Flora and Vegetation Survey Report
Proposed Gulkula Mine

Gulkula Mining Pty Ltd

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Signature

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Background of author:
Andrew lived in Gove during his early years and spent a lot of time on Country with Yolgnu people and this shared time many years ago is still remembered by some community elders. During these years, Andrew was identifying local plants, collecting them and growing them. Andrew's interest has continued and today Andrew is a professional botanist with experience in many mining and horticultural projects. This experience includes more than ten years of botanical consulting in the northern part of Cape York Peninsula for Indigenous groups, Alcan South Pacific and Cape Alumina. In the field Andrew was usually assisted by indigenous staff who helped Andrew understand the country and in return learned the art and science of recording flora and fauna. Currently Andrew has a large project in the Torres Strait, tracking ecological changes due to climate change. The fieldwork for this project will largely be undertaken by indigenous land and sea rangers.

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1 Executive Summary

This report was commissioned by Gulkula Mining Pty Ltd as part of the environmental baseline assessment for the proposed Gulkula Mine Project on the Dhupuma Plateau in North East Arnhem Land.

The Flora and Vegetation Survey provides an assessment of the flora species and vegetation of the proposed mine site and immediately adjacent areas. The survey was designed to determine whether listed threatened species are present and assess the significance of any finds. Vegetation types can also be listed as threatened. This survey investigates their potential presence. Finally the survey documents the condition of the vegetation present in the pre-mining environment. This information can be used to provide a benchmark for post-mining rehabilitation standards.

The survey covered all areas within the proposed mining lease, however only the footprint of the proposed mine was intensively surveyed. Outlying areas were viewed from the air and were surveyed where there was road access. Potentially sensitive areas in close proximity to the proposed mine and areas that may be hydrologically connected to the proposed mine site by surface water or groundwater were also intensively investigated.

The survey methodology was based on the Northern Territory Government (NT) Guidelines for Vegetation Survey and Mapping. Searches for threatened species focused on listed threatened species under the Territory Parks and Wildlife Conservation Act (obtained from www.nt.gov.au/ipe/pwcnt) and from the Commonwealth Governments Protected Matters Search Tool. The survey was undertaken in three stages with a preliminary survey in May 2014, a dry season survey in October 2014 and a wet season survey in May 2015. Cyclone Nathan crossed the plateau just prior to the 2015 wet season survey so the vegetation was cyclone damaged.

The vegetation present on the Dhupuma plateau and its surrounding colluvial plains is dominated by Darwin Stringybark (*Eucalyptus tetrodonta*) woodlands, which is the predominant vegetation type present within the region. Minor variations in the stringybark woodland were recorded and these were associated with the position of the vegetation in the terrain. The terrrain included plateau, escarpment, colluvial flats, sand plains and surrounding low hills.

The stringybark woodland present within the proposed mine footprint is extremely uniform. The footprint of the proposed mine area was previously cleared for the ELDO Project, which was a radar tracking station, which began operations in 1960. Vegetation has been regenerating in these areas over a period of approximately forty years. The plateau environment is harsh and has high levels of tree mortality due to prevailing dry season winds, shallow soils, frequent bushfire and cyclones. Consequently the vegetation present is of limited stature and species diversity.

In the balance of the study area (i.e. not within the footprint of the proposed mine) there are other vegetation types. A few small vine forest patches occur on some of the steepest slopes of the escarpment. The best developed of these patches, which is directly below the Garma Site, had a small possibly perennial spring. The other closed forest patches where associated with rocky slopes and dry drainage lines. At the base of the escarpment were are few perennial seepage areas which support low sedge swamps with occasional pandanus and paperbarks or other water-loving tree species. The small size of these patches means that they are subject to very high edge effects and disturbance (cyclone, fire and buffalo). As a result these patches were filled with adaptable common species which are widely dispersed rather than uncommon species which have limited geographic ranges or highly specialised habitat requirements.

Approximately 300 plant species were photographed and identified during the field surveys. None of these species are listed as threatened in Northern Territory or Commonwealth lists. Targeted searches for listed threatened species were undertaken within the most suitable habitats present in the vicinity of the proposed mine. These searches did not find any of the listed threatened species known from the region. Based on habitat assessment, it is considered unlikely that any listed species are present in the proposed mining area or in immediately adjacent areas.

Data from secondary transects and very close observation of vegetation across the plateau suggest that the regenerated areas have a slightly higher tree density and slightly lower groundcover diversity/density. As tree density in the regenerated areas decreases due to natural thinning over time, the demarcation between regenerated vegetation and original woodland vegetation is likely to become increasingly difficult to determine.

2 Introduction

A preliminary site inspection was undertaken in April/May 2014, during which a preliminary wet season survey was undertaken. Formal dry season and wet season flora surveys of the Dhupuma Plateau were undertaken in October 2014 and April/May 2015 respectively. The flora survey concentrated on the area covered by the 2014-5 bauxite exploration program, which represents the likely footprint of the proposed mine. Adjacent and downstream vegetation communities were also sampled. The 2015 wet season survey took place after Cyclone Nathan had impacted on the Gove Peninsula. This even provided an opportunity to record the impact of a strong tropical cyclone on the local vegetation.

The preliminary site inspection and the wet season survey focused on cataloguing the botanical biodiversity of the study area, particular the area proposed to be mined. During this phase of the survey, a virtual herbarium was created to store photos of all of the plant species encountered in the field.

Fires on the Dhumpuma Plateau are an annual event so the dry season survey concentrated on recording vegetation structure which can be undertaken even in burnt forest. Eight 100 m full characterisation (secondary) transects were collected within this study area. The field survey methodology used was an implementation of the level VI methodology described in the Northern Territory vegetation mapping guide. This is the most detailed level of data collection. Attributes recorded include tree size, tree density and species composition. Vegetation is also crucial to landform stability in most places, so records are also made of vegetation coverage of the ground including which groundcover species were present. Finally the ecological and habitat values of the vegetation were assessed. Ecological assessments for mining projects, place a high value on the presence of large mature trees as these trees provide most of nesting and shelter resources for many species of native wildlife so large trees were measured and recorded individually.

Secondary transects provide detailed descriptions of vegetation types which are used to validate and formally describe vegetation patterns which were previously mapped from aerial imagery. A validated vegetation map provides a key tool for assessment of potential environmental impacts in local, regional and national contexts. In the case of the proposed mine site, which was partially cleared many decades ago for a satellite tracking facility, the secondary transects also provide detailed insights into the stature and diversity of the vegetation that has regenerated unassisted in the approximately 40 years since the site was abandoned. Knowing how well the natural regeneration processes have performed provides a means of benchmarking post-mining regeneration efforts. More fundamentally, it helps to answer the question of whether native vegetation can recovers to a level that is comparable to undisturbed vegetation.

During the wet season survey, some additional secondary level transects were also undertaken to provide at least two full characterisation transects for each type or variation of vegetation within the proposed mining area. One of the secondary transects collected during the dry season was re-sampled to help determine the effect of Cyclone Nathan on vegetation. Loss of much of the tree canopy appears to have exposed the understorey to relatively dry conditions and there was noticeably fewer seasonal plants than during the same period a year before. Fortunately the preliminary survey collected sufficient information to record the typical wet season condition.

Areas adjacent to or downstream from the proposed mine were sampled using tertiary level transects which record the size and abundance of each species semi-quantitatively. Tertiary transects are very useful for small patches of vegetation which are too small for secondary transects. The tertiary transects were also used to document vegetation patterns that were not present within the proposed mine footprint, but which are present in vegetation mapping of the greater mine lease area. These areas could have ecological or hydrological connections within the vegetation present within the proposed impact area. Searches for listed threatened plants were undertaken in all areas surveyed.

Local indigenous people have been involved in all flora surveys conducted for over the proposed mine area They have also been informed throughout in the use of field survey tools and photographic reporting tools used to create this report.

3 Methodology

The flora survey methodology used was consistent with the Northern Territory Guidelines and Field Methodology for Vegetation Survey and Mapping (Brocklehurst et al. 2007).

3.1 Vegetation Mapping

No previous vegetation mapping of suitable scale was available for the study area, so prior to the field survey, the vegetation patterns in the area were mapped using available aerial imagery. Several aerial and satellite images were used to allow for mapping of areas obscured by clouds or where photo patterns had been altered by recent bushfires. Preliminary mapping was undertaken at a scale of approximately 1:25 000 which will provide a final map of 1:50 000 scale. To ensure consistency, a visual dictionary of aerial photo patterns was created, part of which is presented in **Figure 1**.

	*Eucalypt Riparian* (top) Has larger trees and a dark understorey *Sand Plain* (below) Small uniformly spaced trees with a grey colour
	*Closed Forest* Always appears as a small area of dense vegetation with large tree crowns. Very green in comparison to other communities. Surrounding vegetation is in the *sand plain* pattern.

Figure 1: Extract from Aerial Photo Pattern Dictionary

3.2 Map Groundtruthing

The preliminary map of vegetation patterns was loaded onto a handheld GPS before the field survey. In the field the positions of vegetation boundaries were validated by confirming that the vegetation boundary observed on the ground was in a similar position to that indicated by the map. Tertiary sites (check sites) were collected for vegetation patterns that were not located on or adjacent to the proposed mining footprint. Tertiary sites often recorded visual estimates or measurements of strata heights, cover values and basal area. At every tertiary site, each species was recorded by the strata in which it occurred and by abundance code. Several photos were taken to document key features and general characteristics. The terms secondary transects and tertiary sites are from the Queensland Regional Ecosystem Mapping Guide (Nelder et al. 2012) but are also widely used by the international vegetation mapping community.

Following collation and review of all field data, the preliminary map of vegetation patterns was revised to produce a vegetation map. The vegetation mapping units were defined using the regional ecosystems mapping process. Each vegetation mapping unit (~vegetation type) was labelled with a combination of landform and vegetation description such as Plateau Woodland. A visual guide to vegetation mapping units was created from photos taken in the field. The term vegetation mapping unit is used to in mapping to describe vegetation patterns which can be mapped from aerial photography but which have yet to be described on the ground and formally named.

3.3 Plant Identification

Most of the species present were familiar to the author as they are widely distributed across northern Australia so adding scientific names to photos was in most cases straightforward. Approximately 300 species were identified and approximately 10 species are pending full identification. The remaining unidentified plants have been entered into the virtual herbarium and will be identified if suitable plant material for identification can be obtained.

The virtual herbarium provides a way of making sure that all species encountered are recorded, whether they have been fully identified or not. Partially identified plants are given temporary working names such as *Hibbertia* 'glossy'. A species list was generated from the virtual herbarium, and was used as a reference for species identification during secondary transects data collection. Some species present on the site have changed scientific name up to three times in recent history, so use of a virtual herbarium also provides an important tool for attaching plant names to plant species when the current scientific name is uncertain. **Figure 2** presents an example of a species record in the virtual herbarium.

