

Weed Survey of the Amrun Project Area, July 2016




Final Report

Prepared for
Rio Tinto Amrun Project.

4th August 2016

Cover Photo: The weed Grader Grass (*Themeda quadrivalvis*) at Pera Head cliffs

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1. Introduction

1.1 Background and Scope

Ecotone Environmental Services previously undertook baseline weed surveys of the Amrun Project Area in July 2013 and July 2015 to document the incidence of exotic weeds prior to project development. The current survey reported here comprised a repeat Annual Weed Survey similar to those conducted in 2013 and 2015 plus a Periodic Weed Survey targeting additional areas more removed from past and current Rio Tinto activity but where weeds may become established via public or Traditional Owner visitation. The implementation of both of these weed surveys is outlined in the Land Use Management Plan and Terrestrial Management Plan for the Amrun Project. The objective of these surveys was to determine whether there had been any major changes in the status of exotic weed species within the project area since the previous weed surveys and following targeted treatment of identified weeds conducted in late 2015.

The previous surveys documented the baseline level of incidence of exotic weeds within the project area, associated with limited levels of clearing and site development works by plant and other machinery during the assessment and exploration phases of the project, or along certain tracks re-cleared in 2012 to support field activities. The Annual Weed Survey re-surveyed these access routes, with some additional, more detailed inspections to sites which could not be easily accessed in previous visits conducted as part of the Periodic Weed Survey.

2. Survey Approach

The survey utilised the rapid survey method approach of the previous surveys whereby inspections were undertaken from a slow-moving vehicle along the tracks and roads to be inspected, with supporting foot-based inspections at key locations. For some of the Periodic Weed Survey locations only foot based access was possible.

The survey recorded all exotic plant species present, including all scheduled weeds and weeds of significance under Queensland and Commonwealth legislation and provisions. Areas included in the Annual Weed Survey are shown in **Figure 2-1**, and comprised:

- Boyd Point car park and access track;
- Boyd Point laydown and office area;
- Hey Point boat landing;
- Hey Point laydown/parking area;
- Tracks cleared for field work in 2012;
- Recent additional access tracks cleared for site development, and
- all main access tracks throughout the Amrun Project area including:
 - Beagle Camp-Boyd Bay
 - Seismic line Boyd Bay-Winda Winda Ck
 - Beagle Camp-Amban
 - Waterfall (Ina Ck) track
 - Hey Point track

The scope for the Annual Weed Survey will change as additional development occurs within the project area, adding additional locations to be surveyed.

Areas included in the Periodic Weed Survey included:

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The survey involved slow vehicle traverses (approx. 20-40km/h depending on conditions) along the tracks observing the vegetation at the side of the tracks and up to 10m in to the woodland. This approach was based on the premise that weed translocation into the area was most likely to occur via vehicles and that weeds, if present, would initially colonise areas where vehicles had been operating especially tracks, laydown areas and parking areas. At discrete locations where there had been intensive vehicle visitation such as the Boyd Bay laydown area and Boyd Point car park area, areas were inspected closely on foot. The position of any located weeds was recorded using GPS and a description of the general weed occurrence made including species present, numbers, spatial distribution, growth stage etc.

The initial identification of exotic weed species was undertaken by ecologist Jason Searle in the field. Any plants suspected to be potential new weed were identified were collected, and submitted for later confirmation by the Queensland Herbarium. This approach allows for any new weeds to the Amrun Project area to be positively identified, and also eliminates any unusual looking or otherwise unrecorded plants not regularly encountered in prior surveys of the site to be identified and eliminated from contention as new weed species.

3. Results and Discussion

3.1 Weed Species Identification

A list of all known exotic weed species recorded at the Amrun site during recent field surveys (July 2013 onwards) is shown in **Table 3-1** below.

Table 3-1. Summary of Known Weed Species for the Amrun Area (up to June 2016).

Scientific Name	Common Name	Herbarium Identification
<i>Andropogon gayanus</i>	gamba grass	Matched with specimens from confirmed infestation at Andoom mine
<i>Themeda quadrivalvis</i>	grader grass	Confirmed BRI - 720/15, 27 Aug 2015
<i>Cenchrus pedicellatus subsp unispiculus</i>	pennisetum grass	Confirmed BRI - 571/16, 29 Jul 2016
<i>Cenchrus echinatus</i>	spiny sandbur	Not yet referred to BRI
<i>Stylosanthes scabra</i>	stylo	Matched with specimens from confirmed infestation at Weipa mine
<i>Sida acuta</i>	smooth sida	Retained BRI - 623/10, 9 Aug 2010
<i>Hyptis suaveolens</i>	hyptis	Matched with specimens from confirmed infestation at Weipa mine
<i>Crotalaria goreensis</i>	rattlepod	Retained BRI - 623/10, 9 Aug 2010
<i>Passiflora foetida</i>	stinking passionflower	Matched with specimens from confirmed infestation at Andoom mine
<i>Mitracarpus hirtus</i>	tropical girdlepod	Confirmed BRI - 348/16, 10 May 2016

This list formed the baseline “search” list for the current weed surveys with any additional suspected weed species also collected and sent to the Queensland Herbarium for positive identification. The identification results and accompanying images of these additional “suspected” weed species are included in **Appendix B**, and summarised in **Table 3-2** below.

Table 3-2. Summary of Potential Weed Species and confirmed identification.

Tentative Field Identification		Confirmed Herbarium Identification	
<i>Aristida / Eriachne sp.</i>	a grass	<i>Capillipedium sp.</i> (indeterminate)	Confirmed native
<i>Desmodium sp.</i>	a legume	<i>Desmodium brachypodum</i>	Confirmed native
<i>Boerhavia sp.</i>	boerhavia	<i>Boerhavia dominii</i>	Confirmed native
<i>Dicliptera sp.</i>	a forb	<i>Dicliptera ciliata</i>	Confirmed native
<i>Flemingia sp.</i>	a legume	<i>Tephrosia laxa</i>	Confirmed native
<i>Eragrostis sp.</i>	a grass	<i>Eragrostis schultzei</i>	Confirmed native

Of the potential weed species collected and referred to the Queensland Herbarium, all were confirmed as native species, not weeds.

A single fertile stem of gamba grass (*Andropogon gayanus*) was recorded at the Boyd Bay beach access steps within the quarantine fencing at the site of the previous infestation of this species (see **Appendix C**, Images C1 and C2). No other signs of gamba grass were recorded within the Amrun area during the June 2016 field surveys. The tall native lemon grass (*Cymbopogon globosus*), which has previously been confused with gamba grass in the field, was again observed in flower throughout the Amrun lease area in June 2016. A comparison of these two similar grasses is included in **Appendix C** (Images C3 and C4).

Large infestations of gamba grass were again seen outside the project area, flowering en-masse along the verges of the Peninsula Developmental Road in the vicinity of York Downs Station, and represent the major source of weed material in the vicinity of the Amrun site.

In the previous weed survey in July 2015, large dry sections of *Themeda* grasses were recorded along the verges of tracks, and due to their deteriorating condition it was sometimes difficult to distinguish between the native wallaby grass (*Themeda arguens*) and the exotic grader grass (*Themeda quadrivalvis*) (see Images C5 and C6, **Appendix C**). It was again confirmed in the current surveys that native wallaby grass *Themeda arguens* was relatively widespread along track verges and also in native forest areas throughout the Amrun Project area, whilst the exotic grader grass (*Themeda quadrivalvis*) was restricted to a few locations.

3.2 Overall Weed Species Distribution and Abundance

Previous (July 2013 and 2015) weed surveys of the Amrun Project area recorded regular low incidences of grader grass (*Themeda quadrivalvis*), stylo (*Stylosanthes scabra*), hyptis (*Hyptis graveolens*) and smooth sida (*Sida acuta*) along established track margins, typically occurring as isolated or scattered patches of one or two of these weed species. This same general pattern of distribution of exotic species is also reflected in the results of the current survey. The incidence of all weed species recorded in the project area during the June 2016 weed survey is shown in **Figure 3-3**. Note that when comparing the two maps below, some additional areas were surveyed during 2016 and provide a false impression that weeds had established in new areas since 2015; e.g. the Aurukun Rd. near Aurukun.

The full results of the current weed survey of the Amrun Project area are presented in **Appendix D**. Although these results show a similar distribution to the previous (July 2015) weed survey (also shown in **Figure 3.3** (right)), the overall abundance of weeds appears to have declined from July 2015 to June 2016, especially on the margins of the more accessible tracks.

