegetation project.

Seed that is propagated and used to rehabilitate the disturbed areas on the Ranger mine site will be utilised during two planting phases described in **Appendix B**. **Table 1** lists all plant species selected from collection. Plant species that will be used to revegetate the RPA are identified according to the relevant planting phase described in **Appendix B**.

Much of the seed collection will occur in close proximity to existing roads/access tracks. The extent of the collection area facilitates genetic diversity, particularly for the purposes of the RPA revegetation from within the green border area (**Figure 1**). Species will be collected by Peter Christophersen, Sandra McGregor and other staff members (including other Bininj) of Kakadu Native Plants Pty Ltd and range from shrubs to trees.

Table 1 lists the maximum total quantities of each species that will be collected over the life of the permit. Past seed collection experience indicates that variability in seasonal rainfall and fire frequency/intensity can make it difficult to predict/estimate annual quantities of seed to be collected. However, it is highly unlikely that these quantities will be achieved for all species within a year, due to logistical constraints associated with finding sufficient plants with ripe fruits/seeds before seeds are naturally dispersed. Also, the collecting activities will be conducted using current best practice guidelines for seed collecting (e.g. collect no more than 20% of the available seed from a population), with the individual plants from one year's harvest being excluded from the consecutive year's harvesting (see Cochrane, *et al.,* 2009). (Refer Appendix C for further information.)

Seeds will be collected using a variety of techniques including: direct collection by hand from plants and ground; long handled tree pruner or cherry picker for trees where seeds are out of reach. Use of the cherry picker will be restricted to within close proximity of existing roads/access tracks. Collection will primarily occur annually from July to November, when most species are in fruit. However, some species will require collection at other times of the year, dependent on fruiting patterns. Seeds will often be collected from individual plants with ripe fruits/seeds that are visible from existing roads/tracks. Other collecting will take place when individual species with ripe fruits/seeds are identified when collectors are out on country. When collecting takes place, location, quantity of seeds and identification of plant species will be recorded using a combination of Bininj regional knowledge and GIS for future reference and to ensure that plants are protected from consecutive years' harvesting.

In support of this permit application, background information on the selection of the seed collection zone shown in **Figure 1**, is provided in **Appendix B**. In addition, an assessment of the potential impacts of seed collection on six matters of national environmental significance (MNES) that are relevant to this activity has been undertaken, and is provided as **Appendix C**.

10. When will the activity take place in the park?

As outlined above, seed collection will primarily occur annually from July to November, when most plant species are in fruit. However, some species will require collection at other times of the year, dependent on fruiting patterns. Seeds will often be collected from individual plants with ripe fruits/seeds that are visible from existing roads/tracks. Other collecting will take place when individual species with ripe fruits/seeds are identified when collectors are out on country. When collecting takes place, location, quantity of seeds and identification of plant species will be recorded for future reference and to ensure that plants are protected from successive or over harvesting.

11. How often and for how long will the activity be?

As described in Section 9, seed collection is seasonal and dependent on fruiting patterns; however most seed collection will occur annually from July to November. Plants will be protected from repeated annual harvesting through record keeping, a copy of which will be provided to Parks Australia on an annual basis.

12. Will the activity: Involve taking, trading keeping or moving native species? **Yes.**

The collected seed will be used solely to revegetate the RPA.

15. Equipment and methods to be used:

As described in Section 9, seeds will be collected using a variety of techniques including: direct collection by hand from plants and ground; long handled tree pruner or cherry picker for trees where seeds are out of reach. Use of the cherry picker will be restricted to within close proximity of existing roads/access tracks.

Nine species listed in **Table 1** occur on, or in adjacent lowlands to, the stone country: *Allosyncarpia ternata, Calytrix achaeta, Eucalyptus phoenicea, E. tintinnans, Gardenia fucata, Grevillea dryandri, Jacksonia dilatata, Livistona inermis, Terminalia carpentariae.*

The total quantity of seed to be collected from each species (kg or fresh seed) is provided in **Table 1**. Importantly, the quantity of seed listed in **Table 1** represents the total quantity of seed per species for the life of the rehabilitation project.

17. Details of all sites to be visited under the proposed permit

It is proposed that the seed collecting activities will be conducted across the entire 6,600 km^2 area shown on **Figure 1**. Plants will be grown in the nursery facilities on the Ranger Project Area.

The area shaded green in **Figure 1**, represents the maximum extent of the local seed collection area approved by the Gundjeihmi Aboriginal Corporation in 2015. Consultation with other clans will be determined by the Northern Land Council via the Land Interest Reference (LIR) process.

18. Details of any assistance or involvement sought from park staff (if applicable)

Kakadu Native Plants Pty Ltd will keep full records of quantities of seed collected from each species including the location and date of collection, which will be available for inspection upon reasonable request by Parks Australia and through prior arrangement. As best practice collecting guidelines will be followed for seed collecting, it is envisaged that there will be no requirement for monitoring impacts on vegetation in the Park, i.e. costs to the director will be negligible.

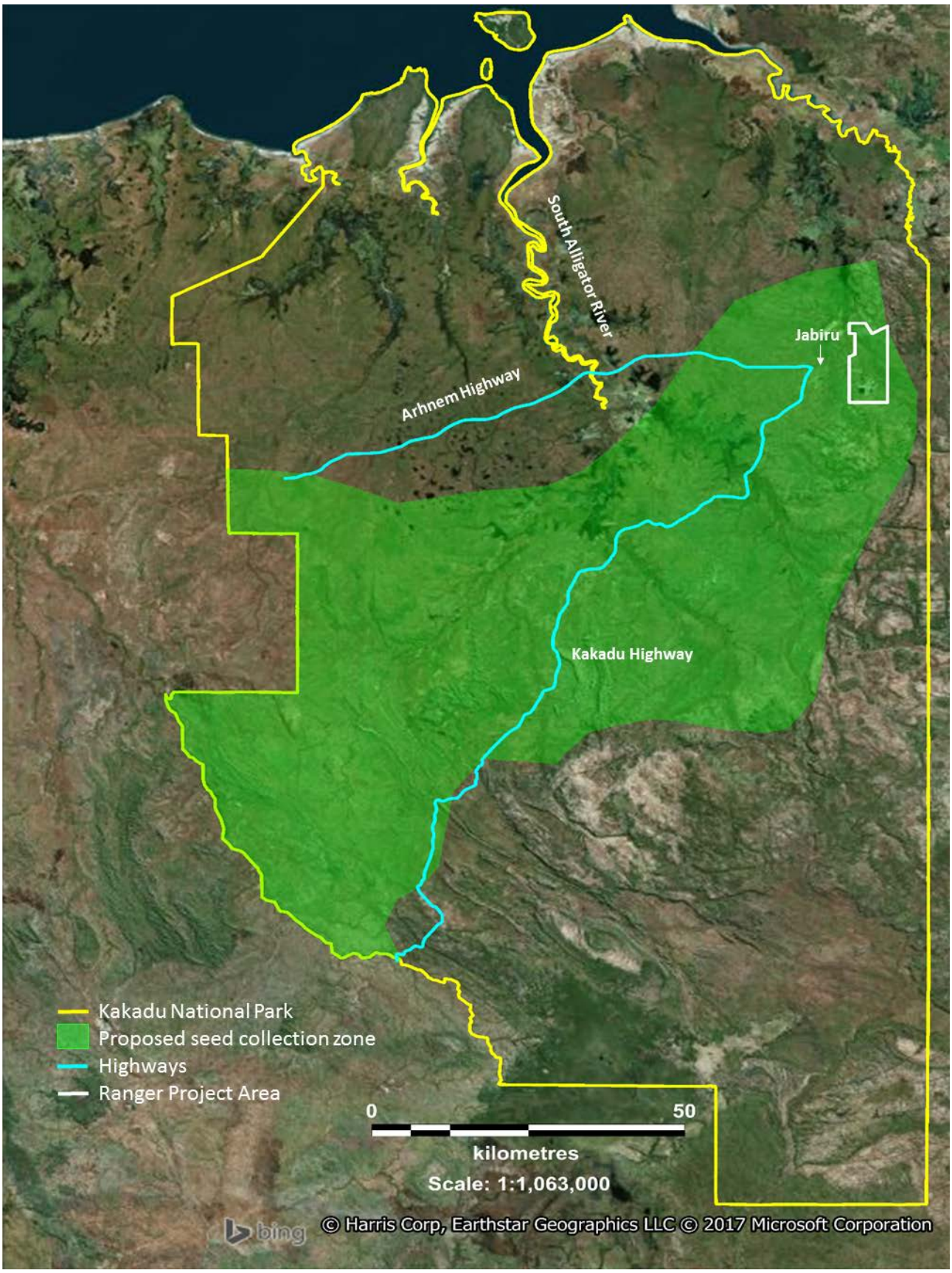

Figure 1: Map of Kakadu National Park showing the shaded blue area over which seed collection is proposed

Table 1: Target list of species and total quantity of seeds per species that would be collected to rehabilitate the RPA

Species	ERA phase 1 species	ERA phase 2 species	Growth form	Habitat type	Total quantity per species (kg)
Acacia aulacocarpa			Tree	Open forest/woodland	1
Acacia difficilis			Shrub/tree	Open forest	3
Acacia dimidiata			Shrub/tree	Open forest	3
Acacia hemignosta			Shrub/tree	Open woodland	25
Acacia latescens			Shrub/tree	Open forest	25
Acacia mimula			Shrub/tree	Open forest	25
Allosyncarpia ternata			Tree	Sandstone country	1,600 fresh fruits/seeds needed
Alphitonia excelsa			Tree	Open forest	1
Asteromyrtus symphyocarpa			Tree	Along streams/ around lagoons and swamps	2
Banksia dentata			Small tree	Lowland wetlands/open forest	2
Brachychiton diversifolius			Tree	Open forest/woodland	5
Brachychiton megaphyllus			Tree	Open woodland	5
Buchanania obovata			Tree	Open forest/woodland	10
Calytrix achaeta			Shrub	Sandstone country	5
Calytrix exstipulata			Shrub	Open forest/woodland	5
Coelospermum reticulatum (Pogonolobus reticulatus)			Shrub/tree	Open forest/woodland	1
Cochlospermum fraseri			Shrub/tree	Open forest/woodland	2
Corymbia bleeseri (Eucalyptus bleeseri)			Tree	Open forest/woodland	3
Corymbia chartacea			Tree	Open forest/woodland	3
Corymbia confertiflora (C. disjuncta)			Tree	Open woodland	3
Corymbia dichromophloia			Tree	Open woodland	3
Corymbia foelscheana (Eucalyptus foelscheana)			Tree	Open woodland	3
Corymbia latifolia (Eucalyptus latifolia)			Tree	Open woodland	3
Corymbia polysciada			Tree	Open woodland	3

Species	ERA phase 1 species	ERA phase 2 species	Growth form	Habitat type	Total quantity per species (kg)
Corymbia porrecta			Tree	Open forest/woodland	5
Corymbia dunlopiana (formerly *Corymbia setosa* subsp. *indeterminate)*			Tree	Open woodland	3
Erythrophleum chlorostachys			Tree	Open forest	80
Eucalyptus miniata			Tree	Open forest/woodland	7
Eucalyptus phoenicea			Tree	Sandstone country	5
Eucalyptus tectifica			Tree	Open woodland	1
Eucalyptus tetrodonta			Tree	Open forest/woodland	7
Eucalyptus tintinnans			Tree	Rises/low stony hills	1
Ficus racemosa			Tree	Monsoon vine thicket/monsoon forest	5 kg fresh fruits/seeds needed
Gardenia fucata			Shrub/tree	Sandstone country	1
Gardenia megasperma			Tree	Open forest/woodland	3
Grevillea decurrens			Tree	Open forest/woodland	12
Grevillea dryandri			Shrub	Sandstone country	2
Grevillea goodii			Prostrate shrub	Open forest/woodland	0.5
Grevillea pteridifolia			Tree	Open forest/woodland	5
Hakea arborescens			Tree	Open forest/woodland	7
Jacksonia dilatata			Shrub/tree	Sandstone country	1
Livistona humilis			Single stemmed palm	Open forest/woodland	15
Livistona inermis			Single stemmed palm	Sandstone country	15
Lophostemon lactifluus			Tree	Along streams/ around lagoons and swamps	5
Melaleuca argentea			Tree	Along streams	0.5
Melaleuca cajuputi			Tree	Along streams/ around lagoons and swamps	0.5

Species	ERA phase 1 species	ERA phase 2 species	Growth form	Habitat type	Total quantity per species (kg)
Melaleuca dealbata			Tree	Open forest/ around lagoons	0.5
Melaleuca leucadendra			Tree	Along streams/ around lagoons and swamps	0.5
Melaleuca nervosa			Tree	Open forest/woodland	0.5
Melaleuca viridiflora			Tree	Streams/lagoons/ swamps	1
Owenia vernicosa			Tree	Open forest/woodland	13,793 fresh fruits/seeds needed
Pandanus spiralis			Tree	Open forest/woodland	17,777 fresh fruits/seeds needed
Persoonia falcata			Shrub/tree	Open forest/woodland	5
Petalostigma pubescens			Tree	Open forest/woodland	2
Petalostigma quadrioculare			Small tree	Open forest/woodland	72
Planchonia careya			Tree	Open forest/woodland	7.5
Stenocarpus acacioides			Shrub/tree		2
Sterculia quadrifida			Tree	Monsoon vine thicket/monsoon forest	1
Syzygium eucalyptoides subsp. *bleeseri*			Tree	Open forest/woodland	16,000 fresh fruits/seeds needed
Syzygium eucalyptoides			Tree	Open forest/woodland	1,600 fresh fruits/seeds needed
Syzygium suborbiculare			Tree	Open forest/woodland	10,526 fresh fruits/seeds needed
Terminalia carpentariae			Tree	Sandstone country	25
Terminalia ferdinandiana			Tree	Open forest/woodland	45
Terminalia pterocarya			Shrub/tree	Open woodland	10
Verticordia cunninghamii			Shrub	Open forest/woodland	1
Vitex glabrata			Tree	Monsoon vine thicket	1
Wrightia saligna			Shrub/tree	Open forest/woodland	5

Species	ERA phase 1 species	ERA phase 2 species	Growth form	Habitat type	Total quantity per species (kg)
Xanthostemon eucalyptoides			Tree	Along streams/ monsoon forest	1
Xanthostemon paradoxus			Tree	Open forest/woodland	10

REFERENCES

Cochrane, A, Crawford, AD & Offord, CA (2009) *Chapter 3: Seed and vegetative material collection.* In: Offord, CA & Meagher, PF (eds.) *Plant Germplasm Conservation in Australia strategies and guidelines for developing, managing and utilising ex situ collections*. Australian Network for Plant Conservation in partnership with Australian Seed Conservation and Research.

APPENDIX B: SELECTION OF THE SEED COLLECTION ZONE

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APPENDIX B

1. BACKGROUND

The proposed activity is in support of closure and rehabilitation activities occurring at the Ranger uranium mine, which must be completed by 8 January 2026. The Ranger Authorisation prescribes:

> *"Revegetation of the disturbed sites of the Ranger Project Area using local native plant species … (8.1.2)"*

In the absence of further definitions of 'local', a conservative seed collection zone of 30 km was adopted in 1994 by ERA based on relevant scientific studies. However, recent experience has demonstrated that the 30 km zone poses a major risk to the Ranger mine's revegetation, as there may not be enough seed available to complete closure revegetation activities across the mine site. Some of the revegetation species are naturally low or erratic seed producers. In addition, fires frequently wipe out entire harvests and can cause delays in flowering and hence seed production.