Figure 2: Extract from Project's Virtual Herbarium

3.4 Listed Threatened Species

Information on listed threatened flora was downloaded and fact sheets/images of species were obtained before the field survey to facilitate targeted searches. Several sources of information were used including the Commonwealth Government's Protected Matters reporting tool, flora and fauna records kindly provided by Dhimurru, listed threatened species information from the NT Government website (Territory Parks and Wildlife Act List) and species records from the Atlas of Living Australia.

3.5 Vegetation Classification

Vegetation classification includes formally describing the vegetation mapping units and determining how these units are related to vegetation types mapped by other parties. In areas where vegetation types are very similar, it helps to view vegetation data in a graphical format. Vegetation catenas are a diagram that provides a view of a slice of forest 5 or 10 m thick. Catenas were used extensively by botanists to describe how vegetation changes in response to landscape position. **Figure 3**, shows a catena-like diagram from the NT vegetation survey guide.

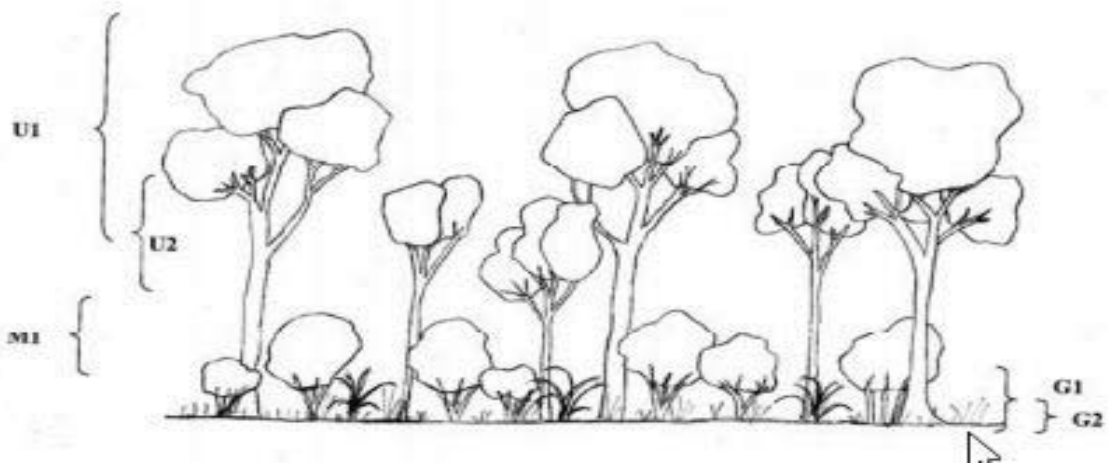
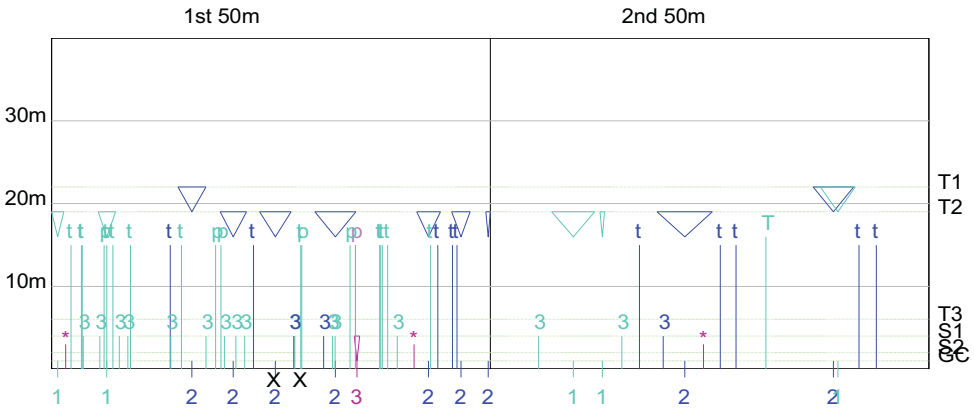


Figure 3: Example of a Vegetation Catena

Data collected from secondary transects which are generally 100 m long by 10 m wide can be plotted in a manner similar to a catena. Triangles represent a line intercept of tree canopies and the vertical lines are tree trunks within a 10 band to one side of the tape. **Figure 4** shows one of the catena-like diagrams generated for the plateau and a change of vegetation is clearly visible at the 50 m mark. Below the diagram are summary statistics such as projected crown cover (PCC). In this case the vegetation is about 20 m tall with 40% PCC which is classified as **woodland** vegetation using table 8 of the NT vegetation survey guideline.



Tree Species found on Transect			Strata Coverage		Strata Heights (m)
S. Rank	Count	Scientific Name	Total PCC	42 %	T1 Canopy: 17 - 22
1	42	Eucalyptus tetrodonta	P2 Cover	3 %	T2 Sub-canopy: 7 - 19
2	22	Eucalyptus miniata	S1 Cover	1 %	T3 Small Trees: 4 - 6
3	4	Livistona humilis	T1 Cover	12 %	S1 Large Shrubs: 2 - 4
4	1	dead	T2 Cover	32 %	S2 Small Shrubs: 1 - 2

Figure 4: Automatically Generated Catena

The vegetation data collected for secondary transects is equivalent to the *National Vegetation Information System* level 6 data (sub-association), which is the most detailed level of vegetation classification. The NVIS system is specified by the NT vegetation survey guideline as the system to use for vegetation classification. The

letters used for strata in Figure 4 are the letters used for the Queensland Coveg System but can be directly translated into letters used for strata by NVIS. The formal NVIS level 6 description derived (except for groundcover species names) from the above data would be:

> Upper stratum+ ^*Eucalyptus tetrodonta, Eucalyptus miniata*\^tree\7\r;
>
> Middle stratum ^*Livistona humilis* \^palm\4\r;
>
> Ground layer *Grevillea dryandri, Buchanania obovata, ^Eucalyptus tetrodonta, Sorghum plumosum*,\^tree, shrub, tussock grass\2\c

The detailed technical description above can be reduced to a regional ecosystem-like short description which would be as follows:

> Eucalyptus tetrodonta (Darwin Stringbark) and Eucalyptus miniata (Woollybutt) woodland on bauxite/laterite plateau.

3.6 Vegetation Structure

Vegetation attributes such as tree density and basal area were collected using standard methods. For each 100 m transect, two Bitterlich sweeps were undertaken. Stem density was undertaken by counting stems in a fixed area, usually 1000 m^2. Large trees, which were defined as trees with a diameter at breast height of greater than 20 cm were measured over a greater area, usually 2000 m^2 (out to 10 m either side of the transect tape), as they occur at lower densities. Tree height was calculated using a clinometer.

All recordings were measurements and not visual estimates so the data is as quantitative and repeatable as is practically possible. All measurements are entered into the survey database as individual measurements to preserve the value of the data for analysis, should this later be required.

To improve the value of the data collected, the recording of trees by strata was extended to describe why a tree was listed in a particular stratum. The extension of the strata system was prompted by the predominance of very tall saplings with very small crowns on another bauxite plateau which traditionally get lumped together with mature trees with wider crowns. There are three reasons for a tree being in a stratum including being a tree with a mature branching structure (T), being large sapling or pole (P) or being a damaged or declining tree that has become smaller than it was originally (D). An upper case T indicates a tree is in the T1 layer and a lower case t that the tree is in the T2 layer and similarly for P,p and D,d. Recording the reason for tree membership in a stratum allows much greater insight into predominant tree form and forest maturity, which is very useful for assessment of rehabilitated mine vegetation. The value of extending the strata recording system to document tree condition was realised when recording cyclone affected transects where trees remained standing but had been stripped off their crowns.

Large trees are disproportionately important to ecosystems, so large trees were recorded by species, trunk diameter and by x, y position relative to the transect tape.

4 Results

4.1 Listed Threatened Species

No listed threatened species were observed within the potential mine footprint during field surveys to date. Particular targets were cycads, orchids and *Erythroxylum sp*. (Cholmondely Creek J.R.Clarkson 9367). Two large cycads were located but are not of a listed species (not fully identified but likely to be either *C. arnhemica* or *C. orientis*). Even though the cycads are not a listed species, they are locally very uncommon and if potentially affected by the proposed mine, could be relocated. One of the cycads is on the edge of the escarpment and the other was in an area which has little bauxite so the cycads are not likely to be disturbed by the proposed mine.

The Commonwealth Environmental Protection and Biodiversity Conservation Act's Protected Matters Search Tool did not list any plants or vegetation types for the Gove Peninsula.

Based on habitat assessment and previous survey records, the only likely listed threatened species would be *Pternandra coerulescens*, however this species is a small rainforest tree with distinctive leaves that grows in well developed spring forests and riparian rainforests. It would not be present in the proposed mine footprint and was not observed in any of the springs or riparian strips investigated. Swamps were also checked for smaller species such as *Burmannia* and *Utricularia* which may not have previously been recorded for the region. No significant finds were made.

4.2 Other Plants

Approximately 300 species were recorded of which 295 are listed in the species list presented in **Annexure 2**. A virtual herbarium with photographs taken in the field in the study area has been created for the project to assist with future plant identification. The virtual herbarium contains more than 850 photos and is too large to attach to this report.

4.3 Vegetation Types

Vegetation patterns mapped prior to visiting the study site were found to be accurate in most areas (as defined by Qld Regional Ecosystem mapping requirements). Changes in vegetation were recognisable on the ground, often very close to the position indicated by the preliminary mapping. A map of vegetation units and secondary transect locations in relation to the bauxite exploration area is presented in Annexure 2.

No listed threatened vegetation types were located within the proposed mine nor were there any vegetation types that have elevated conservation values at the local, regional or national level. A significant part of the proposed mine footprint was previously cleared for a satellite tracking facility and these area were included in the area sampled by secondary transects (Transects 1 and 5 were cleared and 6 probably was and 4 may have been). Full descriptions of the vegetation sampled by transects are presented in **Annexure 3**.

4.3.1 Vegetation of Proposed Mine Footprint

Floristically, all the secondary transect sites on the plateau were very similar with most species encountered on any given transect being common to all sites. Differences in vegetation appearance between sites where generally related to vegetation structure such as the density of saplings and mature trees, canopy height and disturbance history. These structural differences are visible in aerial imagery and were mapped as different vegetation patterns.

Only two closely related vegetation communities were identified on the flat or gradually sloping top of the plateau. The two types are as follows:

•Almost mono-specific stands of *Eucalyptus tetrodonta* (Darwin stringybark), generally with very high sapling densities and relatively low canopy height which is found on slightly raised areas and areas with cemented bauxite soils; and

•Taller, more open woodlands dominated by *Eucalyptus tetrodonta* or with co-dominant *Eucalyptus miniata* (Woolly Butt) that occurs on flat ground or very gentle slopes between the escarpment and the slightly raised areas.