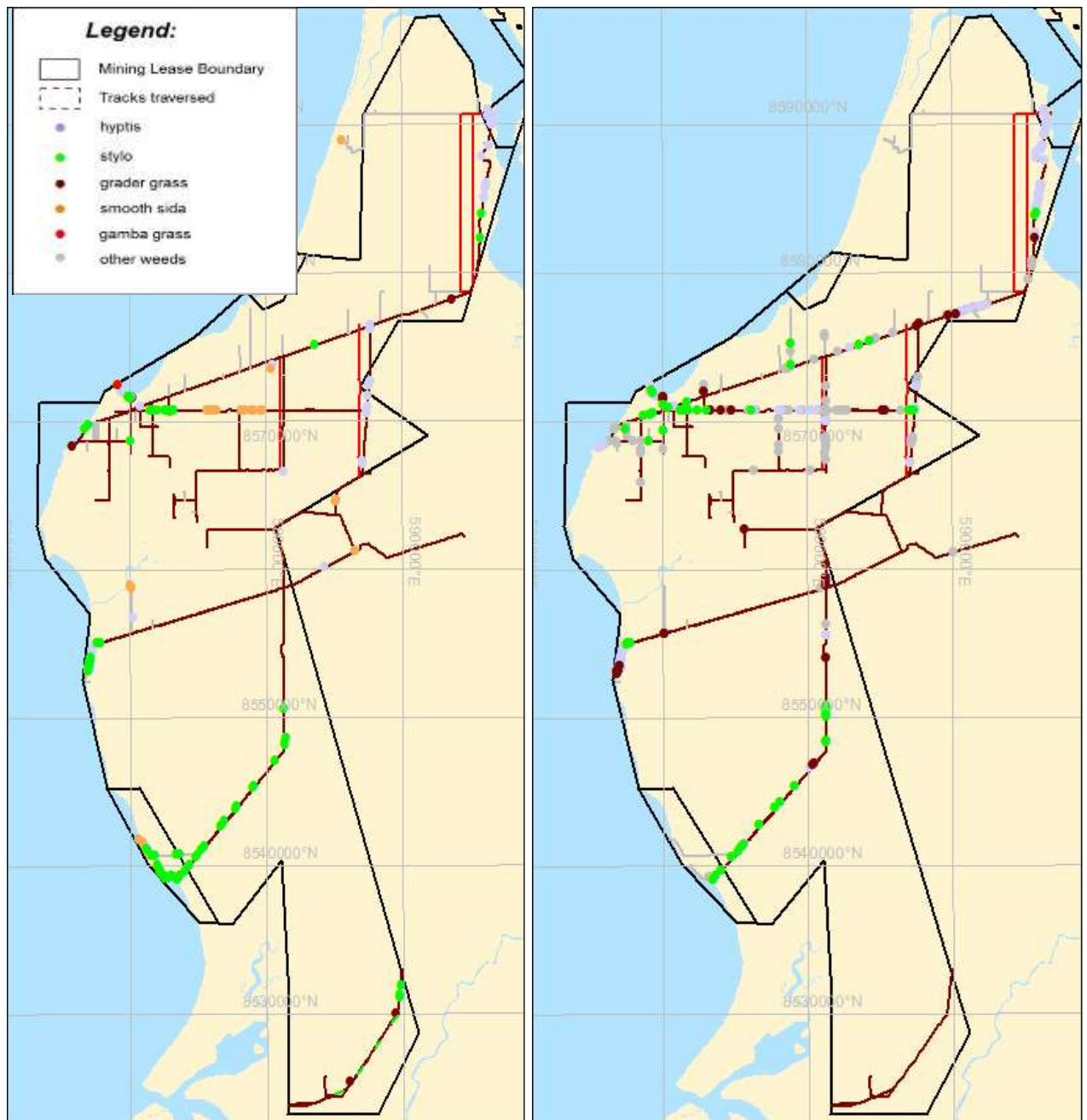


Figure 3-3 Comparative locations of weeds within the Amrun Project area [June 2016 (left) vs July 2015 (right)]

This apparent decline in overall weed distribution over the past 12 months can be explained by several factors, including:

1. Seasonally dry conditions. Road verge grasses (grader grass etc) and the seasonally green hyptis (*Hyptis suaveolens*) appear to have declined in overall abundance as a result of poor seasonal rains, and are not as prominent in locations where they were previously infested (see Image C18, **Appendix C**). Woody perennial weeds (especially smooth sida and stylo) are now the most conspicuous weeds along the road verges in several locations, with sida in particular appearing to have increased in some locations (70,000 line, Norman Creek landing site etc). This however was explained by the confirmation of the similar native plant species (sleepy morning, *Waltheria indica*), which was found to occur naturally along the sides of tracks in these locations;

2. Weed treatment activities. The weed management crew from Weipa visited the site and undertook weed treatment at the Boyd's Bay access steps (quarantine area), and also appear to have undertaken some routine weed management along the margins of some of the main access tracks being used regularly by light vehicles and heavy machinery. This has resulted in decline in overall abundance of weeds across the more accessible areas of the site. However, these weed management activities appear not to have extended to the more remote ends of some access areas, such as the Waterfall and Ina Creek tracks, where stylo in particular has several denser infestations;
3. Road upgrading and maintenance. Several of the main access tracks have been upgraded or re-graded over the past 12 months, including the Seismic Line, Norman Creek water filling station, and Hey Point access circuit. The verges of these areas have been covered in fresh soil and are likely to have smothered many of the weeds and seed store present (see Image C18, **Appendix C**).

Although the incidence of weeds is generally low and appears to have declined over the Amrun Project area over the past 12 months, it will be important to continue a regular weed management program across the site to keep the incidence of weeds low, as the overall risk of weeds spreading has increased as a result more open areas as a result of site clearing, and more machinery moving across the site.

3.3 Non-listed Weed Species

This section focuses on weeds that are not listed as Weeds of National Significance (WoNS) Strategy, nor scheduled under relevant biosecurity Queensland legislation.

The most commonly encountered weeds across the site generally are hyptis (*Hyptis suaveolens*), stylo (*Stylosanthes scabra*) and smooth sida (*Sida acuta*), with these later two woody perennial weeds currently appearing to be more persistent in the unusually dry conditions over the past 12 months. As these are currently at low levels and largely restricted to access tracks and other open areas, a good opportunity currently exists to effect enhanced weed management across the site, and reduce the incidence of these species to a minimal baseline level prior to the return of better growing conditions. Special care will however need to be taken to ensure the similar looking native woody perennial sleepy morning (*Waltheria indica*) is not treated as a weed and removed in locations where it occurs adjoining access tracks.

Similarly, grader grass (*Themeda quadrivalvis*) and pennisetum grass (*Cenchrus pedicellatus subsp unispiculus*) and other less common weed species (*Mitracarpus hirtus*, *Passiflora foetida*, *Cenchrus echinatus* and *Crotalaria goreensis*) are currently restricted to a few locations, and could similar be controlled with the implementation of localised weed spraying in the short-term before they are given the chance to increase.

Key focal areas for short-term weed management include:

- Major access tracks (70,000 line, Hey Point original track and laydown area, Waterfall and Ina Creek tracks);
- Boyd Bay campsite and access track to steps, to minimise large localised infestations of grader grass, buffel grass, hyptis and stylo);
- The peripheral end of the Waterfall and Ina Creek Tracks (heavy trackside infestations of stylo);
- Open coastal areas (Amban Point and Pera Swap campsite areas, Waterfall Creek and Ina Creek outstation sites), especially for hyptis but also other weed species;

These non-listed weed species are primarily environmental weeds that readily colonise roadside and disturbed soil, but generally don't penetrate easily into native forest areas. These weeds are

therefore unlikely to be especially problematic across the Amrun Project area as they are unlikely to colonise further into undisturbed woodland. However these weeds are readily spread by machinery and colonise disturbed areas, and are likely to proliferate in disturbed areas as activities in the project area increase over time, and will nonetheless require on-going monitoring and treatment to ensure their populations are managed and controlled.

3.4 Listed Weed Species

This section addresses weeds that are classed as restricted invasive plants under the Queensland *Biosecurity Act 2014*, or are listed as Weeds of National Significance (WoNS) by the Commonwealth Government. The nation's 32 worst weeds are listed under the WoNS Strategy, and are targeted for management under the Biosecurity legislation of the State in which they occur. The Queensland *Biosecurity Act 2014* came into force on 1 July 2016 and replaces previous legislation in which certain weed species were Declared Plants and required various levels of management or intervention by landholders.

Gamba grass (*Andropogon gayanus*) is the only weed species currently listed under the Queensland *Biosecurity Act 2014* which has been recorded and is known to occur within in the Amrun Project area, and its known occurrence is restricted to the quarantined weed treatment area at Boyd's Bay, where a single specimen was recorded in the June 2016 field surveys. Gamba grass is now naturalised in northern Australia, and currently occurs in scattered populations estimated to total of 60,000ha across Queensland's north, with most sites on Cape York Peninsula and Atherton Tableland (Queensland Government, 2016). A Management Plan has recently been developed for the control of gamba grass in North Queensland by the Far North Queensland Region of Councils (FNQROC, 2016), highlighting the invasiveness of gamba grass and the sourcing of \$750,000 funding for its control in 2015-2016.

The Queensland *Biosecurity Act 2014* prohibits the release of gamba grass into the environment, and requires all parties to take all reasonable and practical steps to minimise the risks associated with restricted invasive plants on lands under their control (called a general biosecurity obligation, or GBO). The quarantined site and surrounding area at Boyd's Bay will therefore need to be monitored and treated for gamba grass as a high priority. It is recommended that this area be monitored and if required treated for gamba grass at least every six months for a period of at least three years to ensure the current infestation is eradicated. Hand removal of plants provides a valid treatment option for the small number of plants typically occurring there.

Other Weeds of National Significance potentially present or with a higher likelihood of establishing on site within the Amrun Project area include rubber vine (*Cryptostegia grandiflora*), hymenachne (*Hymenachne amplexicaulis*) and several species of exotic asparagus ferns (*Asparagus* spp.) listed under WoNS and Queensland legislation. An exotic asparagus fern (*Asparagus* spp.) was previously identified for the site, but based on consideration of fruiting specimens observed during this survey it is most likely to have been the native asparagus (*Asparagus racemosus*) (see Image C7, **Appendix C**), as only this native species was recorded in the current field surveys. Ongoing periodic monitoring of the Amrun lease area should therefore be undertaken regularly to ensure none of these or other exotic species become established at this site.

3.5 Summary Recommendations

The Amrun Project area currently has a low incidence of exotic weed species, suggesting that the site can be managed in a relatively weed-free condition into the operational phase of the mining operations if a regular weed monitoring and treatment program is implemented at the site.