In 2011-2013, ERA conducted an extensive study investigating the provenance boundaries of Ranger mine's revegetation, in order to extend the 30 km seed collection zone (Zimmermann, 2013, Zimmermann & Lu, 2015). The usefulness of genetic and non-genetic methods was assessed and a non-genetic approach based on the methods developed by FloraBank, Greening Australia, and other experts in the field was adopted. The method assessed environmental factors, gene flow and species traits known to influence genetic variation in plants and identified zones of least likely genetic variation. The resulting zones match the eco-geography of the Ranger mine area and hence maintain the 'home site' advantage of local plants. Some genetic diversity that may be present in more distant seeds is welcomed, as it may allow plant populations to respond to environmental changes such as climate change. This so called 'composite provenancing' approach ensures increased genetic diversity while reducing the risk of genetic pollution and outbreeding depression.

In identifying the environmental factors, the provenance assessment took into account the unique growing conditions on the constructed final landform, which are unlike those found in the natural surrounding ecosystems. Earlier studies identified an analogue site the nearby Georgetown area on rocky substrates.

The Atlas of Living Australia was identified as the most suitable and accurate environmental modelling tool, in the absence of fine-scale regional soil, vegetation and climate data. Environmental layers relevant to plant species distribution in the Top End (mean annual evaporation, annual precipitation, mean annual temperature, annual drainage, and topographic wetness index) were combined to predict a zone with a similar environment to the Ranger mine, representing the so called Ranger mine 'environmental provenance zone'. Investigations into revegetation species distributions found that each is well represented within the conservative provenance zone.

An assessment of potential gene flow indicated that there are no major geographic barriers within the Top End that may hinder the exchange of genetic material. As far as is known, there were no historical barriers in the Top End in the more recent geological past and the evolution in climate and vegetation was most likely uniform. Pollination takes place for the large majority of the investigated species not only by insects, but also by birds and bats, with most birds being generalists and hence being able to use other species as stepping stones between populations. Dispersal mostly takes place within 1 km of the source, but birds and bats can carry seeds over longer distances (e.g. 100 km).

Considering the abundance of birds, a continuous vegetation cover and that most revegetation species are common and widespread across the Top End, genetic exchange is likely to happen over large areas, if not the entire region. Any localised environmental variations that could cause genetic variation were eliminated by composite provenancing, which identified the 'environmental provenance zone' eco-geographically similar to the Ranger mine. This was further narrowed by applying the conservative provenance zone. Seed collection guidelines further define and match the vegetation community and local environmental characteristics with the disturbed and created environments to be revegetated.

The seeds collected within the proposed conservative provenance zone (Appendix A, Figure 1) should be well adapted to the current conditions of the Ranger mine, as well as provide sufficient genetic diversity to reduce inbreeding, promote the plants' adaptive potential and increase the resilience of the revegetation areas against moderate changes in climate. However, larger changes in climate may require seeds to be sourced from environments currently dissimilar to the Ranger mine area, with the risk that they may not perform well under the current environmental conditions at the mine. The scope of changes in climate and associated risks for revegetation has a high degree of uncertainty at this point in time and should be reassessed in the future.

The outcomes of this study were presented to Alligator Rivers Region Technical Committee and submitted to the GAC Board for endorsement. The GAC advised that *"… after long and careful consideration… [the GAC Board] …are comfortable with seeds being collected for rehabilitation only within the borders of Kakadu" (*Impey, M. 2015, pers. comm.12 August 2015). This makes provision for harvesting seeds from the southern part of KNP, where edaphic conditions are closer to the future conditions at Ranger under global climate change scenarios.

2. FLORA SPECIES COMPOSITION AND COMMUNITY STRUCTURE

Plant species composition and relative abundance in the RPA and surrounding natural analogue sites have been studied extensively over the last dozen years by ERA and ERISS (e.g. Brennan, 2005, Hollingworth *et al*., 2007, Humphrey, 2013, Humphrey & Fox, 2010, Humphrey, *et al*., 2009, Humphrey *et al*., 2011, Humphrey, *et al*., 2008, Humphrey *et al*., 2012). Based on these studies, a revegetation species list with relative density was developed for the revegetation of the trial landform in 2007 by ERA in collaboration with ERISS and was provided to GAC for consultation in 2014 (Lu, 2014a). In 2015, the Mirarr developed a list of culturally important flora (Garde, 2015) based on various criteria that pertain to an end use continuum, including but not limited to whether the plant is used as a cultural resource (e.g. for food, medicinal, aesthetic, material culture and/or ritual purposes), provides faunal linkages, and promotes biodiversity (Garde, 2015).

In March 2016, the flora and fauna closure criteria technical working group reached a consensus on a Ranger revegetation tree and shrub species list (Appendix A, Figure 1). The revegetation species list was developed based on:

- previous analogue vegetation studies in undisturbed RPA and surrounding areas by ERISS and ERA (125 studied analogue sites, including 10 sites from KNP with a land surface similar to Ranger's final landform) (Figure B-1);
- a recent list of culturally-important plant species, identified by the Mirarr traditional owners in Garde, (2015); and
- learnings from progressive revegetation activities and in particular the learnings from the trial landform.

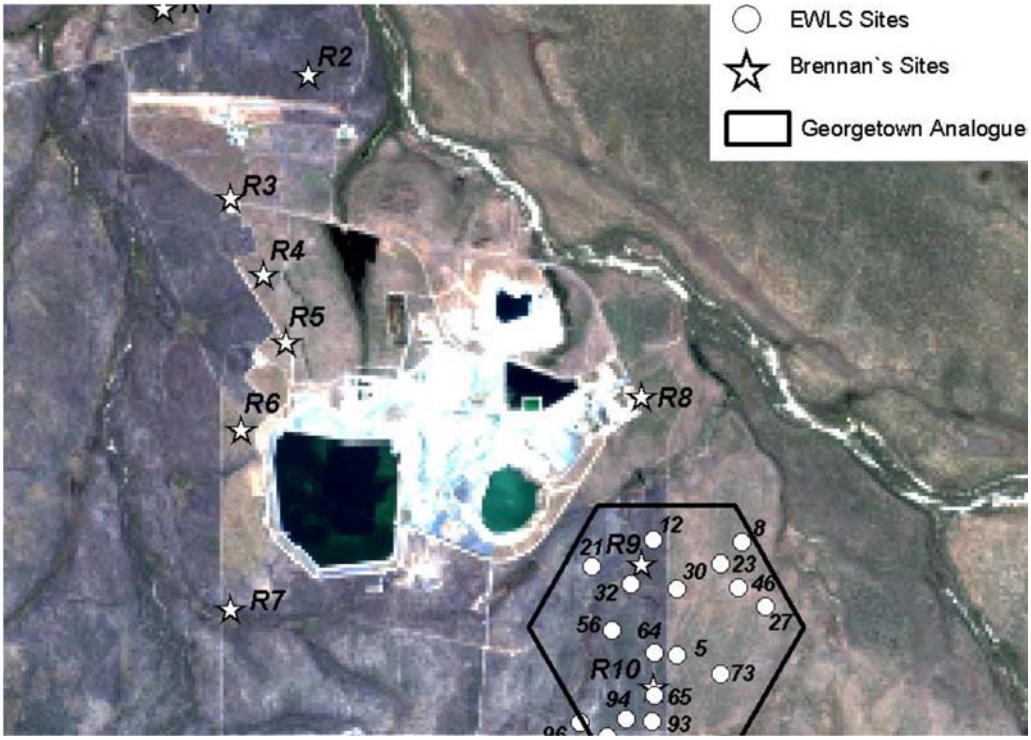
The species listed in Table B-1 are to be planted in two main planting phases:

- Phase 1 consists of 49 species, a number of which are "framework species" – i.e. those plants that will dominate and help to re-establish the natural mechanisms of the savanna woodland regeneration and accelerate biodiversity recovery (Reddell & Meek, 2004); and
- Phase 2 consists of 31 plant species that can be described as "niche" species. For example, plants less likely to occur in abundance in a savannah woodland (e.g. *Persoonia falcata* and *Allosyncarpia ternata*); or that occur only within riparian margins, billabongs or watercourses; or, that are known to naturally recruit. They will eventually be revegetated when suitable habitats are developed.

Compared to the phase 1 framework species, planting of the phase 2 species may be more site-specific, dependent on habitat type or subject to other environmental restrictions, which in some cases could challenge the long-term viability of some species. In this context, it is acknowledged by the Mirarr that it may not be possible to propagate and establish all species. Nevertheless, the intention is to plant as many species identified by the Mirarr on the final landform as practicable, to address cultural and other values such as aesthetics.

Fifteen species identified by Garde (2015) do not occur in any of the 125 surveyed sites; however, their cultural significance warrants their inclusion as phase 2 species in the revegetation species list such that they can be considered for planting. These species may be planted on the final landform whether or not suitable habitat develops; however, their successful establishment and long-term survival will depend on habitat, climate and other factors. An additional eight species are on the list that were identified as culturally important plant species by the Mirarr traditional owners, however these are out of scope or of taxonomic uncertainty. The intention is to plant as many species identified by Mirarr on the final landform as practicable, to address cultural and other values such as aesthetics.

This list will not only be used for the revegetation, but also forms a basis for assessing whether revegetation is similar to the natural surroundings.



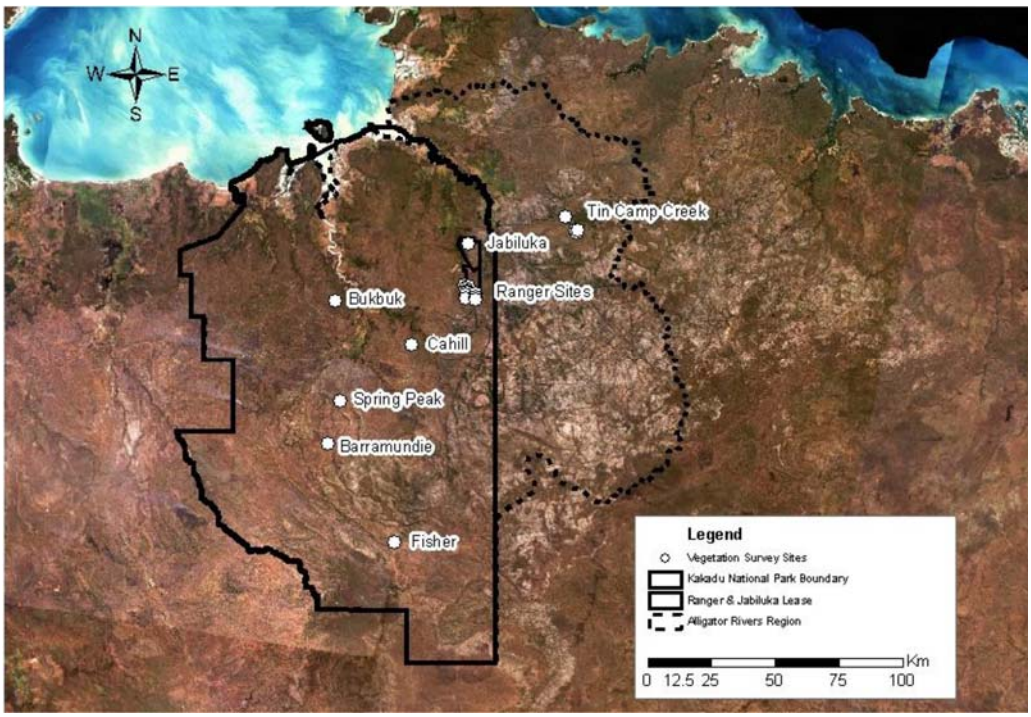


Figure B-1: Maps of plant analogue sites surveyed by Brennan (2005) (top and bottom) and Hollingsworth *et al.*, (2003) (bottom) (source Humphrey *et al*., 2006)

Table B-1: Revegetation species list

Species	Species list compiled by GAC[1]	Species list compiled by ERA[2]	Species recorded in analogue eucalypt community	Species recorded in analogue *Melaleuca* woodland	Stems per ha
Phase 1 species					
Acacia difficilis	*		*	*	3.69
Acacia dimidiata	*	*	*	*	5.04
Acacia hemignosta		*	*	*	1.02
Acacia latescens		*	*	*	1.93
Acacia mimula		*	*	*	200.09
Asteromyrtus symphyocarpa		*	*	*	1.49
Brachychiton diversifolius	*	*	*		0.46
Brachychiton megaphyllus	*	*	*	*	2.12
Buchanania obovata	*	*	*	*	8.46
Calytrix achaeta			*	*	3.76
Calytrix exstipulata	*		*	*	9.28
Cochlospermum fraseri	*	*	*	*	27.12
Corymbia bleeseri (Eucalyptus bleeseri)	*	*	*		11.87

Species	Species list compiled by GAC[1]	Species list compiled by ERA[2]	Species recorded in analogue eucalypt community	Species recorded in analogue *Melaleuca* woodland	Stems per ha
Corymbia chartacea			*		6.11
Corymbia confertiflora (C. disjuncta)	*	*	*	*	23.33
Corymbia dichromophloia			*		3.1
Corymbia foelscheana (Eucalyptus foelscheana)	*	*	*	*	34.65
Corymbia latifolia (Eucalyptus latifolia)	*	*	*	*	34.65
Corymbia polysciada	*	*	*		0.18
Corymbia porrecta		*	*	*	41.02
*Corymbia dunlopiana (*formerly *Corymbia setosa* subsp. *indeterminate)*			*		4.38
Erythrophleum chlorostachys	*	*	*	*	20.44
Eucalyptus miniata	*	*	*		40.36
Eucalyptus phoenicea	*	*	*		1.86
Eucalyptus tectifica		*	*	*	11.28
Eucalyptus tetrodonta	*	*	*	*	76.36
Eucalyptus tintinnans		*	*		0.18
Gardenia megasperma		*	*	*	6.87
Grevillea decurrens	*	*	*		12.68
Grevillea pteridifolia	*	*	*	*	8.42
Hakea arborescens		*	*	*	3.56
Jacksonia dilatata		*	*		0.97
Livistona humilis	*	*	*	*	9.34
Livistona inermis		*	*		6.90
Melaleuca viridiflora	*	*	*	*	30.92
Owenia vernicosa	*	*	*		0.71
Pandanus spiralis	*	*	*	*	14.01
Petalostigma pubescens	*	*	*	*	3.09
Petalostigma quadrioculare		*		*	0.20
Planchonia careya	*	*	*	*	18.41
Stenocarpus acacioides		*	*		0.38
Syzygium eucalyptoides subsp. *bleeseri*	*	*	*	*	5.02

Species	Species list compiled by GAC[1]	Species list compiled by ERA[2]	Species recorded in analogue eucalypt community	Species recorded in analogue *Melaleuca* woodland	Stems per ha
Syzygium suborbiculare	*	*		*	2.15
Terminalia carpentariae	*	*	*	*	0.50
Terminalia ferdinandiana	*	*	*		26.79
Terminalia pterocarya			*		31.51
Verticordia cunninghamii			*	*	6.35
Wrightia saligna		*	*	*	1.11
Xanthostemon paradoxus		*	*	*	71.98
Phase 2 species					
Acacia aulacocarpa	*		*		0.24
Allosyncarpia ternata	*				
Alphitonia excelsa	*		*	*	2.42
Banksia dentata	*			*	0.80
Barringtonia acutangula	*				
Bombax ceiba	*				
Callitris intratropica	*				
Carallia brachiata	*			*	0.09
Clerodendrum floribundum	*		*		0.02
Coelospermum reticulatum (Pogonolobus reticulatus)	*		*		0.06
Elaeocarpus arnhemicus	*				
Ficus platypoda	*				
Ficus racemosa	*				
Gardenia fucata	*				
Grevillea dryandri	*				
Grevillea goodii	*				
Lophopetalum arnhemicum				*	4.44
Lophostemon lactifluus			*	*	3.64
Melaleuca argentea	*			*	0.35
Melaleuca cajuputi	*				
Melaleuca dealbata	*				
Melaleuca leucadendra	*		*	*	5.33
Melaleuca nervosa	*		*	*	2.66
Nauclea orientalis	*				
Pandanus aquaticus	*				

Species	Species list compiled by GAC[1]	Species list compiled by ERA[2]	Species recorded in analogue eucalypt community	Species recorded in analogue *Melaleuca* woodland	Stems per ha
Persoonia falcata	*		*	*	6.18
Sterculia quadrifida	*				
Syzygium armstrongii				*	0.176
Syzygium eucalyptoides	*		*		0.18
Vitex glabrata	*		*		0.08
Xanthostemon eucalyptoides	*			*	2.14

[1] Garde (2015)
[2] Lu (2014b)

Figure B-2 and Table B-2 identify the vegetation communities surveyed across the Ranger analogue sites were classified into four broad vegetation types based on multivariate analysis (Humphrey *et al*., 2012).