Soil depth and hydrology largely determines which areas have which vegetation. Slightly raised areas are a source of groundwater and overland flow and adjacent gently sloping areas can receive these additional waters, which allows for growth of larger trees.

Summaries of transect data are presented in Annexure 2 and catena diagrams in Annexure 3.

4.3.2 Historical Vegetation Clearing

Much of the vegetation within the proposed mine site is natural regeneration as the mine site was previously a radar facility associated with tracking rockets launched from Woomera. The site was abandoned in the early 1970's however windrows indicating clearing of vegetation are widespread across the plateau. The approximate boundary on the Vegetation Map is based on photos and recollections of people familiar with the area and on the presence of earth mounds and windrows created during clearing. In the data, there also appears to be a subtle signature that can be used to identify regenerated forest. The density of trees in regenerated forest is higher and the crowns of trees often overlap significantly as larger trees start to develop wide crowns that over top adjacent slightly smaller trees. Understorey species lists are similar however many understorey species although present are less abundant than in never-cleared areas. Shallow soils and natural events such as cyclones can also produce similar vegetation signatures, however cyclone damage and rocky outcrops generally occur as small patches within areas of vegetation that is of typical character. It is of great interest to see how an area that was cleared but not mined has regenerated as this provides a reference for evaluation the success of mine revegetation. Considerable care was taken to accurately record these areas.

4.3.3 Vegetation of Surrounding Landscape

The vegetation patterns on the escarpments and footslopes of the plateau were of very similar species composition to the vegetation on the top of the plateau and were mainly distinguished by the presence of a few additional species that rely on seasonal seepage from the escarpment or on protected slopes which provide shelter from wind. However as these vegetation patterns are associated with different landforms, several of the patterns would be recognised as different regional ecosystems, despite their floristic similarity if a regional ecosystems approach was used.

Small pandanus and sedge swamps occur at the base of the escarpment in some places, however in most places there is a wide sand plain at the base of the escarpment and the small creeks where seepage emerges are a few hundred metres away from the base of the escarpment. These swamp and riparian ecosystems support a range of species not found on the plateau. Even in mid-October, seeps were active, and it is likely that these seepage zones are perennial. However these seepage areas are small and appear to be subject to fire and fire sensitive riparian trees are limited to the channels of larger drainage lines. Water buffalo impacts, mainly trampling damage, was apparent in the perennial seepage zones.

In the lowlands lie several kilometres to the east of the plateau, there were alluvial or sand plain ecosystems and coastal dune ecosystems which were floristically distinct from the plateau vegetation. The species composition of these ecosystems has only been subject to preliminary investigation. Mapping of vegetation patterns for these areas was subject to preliminary groundtruthing and it is considered that most or all vegetation types have been discovered. The mapped boundaries of the vegetation patterns are sufficiently accurate for a 1:50 000 scale map.

4.4 Ecology

4.4.1 Moisture Availability

The principle environmental gradients within the study area appeared to be soil availability and hydrology. as Shallow soils and soil that include a high proportion of rock have less water holding capacity. Areas where soil moisture storage capacity or root penetration capacity were low tended to have thickets of stringybark saplings and fewer mature trees. Areas with deeper soils had vegetation with taller trees with thicker trunks and wider crowns and had more open understoreys with fewer saplings. Near the edges of the plateau trees where often growing directly on a laterite surface, with roots following the small vertical holes that perforate the laterite. Root system development was severely restricted and many of these trees blew over in the cyclone to reveal a flat disc of roots less than 5 cm thick. Away from the edges of the plateau, deeper soils were available however toppled trees showed that these soils were typically only 20-30 cm deep and overlay a hardpan of cemented bauxite. Many hundreds of toppled trees were observed, each with a flat bottomed root mass that had no significant root penetration into the underlying rock. Examining the ground where root balls had been lifted revealed no sign of gaps in the hardpan where tree roots could penetrate (or any snapped roots).

Approximately 30 m below the top of the plateau, seasonal or permanent seeps from the sides of the plateau many occur. *Corymbia ptychocarpa* (Gove Gums) appeared to be a marker for areas which experience seasonal seepage. Permanent seeps have open sedgelands ringed by pandanus, paperbarks and waterloving understorey species including ferns and pine tree moss (*Lycopodiella*). These areas are too waterlogged for rainforest species. Only one hillside spring with rainforest species was encountered and this spring was located just below the Garma ceremonial site (Site 11). A few hundred square metres of rainforest surrounded the spring, however all species present were common, widely dispersed species. In other locations, larger patches of rainforest exist but no surface water was found during the limited survey of these hillside vine forests (Site 10).

In contrast, the gently sloping sand plains at the base of the escarpment have surface soils of fine white silica sand and laterite gravel. It appears that most plants other than eucalypts appear to be unable to benefit from the groundwater passing below. Soils were not investigated and it is possible that the low plains have subsurface laterite or hard clay that limits dry season water storage. In some places, small sandstone boulders are present at the surface, suggesting sandstone underlies some of the vegetation patterns, particularly the hardpan pattern.

A sandstone exposure is visible in a cutting where the road to Port Bradshaw descends from the plateau and is also visible near the Garma spring. It is likely that the sandstone provides the confining layer that determines groundwater storage capacity and groundwater movement.

4.4.2 Wind Exposure

Wind has greatest effect where laterite sheets lie at or just below the soil surface and trees are poorly anchored to the ground due to lack of opening in the laterite. Prior to the cyclones of 2015, a few trees had fallen over to reveal root masses that were pancake thin. The cyclones toppled a large number of trees growing on stone. Even in areas with soils up to 0.5 m deep, the presence of an unbroken laterite sheet enabled cyclonic tree throw. Valley heads seemed to have higher levels of wind damage and even the vine forests which were nestled into the valleys were extensively damaged. Trees on the rim of the plateau suffered patchy wind damage, however trees on broad flat areas probably suffered more crown damage. Only valleys that were protected from the south were spared from serious cyclone damage.

Wind exposure seriously affects coastal vegetation in the Gove area and it is likely that the vegetation of the Dhupuma Plateau is also affected by strong dry season winds. The hill forest vegetation pattern seems to be defined by a dense coppice layer dominated by Cooktown ironwood, which creates a dark understorey that is visible in aerial photography. It is possible that the Cooktown ironwood requires the topographic sheltering of the plateau. More exposed locations have the *Plateau Woodland* pattern, which is dominated by Darwin stringybark saplings. In areas where the escarpment is high and very steep, the sun strikes the ground at a glancing angle and this appears to create a milder habitat for herbaceous plants (native grape, ferns etc) and these areas have been mapped as '*Escarpment Open Forest*'.

4.4.3 Fire

Fire reach all parts of the landscape on an annual or near annual basis, except for the core areas of vine forests and the banks of larger creeks. A partially effective fire refuge also occurs on some of the rockiest slopes, however some fire seem to burn through in a patchy, low intensity fashion so the fire sensitive species that occur there are greatly set back. The breakaway zone at the edge of the escarpment provides the most habitat for rocky area loving species.

Fire sensitive tree species like figs were almost entirely absent from the landscape. Even common savanna non-eucalypt trees that should be tolerant of fire were greatly reduced in number. The only places that many of these species were encountered at full size were in the Garma grounds or in the ruins of the old Eldo facility, where old streets, pits or other features created some fire protection. Grass is sparse over most of the plateau and leaf litter and shrubs are probably the main fuel. Prevailing winds drive the fire across flat ground.

4.4.4 Soils

Most soils on the plateau contained a high proportion of bauxite and laterite boulders (0.25-0.5 m long), often covering most of the ground surface. There was little obvious variation in soil types on the surface, although soils were not investigated in detail. The presence of a high proportion of rock may enhance the dominance of shrubs over grass on the plateau. In the bauxite regions of Cape York Peninsula, grass is usually the dominant understorey plant, with sedges dominating the ground layer in areas with harsher conditions (areas with shallow soils and waterlogging). Whilst the same species of grass and sedge are present on the Dhupuma Plateau, they are rarely dominant. Understoreys dominated by perennial shrubs are a distinctive feature of the bauxite plateau near Gove.

In the surrounding landscape including on the low footslopes of the plateau, sand plains with fine white quartz sand were present. Areas with deep white sands supported a heath vegetation that was quite distinct from the vegetation of the plateau and plateau sides. Peaty organic soils were present in permanently moist areas on the coastal plain and supported swampy rainforest or wet paperbark swamp/sedge swamp.

4.4.5 Feral Animal Impacts

Water buffalo footprints and occasional tracks were present on the plateau and plateau sides but vegetation impacts appear to be slight. In permanent seepage areas, vegetation trampling by buffalo was significant. Feral cattle are also reported as being present but were not observed. No feral pig sign was observed.

5 Impact Assessment and Mitigation

No listed threatened species or vegetation types have been located within or immediately adjacent to the proposed mine footprint based on the spatial extent of the 2015 test drilling program.

In the case of the Dhupuma Plateau, the landscape and its vegetation are so uniform that there were no places with elevated flora for fauna habitat values were observed. The best observed opportunity for impact mitigation was a single cycad located within the test drilling area, however at this time it is not known if the cycad is located in a future mining area.

Some significant environmental values were observed in areas outside the proposed mining footprint and these areas are unlikely to be impacted by the proposed mine directly or by indirect processes such as changes to fire regime or hydrology. As the rainforest patch begins approximately 20 m below the lip of the escarpment and is on the upwind side of the proposed mine, it is unlikely that there would be any significant impact on the rainforest patch due to dust, changes to fire regime. A search of the dry rainforest did not locate any water loving species such as water palms and examination of the drainage lines did not indicate seasonal surface flows that persisted beyond storm events. In areas with deep gravels or scree, most of the water flows can be subsurface following what appear to be drainage lines on the surface (linear depressions may form as the rock dissolves and the ground level falls).

Most of the environmental values for which East Arnhem Land is known were not observed within the study

area. There were some remote wetlands and rainforest patches on the low ground on the flats which occur beyond the footslopes of the escarpment. These areas were not surveyed as they are remote (> 5 km) from any proposed mining activity. The main concentration of values appears to be in semi-permanent coastal wetlands that occur in the transition zone between coastal dune systems and regular coastal plain with clay soils. In these areas, groundwater from the dune systems supports a wide variety of vegetation including well developed rainforest.

6 Summary

The vegetation present within the proposed mine footprint has been documented at the most detailed level of the vegetation survey and mapping system used by the Northern Territory Government. Mapping and limited groundthruthing has also been undertaken for the balance of the proposed mining lease.

No listed threatened plant species or threatened vegetation types were observed.

The proposed mine site is also almost weed free and no significant environmental weeds are present.