In addition, the incidence of most exotic weeds appears to have stabilised or slightly declined over the past 12 months, suggesting that weeds can be managed in a cost-effective manner in the immediate future, and no large scale control measures are required on the site in the short term.

Priorities for weed management and control are therefore summarised as:

- Implement prioritised early wet-season treatment and ongoing routine monitoring of gamba grass and other exotic plant species at and in the vicinity of the Boyd Bay quarantine area. This area, extending back up the access track to the initial campsite, has a high incidence of exotic species, which should be treated as a priority once the first new growth commences in the early wet-season of late 2016. This should minimise ongoing incidences of weeds at this site, although regular follow-up monitoring should be undertaken (as a priority for gamba grass, but also for other exotic species), to identify any additional treatments required should initial treatments not be fully effective.
- Ensure an appropriate weed monitoring and treatment program is put in place across the broader project area to detect any increased incidences of weeds or new weed infestations, and act on these early to prevent broad-scale infestation during the construction and early operational stages of minesite development in the Amrun Project area;
- Ensure appropriate controls such as weed washdown procedures and facilities are established at the entry to the site to prevent the introduction of weed sources. Ideally this would be operational prior to the 2016/17 wet season. Maintenance of this facility to ensure it is continually operational should also be a priority for weed control on site;
- Undertake maintenance-level weed control along existing tracks and access points to control and reduce the incidence of established non-listed weed species (especially *Themeda quadrivalvis*, *Stylosanthes scabra* and *Hyptis graveolens*), particularly in those locations where they are known to occur (as shown in **Figure 3-3**). In this regard, the more peripheral areas (notably Waterfall Creek, Ina Creek track heads; Amban and Pera Swamp campsite areas) should be a focus point to control these species. It may be useful to target perennial woody weeds (*Stylosanthes scabra*, *Sida acuta*) in the short-term as these appear to have persisted most stubbornly over the last 12 months. Both these woody weeds have hairy leaf surfaces and may have been less responsive to recent treatment, and higher levels of surfactant may be appropriate when the herbicide is applied in future treatments.;
- Promote proactive management of gamba grass (currently the greatest risk and most threatening invasive weed for the site) at major source areas in the surrounding region, in particular on the roadside of the Peninsula Developmental Road at York Downs Station en-route to Amrun. Significant eradication of these source populations of this threatening major weed would significantly reduce the risk of this weed establishing on site, and consequently reducing ongoing weed management costs into the future. A site entry weed washdown facility and associated procedures would similarly reduce this risk.

4. References

Queensland Government (2016a) Queensland Government Business & Industry Portal Website, Declared Weeds. <https://www.business.qld.gov.au/industry/agriculture/species/declared-pests/weeds/gamba-grass>. Accessed 17 July 2016.

Queensland Government (2016b) Queensland Government Business & Industry Portal Website, Declared Weeds. <https://www.business.qld.gov.au/industry/agriculture/species/declared-pests/weeds/gamba-grass>. Accessed 17 July 2016.

5. Appendices

Appendix A Schedule of Data Deliverables

Appendix B Weed Species Identification Data

Appendix C Survey Site Images

Appendix D Survey Results – Amrun Project Area

Appendix E Distribution Maps for Individual Weed Species

Appendix A Schedule of Data Deliverables

Data Type	Filename
Raw survey data	<i>Lease Weed Data 12Jul16.xlsx</i>
Summary species list	<i>N/A</i>
Survey site locations	<i>Survey_locations_2016.shp</i>
Survey trackers	<i>N/A</i>
Survey coverage polygons (flora and fauna)	<i>N/A</i>
Polyline tracks/Waypoints	<i>N/A</i>
GIS map output files	<i>Weed_locations_2016.shp</i> <i>Access_tracks_2016.shp</i> <i>Figure2_Legend_2016.shp</i>
Reference images	<i>N/A; included in report</i>
Details of Herbarium/Museum specimen	<i>N/A; included in report</i>
Flora fauna data	<i>N/A</i>

Appendix B Weed Species Identification Results

Queensland Herbarium

Brisbane Botanic Gardens Mt Coot-tha • Toowong 4066 Queensland • Australia
Telephone +61 7 3896 9326 • Facsimile +61 7 3896 9624
e-mail Queensland.Herbarium@qld.gov.au
<http://www.qld.gov.au/herbarium>

Enquiries: Melinda Laidlaw
Telephone: 07 3896 9318
Your reference:
Our reference: MJL: 571/16



Department of
Science, Information Technology
and Innovation

29 July 2016

Jason Searle
57 Fifteenth Ave
PALM BEACH 4221

Dear Jason

The botanical specimens received by the Queensland Herbarium on 20 July 2016 have been identified/confirmed as:

JS16029 **Cenchrus pedicellatus* subsp. *unispiculus*
JS16030 *#Chrysopogon* sp. Does not match existing material
JS16031 *Capillipedium* sp. Fertile material is required for identification
JS16032 *#Desmodium brachypodium*
JS16033 *#Boerhavia dominii*
JS16034 *Canavalia rosea*
JS16035 *#Cyperus stoloniferus*
JS16036 *#Dicliptera ciliata*
JS16037 *#Plumbago zeylanica*
JS16038 *Jasminum didymum* subsp. *didymum*
JS16039 *#Tephrosia laxa*
JS16040 *#Eragrostis schultzei*
JS16041 *Waltheria indica*
JS16042 *#Cymbopogon globosus*

* Naturalised, non-native species

These specimens have been retained for incorporation into the Herbarium collection, with thanks.

There is a charge of \$427.20 (4 hrs @ \$106.80 per hr incl GST) for these identifications and a tax invoice and receipt are enclosed.

Yours sincerely

G.P.Guymer
Director

Download a full version of Census of the Queensland Flora 2015
<https://data.qld.gov.au/dataset/census-of-the-queensland-flora-2015>

Appendix C Images



Image C1. Gamba Grass (*Andropogon gayanus*), a single fertile stem located within the quarantine fencing at the site of the previous infestation of this weed at the Boyd's Bay access steps.



Image C2. Young flower spike of Gamba Grass (*Andropogon gayanus*).



Image C4. Inflorescence of Gamba Grass (*Andropogon gayanus*), part of a large roadside infestation at York Downs.



Image C3. Inflorescence of the tall native grass *Cymbopogon globosus*, growing within the Amrun mining lease.



Image C5. The exotic grass *Themeda quadrivalvis* (Grader Grass), local incidences of this weed occur along track edges in the Amrun Project area, including the Boyd's Bay beach access track.



Image C6. The native grass *Themeda arguens* (Wallaby Grass), closely related to the weed species Grader Grass and widely distributed throughout the Amrun Project area, particularly long track edges.



Image C7. Formerly suspected as an exotic weed, the Native Asparagus (*Asparagus racemosus*) is uncommon but widely distributed across native forest throughout the Amrun Project area.



Image C8. Sleepy morning (*Waltheria indica*) is a woody native species similar to and confused with the exotic weed Smooth Sida (*Sida acuta*).



Image C9. An unidentified *Capillipedium* (recorded as *Aristida* sp JS16035) was suspected as a weed species. This grass could not be positively identified, but belongs to one of the two native species of *Capillipedium* present in the Weipa region.



Image C10. Formerly suspected as an exotic weed, the native Large Tick-trefoil (*Desmodium brachypodum*) is uncommon across native forest throughout the Amrun Project area.



Image C11. Formerly suspected as an exotic weed, the native *Dicliptera ciliata* was largely restricted to littoral rainforest on sand (Amban Point) within the Amrun Project area.



Image C12. Formerly suspected as an exotic weed, the native tar vine (*Boerhavia dominii*) was largely restricted to coastal areas (Boyd's Bay, Amban Point) within the Amrun Project area.



Image C13. Formerly suspected as an exotic weed, the native tephrosia (*Tephrosia laxa*) is uncommon in native forest throughout the Amrun Project area.



Image C14. Tropical girdlepod (*Mitracarpus hirtus*) is as an exotic weed first recorded at Amban campsite in the Amrun Project area in early April 2016 .



Image C15. Pennisetum grass (*Cenchrus pedicellatus subsp unispiculus*) is an exotic weed that appears to be largely restricted to the Boyd's Bay campsite area in the Amrun Project area, where there is a heavy infestation at this site clearing.



Image C16. The Amban campsite area is heavily infested with weeds in the open clearings, particularly stylo (*Stylosanthes scabra*) and hyptis (*Hyptis suaveolens*).



Image C17. The verges of many of the existing tracks are unusually dry and support low incidences of scattered weeds, such as hyptis (*Hyptis suaveolens*) along the old access track to Hey Point.



Image C18. The verges of upgraded tracks such as the one-way loop to Hey Point are heavily graded and soil covers most of the verge, currently reducing the presence of weeds.