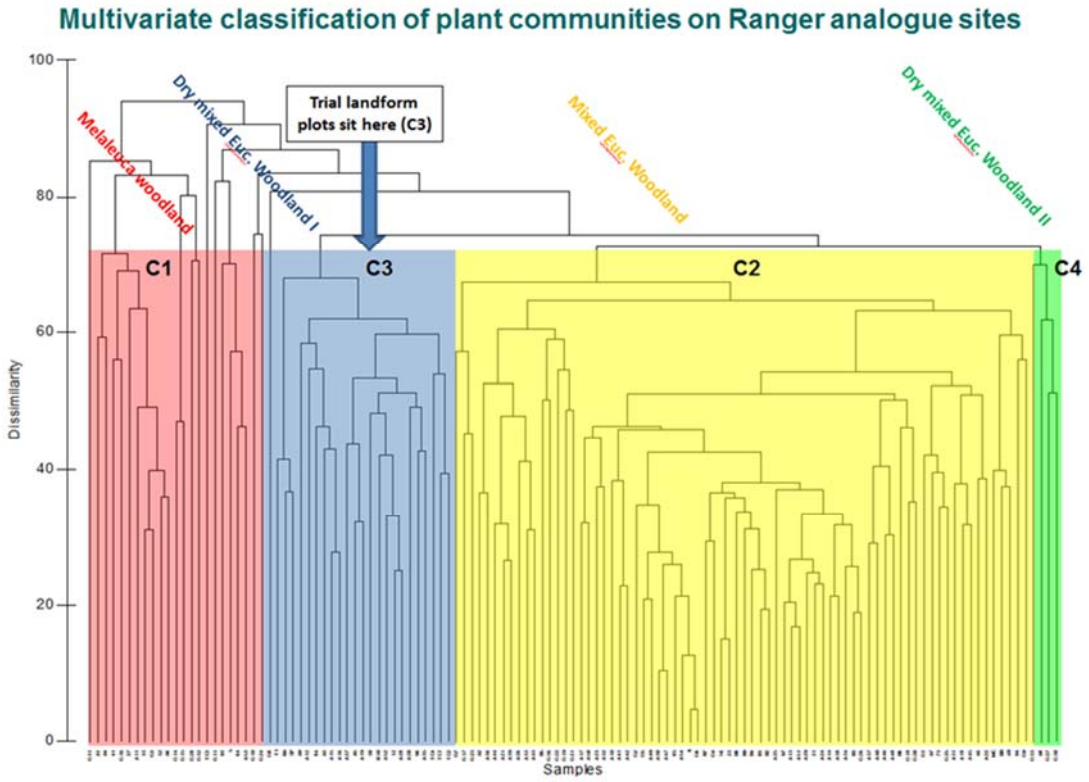


Figure B-2: Cluster analysis (group average linkage) of trees and shrubs data for Alligator Rivers Region vegetation analogue sites. [Vegetation data log transformed density/ha units (Humphrey *et al*., 2012).]

Table B-2: Descriptions of the Ranger analogue communities

Broad vegetation community	**Dominant and/or distinguishing tree or shrub species**	**Classification unit[1]**
Melaleuca woodland	*Melaleuca viridiflora, Pandanus spiralis, Planchonia careya*	C1
Mixed eucalypt woodland	*Acacia mimula, Eucalyptus tetrodonta, Corymbia porrecta, E. miniata, Xanthostemon paradoxus, Terminalia ferdinandiana*	C2
Dry mixed eucalypt woodland: Type 1	*Corymbia foelscheana/latifolia, X. paradoxus, T. ferdinandiana, P. careya, Cochlospermum fraseri*	C3
Dry mixed eucalypt woodland: Type 2	*Terminalia pterocarya, Acacia mimula, X. paradoxus, C. disjuncta, E. tectifica*	C4

[1] Source: Figure 2A in Humphrey *et al.* (2012)

The re-established vegetation communities can be only as 'similar' to the vegetation communities in surrounding areas as these surrounding vegetation communities are similar among themselves. To assess the similarity among the common mixed and dry mixed eucalypt woodlands, the Bray-Curtis similarity index has been largely used in worldwide vegetation studies (Bray & Curtis, 1957), restoration ecology (Humphrey, 2016) and in the RPA (Humphrey, 2013, Humphrey & Fox, 2010, Humphrey *et al.,* 2009, Humphrey *et al*., 2011, Humphrey *et al.,* 2008, Humphrey *et al.,* 2012). The Bray-Curtis similarity index compares community composition (species presence or absence) or structure (species and their relative abundances) between two samples, sites, etc. (where 0% = no similarity between communities, 100% = identical communities). The mean Bray-Curtis similarity among Ranger analogue communities C2, C3 and C4 (Figure B-2) was approximately 25% with a substantial range (Figure B-3).

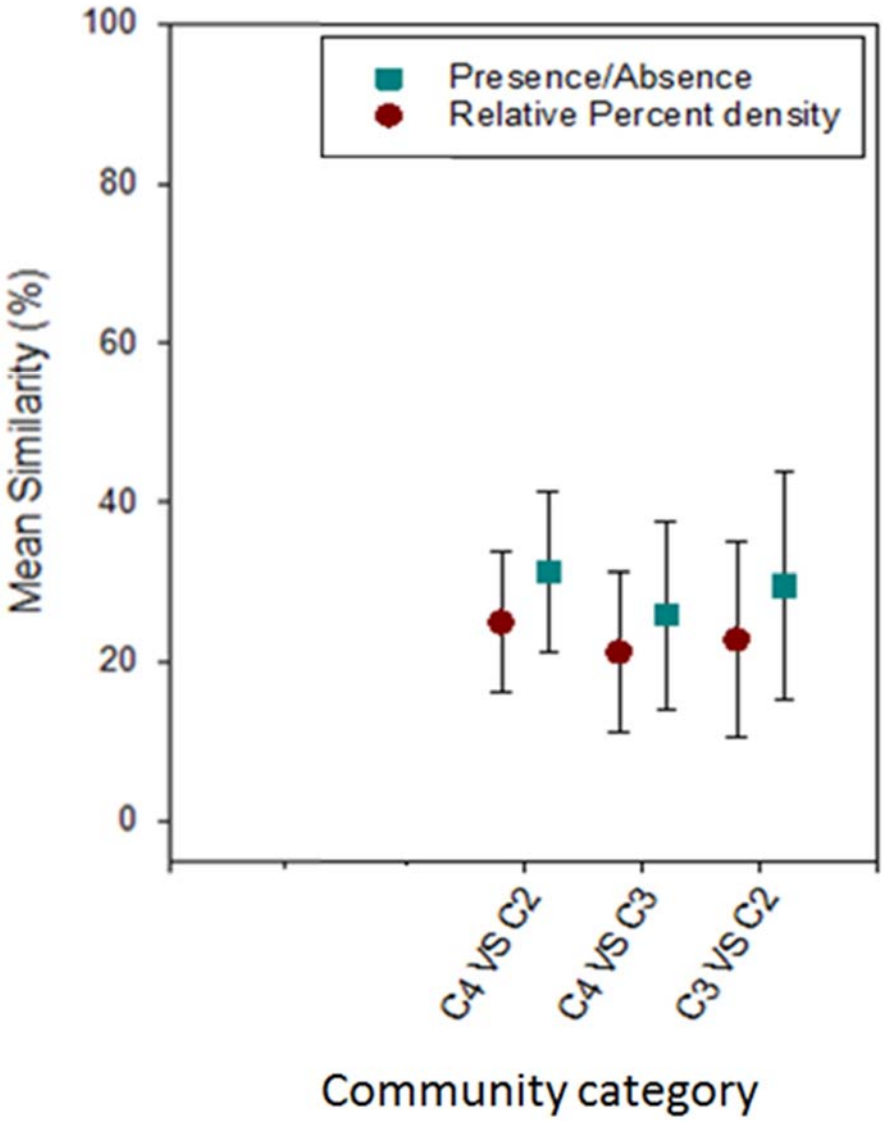


Figure B-3: Mean intra-classification (C1-trial landform) and inter-classification (X vs Y) Bray-Curtis similarity. Error bars are standard deviations (Humphrey, 2016)

Eco Logical Australia (ELA) has been engaged by ERA to implement a long-term vegetation and fauna monitoring program was to document the condition and seasonal variation of reference sites in adjacent areas of KNP and relatively undisturbed areas in the RPA to provide a comparative dataset to assess future rehabilitation success. Sixteen sites were surveyed, with all sites burnt within the last two years, consistent with surrounding areas in KNP. The sites will be monitored bi-annually to establish baselines of the long term dynamics, seasonal fluctuations and responses to natural disturbances such as fire or cyclone.

3. REFERENCES

Bray, R and Curtis, J 1957. *An ordination of the upland forest communities of southern Wisconsin.* Ecological Monographs, 27 75-88.

Brennan, K. 2005. *Quantitative Descriptions of Native plant communities for use in revegetation at Ranger Uranium Mine.* Supervising Scientist, Darwin Unpublished paper. 1-Aug-05, p 71.

Garde, M (2015). *Closure Criteria Development - Cultural. ERA Ranger Integrated Tailings, Water and Closure. Confidential report*, Northern Territory. April 2015, p 160.

Hollingsworth, I, Odeh, I, Bui, E and Croton, J. 2007b. *Planning for Closure at Ranger Mine - Landscape Reconstruction using Natural Analogs.* EWL Sciences Pty Ltd. Jun-07, p 8.

Hollingsworth, I, Zimmermann, A, Corbett, L, Milnes, A, Batterham, R and Harwood, M. 2003. *Ecosystem Reconstruction for the Ranger Mine Final landform- Phase 1 Target Habitats.* EWL Sciences Pty Ltd. Mar-03, p 93 plus app.

Humphrey, C 2013. Use of vegetation analogues to guide planning for rehabilitation of the Ranger mine site. *In:* van Dam, R, Webb, A and Parker, S (eds.) *eriss research summary 2011-2012.* Supervising Scientist Report 204, Supervising Scientist, Darwin and, pp. 158-162.

Humphrey, C and Fox, G 2010. Use of vegetation analogues to guide planning for rehabilitation of the Ranger minesite. *In:* Jones, D and Webb, A (eds.) *eriss research summary 2008-2009.* pp. 150–154.

Humphrey, C, Fox, G and Lu, P 2009. Use of vegetation analogues to guide planning for rehabilitation of the Ranger minesite. *In:* Jones, D and Webb, A (eds.) *eriss research summary 2007-2008.* Supervising Scientist Report 200, Supervising Scientist, Darwin and, pp. 136-146.

Humphrey, C, Fox, G, Staben, G and Lowry, J 2011. Use of vegetation analogues to guide planning for rehabilitation of the Ranger mine site. In: Jones, D and Webb, A (eds.) *eriss research summary 2009-2010.* Supervising Scientist Report 202, Supervising Scientist, Darwin and, pp. 122-124.

Humphrey, C, Hollingsworth, I and Fox, G 2006. Development of predictive habitat suitability models of vegetation communities associated with the rehabilitated Ranger final landform. *In:* Evans, K, Rovis-Hermann, J, Webb, A and Jones, D (eds.) *eriss research summary 2004-2005*. Darwin, Supervising Scientist Report 189, Supervising Scientist, pp. 86-98.

Humphrey, C, Hollingsworth, I, Gardener, M and Fox, G 2008. Use of vegetation analogues to guide planning for rehabilitation of the Ranger mine site. *In:* Jones, D, Humphrey, C, van Dam, R and Webb, A (eds.) *eriss research summary 2006-2007.* Supervising Scientist Report 196, Supervising Scientist, Darwin and, pp. 90-94.

Humphrey, C, Lowry, J and Fox, G 2012. Use of vegetation analogues to guide planning for rehabilitation of the Ranger mine site. *In:* Jones, D and Webb, A (eds.) *eriss research summary 2010-2011*. Supervising Scientist Report 203, Supervising Scientist, Darwin and, pp. 135-145.

Humphrey, C (2016). *Revegetation objective associated with composition and density*, May 2016.

Lu, P 2014a. *Is there enough water in the waste-rock substrate to support a functional tropical woodland?* PowerPoint presentation by ERA to ARRTC Meeting #32. May 2014, p 17.

Lu, P 2014b. *Revegetation needs for GAC consultation*. ERA PowerPoint document provided to M Garde, Darwin, 24 May 2014.

Reddell, P and Meek, I. 2004. *Discussion Paper: ARRTC Meeting March 2004 Revegetation strategy for the Final Landform at Ranger Mine - approach and current status.* EWL Sciences Pty Ltd. Mar-04, p 45.

Zimmermann, A. 2013. *Potential seed provenance for Ranger Mine revegetation. Delineation and recommendations*. Report by Energy Resources of Australia Ltd, Darwin, November 2013, p 145.

Zimmermann, A and Lu, P 2015. 'A Multilevel Non-genetic Approach to Delineate Provenance Boundaries of Revegetation Species: Ranger Uranium Mine Case Study.' *In:* Proceedings of 3rd Australian Mine Rehabilitation Conference on Innovation in Mine Planning and Rehabilitation workshop, 18-20 August 2015 2015 Adelaide, Australia. 4.

APPENDIX C: POTENTIAL IMPACT ASSESSMENT

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APPENDIX C

1 INTRODUCTION

Kakadu Native Plants Pty Ltd is a wholly owned Bininj business that currently has a permit for collecting seeds and seedlings within Kakadu National Park, for the purpose of suppling seeds and plants for use in Jabiru and its environs. To date, Kakadu Native Plants Pty Ltd has employed 6 Bininj staff (4 on a full-time, 2 on a casual basis) and this number is likely to increase. In addition, to these financial benefits, the land management activities of Kakadu Native Plants Pty Ltd (including seed collecting) result in Bininj being on country, which is important for maintaining customary traditions. The proposed action facilitates on-country activities which will encourage intergenerational transfer of knowledge to the younger Bininj generation; thereby contributing towards the long-term sustainability of this wholly Bininj owned business.

The company has developed considerable expertise in seed collecting and propagation of native plant species, with the necessary facilities for producing plants for the planned revegetation of the disturbed areas of the Ranger Project Area (RPA). The objective is to close and rehabilitate the entire RPA, to form one final landform across the site that will blend with the surrounding landscape of Kakadu National Park. The total area of disturbance in the RPA to be rehabilitated is approximately 950 hectares. The company has already supplied native plants for planting in Jabiru, Jabiluka, and ecological restoration of disturbed areas, and has been the source of native plants donated to the former Jabiru Town Council by Energy Resources of Australia Ltd (ERA).