A significant part of the proposed mine footprint was previously cleared for a satellite tracking facility and its associated small town. During the previous forty plus years, bushland vegetation has regenerated across most of the previously cleared area and this vegetation is now very similar in most respects to vegetation present in areas areas which do not appear to have been cleared.

Vegetation within the proposed mining area is of limited stature due and many of the trees are poorly formed due to a layer of cemented bauxite at or just below the ground surface, which limits root development. However the current prevailing fire regime also appears to be preventing many of the plant species present from reaching maturity and bearing fruit or seed. These plants are present only coppice shoots and their inability to reproduce by seed probably has long term implications for the environment.

■

7 References

Brocklehurst, P., Lewis, D., Napier, D., Lynch, D. (2007) Northern Territory Guidelines and Field Methodology for Vegetation Survey and Mapping. Technical Report No. 02/2007D. Department of Natural Resources, Environment and the Arts, Palmerston, Northern Territory.

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Fisher A. (2009) Sites of Conservation Significance – Gove Peninsula and north-east Arnhem Coast. Northern Territory Government. (extract from a larger report)

A Guide to Threatened Species in the Northern Territory – Northern Territory Planning Scheme Clearing of Native Vegetation 2004

- end of report -

Annexure 1

Cumulative Species List

Cumulative Species List for Proposed Gulkula Mine Study Area

This report includes species names from the project virtual herbarium and from site-based species lists. Species that could not be fully identified due to fertile material not being available or other reasons are listed with a number, which relates to a photograph of the species in the virtual herbarium. Species list covers both area proposed for mining and balance of study area.

Season Codes:

W – plant records were only from the wet season survey. These plants are generally short lived species that disintegrate after death or become difficult to find for other reasons.

Location Codes:

M – Occurs in areas including proposed *Mining* area

D – Plants of *Disturbed* areas near Sawmill or Garma Grounds

E – Occurs on or near lip of *Escarpment* (not proposed for mining)

O – Occurs only *Outside* proposed mining area and unlikely to be affected by mining.

Species listed by family

Family/Group	Scientific Name	Common Name	Season	Location
lAcanthaceae	Brunoniella australis	blue trumpet	W	M
Adiantaceae	Cheilanthes brownii			E
	Cheilanthes nudiuscula			E
Amaryllidaceae	Crinum angustifolium	field lily	W	O
Anacardiaceae	Buchanania arborescens	satinwood.		O
	Buchanania obovata	green plum.		M
	Semecarpus australiensis	native cashew tree		O
Apocynaceae	Alyxia spicata	chain-fruit vine.		M
	Marsdenia sp.			E
Araceae	Amorphophallus galbra	stinking snakeskin lilly.	W	O
Araliaceae	Trachymene sp		W	O
Arecaceae	Hydriastele wendlandiana	palm.		O
	Livistona humilis	cabbage tree palm		M
Asparagaceae	Asparagus racemosus	native asparagus		O
Asteraceae	Blumea saxatilis		W	M
	Camptacra gracilis		W	M
	Sigesbeckia orientalis	Indian weed		D
	Sonchus oleraceus	common sowthistle		D
	Tridax procumbens	tridax daisy		D
	Wedelia longipes		W	E
Bignoniaceae	Pandorea sp?			O

Blechnaceae	Blechnum orientale			O
	Stenochlaena palustris	climbing swamp fern		O
Boraginaceae	Heliotropium sp.		W	M
Burseraceae	Canarium australianum	scrub turpentine.		E
Byttneriaceae	Waltheria indica	spinyhead sida		D
Caesalpiniaceae	Chamaecrista mimosoides	dwarf cassia	W	O
	Erythrophleum chlorostachys	red ironwood.		M
Capparaceae	Capparis sepiaria			O
Caryophyllaceae	Polycarpaea sp.		W	O
Celastraceae	Denhamia obsura			E
Clusiaceae	Calophyllum sil	blush touriga.		O
	Calophyllum soulattri			O
Combretaceae	Terminalia carpentariae	terminalia.		M
Commelinaceae	Cartonema spicatum		W	O
	Commelina ensifolia	scurvy grass	W	M
	Murdannia 7525 white		W	O
	Murdannia cryptantha		W	O
Convolvulaceae	Ipomoea eriocarpa		W	D
	Ipomoea gracilis		W	O
	Jacquemontia paniculata		W	M
	Merremia quinata		W	M
	Xenostegia tridentata		W	M
Cycadaceae	Cycas arnhemica?	cycad.		E
Cyperaceae	Cyperus aquatilis			O
	Cyperus carinatus			O
	Fuirena ciliaris			O
	Fuirena umbellata			O
	Gahnia aspera	saw sedge.		O
	Rhynchospora rubra			O
	Schoenus sparteus			O
	Scleria ciliaris			O
	Tricostularia undulata			O
Dilleniaceae	Dillenia alata	red beech.		O
	Hibbertia dealbata	guinea flower.		M
	Hibbertia sp. glossy	guinea flower.		M
	Hibbertia sp. 7467 terete leaves			O
	Pachynema complanata			M
Dioscoreaceae	Dioscorea bulbifera	aerial potato.		E
	Dioscorea sp.	yam		E
Droseraceae	Drosera petiolaris			O
	Drosera sp. 14083 spatulata			O

	Drosera spatulata			O
Eriocaulaceae	Eriocaulon 14091 turf			O
	Eriocaulon australe	pipewort.		O
	Eriocaulon setaceum		W	O
	Eriocaulon truncatum?			O
Euphorbiaceae	Chamaesyce bifida			M
	Euphorbia heterophylla	milkweed.		D
	Glochidion sp.			E
	Homalanthus novoguineensis			O
	Macaranga tanarius	macaranga		O
	Microstachys chamaelea			M
Fabaceae	Abrus precatorius	crabs-eye vine		E
	Alysicarpus sp. 14122			E
	Bossiaea bossiaeoides			O
	Cajanus sp.			M
	Crotalaria 8377			O
	Crotalaria brevis?			M
	Crotalaria calycina			O
	Crotalaria medicaginea	Rattlepods		M
	Crotalaria montana			M
	Cyclocarpa stellaris			O
	Desmodium tiny			M
	Desmodium tortuosum	Florida beggar-weed		D
	Eriosema chinense			M
	Fabaceae 7378			E
	Fabaceae 7382			E
	Fabaceae 7456			E
	Fabaceae 7466 prostrate leafless pea			O
	Fabaceae 7623			E
	Fabaceae 8173			E
	Flemingia parviflora	flemingia	W	M
	Galactia tenuiflora	snail flower.		M
	Glycine tabacina			E
	Gompholobium subulatum			M
	Indigofera linifolia			O
	Indigofera trifoliata			E
	Jacksonia dilatata			E
	Jacksonia sp.			O
	Leafless pea			E
	Stylosanthes guianensis	common stylo.		D
	Tephrosia juncea			M

	Tephrosia simplicifolia			M
	Uraria lagopodioides			O
	Vigna adenantha			E
	Vigna lanceolata	wild cow pea.		O
	Vigna vexillata	snail flower.		O
Flacourtiaceae	Flacourtia territorialis			O
Flagellariaceae	Flagellaria indica	whip vine		O
Gentianaceae	Exacum tetragonum			O
Gleicheniaceae	Dicranopteris linearis	coral fern.		O
Goodeniaceae	Goodenia armstrongiana		W	M
	Goodenia pilosa			M
	Goodenia sp. 14068 hardpan		W	M
Haloragaceae	Gonocarpus acanthocarpus			M
Helicteraceae	Helicteres angustifolia			E
	Helicteres cana			M
	Helicteres procumbens			M
Hemerocallidaceae	Dianella odorata	blueberry lily.		M
	Dianella sp?			M
Hypoxidaceae	Curculigo ensifolia var. ensifolia			O
Lamiaceae	Anisomeles malabarica	Chodhava		E
	Clerodendrum costatum	lolly bush.		E
	Clerodendrum floribundum	thurkoo.		O
	Hyptis suaveolens	hyptis		D
	Lamiaceae 14025			M
	Plectranthus scutellarioides	native coleus.		E
	Premna acuminata	vitex.		E
	Premna serratifolia			O
	Vitex glabrata	vitex.		O
Lauraceae	Cassytha filiformis	dodder laurel		M
Laxmanniaceae	Caesia setifera			O
	Cordyline cannifolia	palm lily		O
	Lomandra sp.	spiny mat rush.		E
	Thysanotus chinensis	fringed lily.		O
Lecythidaceae	Planchonia careya	cockatoo apple		M
Lentibulariaceae	Utricularia 14086 minutissima			O
	Utricularia caerulea	blue bladderwort		O
Lindsaeaceae	Lindsaea ensifolia			O
Loganiaceae	Mitrasacme 7555		W	O
	Mitrasacme nudicaulis		W	O
	Mitrasacme sp.		W	O

Lycopodiaceae	Lycopodiella cernua	coral fern.		O
Malvaceae	Abelmoschus moschatus subsp. tuberosus	climbing hibiscus.	W	O
	Hibiscus meraukensis	Merauke hibiscus	W	O
	Hibiscus tiliaceus	cotton tree		O
	Sida acuta	spinyhead sida		D
Melastomataceae	Melastoma malabathricum	blue tongue.		O
Meliaceae	Aglaia brownii			O
	Owenia vernicosa			O
Mimosaceae	Acacia aulacocarpa	hickory wattle.		M
	Acacia drepanocarpa			E
	Acacia hemsleyi			E
	Acacia latescens			E
	Acacia leptocarpa	north coast wattle		M
	Acacia sp. 7444			M
	Acacia sp. 7482 prostrate			E
	Acacia sp. 7488			M
	Acacia sp. 7540 terete swamp			O
	Acacia sp. 8236			M
	Acacia sublanata			E
	Acacia torulosa			O
	Neptunia amplexicaulis		W	M
	Neptunia gracilis	sensitive plant.		M
Moraceae	Ficus aculeata	sandpaper fig.		M
	Ficus hispida	sandpaper fig.		O
	Ficus sp.			O
	Trophis scandens	burny vine.		O
Myristicaceae	Myristica insipida	nutmeg.		O
Myrtaceae	Asteromyrtus symphyocarpa	liniment tree.		O
	Calytrix exstipulata			O
	Corymbia bella			O
	Corymbia confertiflora	broad-leaved carbeen.		E
	Corymbia ferruginea			M
	Corymbia ptychocarpa	Gove gum		E
	Corymbia sp. 7425			M
	Eucalyptus alba			O
	Eucalyptus miniata	Darwin woollybutt		M
	Eucalyptus tetrodonta	Darwin stringybark		M
	Lophostemon lactifluus	swamp box		O
	Melaleuca acacioides			O
	Melaleuca cajuputi			O
	Melaleuca viridiflora	coarse-leaved paperbark.		E