Appendix D Weed Survey Results – Amrun Project Area (June 2016 Survey)

Waypoint	Lat	Long	<i>Themeda quadrivalvis</i>	<i>Stylosanthes scabra</i>	<i>Hyptis suaveolens</i>	<i>Andropogon gayanus</i>	<i>Passiflora foetida</i>	<i>Cenchrus pedicellatus</i>	<i>Mitracarpus hirta</i>	<i>Crotalaria goreensis</i>	<i>Sida acuta</i>	Field Comment
			Grader grass	Stylo	Hyptis	Gamba	Stinking passionfruit	Pennisetum grass	Girdlepod	Rattlepod	Smooth sida	
2673	596876	8590624			Y							100x50m patch
2675	596792	8590696			Y							isolated N edge
2676	596755	8590668			Y							isolated S edge
2678	596440	8590969			Y							20 plus
2686	585665	8588902									Y	isolated
2687	595854	8582248		Y								isolated roadside
2688	595883	8583901		Y								10 plus
2689	596094	8584945			Y							20 plant E side
2690	596120	8585047			Y							10 plants E side
2691	596195	8585614			Y							10 plants E side
2692	596225	8585791			Y							20 plants both sides
2693	596253	8585882			Y							20 plants W side
2694	596275	8585991			Y							40 plants E side
2695	595911	8587725			Y							20 plant W side
2696	596444	8588500			Y							20 plants E side
2697	596678	8589906			Y							10 plants E side
2698	596746	8590046			Y							10 plants E side
2699	596678	8590379			Y							20 plants E side
2700	596641	8590438			Y							20 plants both sides
2701	593689	8578164	Y									5x5m W side
2702	587685	8576467			Y							5 plant S side
2703	587681	8576422			Y							5 plant N side
2704	587462	8570566			Y							5 plant E side

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2705	587477	8570659			Y						20 plants open patch
2706	587505	8570910			Y						5 plant W side
2707	587561	8571644			Y						30 plus, for 30m
2708	587655	8572354			Y						200 plus both sides for 100m
2709	587689	8572539			Y						5 plant E side
2710	587669	8572685			Y						10 plant E side
2711	587688	8576124			Y						30 plants both sides 30m
2712	587688	8576124			Y						30 plants both sides 30m
2713	587690	8576421			Y						50 plants at crossing
2715	583599	8575106		Y							5 plant S side
2716	580496	8573781			Y						300 plus 50x50m patch
2717	580494	8573443								Y	5 plants N side
2718	581309	8566566			Y						10 plant E side
2719	579843	8570663								Y	20 plus for 50m S side
2720	579712	8570664								Y	30 plus, for 30m
2720	579712	8570664			Y						isol
2721	579505	8570662			Y						30 plus for 30m
2722	579190	8570662								Y	100 plus for 100m
2723	579072	8570662								Y	20 plus
2724	578251	8570665								Y	isol
2726	570803	8570995			Y						30 plus at crossing
2727	566994	8569766		Y							5 plant W edge
2728	566734	8569409		Y							10 plant W edge
2729	565819	8568286	Y								50 plus 30m
2729	565819	8568286							Y		ISOL
2730	570087	8568677		Y							5 at crossing
2731	571501	8570665		Y							10 plant N side
2732	571688	8570663		Y							isol S side
2733	572118	8570662		Y							isol N side
2734	572614	8570664		Y							isol N side
2735	572749	8570663		Y							isol S side
2736	572941	8570663		Y							isol S side
2737	573017	8570653		Y							isol S side
2738	573158	8570663		Y							50m 5 patches
2739	573206	8570663		Y							isol plants every 50m
2740	573299	8570659		Y							isol plants every 50m

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2741	575692	8570661									Y	50 plants for next 100m
2742	575786	8570666									Y	51 plants for next 100m
2743	575903	8570661									Y	200 plus S side
2744	575990	8570662									Y	500 plus for next 200m
2745	576238	8570664									Y	500 plus for next 200m
2746	576401	8570665									Y	500 plus for next 200m
2747	578218	8570669									Y	isol N side
2748	578293	8570664			Y							isol N side
2749	578556	8570663									Y	isol S side
2750	578987	8570663									Y	isol N side
2751	587453	8570519			Y							isol E side
2752	587145	8567188			Y							30 plus for 30m W side
2753	587144	8567026			Y							80 plants for 100m both sides
2754	585218	8564636									Y	10 plants both sides
2755	585186	8564515									Y	20 plants both sides
2756	586545	8561176									Y	20 plants both sides
2756	586545	8561176					Y					10x10m
2756	586545	8561176			Y							heavy infestation beagle camp
2756	586545	8561176								Y		10x10m
2757	584348	8560112			Y							10 plant both sides
2758	567865	8555049		Y								10 plants both sides
2759	567799	8555032		Y								20 plants both sides
2760	567700	8555010		Y								20 plants both sides
2761	567608	8554989		Y								20 plants both sides
2762	567528	8554964			Y							10 plant both sides
2763	570205	8556681			Y							20 plants both sides
2764	570156	8558732									Y	20 plants both sides
2765	570155	8558731									Y	300 plus plants all way to laydown area
2766	570138	8558804									Y	300 plus plants all way to laydown area
2767	570051	8558857									Y	300 plus at pad
2768	567297	8554570			Y							50 plants
2769	567259	8554366			Y							10 plant E side
2770	567206	8554190			Y							5 plant E side
2771	567135	8554006		Y								5 plant E side
2771	567135	8554006			Y							30 Plant W side
2772	567123	8553969			Y							200 plants both sides

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2773	567110	8553902			Y						300 plants both sides
2774	567106	8553852			Y						500 plants heavy infestation
2774	567106	8553852		Y							100 plants heavy infestation
2775	567084	8553766		Y							continuous infestation
2775	567084	8553766			Y						300 plants for 50m
2776	567075	8553670			Y						300 plants for 50m
2777	567042	8553587		Y							continuous infestation
2777	567042	8553587			Y						Dense infestation along track
2778	567039	8553540						Y			isolated
2779	567075	8553461		Y							continuous infestation
2779	567075	8553461			Y						continuous infestation
2780	567126	8553348			Y						scattered
2780	567126	8553348							Y		scattered
2781	567002	8553352			Y						scattered
2782	566944	8553264		Y							scattered, dense infestations around old camp shelters
2783	566923	8553110		Y							heavy infestation
2782	566944	8553264			Y						scattered, dense infestations around old camp shelters
2783	566923	8553110			Y						heavy infestation
2783	566923	8553110								Y	scattered
2783	566923	8553110						Y			scattered
2784	581302	8550594		Y							isolated W side
2785	581327	8550530		Y							isolated E side
2786	581388	8548592			Y						isolated E side
2787	581443	8548571		Y							20 plants E side
2788	581396	8548342		Y							isolated E side
2789	581341	8548133		Y							isolated E side
2790	580670	8547089		Y							isolated W side
2791	579128	8545367		Y							10 plant W side
2792	579017	8545240		Y							20 plants E side
2793	577841	8543950		Y							10 plant W side
2794	577714	8543813		Y							isolated W side
2795	576953	8542974		Y							isolated W side
2796	576725	8542712		Y							isolated W side
2797	576657	8542627		Y							isolated W side
2798	575467	8541277		Y							5 plant W side

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2799	575356	8541187		Y								isolated W side
2800	575171	8540989		Y								isolated W side
2801	574934	8540695		Y								5 plant W side
2802	574797	8540562		Y								5 plant W side
2803	574339	8540069		Y								isolated both sides
2804	574233	8539918		Y								isolated both sides
2805	573959	8539618		Y								10 plant W side
2806	573674	8539341		Y								isolated both sides
2807	573628	8539264		Y								isolated both sides
2808	573526	8539171		Y								isolated both sides
2809	573429	8539050		Y								100 plus dense infestation
2810	573173	8539238		Y								isolated both sides
2811	573042	8539267		Y								isolated both sides
2812	572829	8539184		Y								isolated both sides
2813	572759	8539170		Y								20 plants both sides
2814	572591	8539173		Y								isolated both sides
2815	572464	8539320		Y								40 plants around camp area
2816	572186	8539576		Y								100 plus dense infestation
2817	572166	8539676		Y								200 plus dense infestation
2819	572147	8539698		Y								dense infestation to Wpt 820
2820	572077	8539836		Y								Dense infestation along track
2821	571996	8539999		Y								isoaltee patches
2822	572259	8539472		Y								isolated both sides
2823	573653	8540724		Y								isolated both sides
2824	573396	8540707		Y								isolated both sides
2825	571868	8540693		Y								50 plus, both sides
2826	571632	8540668		Y								isolated both sides
2827	571556	8540675		Y								isolated both sides
2828	571447	8540683								Y		isolated both sides
2829	571247	8541015		Y								30 plus both sides
2830	571179	8541155			Y							isolated both sides
2828	571447	8540683							Y			isolated both sides
2829	571247	8541015								Y		isolated both sides
2830	571179	8541155		Y								isolated both sides
2831	571076	8541331			Y							isolated both sides
2832	571061	8541369			Y							isolated both sides

2833	570931	8541534									Y	10 plants both sides
2834	570914	8541562			Y							100 plus both sides
2835	570684	8541786			Y							heavy infestation to Wpt 836
2834	570914	8541562									Y	20 plants
2835	570684	8541786									Y	heavy infestation to Wpt 836
2836	596631	8555320	Y									heavy infestation to Wpt 836
2837	589806	8531872		Y								20 for next 100m
2838	589743	8531246		Y								end of stylo
2839	589724	8531069		Y								sporadic along road until wpt 840
2840	589513	8529955	Y									sporadic along road until wpt 840
2841	586141	8525367	Y									dense infestation both sides
2842	596369	8590455			Y							50 plant both sides
2843	570111	8571516		Y								20 plants both sides
2844	570073	8571632			Y							50 plant both sides
2845	570004	8571647			Y							20 plants
2846	569904	8571636			Y							50 plant both sides
2844	570073	8571632		Y								50 plant both sides
2845	570004	8571647		Y								20 plants
2846	569904	8571636		Y								50 plant both sides
2847	569854	8571663			Y							scattered infestation up to wpt 848
2848	569191	8572400		Y								scattered infestation up to wpt 848