The proposed seed collecting activities described in this permit application, are to enable collection of a wide range of genetically diverse species, to facilitate locally sourced plants to be used in the RPA revegetation program. As discussed in **Appendix B**, Section 1, ERA undertook an extensive provenance study, the outcomes of which were presented to the Alligator Rivers Region Technical Committee and the Gundjeihmi Aboriginal Corporation (GAC) Board for endorsement. The GAC advised that: *"… after long and careful consideration… [the GAC Board] …are comfortable with seeds being collected for rehabilitation only within the borders of Kakadu"* (Impey, M. 2015, pers. comm.12 August 2015).

1.1 Document Structure

Appendix C comprises three main sections intended to identify and assess the potential impacts of seed collection on matters of national environmental significance (MNES) and within the context of key threatening processes, which can be applied to both Commonwealth and Northern Territory (NT) conservation listed species.

Section 2 lists the currently recognised NT and Commonwealth listed threatened and near threatened plant and animal species that occur within Kakadu National Park. The contents of the tables in this section are adapted from Woinarski (2004) and updated to reflect the current status of each species and includes new species not previously listed in Woinarski (2004). This section also identifies whether a threatened species occurs within the proposed seed collection zone.

Section 3 gives an overview of the assessment of the potential impacts of seed collection on the six matters of national environmental significance (MNES) that are relevant to this activity. This section provides some background information on comparative volumes of seed produced within the park and proposed volumes to be collected, and includes intended management practices for seed collection and propagation.

Section 4 collates all the information from the previous sections, **Appendix A** and **Appendix B** to assess the potential impacts of this activity on the MNES and NT listed conservation species. The assessment uses the Commonwealth criteria, as it is the most comprehensive criteria available.

2 LISTED THREATENED SPECIES

This section lists the recognised plant and animal species registered as threatened under national and/or Northern Territory legislation that occur within Kakadu National Park and the likelihood of occurrence of each species within the proposed seed collection zone (**Appendix A**, **Figure 1**).

Tables C1 – C4 have been adapted from the list of threatened and near threatened species identified in Woinarski (2004). Many of the plant species previously registered under the *Environment Protection and Biodiversity Conservation Act [1]999* have been delisted since this revision, including but not limited to several *Boronia* species. **Tables C1 – C4** reflect the status of conservation listing for each species as at 2017 and include new threatened and near threatened listed species known to occur in the park.

The purpose of these tables is to assist in determining the potential impacts that may occur during seed collection and to address the subsequent impact assessments provided in **Tables C5 – C11**, inclusive of this Appendix. Listed threatened species have been cross-checked against NT and Commonwealth spatial data sets to determine their occurrence within the proposed seed collection zone. Those species known to occur within the proposed seed collection zone are shown in **Figures C1 – C4**.

Table C1: Plant species recorded from Kakadu National Park (2017) considered as threatened under the *Environment Protection and Biodiversity Conservation Act 1999* and/or the *Territory Parks and Wildlife Conservation Act* (adapted from Woinarski 2004)

Scientific name	Status as at 2017		Kakadu significance	Occurrence within the collection area
	Northern Territory	C'wealth		
Acacia sp. Graveside Gorge	CE	CE		No records of occurrence within the seed collection zone.
Boronia laxa [1]	NT	not listed	High	Restricted to Mt Brockman area and the western Arnhem Land Plateau. Occurs in 14 locations on the eastern perimeter of the seed collection zone (Figure C1).
Boronia quadrilata [1]	VU	VU	High	No records of occurrence within the seed collection zone.
Boronia rupicola [1]	NT	not listed	High	Known only from eight populations around Mt Brockman and near Nabalerk. Occurs at several sites on the eastern perimeter of the seed collection zone but restricted to vertical sandstone surfaces (Figure C1). Seed collection will not take place on vertical surfaces or within habitat where this species occurs.
Boronia suberosa [1]	NT	not listed	High	Grows only on sandstone cliff faces on the Arnhem Plateau (Figure C1). However, seed collection will not be undertaken in escarpment areas.
Boronia verecunda [1]	NT	not listed	High	No records of occurrence within the seed collection zone.
Boronia xanthastrum [1]	NT	not listed	High	Two populations known to occur in western Arnhem Land. The extent of

Scientific name	Status as at 2017		Kakadu significance	Occurrence within the collection area
	Northern Territory	C'wealth		
				occurrence for this species is considered to be approximately 5 760 km^2. Occurs at one site within the seed collection zone (Figure C1).
Calytrix inopinata [1]	NT	not listed	High	No records of occurrence within the seed collection zone.
Cycas armstrongii [1]	VU	not listed	Low	No records of occurrence within the seed collection zone.
Dienia montana (*Malaxis latifolia*)	VU	not listed	Moderate - high	No records of occurrence within the seed collection zone.
Dubouzetia australiensis [1]	NT	not listed	Low - moderate	No records of occurrence within the seed collection zone.
Gleichenia dicarpa	NT	not listed	Moderate	No records of occurrence within the seed collection zone.
Helicteres sphaerotheca [1] (referred to as *Helicteres* D21039 *linifolia*) (Cowie, 2011)	VU	not listed	High	No records of occurrence within the seed collection zone.
Hibbertia tricornis [1]	VU	not listed		Recorded only from the Mt Brockman outlier of the Arnhem Land escarpment on sandy areas on sandstone escarpment. Occurs in 4 locations on the perimeter of the seed collection zone (Figure C1). However, seed collection will not be undertaken in escarpment areas.
Hibiscus brennanii [1]	VU	VU	High	Known from only one population in west Arnhem Land. Grows in sandstone gullies and cliffs. Occurs on the perimeter of the seed collection zone (Figure C1). However, seed collection will not be undertaken in escarpment areas.
Lithomyrtus linariifolia	VU	not listed		Occurs in sandstone woodland or shrubland of western parts of the west Arnhem Land plateau. Occurs at 1 site within the seed collection zone (Figure C1).
Monochoria hastata	VU	not listed	Low - moderate	No records of occurrence within the seed collection zone.
Sauropus filicinus	DD	not listed	High	A short pendulous shrub growing from sandstone cliff faces. Occurs from four locations within the seed collection zone (Figure C1). However seed collection will not be undertaken along cliff faces.
Utricularia subulata	NT	not listed	Moderate	No records of occurrence within the seed collection zone.
[1] Endemic [2] Conservation listed post 2004				
Status: CE: Critically endangered, DD: Data deficient, EN: Endangered, LC: Least concern, NT: Near threatened, VU: Vulnerable				

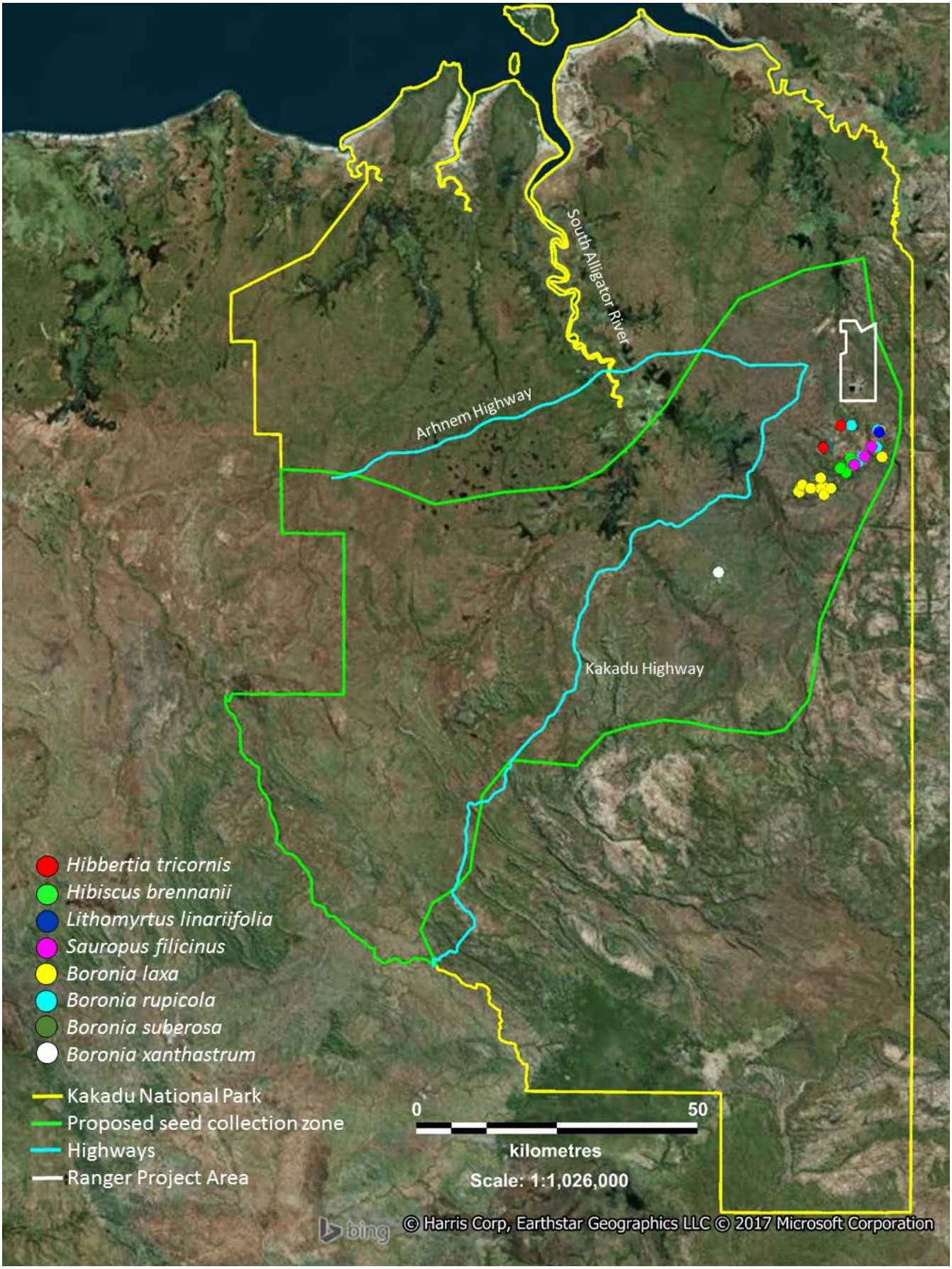

Figure C1: Conservation listed flora species known to occur within the seed collection zone

Table C2: Reptiles (terrestrial and aquatic) recorded from Kakadu National Park (2017) considered as threatened under the *Environment Protection and Biodiversity Conservation Act 1999* and/or the *Territory Parks and Wildlife Conservation Act* (adapted from Woinarski 2004)

Scientific name	Common Name	Conservation status as at 2017		Kakadu significance	Occurrence within the collection area
		Northern Territory	C'wealth		
Caretta caretta	Loggerhead turtle	EN	EN	Low	No records of occurrence within the seed collection zone.
Chelonia mydas	Green turtle	LC	VU	Low – moderate	No records of occurrence within the seed collection zone.
Glyphis sp.A.	Speartooth shark	EN	CE	Moderate – high	No records of occurrence within the seed collection zone.
Glyphis sp. C.	Northern river shark	EN	EN	Uncertain	No records of occurrence within the seed collection zone.
Acanthopsis hawkei [2]	Plains death adder	VU	VU		Known to occur on the cracking soils on floodplains of the Adelaide, Mary and Alligator Rivers. However the likely distribution of *A. hawkei* is extensive, covering over 50% of Kakadu National Park (Figure C2). Occurs in the seed collection zone.
Bellatorias obiri [1]	Arnhemland egernia	EN	EN	High	Occurs mainly on the perimeter of the seed collection zone but restricted to the escarpment (Figure C2). However, no seed collection will be undertaken in escarpment areas.
Diplodactylus occultus [1]	Yellow-snouted gecko	VU	EN	Moderate	No records of occurrence within the seed collection zone.
Lepidochelys olivacea	Olive ridley	VU	EN	Low – moderate	No records of occurrence within the seed collection zone.
Morelia oenpelliensis [1]	Oenpelli python	VU	not listed	High	Occurs mainly on the perimeter of the seed collection zone but restricted to the escarpment (Figure C2). However, no seed collection will be undertaken in escarpment areas.
Natator depressus	Flatback turtle	DD	VU	Moderate	No records of occurrence within the seed collection zone.
Pristis clavata	Dwarf sawfish	VU	VU	Low – moderate	No records of occurrence within the seed collection zone.
Pristis pristis	Freshwater sawfish, largetooth sawfish, river sawfish, leichhardt's sawfish, northern sawfish	DD	VU	Low – moderate	No records of occurrence within the seed collection zone.
Varanus mertensi	Mertens water monitor	VU	not listed		A semi-aquatic monitor seldom seen far from water, occurring across a broad geographic range, In the NT it has been recorded across most of the Top End and the Gulf Region.

Scientific name	Common Name	Conservation status as at 2017		Kakadu significance	Occurrence within the collection area
		Northern Territory	C'wealth		
					Occurs in the seed collection zone (Figure C2).
Varanus mitchelli	Mitchell's water monitor	VU	not listed		A semi-aquatic and arboreal water monitor that inhabits margins of watercourses, swamps and lagoons. Occurs in the seed collection zone (Figure C2).
[1] Endemic [2] Conservation listed post 2004					
Status: CE: Critically endangered, DD: Data deficient, EN: Endangered, LC: Least concern, NT: Near threatened, VU: Vulnerable					

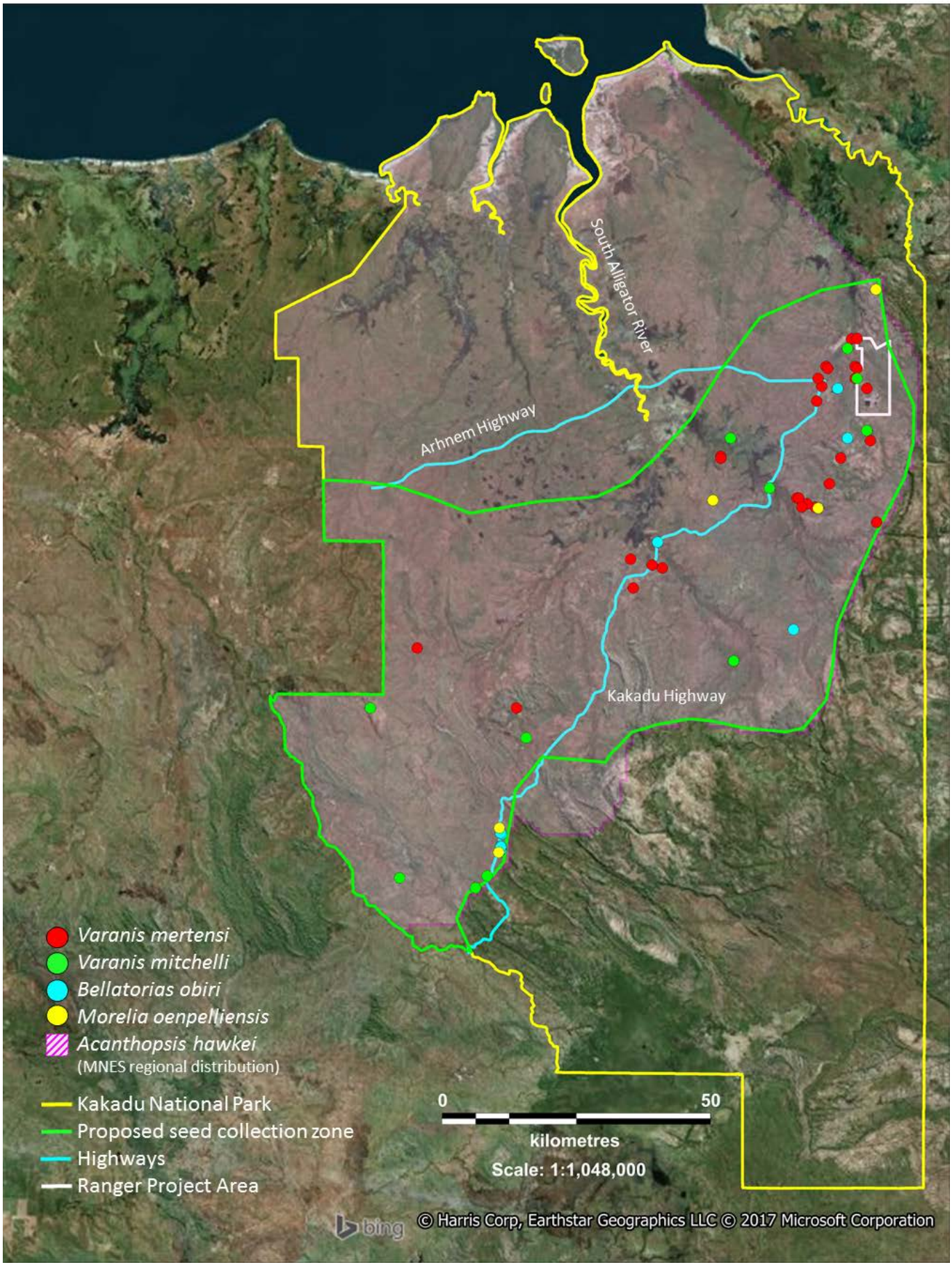

Figure C2: Conservation listed reptiles known to occur within the seed collection zone