	Syzygium nervosum			O
	Syzygium suborbiculare	murl-kue-kee.		E
	Verticordia verticillata	heath platysace		O
Nephrolepidaceae	Nephrolepis hirsutula			O
Oleaceae	Jasminum didymum	native jasmine.		O
Onagraceae	Ludwigia octovalvis	willow primrose		O
Opiliaceae	Opilia amentacea			O
Pandanaceae	Pandanus spiralis	Pandanus		M
Passifloraceae	Passiflora foetida	wild passionfruit.		D
Philydraceae	Philydrum lanuginosum	frogsmouth		O
Phyllanthaceae	Breynia cernua	fart bush.		E
	Bridelia leichhardtii	Leichhardt's ironbark.		E
	Flueggea virosa subsp. melanthesoides	white berry bush.		E
	Phyllanthus sp. 7743			M
	Sauropus sp.7578			M
	Sauropus glaucus			M
	Sauropus sp.			M
Picrodendraceae	Petalostigma banksii			M
	Petalostigma pubescens	quinine tree		M
	Petalostigma quadriloculare	quinine tree		M
Poaceae	Arundinella nepalensis	reedgrass		O
	Bothriochloa bladhii	forest bluegrass.		D
	Chrysopogon elongatus			O
	Cymbopogon ambiguus	lemon grass		E
	Cymbopogon bombycinus	silky oilgrass		M
	Ectrosia leporina			D
	Eleusine indica	crowsfoot grass		D
	Eulalia sp? 7719			M
	Germainia capitata			O
	Heteropogon triticeus	giant speargrass		M
	Ischaemum australe			O
	Mnesithea rottboellioides	cane grass.		E
	Panicum seminudum			D
	Panicum sp. 7396			D
	Sarga plumosum			E
	Schizachyrium sp. 7469			D
	Setaria surgens			M
	Themeda arguens			D
Polygalaceae	Comesperma aphyllum			E
	Polygala 7600			O
	Polygala 7741			O
	Polygala longifolia		W	M

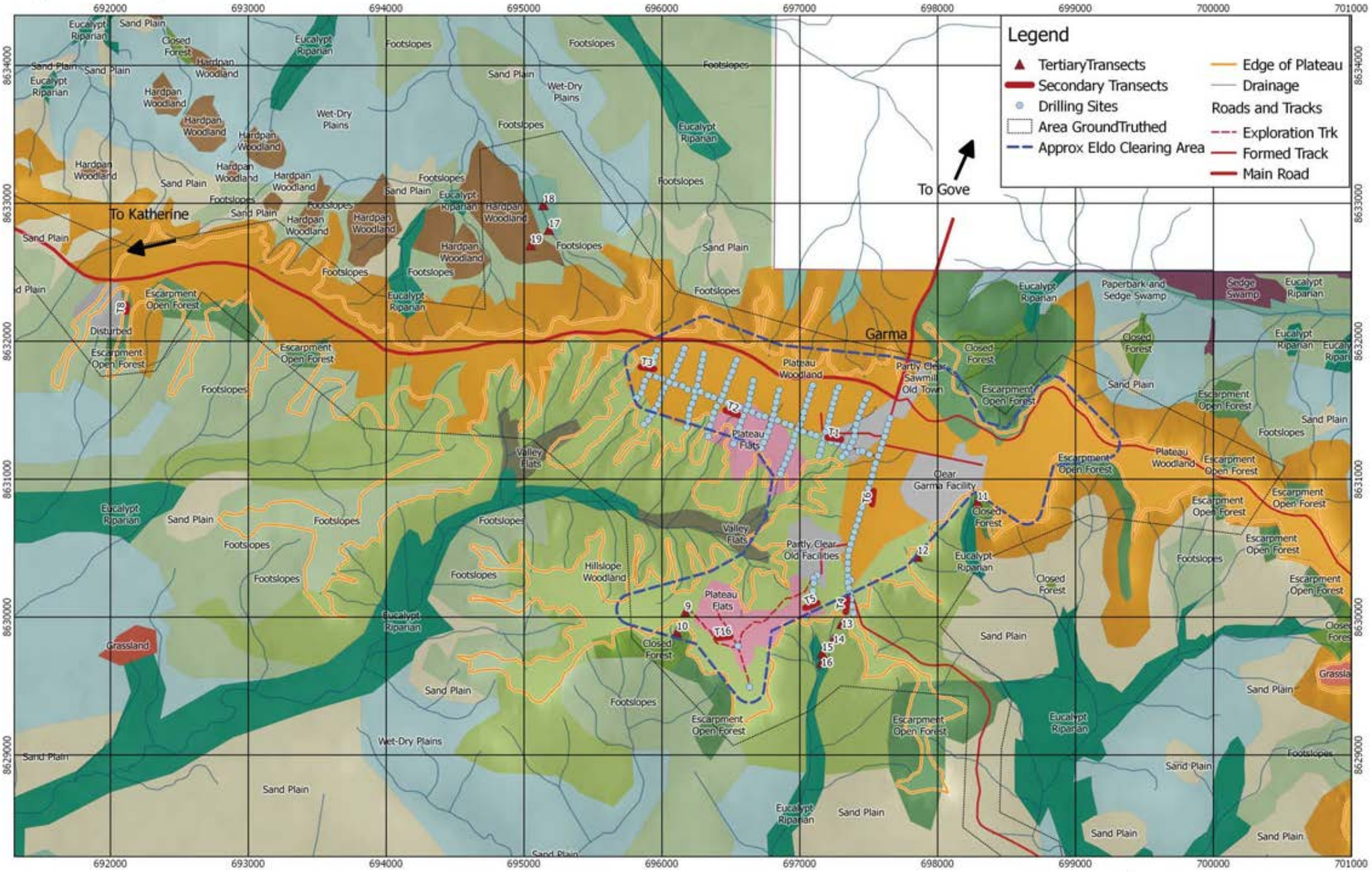
Proteaceae	Banksia dentata	tropical banksia.		O
	Grevillea dryandri			E
	Grevillea goodii ssp. goodii			O
	Grevillea heliosperma	Rock Grevillea		M
	Grevillea pteridifolia	golden parrot tree		E
	Grevillea pungens			O
	Helicia australasica			O
	Persoonia falcata	geebung.		M
	Stenocarpus cunninghamii	little wheel bush.		M
Putranjivaceae	Drypetes deplanchei	grey boxwood		E
Restionaceae	Dapsilanthus elatior			O
	Dapsilanthus spathaceus			O
Rhamnaceae	Alphitonia excelsa	soap tree		O
	Alphitonia oblata			M
Rhizophoraceae	Carallia brachiata	carallia		E
Rubiaceae	Ixora timorensis	Native Ixora		O
	Larsenaikia suffruticosa			M
	Morinda citrifolia	great morinda.		O
	Morinda reticulata	mappoon.		E
	Oldenlandia galioides		W	E
	Pogonolobus reticulatus			E
	Psychotria nesophila	hairy psychotria		E
	Rubiaceae 7534			O
	Spermacoce 7487		W	O
	Spermacoce 7507 white		W	M
	Spermacoce 7585		W	M
	Spermacoce argillacea		W	M
	Spermacoce latifolia			D
	Tarenna dallachiana			O
	Timonius timon var. timon			D
Rutaceae	Boronia lanuginosa			O
Santalaceae	Anthobolus filifolius			E
	Exocarpos 7564 swamp fine			O
	Exocarpos latifolius	scrub cherry.		M
	Mistletoe 14073 loops			M
	Santalum album	sandalwood.		O
	Santalum lanceolatum	sandalwood.		O
Sapindaceae	Cupaniopsis anacardioides	tuckeroo		O
	Dodonaea hispidula			E
	Dodonaea viscosa	wedge-leaf hopbush.		O
	Ganophyllum falcatum	scaly-bark ash.		O

Sapotaceae	Sersalisia sericea	mongo.		E
Schizaeaceae	Lygodium microphyllum	snake fern		O
Scrophulariaceae	Buchnera 7712		W	M
	Buchnera linearis		W	M
	Striga curviflora	witchweed.	W	E
Smilacaceae	Smilax australis	barbed-wire vine		E
Sparrmanniaceae	Grewia retusifolia	Emu berry.		O
Sterculiaceae	Brachychiton diversifolius subsp. diversifolius			O
	Brachychiton megaphyllus	red flowered kurrajong.		M
Stylidiaceae	Stylidium sp 14080 plantain			O
Taccaceae	Tacca leontopetaloides	native arrowroot.	W	E
Thymelaeaceae	Thecanthes punicea		W	M
	Thecanthes sp 7714		W	M
Verbenaceae	Stachytarpheta jamaicensis	Jamaica snakeweed		D
Violaceae	Hybanthus enneaspermus	native violet.	W	E
Vitaceae	Ampelocissus acetosa			E
	Cayratia trifolia			E
	Cissus adnata			O
Xyridaceae	Xyris juncea	dwarf yellow-eye		O

Annexure 2

Vegetation Survey Locations and Vegetation Map Units

Vegetation Survey Sites - Proposed Gulkula Mine



Notes: Map shows locations of secondary and tertiary vegetation transects in relation to area of 2014-5 drilling program on preliminary vegetation mapping (by Andrew Mitchell) and lidar derived hillshading (from Rio Tinto/SRTM).

Grid - MGA94 Z53; Scale at A3 1:25 000; Drafted on 22/5/2015 - 7/7/2015 by Andrew C. Mitchell for LandRoc

North

0 500 1000 m

Vegetation Mapping Units for Gulkula Mine Study Area

The following provides a visual description of the key features that can be used to separate vegetation types on the ground. Each of the vegetation mapping units also has an aerial vegetation pattern so is mappable from aerial imagery.

Map unit name is mostly composed of the structural vegetation type (forest, open forest, woodland) and the terrain feature the vegetation unit is associated with. If the map name has been shortened, the omitted words are displayed in square brackets. The following vegetation mapping unit are presented in the following pages:

Vegetation types in proposed mining area

- Plateau Flats [Woodland]
- Plateau Woodland

Vegetation types in balance of study area

- Closed Forest
- Eucalypt Riparian [Forest]
- Footslopes [Woodland]
- Hardpan Woodland
- Hillslope Woodland
- Paperbark and Sedge Swamp
- Sand Plain [Woodland]
- Slope [Open] Forest
- Valley Flats [Woodland]

Data from transects within the map units can be aggregated to create formal text descriptions of the vegetation types, however at the time of writing, this step had not been undertaken. Grouping of sites by vegetation unit needs to be completed prior to this step and this document provides the basis for the grouping system proposed.

Vegetation Types in Proposed Mining Area

Plateau Flats

Slight depressions or long flat slopes on top of plateau which have clay soils with enough depth for tree roots and grass
(Photo Set: 137-555)

Soils may still be quite shallow, less than 0.5 m deep and trees subject to wind throw. However soils are deep enough for most of the tree root to develop above the hardpan. Grass understorey present in areas with deeper soils. Bare ground with gravel armour present where soils are very shallow.