Appendix E Distribution Maps for Individual Weed Species

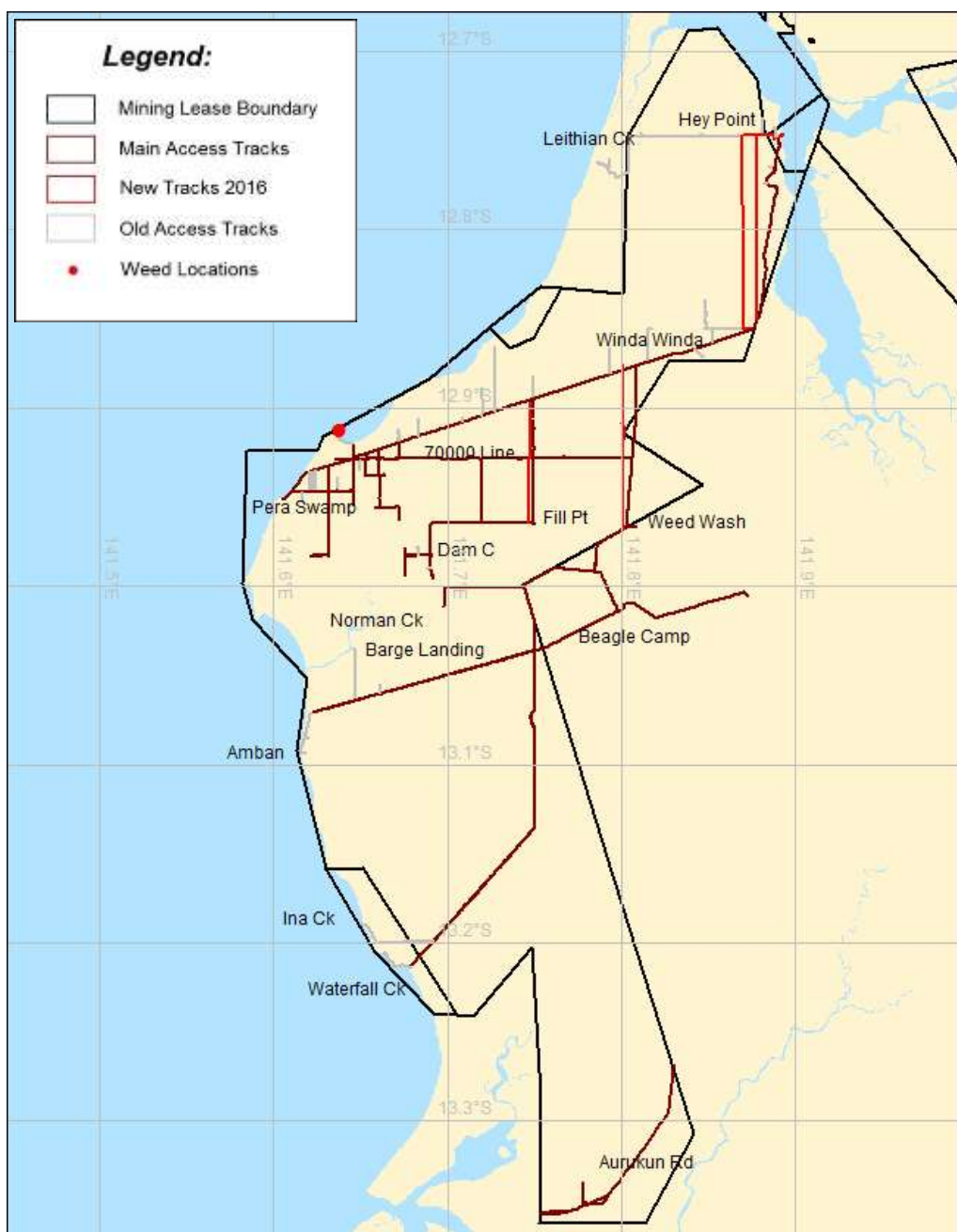


Figure E-1 Location of gamba grass within the Amrun Project area (June 2016)

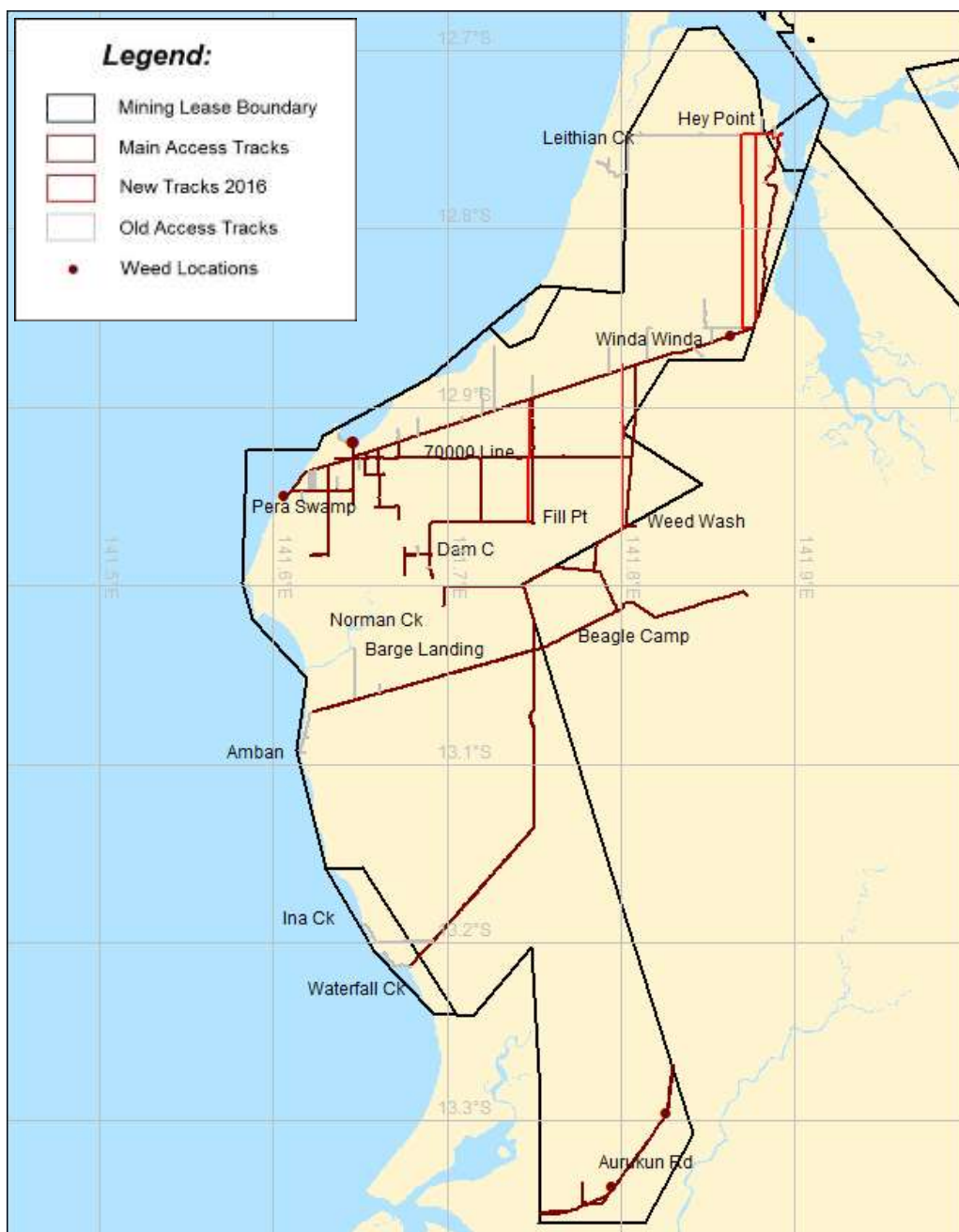


Figure E-2 Location of grader grass within the Amrun Project area (June 2016)