Table C3: Birds recorded from Kakadu National Park (2017) considered as threatened under the *Environment Protection and Biodiversity Conservation Act 1999* and/or the *Territory Parks and Wildlife Conservation Act* (adapted from Woinarski 2004)

Scientific name	Common Name	Status as at 2017		Kakadu significance	Occurrence within the collection area
		Northern Territory	C'wealth		
Amytornis woodwardi [1]	White-throated grasswren	VU	VU	High	Known to occur in the seed collection zone (Figure C3). However seed collection will not occur along the sandstone massif of the western Arnhem Land.
Epthianura crocea tunneyi [1]	Yellow chat	VU	EN	High	Known to occur within the seed collection zone (Figure C3); mainly occurs within a small number of sites on the Adelaide River to the East Alligator River.
Erythrotriorchis radiatus	Red goshawk	VU	VU	Low - moderate	Occurs in the seed collection zone (Figure C-3). However Kakadu comprises only a small proportion of this range and total population.
Erythrura gouldiae	Gouldian finch	EN	EN	Moderate	Occurs in the seed collection zone (Figure C3).
Falcunculus (frontatus) whitei	Northern/crested shrike-tit	NT	VU	Low	Known to occur at two sites within the seed collection zone (Figure C3).
Geophaps smithii smithii [1]	Partridge pigeon	VU	VU	Moderate	Occurs in the seed collection zone (Figure C3).
Limosa lapponica [2]	Bar-tailed godwit	VU	CE		Occurs predominantly in the coastal areas of all Australian states.
Tyto novaehollandiae kimberli	Masked owl	VU	VU	Uncertain	Known to occur in the seed collection zone (Figure C3). However very little information is known about the distribution, population size and trends in population.

[1] Endemic
[2] Conservation listed post 2004

Status: CE: Critically endangered, DD: Data deficient, EN: Endangered, LC: Least concern, NT: Near threatened, VU: Vulnerable

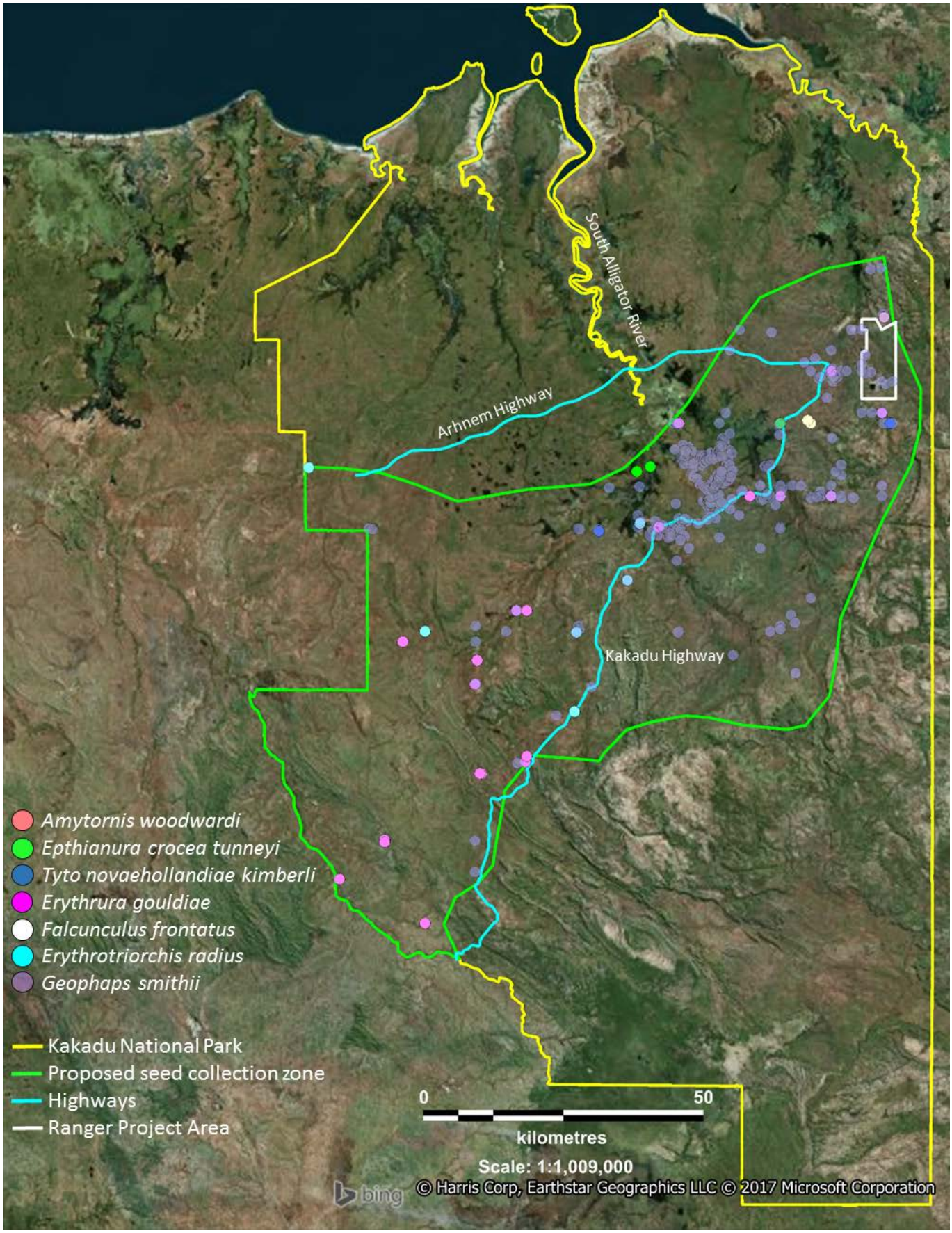

Figure C3: Conservation listed birds known to occur in the seed collection zone

Table C4: Mammals recorded from Kakadu National Park (2017) considered as threatened under the *Environment Protection and Biodiversity Conservation Act 1999* and/or the *Territory Parks and Wildlife Conservation Act* (adapted from Woinarski 2004)

Scientific name	Common Name	Status as at 2017		Kakadu significance	Occurrence within the collection area
		Northern Territory	C'wealth		
Antechinus bellus [2]	Fawn antechinus	VU	EN		The only species of Antechinus found in the savanna woodland and tall open forest of the Top End of the NT. Occurs in the seed collection zone (Figure C4).
Conilurus penicillatus	Brush-tailed rabbit-rat	EN	VU	Moderate – high	Occurs in the seed collection zone (Figure C4).
Dasyurus hallucatus	Northern quoll	CE	EN	Uncertain	Occurs in the seed collection zone (Figure C4).
Hipposideros diadema inornata [1]	Arnhem leaf-nosed bat	VU	EN	High	Limited distribution within the Kakadu escarpment an adjoining western edge of the Arnhem Land plateau. Occurs in the seed collection zone (Figure C4).
Isoodon auratus auratus	Golden bandicoot	EN	VU	Uncertain	No records of occurrence within the seed collection zone.
Macroderma gigas	Ghost Bat	not listed	VU		Occurs across a broad range of habitats including rainforests, arid zones near rock outcrops, throughout the tropical savanna and mangroves. The species roosts in caves, mines, and rock clefts. Occurs in the seed collection zone (Figure C4).
Mesembriomys gouldii [2]	Black-footed tree-rat	VU	EN		Occurs in tropical woodlands and open forests in coastal areas in the NT. Occurs in the seed collection zone (Figure C4).
Mesembriomys macrurus	Golden-backed tree-rat	CE	VU	Uncertain	No records of occurrence within the seed collection zone.
Petrogale concinna	Nabarlek	EN	VU		Largely restricted to rocky areas (sandstone or granite), especially on steep slopes, with large boulders, caves and crevices. Occurs in the seed collection zone (Figure C4).
Phascogale (tapoatafa) pirata [1]	Northern Brush-tailed Phascogale	EN	VU	Moderate – high	Occurs in the seed collection zone (Figure C4).

Scientific name	Common Name	Status as at 2017		Kakadu significance	Occurrence within the collection area
		Northern Territory	C'wealth		
Saccolaimus saccolaimus nudicluniatus	Bare-rumped sheath-tail bat	DD	CE	Uncertain	No records of occurrence within the seed collection zone.
Xeromys myoides	False water-rat water mouse	DD	VU	Uncertain	No records of occurrence within the seed collection zone. Seed collection will not occur within known habitat – e.g. mangrove forests, freshwater swamps and floodplain saline grasslands.
Zyzomys maini [1]	Arnhem rock-rat	VU	VU	High	Endemic to the sandstone massif of western Arnhem Land. Restricted to areas with large sandstone boulders or escarpment with fissures and cracks in monsoon forests. Known to occur at one location on the north-eastern edge of the seed collection zone (Figure C4).
[1] Endemic [2] Conservation listed post 2004					
Status: CE: Critically endangered, DD: Data deficient, EN: Endangered, LC: Least concern, NT: Near threatened, VU: Vulnerable					

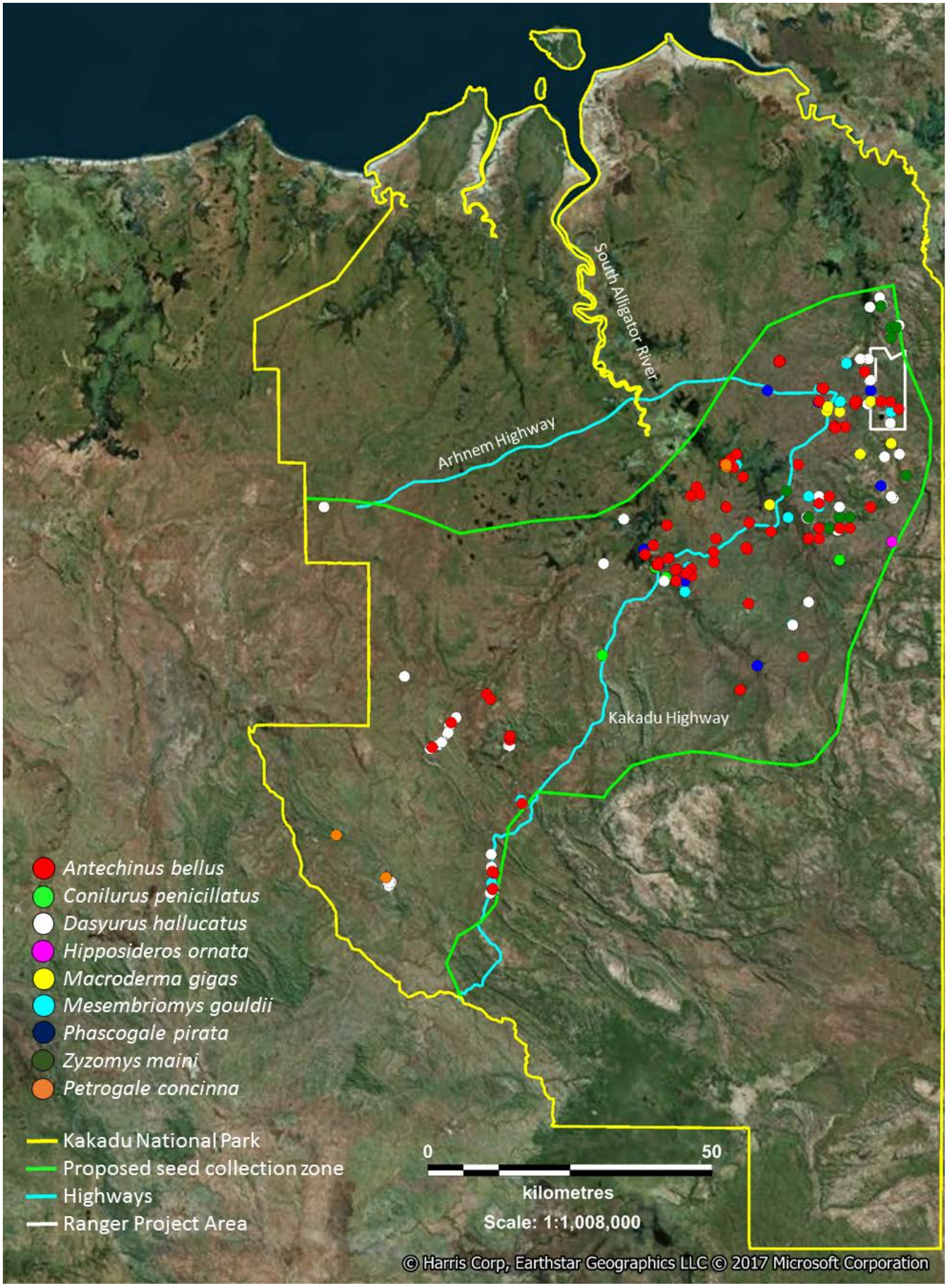

Figure C4: Conservation listed mammals known to occur in the seed collection zone

3 ASSESSMENT OVERVIEW

In support of the permit application, an assessment of the potential impacts of seed collection on the following six matters of national environmental significance (MNES) that are relevant to this activity has been undertaken, based on the criteria outlined in the Commonwealth *Significant Impact Guidelines 1.1* (DoE 2013):

1. Threatened ecological communities
2. Threatened species
3. Migratory species
4. World heritage values
5. National heritage places
6. Wetland of international importance
7. Commonwealth land

The assessment has been completed on the various characteristics and attributes of the park and the Ramsar wetland against significant impact criteria and world heritage values/criteria. Each significant impact criterion was assessed as 'likely' or 'unlikely', where to be likely, the criterion was considered to have a greater than 50% chance of occurring, or likely to be important, notable or of consequence, having regard to their context or intensity (DoE 2013).

The assessment takes into consideration that the collecting activities will be conducted across the approximately 6,600 km^2 collection zone (**Appendix A, Figure 1**), using current best practice guidelines for seed collecting (e.g. collect no more than 20% of the available seed from a population) (Cochrane *et al.,* 2009). The guidelines developed by Cochrane *et al.,* (2009) were intended to be suitable for all species, including rare and threatened species. (Note: rare and threatened species will not be collected under this proposed action.) The guidelines will be applied in combination with a collecting regime where seed collecting will not occur from the same population/individual in two consecutive years, thus preventing any potential exponential increase in impacts to MNES through repeat collection. Limiting collection per plant species to these maximum rates should result in a negligible impact on natural regeneration and native flora, and ensure that there will be no negative impact on the natural attributes of the park and specifically there will be no impacts on habitat values, ecological processes (e.g. seed as a food source for fauna) or rare and threatened species.