2: Another view of regeneration near the former Eldo project

photo: 7759

3: This area has very shallow soils and trees are widely spaced. This area is put into this photo pattern as it has a very flat surface with soil and poor wet season drainage.

photo: 14302

4: Gravel armour.

photo: 14303

5: When soil depth increases only a little, grass replaces gravel as the main surface cover.

photo: 14304

6: Trees can be quite tall

photo: 14339

7: View of bushland in late dry.

photo: 14340

Plateau Woodland

Ground truthing and aerial images for mapped vegetation patterns
(Photo Set: 137-251)

Covers only resource area and immediately adjacent patterns at this stage. Cemented bauxite often visible on surface, particularly where wind-thrown trees have brought up blocks of material. Dense sapling and coppice growth of Darwin stringybark is the most obvious feature of the vegetation. Ground cover is sparse and herbaceous or low shrubby rather than grassy, although grasses are relatively abundant is not previously cleared areas. Grass is usually present but not dominant.

1: View of the regeneration near the former Eldo project.

photo: 7356

3: Further from the former Eldo project the vegetation is in better condition and the determination of whether the vegetation is regrowth or remnant vegetation is more difficult. Clearing was quite widespread and signed of clearing such as windrows and pushouts generally confirm that areas with thinner vegetation and fewer mature trees had previously been cleared.

photo: 7760

4: View of regenerating forest in eastern part of proposed exploration area.

photo: 7770

5: The ground surface may have pisolites.

photo: 7761

6: Patches of cemented bauxite were also common and may have been produced by former land uses. This patch was about 50 m from the Arnhem Highway. The stones are jumbled, rather than forming a pavement and lack the black algal staining of rocks on the edge of the plateau so may have been brought to the surface by ripping.

photo: 7762

Vegetation Types in Balance of Study Area

Closed Forest

Dry rainforests or rainforest patches on hillside springs.
(Photo Set: 137-560)

There is a substantial slope to the ground so drainage is generally good. No broad seepage fronts were located. The spring near Garma had a point source and a narrow run which was less than 1 m wide and which supported water loving plants but beyond this the rainforest was regular rainforest, then eucalypt riparian pattern around the margins.

1: Inside a well developed closed forest.

photo: 14325

2: Closed forest in background with coppice margin (hillslope woodland) in foreground.

photo: 14326

3: Closed forests were generally found on steep valley heads.

photo: 14327

4: Ground surface within closed forest

photo: 14328

5: Often the understorey was very open, however there was no sign of cattle or buffalo, which often graze the understorey out rainforest stands. The vines occupy a dry 'drainage line' in the foreground.

photo: 14329

6: Only one rainforest spring was found and this was the one below the Garma site. The actual spring was quite small and flow was only a couple of litres per second.

photo: 14330

7: Some of the closed forests were damaged by Cyclones Lam and/or Nathan.

photo: 14331

Eucalypt Riparian

Places that have well developed small streams with flanking belts of greener eucalypt forest vegetation.
(Photo Set: 137-559)

The species diversity is highest in this bushland variant. It occurs in areas where seepage is feeding streams. As the groundwater is accessible for tens to several tens of metres on either side of the main channel the eucalypt riparian zone can be quite broad. It may also contain species which can grow in rainforest margins such as Lady Apple.

1: Cooktown ironwood coppice growth after a fire.

photo: 14298

2: View of bushland growing in an area with a hgih water table. The vegetation is relatively lush and contains may softer species but is regularly burned.

photo: 14315

3: A large eucalypt species (*Corymbia bella*) occurs in these areas.

photo: 14316

4: A view of the creek bed filled with seepage. Thirty metres upstream the creek bed is dry.

photo: 14317

5: Bushland closely approaches most creeks and there is no gallery rainforest. Where the creek is incised into the ground and is filled with seepage for most or all of the year, a belt of ferns may develop.

photo: 14318

6: Further away from the creek, there may be a broad belt of bushland with species such as Lady Apple or Gove Gums which appreciate additional moisture and the understorey will be thick with coppice growth of many tree species. Usually grades into footslopes or sand plain.

photo: 14319

Footslopes

Harsh footslopes at base of Escarpment and low hills that are not capped with bauxite
(Photo Set: 137-554)

The vegetation in these areas resembles the woodland near the town of Gove. It is what the prevailing country is like in areas that have sandy, clay and gravel soils rather than bauxite.

4: Patch on road to Port Bradshaw

photo: 14297

24: The lower slopes are similar to the prevailing vegetation around Gove town. The are on gently undulating land.

photo: 7781

25: Ground surface is gravelly.

photo: 7782

26: *Bossiea* is sometimes present.

photo: 7783

Hardpan Woodland

Occurs on footslopes of plateau where there appears to be underlying sandstone
(Photo Set: 137-557)

Myrtle Heath (*Calytrix sp*.) is a marker for this photo pattern.

1: *Calytrix* heath dominates the understorey.

photo: 14293

2: View of patch 3.5 km north west of Garma

photo: 14294

3: Broken sandstone is occasionally visible at the surface.

photo: 14295

4: Patch on side of road to Port Bradshaw

photo: 14296

Hillslope Woodland

Hillslopes that have frequent to dense coppice growth of Cooktown Ironwood and other non Darwin stringybark species
(Photo Set: 137-556)

These slopes are steep enough and moist enough to grow escarpment forest but appear to be burnt so often that the vegetation present is quite stunted and is dominated by coppice growth. Differs from Plateau Flats in having a dense understorey of coppice growth with non-eucalypt species in addition to Darwin stringybark.

1: View across escarpment

photo: 14290

2: View down the escarpment

photo: 14291

3: Cooktown ironwood is abundant in the understorey in some places.

photo: 14292

Laterite Slopes

Dry slopes and breakaways with a surface of laterite boulders and dry rainforest coppice or prostrate xerophytic plants
(Photo Set: 137-553)

This photo pattern is generally linear and occurs in small areas on the margins of the plateau and sometimes on isolated hills or steep slopes. It is not clearly visible in aerial imagery and is also too small to be mapped independently as an aerial photo pattern despite being a distinctive photo pattern at ground level. Impact to these area should be avoided if possible.

7: The edges of the plateau are usually defined with large laterite boulders.

photo: 7763

8: A laterite slope at the bottom of the escarpment, next to a second order stream.

photo: 14305

8: On the mid-slope the boulders have decreased in size and rock pavement vegetation including various heath and prostrate plant species may be present.

photo: 7764

9: The laterite is darker and is more massive than the pisolitic laterite found at the top of the escarpment.

photo: 14306

9: Ground is gravelly on the surface.

photo: 7765

10: Some areas have balds in the understorey where there is too much laterite.

photo: 14307

10: Massive red clay may also be beneath the surface, here exposed by a gully forming below a turnout drain.

photo: 7766

11: This hill is immediately beside the Arnhem Highway on the project areas northern boundary.

photo: 7767

12: A prostrate Grevillea (*G dryandri*).

photo: 7768

13: An acacia that is also common on the rocky slopes. The species list from the laterite slope was quite distinct from the adjacent sand plain/seepage plain.

photo: 7769

Paperbark and Sedge Swamp

Usually an open sedgeland ringed by a stand of paperbarks, associated with permanent seepage zone on the footslopes.
(Photo Set: 137-561)

These are present at the base of the escarpment which at one point of measurement was 36 metres below the rim of the escarpment. Buffalo damage in these areas is moderate due to the soft soils. These areas are too wet for local rainforest tree species.

1: Example from seepage area 3.5 km north west of Garma

photo: 14313

2: Dense sedge understorey on wet ground

photo: 14314

3: Spring at base of escarpment beside road to Port Bradshaw.

photo: 14332

4: Ground is probably almost always wet.

photo: 14333

5: Small wildflowers and insectivorous plants abundant.

photo: 14334

6: Contain buffalo wallows

photo: 14335

7: View of a sedge swamp from the plateau.

photo: 14336

8: Sedge swamp near radio mast site (generators).

photo: 14337

Sand Plain

Heath vegetation on white sands with a relatively tall open woodland of Darwin stringybark
(Photo Set: 137-558)

Occurs on flats that surround the base of the plateau beyond the foot slopes. Soils appear to be pure white quartz sand. The heath vegetation is generally about 0.5 to 1 m tall and is composed mainly of fine leaved shrubby vegetation.

1: A wet variation of sand plain can occur adjacent to eucalypt riparian areas. It is likely that seepage emerges in these areas and removes the organic content of the soils leaving only a nutrient depleted white sand which supports fine graminoid vegetation and herbs.

photo: 14311

1: *Asteromyrtus* understorey on white sandy soils

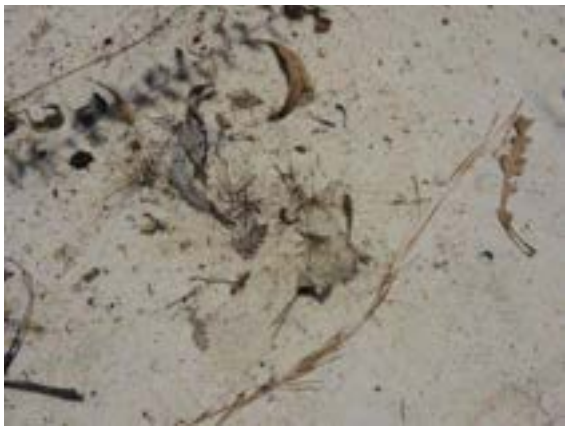
photo: 14299

2: Tree cover is often provide by large well-spaced stringybark trees.

photo: 14312

2: View of the soil surface.

photo: 14300



3: A spiky grevillea (*G. pungens*) is a common species on sand plains

photo: 14301

4: This area shows signs of having a shallow wet seaons water table. Banksias and fern-leaved grevilleas are indicator species for wetness.

photo: 14308

5: Herbs can be common in the understorey including Goodenias and sundews (not in this photo).

photo: 14309

6: Groundcover is usually almost continuous.

photo: 14310

9: A yellow-green *Pachynema* understorey can be quite striking.

photo: 14338

Slope Forest

Open Forest with tall trees and mid-dense canopy with a mesic herbaceous understorey which occurs on escarpments
(Photo Set: 137-551)

Occurs on steep slopes which are protected from drying winds or probably also from intense wind driven fire. They may also be in locations were cyclones do not result in as much tree damage. Trees are noticeably taller and denser (open forest rather than woodland).