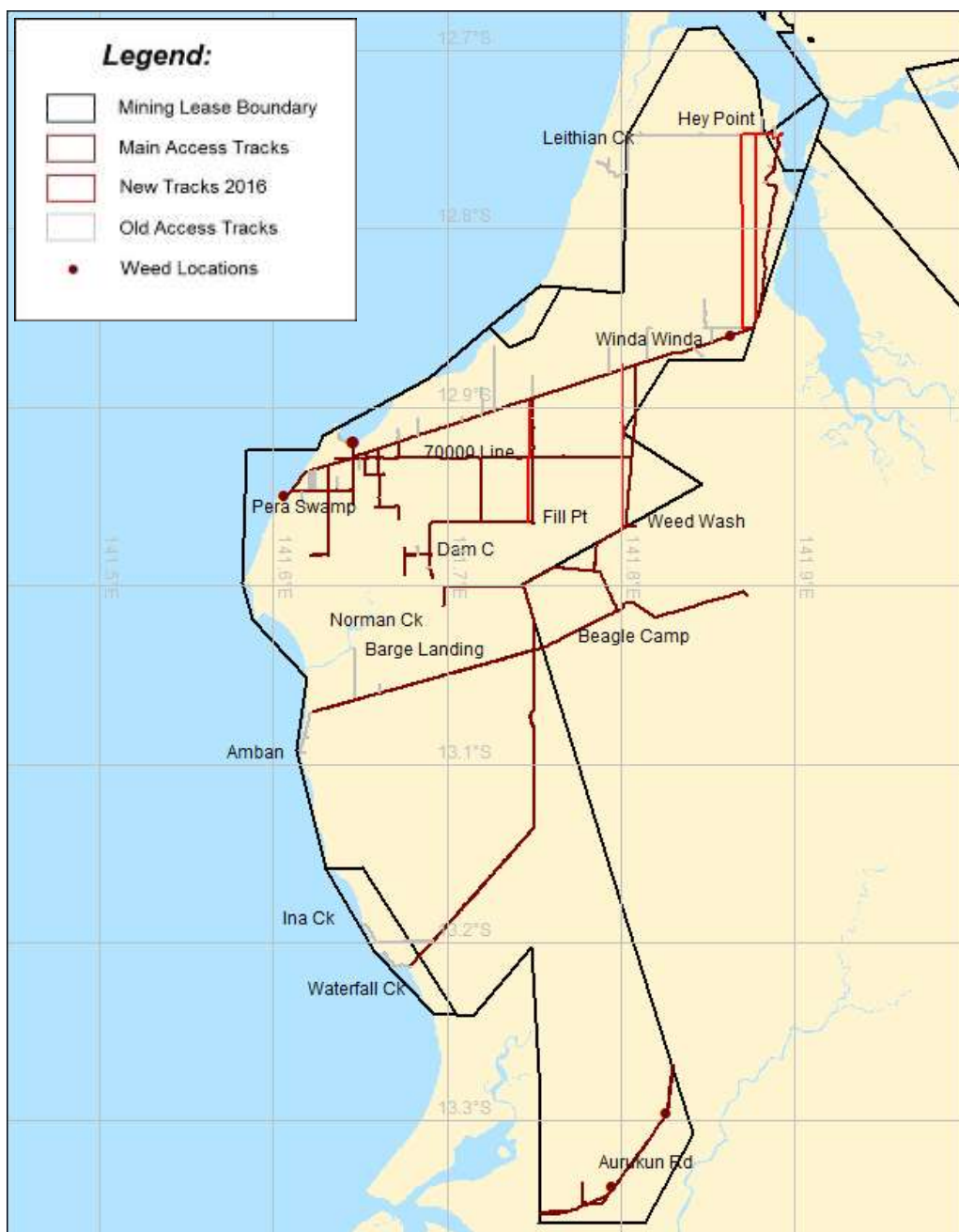


Figure E-3 Location of stylo within the Amrun Project area (June 2016)

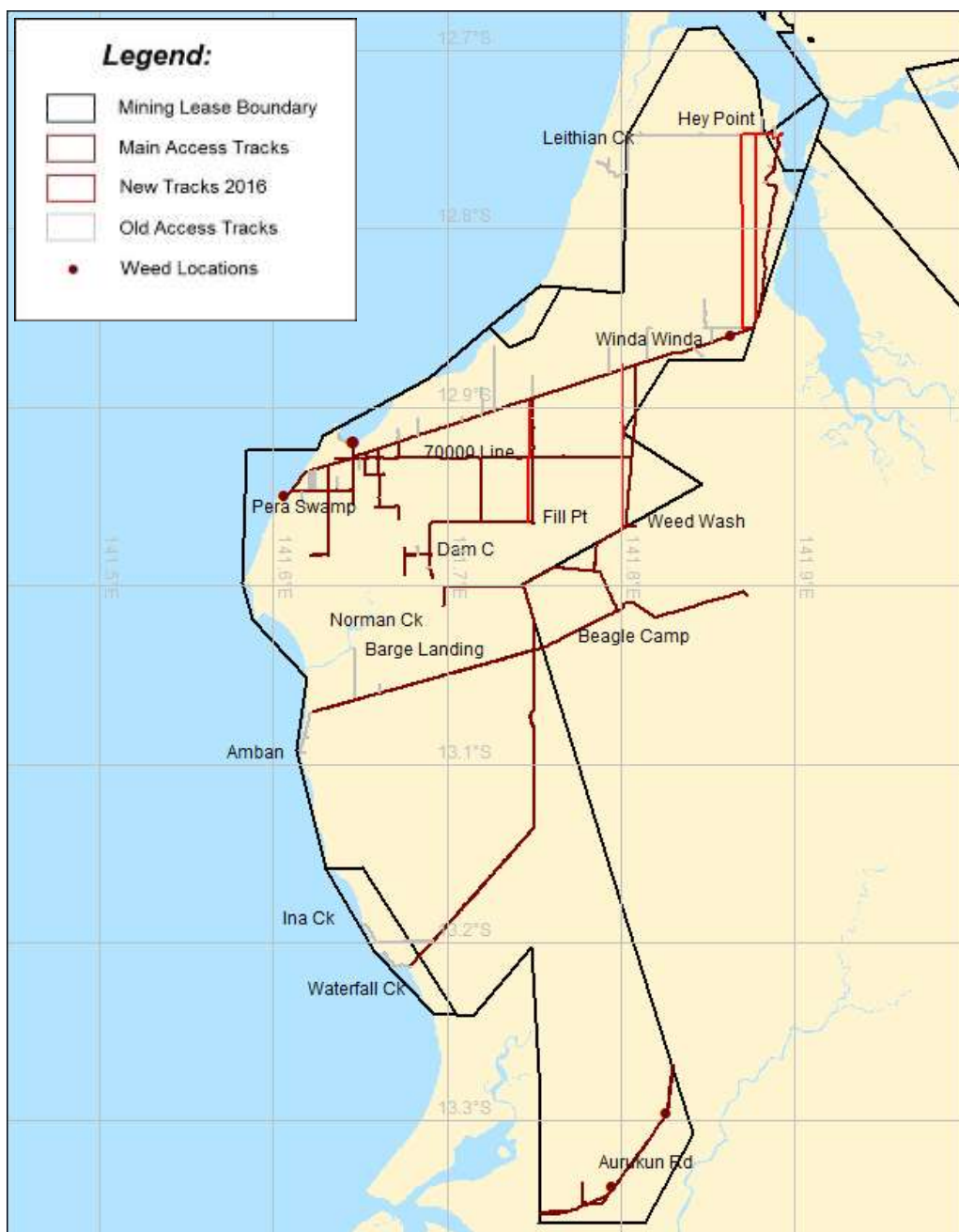


Figure E-4 Location of smooth sida within the Amrun Project area (June 2016)

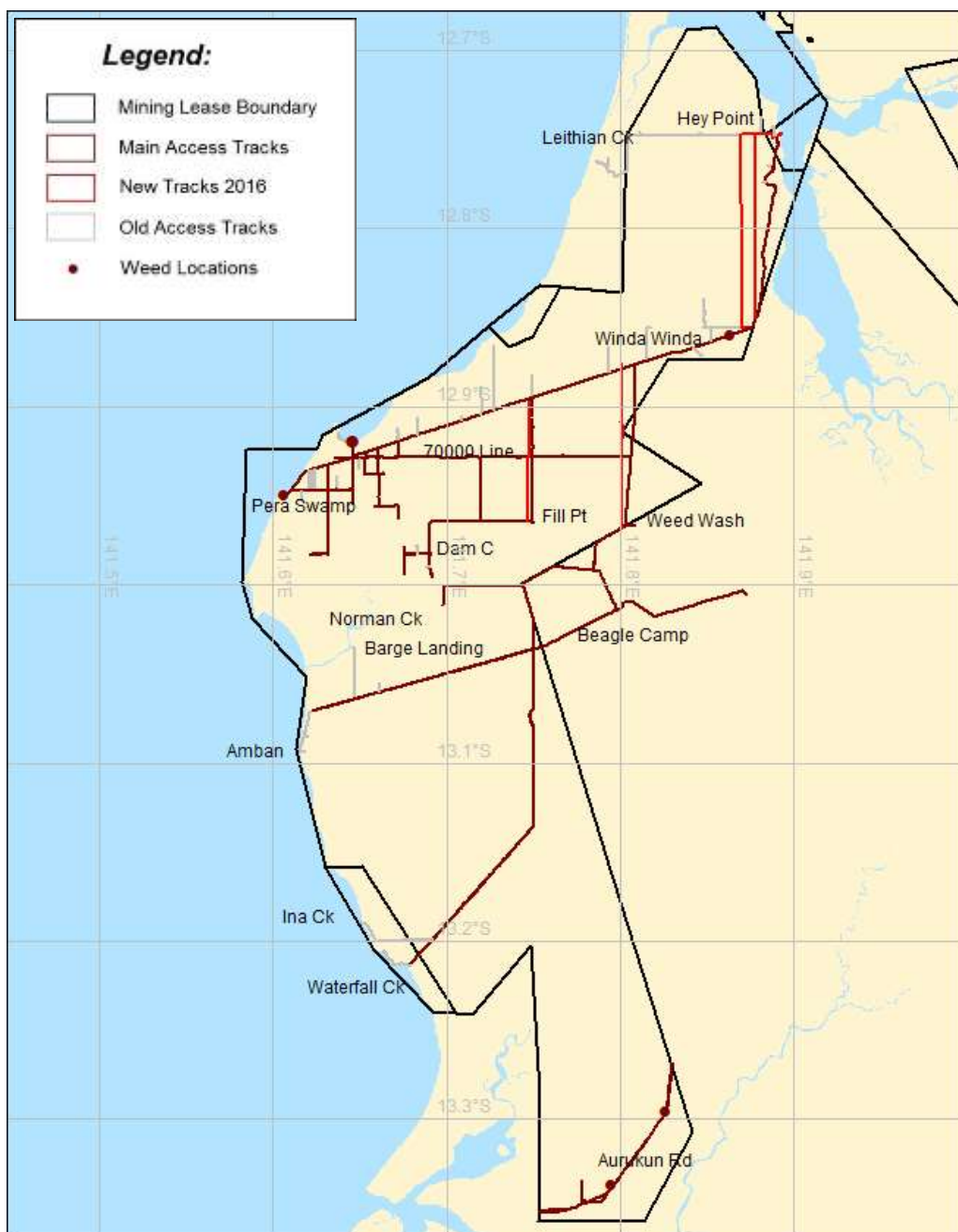


Figure E-5 Location of buffel grass within the Amrun Project area (June 2016)