The assessment also takes into consideration the goals of ecologically sustainable development. For example, plant species produce large quantities of seed, with only small quantities ever resulting in the production of the next generation. Setterfield (1997) reported that the annual seed production of *Eucalyptus miniata* and *E. tetrodonta* was ca. 430,000 and 200,000 seeds per hectare per year, respectively. As an approximate figure, for these two species the planned maximum harvest levels represent less than 0.000001% of the potentially available seed in the park (based on an approximate park area of 19,804 km^2).

Furthermore, natural recruitment (particularly for trees) is extremely limited in the event of fire. Setterfield (2002) reported that in the event of fire, no seedlings of *E. miniata* survive. Consequently any impact of seed collecting on the success of tree recruitment will be minimal, since this relies on the chance overlap of a suitable micro-site for establishment coupled with several fire-free years. In addition, in areas that are subjected to either early or late fires, it has been reported that for *E. miniata* and *E. tetrodonta*, seed production (seed fall) is reduced by between 62 and 98% (Setterfield 1997). Since approximately 55% – 63% of the Park burns each year (Lehmann*, et al.* 2008; Russell-Smith*, et al.* 1997), this means that between 34.1 and 61.7% of the potential seed yield of these species is lost each year from the park. These potential seed losses resulting from fire, are vastly in excess of

the quantities proposed to be collected as part of this permit application. Recent fire records support these earlier fire data, indicating that the average percentage of the park burnt per year during the 10 year timeframe 2005 – 2010, inclusive was 56.1% or 10,681.4 km^2 (NAFI 2015).

The nursery practices followed at Kakadu Native Plants Pty Ltd are considered sustainable with impacts on the surrounding area minimal for the following reasons:

a) only slow release fertilisers will be used thereby reducing nutrient leaching,

b) only natural plant based insecticides will be used,

c) only soilless-based potting mix of predominantly sand and coco-peat will be used in the propagation of seeds, eliminating the potential for the introduction/spread of pathogens/disease,

d) supports on-country activities which will encourage intergenerational transfer of knowledge to the younger Bininj generation; thereby contributing towards the long-term sustainability of this wholly Bininj owned business.

4 ASSESSMENT OUTCOMES

4.1 Threatened Ecological Communities

EPBC Act listed flora and ecological communities that occur within the vicinity of the collection zone include:

- Arnhem Plateau Sandstone Shrubland Complex – threatened ecological community
- *Hibiscus brennanii* – VU (NT/Cth)
- *Boronia quadrilata* – VU (NT/Cth)
- *Sauropus filicinus* – DD/not listed (NT/Cth)

Seed collection will not occur in any EPBC listed threatened ecological communities. It is therefore unlikely that seed collection within the designated collection zone (**Appendix A**, **Figure 1**) will impact the Arnhem Plateau Sandstone Shrubland Complex. Seeds of the NT/EPBC listed plant species that may be present in the proposed collecting area (e.g. *Hibiscus brennanii* and *Sauropus filicinus*) will not be collected. (NB: *Boronia quadilata* does not occur within the proposed seed collection zone; see Table C1.)

4.2 Threatened Species

The likelihood of significant impacts occurring to threatened species (whether extinct in the wild, critically endangered, endangered or vulnerable) was assessed using the criteria in **Table C5**.

Table C5: Assessment of significant impacts to threatened species/ecological communities

Significant impact criterion[1]	Likelihood of impact	Assessment of impact associated with the proposed seed collection
Adversely affect a captive or propagated population or one recently introduced/ reintroduced to the wild	Unlikely	It is unlikely that seed collection within the proposed 6,600 km^2 collection zone (Appendix A, Figure 1) will adversely impact on a captive or propagated population recovery program. Potential cumulative impacts on protected species will be minimised by not repeatedly collecting seeds from the same site(s). In addition, habitat integrity for threatened species will not be impacted by the seed collecting activities since no plants will be destroyed or removed. Further, no NT listed plant species will be affected as seeds of these species will not be collected. Also collection is highly intermittent and random across the seed collection zone; undertaken by a small team, thereby reducing the likelihood of interaction with reintroduced threatened species.
Interfere with the recovery of the species or its reintroduction into the wild.	Unlikely	Potential cumulative impacts on protected species will be minimised by not repeatedly collecting seeds from the same site(s). In addition, habitat integrity for threatened species will not be impacted by the seed collecting activities since no plants will be destroyed or removed. Further, no NT listed plant species will be affected as seeds of these species will not be collected. Also collection is highly intermittent and random across the seed collection zone; undertaken by a small team, thereby reducing the likelihood of interaction with reintroduced threatened species.
Lead to a long-term decrease in the size of a population/important population[2]	Unlikely	Current best practice guidelines that are used for seed collecting, suggest that a harvest rate of 20% of available seeds is ecologically sustainable. Kakadu Native Plants Pty Ltd intends to follow this collection rate. The guidelines will be applied in combination with a collecting regime where collecting will not occur from the same population/individual in two consecutive years, thus preventing any potential exponential increase in impacts to MNES through repeat collection (Cochrane *et al.,* 2009). Implementation of these seed collection practices should minimise the potential for any impact on natural regeneration, native flora and fauna. There is the potential for both EPBC (http://www.environment.gov.au/erin/ert/epbc/index.html) and NT listed mammals, birds and reptiles (http://www.nt.gov.au/nreta/wildlife/animals/threatened/specieslist.html) to occur within the sites that will be visited for seed collecting. However, incidental interactions with fauna represent no more disturbance than would be associated with either Bininj being on country for other customary purposes or tourists. A stated above, potential cumulative impacts on protected species will be minimised by not repeatedly collecting seeds from the same site(s). In addition, habitat integrity for these species will not be impacted by the seed collecting activity since no plants will be destroyed or removed. Further, no NT listed plant species will be affected as seeds of these species will not be collected.

Significant impact criterion[1]	Likelihood of impact	Assessment of impact associated with the proposed seed collection
Reduce the area of occupancy of the species of a population/important population	Unlikely	It is unlikely that seed collection within the 6,600 km^2 collection zone (Appendix A, Figure 1) will reduce, fragment or adversely impact the area of occupancy of the species of a population/ important population that are known to occur across Kakadu National Park. Potential cumulative impacts on protected species will be minimised by not repeatedly collecting seeds from the same site(s). In addition, habitat integrity for threatened species will not be impacted by the seed collecting activities since no plants will be destroyed or removed. Further, no NT listed plant species will be affected as seeds of these species will not be collected.
Fragment an existing population/important population into two or more populations		
Adversely affect habitat critical to the survival of a species		
Disrupt the breeding cycle of a population/important population	Unlikely	It is unlikely that seed collection within the proposed 6,600 km^2 collection zone (Appendix A, Figure 1) will disrupt the breeding cycle of a population/important population. While the area of proposed seed collection zone represents approximately 33% of the total area of Kakadu National, seeds will often be collected from individual plants with ripe fruits/seeds that are visible from existing access tracks/roads. Collection is highly intermittent and random across the seed collection zone; undertaken by a small team, thereby reducing the likelihood of interaction with an entire breeding population of a threatened species. Seed collection will be undertaken by employees of Kakadu Native Plants Pty Ltd, who have extensive experience collecting seeds from within the park and local Bininj knowledge of the breeding cycles of listed threatened species.
Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline	Unlikely	It is unlikely that seed collection within the proposed 6,600 km^2 collection zone (Appendix A, Figure 1) will have a significant impact on quality habitat to the extent that the species is likely to decline. While the area of proposed seed collection zone represents approximately 33% of the total area of Kakadu National, seeds will often be collected from individual plants with ripe fruits/seeds that are visible from existing access tracks/roads. Collection is highly intermittent and random across the seed collection zone; undertaken by a small team, thereby reducing the likelihood of interaction with an entire breeding population of a threatened species. Potential cumulative impacts on protected species will be minimised by not repeatedly collecting seeds from the same site(s). In addition, habitat integrity for these species will not be impacted by the seed collecting activity since no plants will be destroyed or removed.

Significant impact criterion[1]	Likelihood of impact	Assessment of impact associated with the proposed seed collection
Result in invasive species that are harmful to a critically engendered or endangered species becoming established in the endangered or critically endangered species habitat	Unlikely	Current operational pest management systems and procedures will apply. It is unlikely that any pest that could impact critically engendered or endangered species' habitats will be introduced.
Introduce disease that may cause the species to decline	Unlikely	Effective operational pest management procedures and hygiene will apply during both the seed collection and propagation activities to prevent the potential spread of disease/pathogens such as myrtle rust, which has not currently been detected in KNP. The proposed action is unlikely to introduce a disease (e.g. myrtle rust) that would impact threatened species. For comparison, between 96,000 and 124,000 national and international tourists visited KNP during 2014 and 2015, respectively (Daily Telegraph 2016). This represents a greater potential threat of introducing disease/pathogens to KNP than seed collection by a small team of local indigenous people.
Interfere with the recovery of a species	Unlikely	While the area of proposed seed collection zone (Appendix A, Figure 1), represents approximately 33% of the total area of Kakadu National Park, seeds will often be collected from individual plants with ripe fruits/seeds that are visible from existing access tracks/roads. Collection is highly intermittent and random across the seed collection zone; undertaken by a small team, thereby reducing the likelihood of interfering with the recovery of a threatened species. Current best practice guidelines that are used for seed collecting, suggest that a harvest rate of 20% of available seeds is ecologically sustainable. Kakadu Native Plants Pty Ltd intends to follow this collection rate. The guidelines will be applied in combination with a collecting regime where collecting will not occur from the same population/individual in two consecutive years, thus preventing any potential exponential increase in impacts to MNES through repeat collection (Cochrane *et al.,* 2009).

1. Criterion sourced from DoE (2013).

2. Where population relates to critically endangered and endangered threatened species and important population relates to vulnerable threatened species.

4.3 Migratory Species

The likelihood of significant impacts occurring to migratory species from seed collection activities was assessed using the criteria in **Table C6**.

Table C6: Assessment of significant impacts to migratory species

Significant impact criterion[1]	Likelihood of impact	Assessment of impact associated with the proposed seed collection
Substantially modify, destroy or isolate an area of important habitat for migratory species	Unlikely	It is unlikely that seed collection within the proposed 6,600 km^2 collection zone (Appendix A, Figure 1) will have a significant impact on important habitat for migratory species. Potential cumulative impacts on migratory species will be minimised by not repeatedly collecting seeds from the same site(s). In addition, habitat integrity for migratory species will not be impacted by the seed collecting activity, since no plants will be destroyed or removed, and seed collection will be predominantly from individual plants with ripe fruits/seeds that are visible from existing access tracks/roads.
Result in an invasive species that is harmful to the migratory species becoming established in an area of important habitat for migratory species	Unlikely	Effective operational pest management systems and procedures will apply to seed collection and propagation activities. It is highly unlikely that any pest that could impact migratory species will be introduced.
Seriously disrupt the lifecycle of an ecologically significant proportion of the populations of migratory species	Unlikely	It is unlikely that seed collection within the proposed 6,600 km^2 collection zone (Appendix A, Figure 1) will disrupt the breeding cycle of a population/important population. While the area of proposed seed collection zone represents approximately 33% of the total area of Kakadu National, seeds will often be collected from individual plants with ripe fruits/seeds that are visible from existing access tracks/roads. Collection is also highly intermittent and random across the seed collection zone; undertaken by a small team, thereby reducing the likelihood of interaction with an entire breeding population of a threatened species. Seed collection will be undertaken by employees of Kakadu Native Plants Pty Ltd, who have extensive experience collecting seeds from within the park and local Bininj knowledge of the breeding cycles of listed threatened species. Incidental interactions with fauna represent no more disturbance than would be associated with either Bininj being on country for other customary purposes or tourists.

[1] Criterion sourced from DoE (2013).

4.4 World Heritage Properties

An action is considered likely to have a significant impact on world heritage values of a declared world heritage property, i.e. Kakadu National Park, if one or more world heritage values are (DoE 2013): lost; degraded or damaged; or notably altered, modified, obscured or diminished.

The potential likelihood of significant impacts occurring from seed collection to the Kakadu National Park world heritage property was assessed against the values in **Table C7**. These values are specific to Kakadu National Park and address the world heritage values listed in UNESCO website.[1]

Table C7: Assessment of significant impacts to Kakadu National Park's world heritage values

World heritage value[1]	Likelihood of impact	Assessment of potential impacts to the value
World heritage criterion (i)		
Kakadu's art sites represent a unique artistic achievement because of the wide range of styles used, the large number and density of sites and the delicate and detailed depiction of a wide range of human figures and identifiable animal species, including animals long-extinct.	Unlikely	Seed collection activities will not be undertaken in the immediate vicinity of areas of known rock art. It will therefore not impact on, or interfere with known rock art locations. The proposed action will facilitate on-country activities which will encourage intergenerational transfer of knowledge to the younger Bininj generation.
World heritage criterion (vi)		
The rock art and archaeological record is an exceptional source of evidence for social and ritual activities associated with hunting and gathering traditions of Aboriginal people from the Pleistocene era until the present day.	Unlikely	Refer above

[1] UNESCO (1992-2015) World Heritage List - Kakadu National Park, UNESCO World Heritage Centre 1992-2015, <http://whc.unesco.org/en/list/147>. Viewed online: 2 January 2015.

World heritage value[1]	Likelihood of impact	Assessment of potential impacts to the value
World heritage criterion (vii)		
Kakadu National Park contains a remarkable contrast between the internationally recognised Ramsar–listed wetlands and the spectacular rocky escarpment and its outliers. The vast expanse of wetlands to the north of the park extends over tens of kilometres and provides habitat for millions of waterbirds. The escarpment consists of vertical and stepped cliff faces up to 330 m high and extends in a jagged and unbroken line for hundreds of kilometres. The plateau areas behind the escarpment are inaccessible by vehicle and contain large areas with no human infrastructure and limited public access. The views from the plateau are breathtaking.	Unlikely	While the area of proposed seed collection zone (Appendix A, Figure 1), represents approximately 33% of the total area of Kakadu National, seeds will often be collected from individual plants with ripe fruits/seeds that are visible from existing access tracks/roads. Collection is highly intermittent and random across the seed collection zone; undertaken by a small team, thereby reducing the likelihood of disturbing the landscape. Seed collection activities be managed through intermittent seed collection, adoption of best practice seed collection guidelines, combined with not repeatedly collecting seeds from the same site(s) to minimise impacts. Under this framework, it is not expected to change the mix and diversity of habitats found within the Park (refer Section 3.1).
World heritage criterion (ix)		
The property incorporates significant elements of four major river systems of tropical Australia. Kakadu's ancient escarpment and stone country span more than two billion years of geological history, whereas the floodplains are recent, dynamic environments, shaped by changing sea levels and big floods every wet season. These floodplains illustrate the ecological and geomorphological effects that have accompanied Holocene climate change and sea level rise. The Kakadu region has had relatively little impact from European settlement, in comparison with much of the Australian continent. With extensive and relatively unmodified natural vegetation and largely intact faunal composition, the park provides a unique opportunity to investigate large-scale evolutionary processes in a relatively intact landscape.	Unlikely	Seven floristic species are identified for collection adjacent to freshwater aquatic habitats – e.g. occur along the streams, around lagoons and swamps. However none of these plants are aquatic, nor require access or seed collection from waterbodies. While the proposed seed collection zone represents approximately 33% of the total area of Kakadu National, seeds will often be collected from individual plants with ripe fruits/seeds that are visible from existing access tracks/roads. Seed collection activities be managed through intermittent seed collection, adoption of best practice seed collection guidelines, combined with not repeatedly collecting seeds from the same site(s) to minimise impacts. Under this framework, it is not expected to change the mix and diversity of habitats found within the Park (refer Section 3.1). Also refer Tables C5, C6, C9 and C10.