14: The edge of the plateau has a steep escarpment in places which features a small cliff at the top with a scree slope or rubble strewn colluvial slope below which descends to the plain 60-80 m below.

photo: 7771

15: A view of the low cliff at the lip of the escarpment on the southern side of the plateau. This slope appears to be exposed to prevailing winds and hot fires so lacks the soft shrubs that are usually an indicator of this type.

photo: 7772

16: View of the escarpment on the northern side of the plateau.

photo: 7775

17: Close up of the laterite or tubular bauxite in the cliff. It is fully of vertical pipes that are approximately 1 cm in diameter. Here small ferns are growing on the surface of the laterite and reaching water via the pipes.

photo: 7774

18: The shelter from wind and possible shading effects and groundwater result in the slopes being heavily wooded.

photo: 7773

19: Softer herbaceous species occur on the steepest slopes

photo: 7776

20: A wider view of the profusion of soft understorey plants.

photo: 7777

Valley Flats

Tall eucalypt open forest on deeper sandy soils that have accumulated in valleys, continuous grassy groundcover
(Photo Set: 137-552)

These area appear to be created by an accumulation of material that has washed down from the plateau. They are grassy rather than shrubby and the ground is sandy or loamy rather than gravelly.

1: View of vegetation which is very similar to some areas of Plateau flat

photo: 14320

2: View of grass ground layer in a floodway

photo: 14321

3: Some areas which are in floodways have open grassy understoreys. In the background is a hillslope woodland.

photo: 14322

4: A valley flat with a well developed open forest

photo: 14323

5: View from a hillslope into a valley flat

photo: 14324

6: An unmapped example was briefly inspected at the bottom of the escarpment. It was a broad bottomed value without a drainage line and with pandanus and other plants that like seasonally wet areas.

photo: 7778

7: View of understorey which dominated by graminoides

photo: 7779

8: *Corymbia ptychocarpa* is often present in these areas.

photo: 7780

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- End of report -

Annexure 3

Vegetation Survey Data

Vegetation Survey for Proposed Gulkula Mine

The following data is baseline vegetation survey data collected according to Qld/NT vegetation mapping standards.

Transect 1 | Old Town - *Secondary*

A previously cleared area at the centre of the old town, Transect 1 lacks some data that latter transects have due to being the first transect in a new area with a new team.

*Transect Context: Located within centre of old town, which is also in the resource area

T1- Transect Metadata

Recorded By:	AM	Transect Date:	15/10/2014
Transect Level	2	Strata Surveyed	All
Latitude:	-12.37513	Longitude:	136.81419
Magnetic Bearing:	-90	Transect Length:	100
Community Extent:	D: 5-20 ha	Community Width:	F: not linear

1: View from start of transect

2: Dan Roberts laying the tape along the axis of the transect

3: Dead trees in second half of transect

4: Insect damage to tree trunk

5: Tree with epicormic growth in response to insect damage

6: Emergent tree

7: T1 Canopy Tree

8: P2 Transgressive

T1- Disturbance

Storm Damage:	0: none	Age:	
Roadworks:	0: none	Age:	
Wildfire:	3: >5%	Age:	1: 1-3 yrs
Floods:	nil		
Logging:	nil	Ringbarking:	nil
Clearing:	slight	Grazing:	nil
Feral Digging:	nil		

T1- Landform and Ground Information

Disturbed ground was rocky with bauxite/laterite.

T1- Vegetation Structure

Most of the mature trees had died. Many had insect damage to trunks. Large trees still appear to be dying

Strata Visibility: Moderately Visible

Structural Formation:	OW	Ecol. Dom. Layer:	
Regional Ecosystem:		*Vegetation Pattern:	Tetrodonta
Remnant status:	Remnant	Vegetation is Mapped:	False

Strata

Stratum	Median Height	Bottom Height	Top Height	Estimated Cover Density
E	.	20	24	Very Sparse
T1	.	12	14	Very Sparse
T2	.	8	11	Sparse
S1	.	2	4	Medium
S2	.	1	2	Dense
GC	.	0	1	-

T1- Stem Density (Stems/ha): 790

Area surveyed: 1000 m^2

T1- Tree Density Data Summary (stems in 1000 m^2)

Scientific Name:	E:	T1:	T2:	T3:	S1:
Buchanania obovata	.	.	.	.	1
dead	3	.	2	.	.
Eucalyptus miniata	.	6	8	1	.
Eucalyptus tetrodonta	.	2	12	.	.
Livistona humilis	.	.	.	.	1

T1- Basal Area Summary

Sweep Number	Basal Area m/ha
1	6
2	5.5

T1- Basal Area Data

Scientific Name	E	T1	T2	T3	S1
Sweep 1					
dead	.	.	.	.	.

Eucalyptus miniata	.	.	.	.	.
Eucalyptus tetrodonta	.	.	.	.	.
Livistona humilis	.	.	.	.	.
Sweep 2					
dead	.	.	.	.	.
Eucalyptus miniata	.	.	.	.	.
Eucalyptus tetrodonta	.	.	.	.	.

T1- Projected Crown Cover Summary (% linear intercept)

Scientific Name	E	T1	T2	T3	S1	S2
Corymbia sp.	.	.	.	.	.	.
Eucalyptus miniata	.	17.4	3.7	.	.	.
Eucalyptus tetrodonta	.	3.6	3.2	19	.	.
Livistona humilis	.	.	.	.	1	.

Intercept of EDL adjusted for overlaps(m)	**30.9**
Percentage Crown Cover of EDL	**31**

T1- Groundcover (% cover)

Cover Summary	
Litter	32
Grass	21
Shrub-herb	7
Bare soil	37
Rock	0
Cryptophyte	0

Plant Cover - % cover or x for nominal presence

Scientific Name	Cover Density	G1	G2	G3	G4	G5
Heteropogon triticeus	.	.	.	.	.	.
Sarga plumosum	.	.	.	.	.	.

T1- Structural Species List

D - dominant; A - abundant; F - frequent; O - Occasional; S - Scarce; X - Present (any amount)

Species covered: All Species

Extras were mainly on broke rock pushed to side of road.

Scientific Name:	E:	T1:	T2:	T3:	S1:	S2:	G:
Acacia aulacocarpa	.	.	.	.	.	.	.
Alyxia spicata	.	.	.	.	.	.	.

Buchanania obovata	.	.	.	.	O	O	.
corymbia sp. Yellow	.	.	S	S	.	.	.
Dianella odorata	.	.	.	.	.	.	.
Drypetes deplanchei	.	.	.	.	.	.	.
Eucalyptus miniata	.	CD	F	.	.	.	S
Eucalyptus tetrodonta	.	CD	.	D	F	D	.
Ficus opposita	.	.	.	.	.	.	.
Heteropogon triticeus	.	.	.	.	.	.	.
Hibbertia glossy	.	.	.	.	.	.	S
Marsdenia australis	.	.	.	.	.	.	.
Microstachys chamaelea	.	.	.	.	.	.	.
Pachnema complanatum	.	.	.	.	.	.	S
Pandanus spiralis	.	.	.	.	.	.	O
Persoonia falcata	.	.	.	.	.	.	.
Petalostigma quadriloculare	.	.	.	.	.	.	.
Planchonia careya	.	.	.	.	.	.	.
Sarga plumosum	.	.	.	.	.	.	.
Smilax australis	.	.	.	.	.	.	.
Stylosanthes guianensis	.	.	.	.	.	.	.

T1- BioCondition Data

Sum of Coarse Woody Debris Lengths/ha: m

Large Tree Summary

Area surveyed: m^2

No data for this section

Transect 2 | Main Plateau Centre - *Secondary*

An area in the centre of the drilling area, which has taller timber and a more open vegetation structure. Timber in this area is the best observed on the plateau.

*Transect Context: A slight depression in middle of resource area with a woodland of large trees

T2- Transect Metadata

Recorded By:	AM	Transect Date:	15/10/2014
Transect Level	2	Strata Surveyed	All
Latitude:	-12.37349	Longitude:	136.80746
Magnetic Bearing:	0	Transect Length:	100
Community Extent:	E: 20-50 ha	Community Width:	F: not linear

1: Typical view of vegetation along transect

2: T1 Canopy Tree

3: View back along transect

4: The only cycad found during flora survey

5: Typical groundcover

6: Understorey is generally clear but patches of undergrowth are present

T2- Disturbance

Storm Damage:	0: none	Age:	
Roadworks:	0: none	Age:	
Wildfire:	3: >5%	Age:	1: 1-3 yrs
Floods:	nil		
Logging:	slight	Ringbarking:	nil
Clearing:	nil	Grazing:	nil
Feral Digging:	nil		

T2- Landform and Ground Information

A broad shallow depression between low rises. Slopes at approximately 1 degree to south. Land surface is planar and has some gravel armour

Erosion

Erosion Type:	0: none	Erosion Severity:	

T2- Vegetation Structure

Logging is just starting to be undertaken.

Strata Visibility: Clearly Visible

Structural Formation:	OW	Ecol. Dom. Layer:	t1
Regional Ecosystem:		*Vegetation Pattern:	Open Tetrodonta
Remnant status:	Remnant	Vegetation is Mapped:	False

Strata

Stratum	Median Height	Bottom Height	Top Height	Estimated Cover Density
T1	.	20	26	Medium

T2	.	10	15	Very Sparse
T3	.	6	10	Very Sparse
S1	.	2	5	S-Patchy
S2	.	1	2	Sparse
GC	.	0	1	M-Patchy

T2- Stem Density (Stems/ha): 520

Area surveyed: 1000 m^2

T2- Tree Density Data Summary (stems in 1000 m^2)

Scientific Name:	**E:**	**T1:**	**T2:**	**T3:**	**S1:**
Buchanania obovata	.	.	.	.	3
Corymbia sp.	.	.	.	.	3
Eucalyptus miniata	.	1	2	4	12
Eucalyptus tetrodonta	.	6	4	6	.
Grevillea heliosperma	.	.	.	.	1
Livistona humilis	.	.	.	.	6
Planchoneya careya	.	.	.	.	1

T2- Basal Area Summary

Sweep Number	**Basal Area m/ha**
1	10
2	10.5

T2- Basal Area Data

Scientific Name	**E**	**T1**	**T2**	**T3**	**S1**
Sweep 1					
Eucalyptus tetrodonta	.	.	.	.	.
Sweep 2					
Eucalyptus tetrodonta	.	.	.	.	.

T2- Projected Crown Cover Summary (% linear intercept)

Scientific Name	**E**	**T1**	**T2**	**T3**	**S1**	**S2**
Eucalyptus miniata	.	0.3	4.7	.	.	.
Eucalyptus tetrodonta	.	32.3	3.6	.	.	.
Livistona humilis	.	.	.	.	1.3	.

Intercept of EDL adjusted for overlaps(m)	**41**
Percentage Crown Cover of EDL	**41**

T2- Groundcover (% cover)

Cover Summary

Litter	32
Grass	31
Shrub-herb	7
Bare soil	30
Rock	0
Cryptophyte	0

Plant Cover - % cover or x for nominal presence

Scientific Name	Cover Density	G1	G2	G3	G4	G5
Heteropogon triticeus	.	.	.	.	.	.
Sarga plumosum	.	.	.	.	.	.