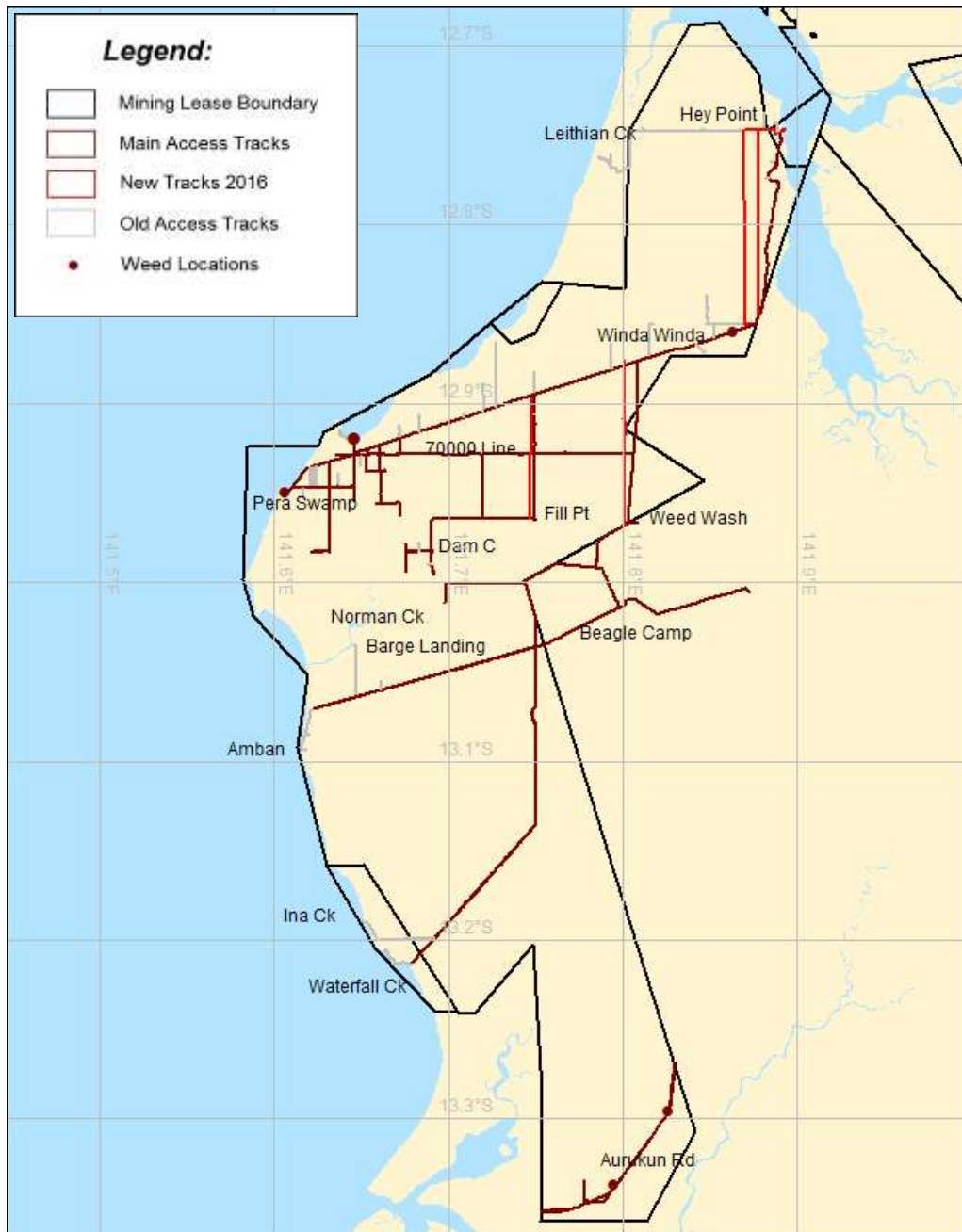


Figure E-6 Location of hyptis within the Amrun Project area (June 2016)

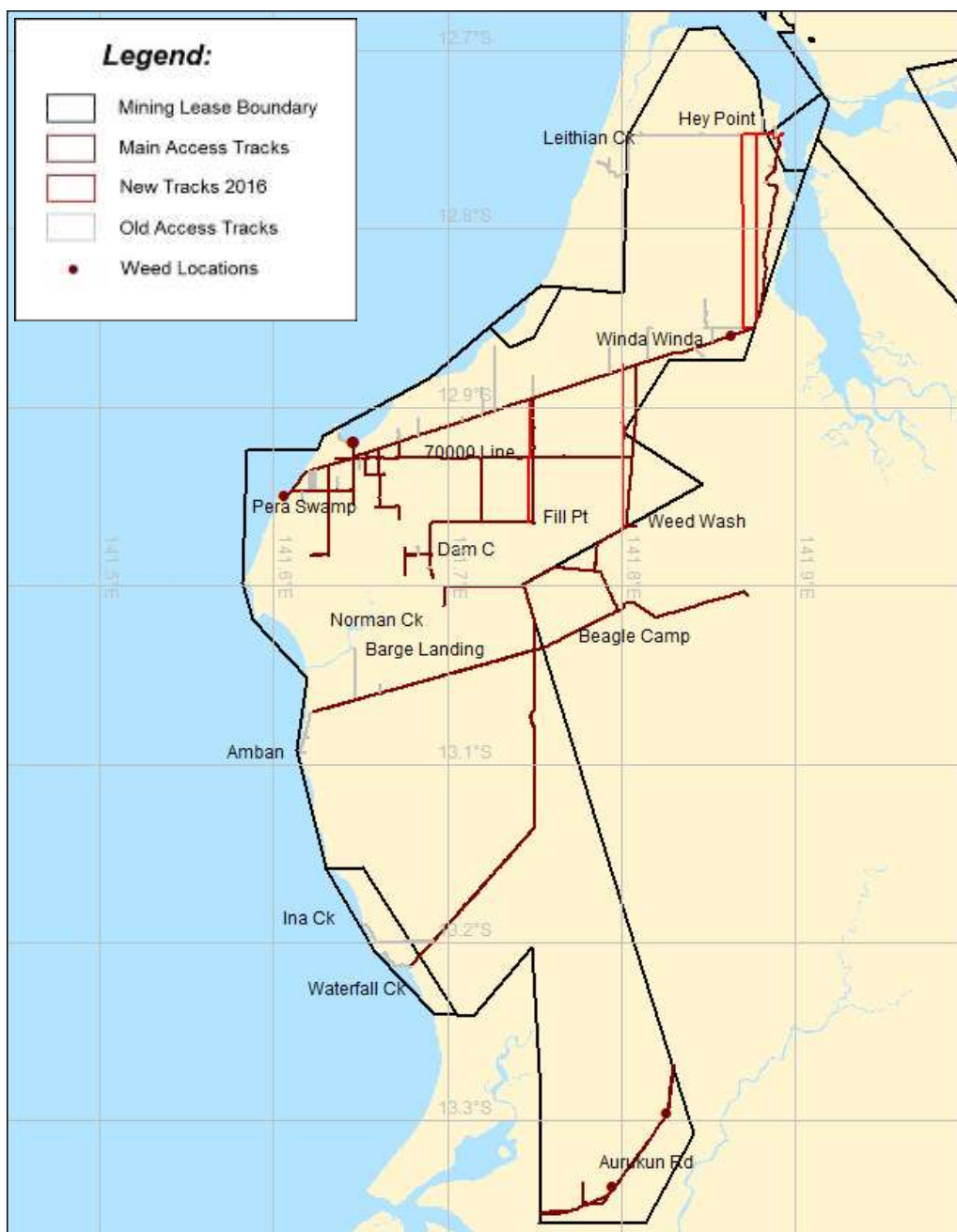


Figure E-7 Location of rattlepod within the Amrun Project area (June 2016)