World heritage value[1]	Likelihood of impact	Assessment of potential impacts to the value
Kakadu's indigenous communities and their myriad rock art and archaeological sites represent an outstanding example of humankind's interaction with the natural environment.		
World heritage criterion (x)		
The park is unique in protecting almost the entire catchment of a large tropical river and has one of the widest ranges of habitats and greatest number of species documented of any comparable area in tropical northern Australia. Kakadu's large size, diversity of habitats and limited impact from European settlement has resulted in the protection and conservation of many significant habitats and species. The property protects an extraordinary number of plant and animal species including over one third of Australia's bird species, one quarter of Australia's land mammals and an exceptionally high number of reptile, frog and fish species. Huge concentrations of waterbirds make seasonal use of the park's extensive coastal floodplains.	Unlikely	Refer Tables C5, C7, C9 and C10 Also, incidental interactions with fauna represent no more disturbance than would be associated with either Bininj being on country for other customary purposes or tourists. In addition to the above and as previously outlined, as an approximate figure, the planned maximum harvest levels for *E. tetradonta* and *E. miniata* represent less than 0.000001% of the potentially available seed in the park (based on an approximate park area of 19,804 km^2).

[1] Values described in DoE (2014a).

4.5 National Heritage Places

On 15 May 2007, the then Minister for the Environment and Water Resources determined that Kakadu National Park met eight national heritage criteria in accordance with sub item 1A(3) of Schedule 3 of the *Environment and Heritage Legislation Amendment Act (No.1) 2003* (DEWR 2007) (**Table C8**), where if a place has a world heritage value, it is understood to meet a national heritage criterion. Kakadu National Park, therefore, was one of 15 world heritage places included in the National Heritage List under the EPBC Act on 21 May 2007.

Table C8: Kakadu National Park national heritage values and criteria

National heritage values[1]	Criteria
Events, processes Rarity Research Principal characteristics of a class of places Aesthetic characteristics Creative or technical achievement Social value Indigenous tradition	This place is taken to meet this national heritage criterion in accordance with sub-item 1A(3) of Schedule 3 of the *Environment and Heritage Legislation Amendment Act (No.1) 2003*, as the World Heritage Committee has determined that this place meets the relevant World Heritage criteria: • Events, processes: (vi), (ix) and (x). • Rarity: (x). • Research: (ix) and (x). • Principal characteristics of a class of places: (ix). • Aesthetic characteristics: (vii). • Creative or technical achievement: (i). • Social value: (vi). • Indigenous tradition: (vi).

1. Criterion sourced from AHC (2009).

The national heritage values and criteria are analogous to the world heritage values for Kakadu National Park. An action is considered likely to have a significant impact on national heritage values of a national heritage place, i.e. Kakadu National Park, if one or more national heritage values are: lost; degraded or damaged; or notably altered, modified, obscured or diminished.

The assessment in **Table C7** explains how it is expected that Kakadu National Park's world heritage values will be maintained during seed collection. This infers that Kakadu National Park's national heritage values will also be maintained. Therefore, the seed collection is unlikely to have a significant impact on a national heritage place.

4.6 Wetlands of International Importance

The Kakadu National Park Ramsar site is a series of wetlands comprising two large river catchments, the East and South Alligator rivers, as well as seasonal creeks and the lower reaches of the East Alligator River. It also includes the Magela Creek floodplain, the lower South Alligator floodplain, and nearly the entire West Alligator River and Wildman River systems (DoE 2014b).

The likelihood of significant impacts occurring to the Kakadu National Park Ramsar wetland due to the seed collection within the proposed collection zone (**Appendix A, Figure 1**) was assessed using the criteria in **Table C9**. The assessment demonstrates that significant impacts on a wetland of international importance are either unlikely or not applicable.

Table C9: Assessment of significant impacts to wetlands of international importance

Significant impact criterion[1]	Likelihood of impact	Assessment of Project impact
Areas of the wetland being destroyed or substantially modified	Unlikely	Seven floristic species are identified for collection adjacent to freshwater aquatic habitats – e.g. occur along the streams, around lagoons and swamps. However none of these plants are aquatic, nor require access or seed collection from waterbodies. Therefore, the collection of seed from native plant species adjacent to freshwater aquatic habitats (e.g. Melaleuca spp., *Barrintonia acutangula*) is unlikely significantly impact the wetlands of Kakadu National Park. While the area of proposed seed collection zone represents approximately 33% of the total area of Kakadu National, seeds will often be collected from individual plants with ripe fruits/seeds that are visible from existing access tracks/roads.
A substantial and measurable change in the hydrological regime of the wetland, for example, a substantial change to the volume, timing, duration and frequency of ground and surface water flows to and within the wetland	Not applicable	Seed collection from the proposed collection zone (Appendix A, Figure 1) will not impact the hydrological regime of the wetland.
The habitat or lifecycle of native species, including invertebrate fauna and fish species, dependent upon the wetland being seriously affected	Unlikely	Collection is highly intermittent and random across the seed collection zone; undertaken by a small team, thereby reducing the likelihood of interaction with an entire breeding population of a threatened species. There are no plant species identified for seed collection that require access or collection from waterbodies. Incidental interactions with invertebrate fauna and fish species represent no more disturbance than would be associated with either Bininj being on country for other customary purposes or tourists.
A substantial and measurable change in the water quality of the wetland – for example, a substantial change in the level of salinity, pollutants, or nutrients in the wetland, or water temperature which may adversely impact on biodiversity, ecological integrity, social amenity or human health	Not applicable	Seed collection from the proposed collection zone (Appendix A, Figure 1) will not impact the water quality of the wetland.

Significant impact criterion[1]	Likelihood of impact	Assessment of Project impact
An invasive species that is harmful to the ecological character of the wetland being established (or an existing invasive species being spread) in the wetland.	Unlikely	Effective operational pest management systems and procedures will apply during seed collection. It is highly unlikely that any pest that could impact the ecological character of the wetland will be introduced, or spread during seed collection activities.

1. Criterion sourced from DoE (2013).

Details of potential impacts from seed collection within the proposed collection zone (**Appendix A, Figure 1**) on the individual ecological character values (critical components) for the Ramsar wetland are presented in **Table C10**.

Table C10: Assessment of potential impacts to the ecological character values of the Ramsar wetland from the proposed seed collection

Critical components	Likelihood of impact	Assessment of potential impacts on each critical component, process or service
C1 - Mangroves	Not applicable	There will be no impact on mangroves as a consequence of the seed collection due to the distance from the tidal wetlands of the Kakadu National Park of the seed collection zone. Seed collection is unlikely to influence or exceed the limits of acceptable change (number 1), in which mangrove extent declines by greater than 25% from baseline values outlined in BMT WBM (2010).
C2 – *Melaleuca* forests	Unlikely	It is proposed to collect seed from six species of *Melaleuca*, of which 5 are associated with *Melaleuca* forest habitat. Current best practice guidelines that are used for seed collecting, suggest that a harvest rate of 20% of available seeds is ecologically sustainable. Kakadu Native Plants Pty Ltd intends to follow this collection rate. The guidelines will be applied in combination with a collecting regime where collecting will not occur from the same population/ individual in two consecutive years, thus preventing any potential exponential increase in impacts to MNES through repeat collection (Cochrane *et al.,* 2009). Limiting collection to these maximum rates should minimise the potential for any impact on natural regeneration, native flora and fauna. Also, collecting will not occur from the same population/individual plant species in two consecutive years to prevent any possible 'multiplication of risk' associated with repeat collection. The collection of *Melaleuca* spp. seed is unlikely to exceed the limits of acceptable change (number 2) whereby:

Critical components	Likelihood of impact	Assessment of potential impacts on each critical component, process or service
		"The number of *Melaleuca* trees at the Magela floodplain will not decline by greater than 50% of baseline values of (Riley & Lowry 2002) for the year 1996 (24,704 trees) (BMT WBM 2010)."
C3 – Palustrine wetlands and billabongs	Unlikely	Seven floristic species are identified for collection adjacent to aquatic habitats – e.g. occur along the streams, around lagoons and swamps. However none of these plants are aquatic, nor do they require access or seed collection from waterbodies. It is therefore not expected that this activity will change the diversity or character of landscapes found within the Park. Seed collection is unlikely to result in a permanent loss of billabongs in the South Alligator River catchment as a direct result of anthropogenic changes in hydrological or geomorphological processes (number 3) (BMT WBM 2010).
C4 – Waterfalls, seeps and waterholes	Not applicable	Seed collection from the proposed collection zone is unlikely to cause any instances of drying for perennial seeps and permanent waterholes, as per the limits of acceptable change (number 4) (BMT WBM 2010).
C5 – Populations of migratory and resident waterbirds	Unlikely	Based on an assessment of the potential impact of seed collection on migratory species (refer Table C6) and resident waterbirds (refer Table C9), it is considered unlikely to have a significant impact on migratory species and resident waterbirds at a regional or national scale. As noted in relation to threatened species, the activity involves the collection of seed from a variety of habitats within the proposed seed collection zone (Appendix A, Figure 1). Incidental interactions with fauna represent no more disturbance than would be associated with either Bininj being on country for other customary purposes or tourists. Seed collection from the proposed collection zone is unlikely to impact on the limits of acceptable change (numbers 10, 11, 12, and 13) for waterbird abundance as outlined in (BMT WBM 2010).
C6 – Populations of freshwater fish	Unlikely	Seven floristic species are identified for collection that are adjacent to freshwater aquatic habitats – e.g. occur along the streams, around lagoons and swamps. However none of these plants are aquatic, nor require access or seed collection from waterbodies. Incidental interactions with freshwater fish species represent no more disturbance than would be associated with either Bininj being on country for other customary purposes or tourists. Therefore, the collection of seed from native plant species adjacent to aquatic habitats (e.g. *Melaleuca* spp., *Barrintonia acutangula*) is unlikely to influence or exceed the limits of acceptable change for freshwater fish abundance in billabongs (number 15), as outlined in BMT WBM (2010): "The average abundance of freshwater fish species will not fall below the minimum recorded values of (Humphrey, *et al.* 2005) at both

Critical components	Likelihood of impact	Assessment of potential impacts on each critical component, process or service
		Sandy and Mudginberri Billabongs on more than 50% of sampling occasions over a 20 year period."
C7 – Populations of freshwater and saltwater crocodiles	Unlikely	Seven floristic species are identified for collection adjacent to aquatic habitats – e.g. occur along the streams, around lagoons and swamps. However none of these plants are aquatic, nor require access or seed collection from waterbodies. Seed collection is unlikely to impact on local species' populations or reduce the area of habitat used by species (refer Table C5 and C6). Incidental interactions with population of fresh and saltwater crocodiles represent no more disturbance than would be associated with either Bininj being on country for other customary purposes or tourists. The proposed seed collection activity is unlikely to influence or exceed the limits of acceptable change for the abundance of saltwater and freshwater crocodiles (numbers 16 and 17) (BMT WBM 2010): "The average abundance of saltwater crocodiles will not fall below 35,000 individuals, which represents a 50% reduction in the 1994 estimated population. The average abundance of freshwater crocodile will not fall below the minimum recorded values of Parks Australia on more than 50% of sampling occasions over a 20 year period."
C8 – Populations of threatened sharks	Unlikely	Seven floristic species are identified for collection adjacent to aquatic habitats – e.g. occur along the streams, around lagoons and swamps. However none of these plants are aquatic, nor require access or seed collection from waterbodies. Seed collection is unlikely to impact on local species' populations or reduce the area of habitat used by species (refer Table C5 and C5). Seed collection from the proposed collection zone is unlikely to influence or exceed the limits of acceptable change for the spear tooth shark and northern river shark distribution and abundance (number 5) (BMT WBM 2010): "The site continues to support spear-tooth shark in the long-term. The Wildman and East, West and South Alligator Rivers continue to support northern river shark in the long-term."
C9 – Yellow chat populations	Unlikely	The Alligator Rivers yellow chat is restricted to floodplains from the Alligator River to the East Alligator River (DoE 2008). Yellow chats forage for insects within grasses, herbs and sedges and stands of mangroves, and aggregate around persisting wet areas at the end of the dry season (Woinarski & Armstrong 2006). Critical habitat for yellow chats comprises alluvial and marine floodplains, which does not lie within the seed collection zone shown in Appendix A,

Critical components	Likelihood of impact	Assessment of potential impacts on each critical component, process or service
		Figure 1. Therefore the proposed activity will not impact either the resources or habitat of yellow chats. In addition, seed collection is highly intermittent and random across the seed collection zone; undertaken by a small team of indigenous people. The sporadic collection of seed and extensive area from which to collect seed reduces the likelihood of impacting on ecological processes such as food sources, or interaction with an entire population of a threatened species, such as the yellow chat. Seed collection will be undertaken by employees of Kakadu Native Plants Pty Ltd, who have extensive experience collecting seeds from within the park and local Bininj knowledge of listed threatened species. Any cumulative impact on protected species will be minimised by not repeatedly collecting seeds from the same site(s). Seed collection from the proposed collection zone is unlikely to influence or exceed the limits of acceptable change for the yellow chat (number 8), as outlined in BMT WBM (2010). The floodplain habitats of the site (Kakadu National Park) will continue to support the yellow chat in the long term.
C10 – Pig-nosed turtles	Unlikely	Seven floristic species are identified for collection adjacent to aquatic habitats – e.g. along streams, lagoons and swamps. While little is known about the extent of the distribution of pig-nosed turtles, none of the plants identified for seed collection are aquatic (refer Appendix A, Table 1), nor do they require access or seed collection from waterbodies. Therefore seed collection adjacent to aquatic habitats is unlikely to impact on local species' populations or reduce the area of habitat used by species.
C11 – Locally endemic invertebrate species	Unlikely	Seed collection is highly intermittent and random across the seed collection zone; undertaken by a small team, thereby reducing the likelihood of interaction with an entire population of a threatened species. Seed collection will be undertaken by employees of Kakadu Native Plants Pty Ltd, who have extensive experience collecting seeds from within the park and local Bininj knowledge of listed threatened species. Any potential cumulative impacts on protected species will be minimised by not repeatedly collecting seeds from the same site(s). Incidental interactions with locally endemic invertebrate species represent no more disturbance than would be associated with either Bininj being on country for other customary purposes or tourists. Seed collection is unlikely to compromise the limits of acceptable change (number 9) as outlined in BMT WBM (2010): "As a minimum, sites at which each species has previously been recorded will continue to provide habitat for these species, unless it

Critical components	Likelihood of impact	Assessment of potential impacts on each critical component, process or service
		can be demonstrated that the species (i) can re-establish naturally and/or (ii) shows great variability in its presence within a site."
Critical processes		
P1 – Fluvial hydrology	Not applicable	The proposed seed collection activity is unlikely to influence or exceed the limits of acceptable change (number 18) (BMT WBM 2010): "A greater than 20% change in the long-term mean annual flow constitutes an unacceptable change based on the following long-term average values: East Alligator = 6.87 million ML/year South Alligator = 5.75 million ML/year West Alligator/Wildman = 0.815 million ML/year"
P2 – Fire regimes	Not applicable	No areas will be burnt by Kakadu Native Plants Pty Ltd while undertaking seed collection. Therefore, the proposed seed collection activity is unlikely to exceed the limits of acceptable change for fire regimes (number 20), specifically: "The area of wetland burnt per year within individual habitat types will not exceed maximum recorded baseline values outlined in Gill, *et al.* (2000) more than twice over a 20 year period."
P3 – Breeding of waterbirds	Unlikely	While seven of the floristic species identified for collection adjacent to aquatic habitats – e.g. along streams, lagoons and swamps, none of these plants are aquatic (refer Appendix A, Table 1), nor do they require access or seed collection from waterbodies. Seed collection will be undertaken by employees of Kakadu Native Plants Pty Ltd, who have extensive experience collecting seeds from within the park and local Bininj knowledge of the breeding cycles of waterbird species. The Project is unlikely to exceed the limits of acceptable change for critical life stage processes for waterbirds (number 19) (BMT WBM 2010): "Based on expert opinion, the site no longer provides adequate refuge function for important flora and fauna species and populations; OR Based on expert opinion, critical life-cycle processes identified in column 1 (e.g. known feeding sites, roosting sites, breeding sites, etc.) have either substantially diminished (in terms of frequency or extent of usage) or are otherwise no longer being supported (relative to natural variability)."