T2- Structural Species List

D - dominant; A - abundant; F - frequent; O - Occasional; S - Scarce; X - Present (any amount)

Species covered: All Species

Scientific Name:	E:	T1:	T2:	T3:	S1:	S2:	G:
Acacia aulacocarpa	.	.	.	.	.	.	S
Acacia leptocarpa	.	.	.	.	.	.	O
Brachychiton paradoxus	.	.	.	.	.	.	O
Buchanania obovata	.	.	.	.	O	.	O
Cassytha filiformis	.	.	.	.	.	.	A
Coronidium rupicola	.	.	.	.	.	.	F
Corymbia confertiflora	.	.	.	.	.	.	O
Eucalyptus miniata	.	O	D	.	.	.	.
Eucalyptus tetrodonta	.	D	.	.	.	.	A
Exocarpos latifolius	.	.	.	.	.	.	O
Gardenia suffruticosa	.	.	.	.	.	.	O
Grevillea dryandri	.	.	.	.	.	.	O
Grevillea heliosperma	.	.	.	.	.	O	.
Hibbertia glossy	.	.	.	.	.	.	O
Microstachys chamaelea	.	.	.	.	.	.	O
Pachnema complanatum	.	.	.	.	.	.	O
Persoonia falcata	.	.	.	.	.	.	S
Petalostigma quadriloculare	.	.	.	.	.	.	F
Planchonia careya	.	.	.	.	.	.	S
Pogonolobus reticulatus	.	.	.	.	.	.	S

Syzygium suborbiculare . . . . . S

T2- BioCondition Data

Sum of Coarse Woody Debris Lengths/ha: m

Large Tree Summary

Area surveyed: 2000 m^2

Large Eucalypt min DBH:	30 cm
Large Eucalypts:	10 trees - 50 per ha
Large Non-Eucalypts:	0 trees - 0 per ha
Average large Eucalypts DBH:	36.6 cm
Average large Non-Eucalypts DBH:	0 cm

Large Tree Data

ScientificName	**Tree diameters (cm)**
Eucalyptus miniata	31
Eucalyptus tetrodonta	30, 32, 33, 34, 36, 39, 42, 43, 46

Transect 3 | Head of Main Valley - *Secondary*

End of main drill lane, which reaches within 200 m of the Central Arnhem Road. This area is relatively close to the western/northern margin of the plateau. The first 50 m of the transect appeared to on bauxite with the second 50 m entering a transition zone onto forest on shallow laterite, close to the edge of the plateau. Normally transects are placed to avoid transition zones but doing this requires selection of sites using aerial imagery, something not available at the time.

*Transect Context: Western end of resource area near Arnhem Highway

T3- Transect Metadata

Recorded By:	AM	Transect Date:	17/10/2014
Transect Level	2	Strata Surveyed	All
Latitude:	-12.37060	Longitude:	136.80174
Magnetic Bearing:	270	Transect Length:	100
Community Extent:	F: > 50 ha	Community Width:	F: not linear

1: T1 Canopy tree

2: T2 Sub-Canopy tree

3: T3 Transgressive

4: Typical groundcover

5: Bauxitic end of transect - dense poles

6: Lateritic end of transect - larger trees more open

7: Loose bauxite on sightly raised areas

8: Laterite dominated surface material in low ground

T3- Disturbance

Storm Damage:	0: none	Age:	
Roadworks:	0: none	Age:	
Wildfire:	3: >5%	Age:	1: 1-3 yrs
Floods:	nil		
Logging:	nil	Ringbarking:	nil
Clearing:	nil	Grazing:	nil
Feral Digging:	nil		

T3- Landform and Ground Information

Transect is near end of drilling area where landscape begins to grade down toward escarpment. Very close and parallel to the latter part of the transect was a very shallow first order drainage line (overland flow path). Some 50 m from the end of the transect, there was surface laterite underneath the bushland that was close to the plateau edge.

Erosion

Erosion Type:	0: none	Erosion Severity:	

T3- Vegetation Structure

Strata Visibility: Clearly Visible

Structural Formation:	W	Ecol. Dom. Layer:	
Regional Ecosystem:		*Vegetation Pattern:	Tetrodonta
Remnant status:	Remnant	Vegetation is Mapped:	False

Strata

Stratum	Median Height	Bottom Height	Top Height	Estimated Cover Density
T1	.	17	22	Very Sparse
T2	.	7	19	Sparse
T3	.	4	6	Medium
S1	.	2	4	Medium
S2	.	1	2	Sparse
GC	.	0	1	Sparse

T3- Stem Density (Stems/ha): 530

Area surveyed: 1000 m^2

T3- Tree Density Data Summary (stems in 1000 m^2)

Scientific Name:	E:	T1:	T2:	T3:	S1:
dead	.	.	.	.	.
Eucalyptus miniata	.	.	10	1	.

Eucalyptus tetrodonta	.	1	13	3	.
Livistona humilis	.	.	.	.	3
track	.	.	.	.	.

T3- Basal Area Summary

Sweep Number	Basal Area m/ha
1	8
2	5

T3- Basal Area Data

No data for this section

T3- Projected Crown Cover Summary (% linear intercept)

Scientific Name	E	T1	T2	T3	S1	S2
Eucalyptus miniata	.	7.8	22.9	.	.	.
Eucalyptus tetrodonta	.	4	8.8	.	.	.
Livistona humilis	.	.	.	.	0.6	.

Intercept of EDL adjusted for overlaps(m)	**42.5**
Percentage Crown Cover of EDL	**42**

T3- Groundcover (% cover)

Cover Summary

Litter	45
Grass	9
Shrub-herb	23
Bare soil	23
Rock	0
Cryptophyte	0

Plant Cover - % cover or x for nominal presence

Scientific Name	Cover Density	G1	G2	G3	G4	G5
Acacia leptocarpa	.	.	.	.	.	.
Buchanania obovata	.	.	x	.	5	5
Eucalyptus tetrodonta	.	x	x	.	.	x5
Exocarpos latifolius	.	.	.	.	5	.
Grevillea dryandri	.	.	.	.	20	.
Heteropogon triticeus	.	.	.	.	.	2

Hibbertia dealbata	.	x	.	5	.	.
Livistona humilis	.	x	.	.	.	.
Microstachys chamaelea	.	x	.	.	x	x
Pachnema complanatum	.	x	x	5	x0	.
Petalostigma quadriloculare	.	.	.	5	.	.
Sarga plumosum	.	.	x	.	.	8

T3- Structural Species List

D - dominant; A - abundant; F - frequent; O - Occasional; S - Scarce; X - Present (any amount)

Species covered:

Some unidentified leafless fabaceae spp. Also present.

Scientific Name:	**E:**	**T1:**	**T2:**	**T3:**	**S1:**	**S2:**	**G:**
Acacia aulacocarpa	.	.	.	O	.	.	.
Acacia calyculata	.	.	.	.	.	.	O
Brachychiton paradoxus	.	.	.	.	.	.	S
Coronidium rupicola	.	.	.	.	.	.	P
Corymbia confertiflora	.	.	.	.	O	.	O
Dianella odorata	.	.	.	.	.	.	S
Eucalyptus miniata	.	.	D	.	.	.	.
Eucalyptus tetrodonta	.	D	.	.	.	.	.
Exocarpos latifolius	.	.	.	.	.	.	O
Gardenia suffruticosa	.	.	.	.	.	.	O
grevillea dryandri	.	.	.	.	.	.	O
Grevillea heliosperma	.	.	.	.	.	.	O
Helicteres cana	.	.	.	.	.	.	S
Heteropogon triticeus	.	.	.	.	.	.	S
Hibbertia glossy	.	.	.	.	.	.	F
Livistona humilis	.	.	.	.	A	.	.
Lomandra longifolia	.	.	.	.	.	.	S
Microstachys chamaelea	.	.	.	.	.	.	O
Mnesithea rottboellioides	.	.	.	.	.	.	S
Pachnema complanatum	.	.	.	.	.	.	A
Persoonia falcata	.	.	.	.	.	.	O
Petalostigma quadriloculare	.	.	.	.	.	.	O
Phyllanthus 7705	.	.	.	.	.	.	F
Pogonolobus reticulatus	.	.	.	.	.	.	S
Sarga plumosum	.	.	.	.	.	.	O
Stenocarpus cunninghamii	.	.	.	.	.	.	S

T3- BioCondition Data

Sum of Coarse Woody Debris Lengths/ha: m

Large Tree Summary

Area surveyed: 2000 m^2

Large Eucalypt min DBH:	20 cm
Large Eucalypts:	7 trees - 35 per ha
Large Non-Eucalypts:	0 trees - 0 per ha
Average large Eucalypts DBH:	29.2 cm
Average large Non-Eucalypts DBH:	0 cm

Large Tree Data

ScientificName	**Tree diameters (cm)**
Eucalyptus miniata	21, 24, 28, 33, 35
Eucalyptus tetrodonta	32, 32

Transect 4 | Thin Arm of Plateau - *Secondary*

Vegetation at the south eastern extension of the drilling area. This area is on a high narrow plateau top that is less than 100 m wide. Area does not appear to have been previously cleared.
*Transect Context: Southern extremity of plateau on south eastern branch of plateau.

T4- Transect Metadata

Recorded By:	AM	Transect Date:	16/10/2014
Transect Level	2	Strata Surveyed	All
Latitude:	-12.38600	Longitude:	136.81527
Magnetic Bearing:	0	Transect Length:	100
Community Extent:	C: 1-5 ha	Community Width:	B: 35-75 m

1: View back along transect

2: T1 Canopy tree

3: View up transect

4: T2 Canopy tree

5: View from escarpment which is about 20 m from transect

6: Typical groundcover

T4- Disturbance

Storm Damage:	0: none	Age:	
Roadworks:	0: none	Age:	
Wildfire:	3: >5%	Age:	1: 1-3 yrs
Floods:	nil		
Logging:	nil	Ringbarking:	nil
Clearing:	nil	Grazing:	nil
Feral Digging:	nil		

T4- Landform and Ground Information

Transect was located on a narrow extension of the plateau. A small reentrant approached within a few metres of the transect and the transect had a slight crossfall of about 1 degree. Ground gravelly on surface.

Erosion

Erosion Type:	0: none	Erosion Severity:	

T4- Vegetation Structure

Strata Visibility: Difficult to Visualise

Structural Formation:	W	Ecol. Dom. Layer:	
Regional Ecosystem:		*Vegetation Pattern:	Tetrodonta
Remnant status:	Remnant	Vegetation is Mapped:	False

Strata

Stratum	Median Height	Bottom Height	Top Height	Estimated Cover Density
T1	.	13	18	Medium
T2	.	8	12	Medium
S1	.	4	7	Sparse