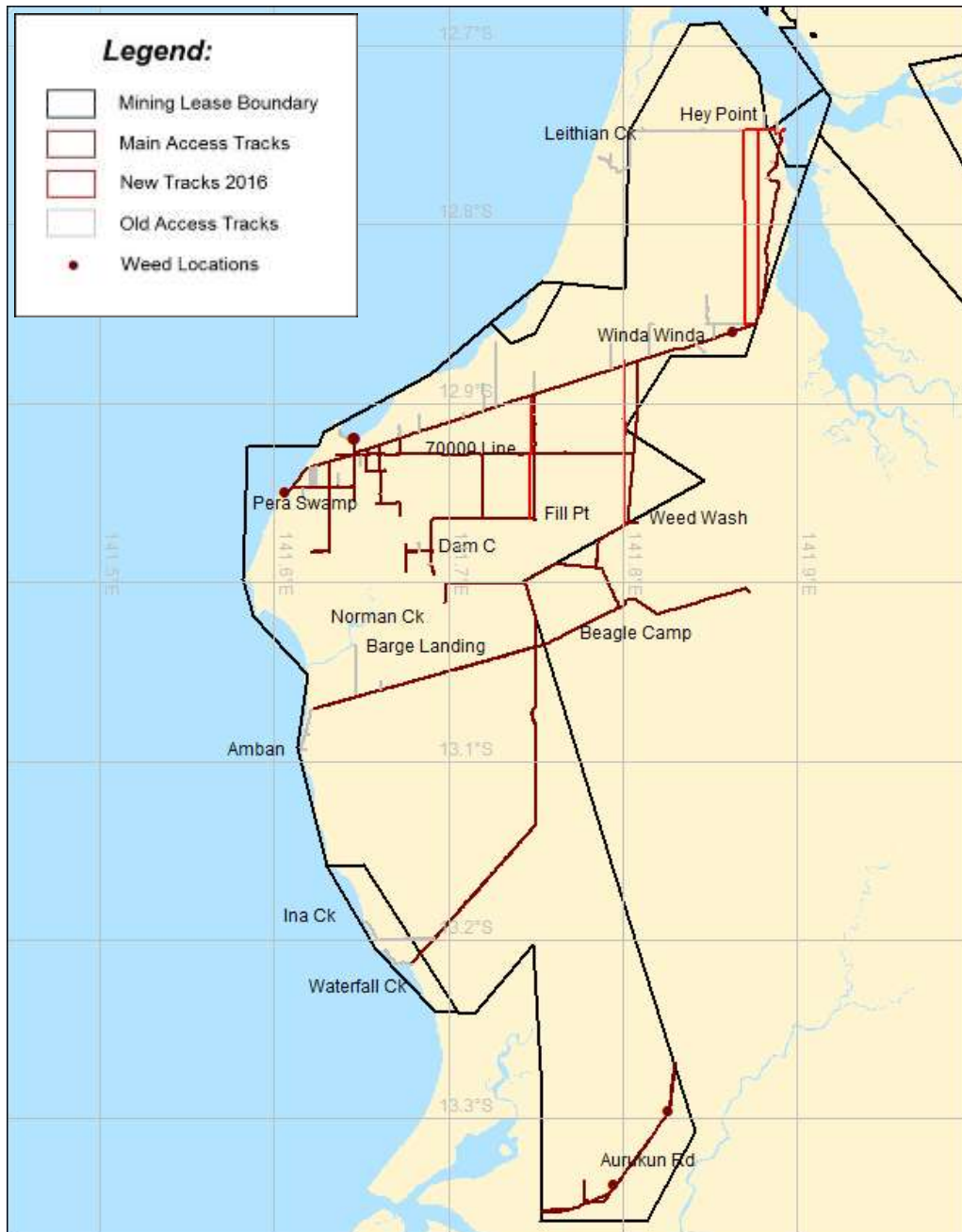


Figure E-8 Location of tropical girdlepod within the Amrun Project area (June 2016)

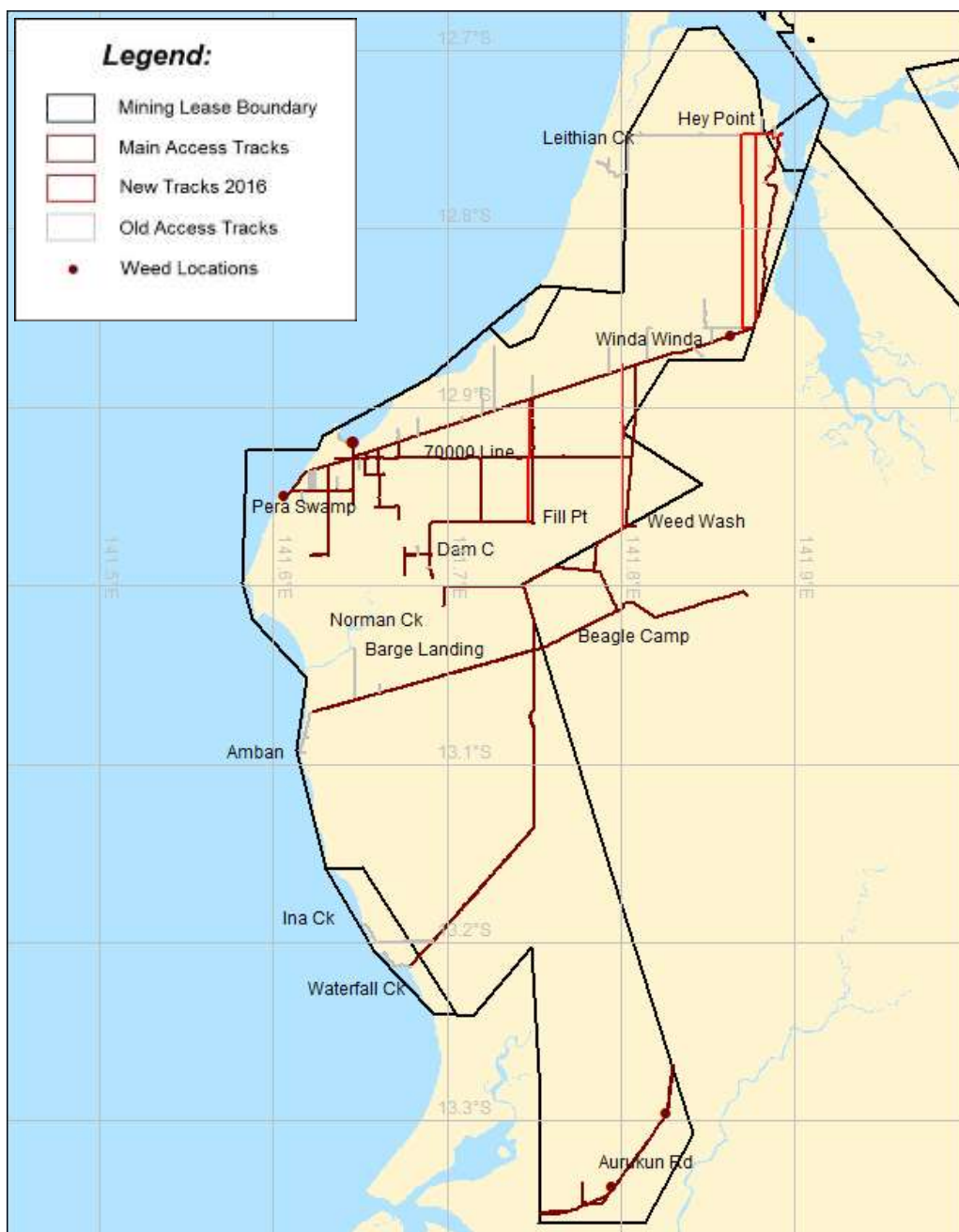


Figure E-9 Location of grader grass within the Amrun Project area (June 2016)

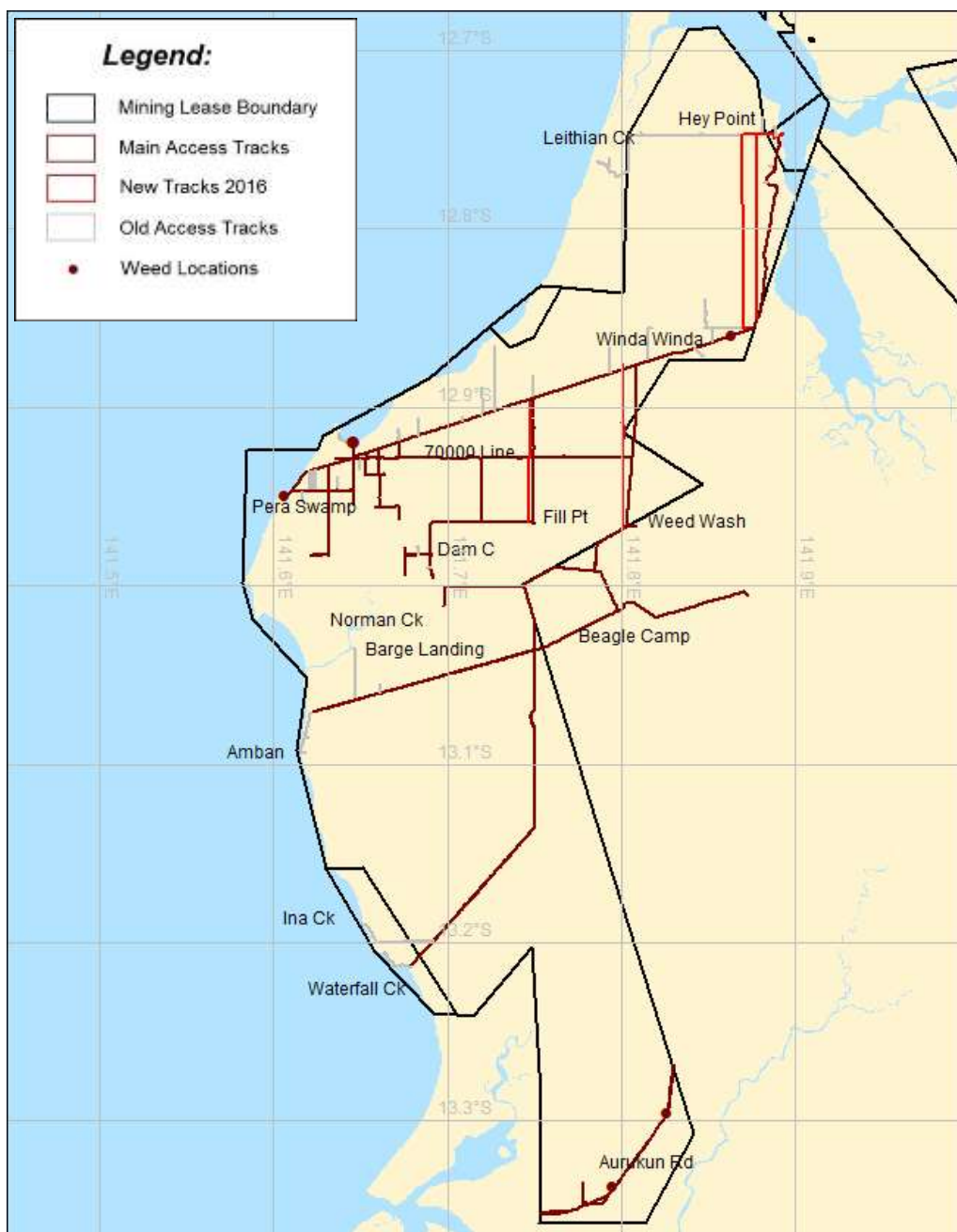


Figure E-10 Location of spiny sandbur within the Amrun Project area (June 2016)