Critical components	Likelihood of impact	Assessment of potential impacts on each critical component, process or service
P4 – Flatback turtle nesting	Not applicable	While seven floristic species identified for collection adjacent to aquatic habitats – e.g. along streams, lagoons and swamps, the seed collection zone (Appendix A, Table 1), does not extend to known nesting sites of the flatback turtle – e.g. coastal, beach regions. Seed collection is unlikely to impact the limit of acceptable change for flatback turtle nesting (number 7) (BMT WBM 2010): "The average number nesting attempts at core turtle nesting areas on Field Island, as measured over a one week period during the peak breeding period, must not fall below 0.8 attempts/night in three successive years (20% reduction in the minimum baseline value of one attempt a night during the peak breeding season)."
Critical services/benefits		
S1 – Maintenance of global biodiversity	Unlikely	Seed collection from the proposed collection zone (Appendix A, Figure 1) will adhere to best practice guidelines of collecting no more than 20% of the available seed of a population. The guidelines will be applied in combination with a collecting regime where collecting will not occur from the same population/individual in two consecutive years, thus preventing any potential exponential increase in impacts to MNES through repeat collection (Cochrane *et al.,* 2009). Seed collection activities are unlikely to have an impact on the maintenance of global biodiversity, as per the limits of acceptable change 5, 6, 7, 8, and 9 in (BMT WBM 2010).
S2 – Fisheries resource values	Unlikely	While seven of the floristic species identified for collection adjacent to aquatic habitats – e.g. along streams, lagoons and swamps, none of these plants are aquatic (refer Appendix A, Table 1), nor do they require access or seed collection from waterbodies. Seed collection activities are is unlikely to affect the limit of acceptable change (14 and 15) whereby the average abundance of barramundi and other freshwater fish species falls below minimum recorded values for Sandy and Mudginberri Billabongs.
S3 – Contemporary living culture	Unlikely	Kakadu Native Plants Pty Ltd is a wholly owned Bininj business that currently employs local Bininj staff. The land management activities of Kakadu Native Plants Pty Ltd (including seed collecting) result in Bininj being on country, which is important for maintaining customary traditions. The proposed action will also facilitate on-country activities which will encourage intergenerational transfer of knowledge to the younger Bininj generation. In this context, the proposed activities are consistent with EPBC Regulations, Schedule 8, Part 1, Principles, 4 and 5 and maintaining the integrity of the IUCN principles listed under Schedule 8, Part 2.

Critical components	Likelihood of impact	Assessment of potential impacts on each critical component, process or service
		BMT WBM (2010) states: *"Due to the lack of quantitative data regarding "living culture" attributes, the limits of acceptable change are unable to be defined quantitatively."* However, for limit of acceptable change 22, it is unlikely that the proposed seed collection activity will affect the ability of Bininj to own, occupy, access and use the land and resources of Kakadu National Park, which could result in a loss of 'living culture'. Conversely, it is likely that the proposed seed collection activity will facilitate Bininj to use and transmit Bininj cultural practices, knowledge, language and spirituality, thereby promoting 'living culture'.

4.7 Commonwealth Land

Approximately 50% of Kakadu National Park is Aboriginal land under the Commonwealth *Aboriginal Land Rights (Northern Territory) Act [1]976*. Most of the remaining area of land is under claim by Aboriginal people. Title to Aboriginal land in the Park is held by the Kakadu Aboriginal Land Trust, which has leased the land to the Director of National Parks (Australian Government), under the EPBC Act, for management of a Commonwealth reserve, i.e. national park. The remaining area of the Park is Commonwealth land vested under the Director of National Parks (BMT WBM 2010). Commonwealth land includes land owned or leased by the Commonwealth, or a Commonwealth agency, and land that is included in a Commonwealth reserve.

The potential for impacts to affect Commonwealth land are assessed in **Table C11** against the criteria provided in the Commonwealth *Significant impact guidelines 1.2 Environment Protection and Biodiversity Conservation Act 1999* (SEWPaC 2013).

Table C11: Assessment of impacts on Commonwealth land

Impact criterion[1]	Assessment of potential impacts
Impacts on landscapes and soils	
Is there a real chance or possibility that the action will:	
Substantially alter natural landscape features	Not applicable. Seed collection will be undertaken by employees of Kakadu Native Plants Pty Ltd, who have extensive experience collecting seeds from within the park, consistent with the principles of ecologically sustainable use. Furthermore, seed collected and propagated for use in the revegetation of the RPA will, long term, result in a positive impact by establishing a contiguous habitat with surrounding vegetation.

Impact criterion[1]	Assessment of potential impacts
Cause subsidence, instability or substantial erosion	Not applicable. Seeds will often be collected from individual plants with ripe fruits/seeds that are visible from existing access tracks/roads. Collection is highly intermittent and random across the seed collection zone; undertaken by a small team, thereby reducing the likelihood of causing subsidence, instability or substantial erosion.
Involve medium or large-scale excavation of soil or minerals	Not applicable.
Impacts on coastal landscapes and processes	
Is there a real chance or possibility that the action will:	
Alter coastal processes, including wave action, sediment movement or accretion, or water circulation patterns	
Permanently alter tidal patterns, water flows or water quality in estuaries	Not applicable. The proposed seed collection zone (Appendix A, Figure 1) does not extend to coastal estuaries.
Reduce biological diversity or change species composition in estuaries	
Extract large volumes of sand or substantially destabilise sand dunes	
Impacts on ocean forms, ocean processes and ocean life	
Is there a areal chance or possibility that the action will:	
Reduce biological diversity or change species composition on reefs, seamounts or in other sensitive marine environments	
Alter water circulation patterns by modification of existing landforms or the addition of artificial reefs or other large structures	Not applicable. The proposed seed collection zone (Appendix A, Figure 1) does not extend to coastal regions.
Substantially damage or modify large areas of the seafloor or ocean habitat, such as sea grass	
Release oil, fuel or other toxic substances into the marine environment in sufficient quantity to kill larger marine animals or alter ecosystem processes	
Release large quantities of sewage or other waste into the marine environment	

Impact criterion[1]	Assessment of potential impacts
Impacts on water resources	
Is there a real chance or possibility that the action will:	
Measurably reduce the quantity, quality or availability of surface or groundwater	Not applicable. The proposed seed collection zone (Appendix A, Figure 1) does not include any practices that will impact on water resources.
Channelise, divert or impound rivers or creeks or substantially alter drainage patterns	
Measurably alter water table levels	
Pollutants, chemicals and toxic substances	
Is there a real chance or possibility that the action will:	
Generate smoke, fumes, chemicals, nutrients or other pollutants which will substantially reduce local air quality or water quality	Not applicable. The proposed seed collection activity does not include any practices that will impact on air quality to a greater extent than is currently experienced in the park from fire burning regimes and/or tourism.
Result in the release, leakage, spillage, or explosion of flammable, explosive, toxic, radioactive, carcinogenic, or mutagenic substances, through use, storage, transport or disposal	Not applicable. The proposed seed collection activity does not include any practices that will results in release, leakage, spillage, or explosion of flammable, explosive, toxic, radioactive, carcinogenic, or mutagenic substances.
Increase atmospheric concentrations of gases which will contribute to the greenhouse effect or ozone damage	Not applicable. The proposed seed collection activity does not include any practices that will increase atmospheric concentrations of gases to a greater extent than is currently experienced in the park from fire burning regimes and/or tourism.
Substantially disturb contaminated or acid-[sulfate] soils	Unlikely. Acid sulfate soils within the Magela Creek floodplain will not be substantially disturbed by the proposed collection of seed.
Impacts on plants	
Is there a real chance or possibility that the action will:	
Involve medium or large-scaled native vegetation clearance	Not applicable. The proposed seed collection activity does not include any practices that will results in vegetation clearance.
Involve any clearance of any vegetation containing a listed threatened species which is likely to result in long-term decline in a population or which threatens the viability of the species	Not applicable. The proposed seed collection activity does not include any practices that will results in any vegetation clearance containing listed threatened species.

Impact criterion[1]	Assessment of potential impacts
Introduce potentially invasive species	Unlikely. Effective operational pest management procedures and hygiene will apply during both seed collection and propagation activities to prevent the potential spread of disease/pathogens such as myrtle rust, which has not currently been detected in KNP. The proposed action is unlikely to introduce a disease (e.g. myrtle rust) that would impact threatened species. For comparison, between 96,000 and 124,000 national and international tourists visited KNP during 2014 and 2015, respectively (Daily Telegraph 2016). This represents a greater potential threat of introducing disease/pathogens to KNP than seed collection by a small team of local indigenous people.
Involve the use of chemicals which substantially stunt the growth of native vegetation	Not applicable. No chemicals will be used during the collection of native seeds.
Involve large-scale controlled burning or any controlled burning in sensitive areas, including areas which contain listed threatened species	Not applicable. No areas will be burnt by Kakadu Native Plants Pty Ltd while undertaking seed collection.

[1] Criterion sourced from (SEWPaC 2013).

5 REFERENCES

AHC (2009) *Guidelines for the Assessment of Places for the National Heritage List*, Australian Heritage Council. <http://www.environment.gov.au/resource/guidelines-assessment-places-national-heritage-list>.

BMT WBM (2010) *Ecological Character Description for Kakadu National Park Ramsar Site*, Prepared for the Australian Government Department of Sustainability, Environment, Water, Population and Communities, p 268. <http://www.environment.gov.au/water/publications/environmental/wetlands/pubs/2-ecd.pdf>.

Cochrane, A, Crawford, AD & Offord, CA (2009) Chapter 3: Seed and vegetative material collection. In: Offord, CA & Meagher, PF (eds.) *Plant Germplasm Conservation in Australia strategies and guidelines for developing, managing and utilising ex situ collections*. Australian Network for Plant Conservation in partnership with Australian Seed Conservation and Research.

Cowie, ID (2011) "New taxa and notes on *Helicteres* L. (Malvaceae: Helicteroideae) from the Northern Territory, Australia." In: *The Beagle: Records of the Museums and Art Galleries of the Northern Territory*. January 2011.

Daily Telegraph (2016) *Visitor numbers down at Kakadu National Park.* http://www.dailytelegraph.com.au/news/visitor-numbers-down-at-kakadu-national-park/news-story/0b0842b50323a43d9c693316cb4cd7f8. Viewed online: 9 March 2017.

Department of Land Resource Management (2017). NT Species_Atlas_Fauna dataset. https://nt.gov.au/environment/environment-data-maps/environment-data-requests. Spatial data package downloaded February 2017.

Department of the Environment (2008) *Approved conservation advice for Epthianura crocea tunneyi (Yellow Chat (Alligator Rivers)).* <http://www.environment.gov.au/biodiversity/threatened/species/pubs/67089-conservation-advice.pdf>. Viewed online: 20 October 2013.

Department of the Environment (2014a) World Heritage Places – Kakadu National Park. <http://www.environment.gov.au/node/19775>. Viewed online: 26 February 2014.

Department of the Environment (2014b) *Australian Wetlands Database. Ramsar wetlands.* <http://www.environment.gov.au/cgi-bin/wetlands/ramsardetails.pl?refcode=2>. Viewed online: February 26 2014.

Department of Environment (2013) *Significant Impact Guidelines 1.1 - Matters of National Environmental Significance,* DoE, <http://www.environment.gov.au/epbc/publications/nes-guidelines.html>. Viewed online: 10 June 2014. p 35.

Department of the Environment & Energy (2017). *Species of National Environmental Significance.* Species of National Environmental Significance (public grids) GIS data: http://www.environment.gov.au/fed/catalog/search/resource/details.page?uuid=%7B337B05B6-254E-47AD-A701-C55D9A0435EA%7D. Spatial data package downloaded February 2017.

Department of the Environment (2017). Species Profile and Threats Database (SPRAT). http://www.environment.gov.au/cgi-bin/sprat/public/sprat.pl. Viewed online: March 2017.

Gill, A, Ryan, P, Moore, P & Gibson, M (2000) 'Fire regimes of world heritage Kakadu National Park, Australia', *Austral Ecology* 25: 616-625.

Lehmann, C, Prior, L, Williams, R & Bowman, D (2008) 'Spatio-temporal trends in tree cover of a tropical mesic savanna are driven by landscape disturbance', *Journal of Applied Ecology* 45: 1304 - 1311.

NAFI (2015) *Kakadu fire scars by year report: 2005 - 2015*. Report by NAFI, 13 November 2015.

Northern Territory Government (2017). Flora NT. Northern Territory Flora Online. http://eflora.nt.gov.au/search?heading=sNTFlora. Viewed online: March 2017.

Northern Territory Government (2017). Threatened animals. https://nt.gov.au/environment/animals/threatened-animals. Viewed online: March 2017.

Riley, S & Lowry, J (2002) *An initial assessment of changes to the Melaluca distribution on a selected area of the Magela Floodplain using aerial photography*, Internal Report 394, Supervising Scientist, Darwin Unpublished paper, Sep-02, p 23.

Russell-Smith, J, Ryan, P & Durieu, R (1997) 'A LANDSAT MSS-derived fire history of Kakadu National Park, monsoonal Northern Australial, 1980-94: Seasonal extent, frequency and patchiness', *Journal of Applied Ecology* 34 (3): 748-66.

Setterfield, S (1997) 'The impact of experimental fire regimes on seed production in two tropical eucalypt species in northern Australia', *Australian Journal of Ecology* 22: 279 - 287.

Setterfield, S (2002) 'Seedling establishment in an Australian tropical savanna: effects of seed suppply, soil disturbance and fire', *Australian Journal of Ecology* 39: 949 - 959.

SEWPaC (2013) *Actions on, or impacting upon Commonwealth land, and actions by Commonwealth agencies. Significant impact guidelines 1.2 Environment Protection and Biodiversity Conservation Act 1999*, Australian Government. Department of Sustainability, Environment, Water, Population and Communities.

Woinarski, J (2004). Threatened plants and animals in Kakadu National Park: a review and recommendations for management. Report to Parks Australia North. Project # NHTKNP01, September 2004; p 185. https://denr.nt.gov.au/__data/assets/pdf_file/0020/255062/2004WoinarskiJ.ThreatenedplantsandanimalsinKakaduNationalPark.pdf. Viewed online: March 2017.

Woinarski, J & Armstrong, M (2006) *Epthianura crocea tunneyi. Threatened Species of the Northern Territory Information Sheet,* Department of Land Resource Management, Northern Territory Government, <http://www.lrm.nt.gov.au/__data/assets/pdf_file/0017/10853/yellow_chat_en.pdf>. Viewed online: August 2013.