Appendix G

North Kiaka Flora and Vegetation Surveys GHD and Trudgen 2024

SIMCOA
Silicon Metal Company of Australia

Simcoa Operations Pty Ltd

North Kiaka Proposal
Flora and Vegetation Surveys

GHD and Trudgen

December 2024

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Executive Summary

SIMCOA Operations Pty Ltd (the **Proponent, (SIMCOA)**) currently operates the Moora Quartzite Mine (Moora Mine), approximately 15 km north of Moora, in the Wheatbelt of Western Australia (WA). Moora Mine has been operating for 30 years and is located on tenements M70/191, G70/91, G70/92, G70/93 and M70/1292 (with activities on M70/1292 limited to mine dewater discharge to Kyaka Brook). Quartzite ore from Moora Mine is currently transported via covered truck to SIMCOA's Kemerton Smelter (Kemerton Smelter) located in Kemerton Strategic Industrial Area (KSIA), approximately 17 km north-east of Bunbury in the South-West of WA. Existing activities at Moora Mine and Kemerton Smelter (the Approved Proposal) are approved under Part IV of the *Environmental Protection Act 1986* (EP Act) and Ministerial Statement 813 (MS 813). The Approved Proposal has been operating since 1989.

SIMCOA is proposing to establish a new quartzite mine, referred to as North Kiaka Mine (the Project), immediately north of Moora Mine (with the mine pit located approximately 1.5 to 2 km north of Kiaka Road). The proposed development of the North Kiaka mine is located within tenement M70/1292.

The flora and vegetation surveys and reporting for North Kiaka were undertaken over many years, beginning in 2012. The surveys have included the detailed survey (2012) and targeted surveys completed in 2016 and 2017, and more recently in 2024 by GHD. The dominant vegetation community is the Coomberdale Chert Threatened Ecological Community (TEC) The Coomberdale Chert is a distinctive vegetation type that is found on low rocky hills between Moora and Watheroo. This vegetation type is the predominant vegetation type both with the North Kiaka DE and the broader regional extent.

The North Kiaka DE consists of remnant vegetation on parts of parallel low chert ridges. The remnants surveyed as part of this survey effort are located on three ridges that trend from the north-north-west to the south-south-east. The southern end of the 1.4-kilometre-long area surveyed is 500 metres north of Kiaka Road and 2.2 kilometres east of the Midlands Road. The ridges are separated by narrow strips of cleared farmland and are part of a larger group of ridges located north of Kiaka Road.

Agriculture is the predominant land use in the Proposal area, with the majority of the landscape cleared for broadacre agriculture. The landscape is very stable with no other land or industry development or activities occurring in the area other than farming and SIMCOA's mine operations. There are no records of bushfires having occurred in the areas of remnant vegetation and flora populations are stable and long established.

Key findings

Vegetation types and condition

The vegetation of the Critically Endangered Coomberdale Chert Threatened Ecological Community (TEC) vegetation and flora occurs between Dalaroo East Road and north of Kiaka Road.

The vegetation was classified into three levels. The lowest order units are defined near the *plant community* level with similar structure, dominance and floristics. The plant communities were grouped into 104 *vegetation associations* that have similar structure and dominant species and then into 31 *vegetation alliances* as a third level of classification.

Vegetation condition ranges from *Completely Degraded* (cleared farmland) to *Very Good* condition. The better condition areas north of Kiaka Road are mainly in the southern part of the main central ridge system.

Flora

Trudgen 2012, 2016-2017 surveys

The Flora surveys reported 102 species of native flowering plants, one native pine (*Actinostrobus arenarius*) and five species of native ferns. This is a significant subset of the 315 native flowering plants recorded for the area of the Coomberdale Chert TEC (2012) and the 192 native flowering plant species recorded north of Kiaka Road within that area. The survey area also reports 332 native flora species and 56 weeds.

Five threatened flora species occur in the survey area. Two of these were found north of Kiaka Rd and in the proposed impact area (*Acacia aristulata* and *Daviesia dielsii)*. Thirteen priority flora species have been recorded in the survey area with three recorded north of Kiaka Road and in the proposed impact area (*Regelia megacephala*, *Diuris recurva* and *Stylidium* sp. Moora.).

GHD (2024) Targeted survey for Threatened and Priority flora

GHD (2024) recorded three Threatened flora species, *Daviesia dielsii*, *Acacia aristulata* and *Eucalyptus pruiniramis*. GHD (2024) recorded 35 plants of *Acacia aristulata* and 81 plants of *Daviesia dielsii* in the Project area. Only two records of *Acacia aristulata* were present in the North Kiaka Development Envelope, and no records of *Daviesia dielsii* were recorded within it. GHD (2024) did not record *E. pruinimaris* in the North Kiaka DE however 9 plants were recorded in the Cairn Hill Reserve Boundary.

GHD (2024) recorded two Priority species, *Regelia megacephala* (P4) and *Babingtonia cherticola* (P3). GHD (2024) recorded *Babingtonia cherticola* (P3) in numerous quantities (total 4,723 plants) in the Project Area. However, none of these records were located within the North Kiaka DE. A total of 2,224 plants were recorded in the Cairn Hill Reserve Boundary, and a further 2,499 plants were recorded in the Cairn Hill North Boundary. Approximately 9,159 plants of *Regelia megacephala* was recorded across all the survey boundaries including in the Cairn Hill Reserve Boundary (3,684), Cairn Hill North Boundary (2019), Moora Mine Development Envelope (18) and the North Kiaka Development Envelope (3,438).

Post-survey likelihood of occurrence

A post survey likelihood of occurrence assessment for all significant flora species identified in the desktop. Of the 69 species listed as potentially occurring within this table, five are listed as possibly occurring, 17 are known to occur and the remaining are listed are unlikely or highly unlikely.

This Report has been prepared to meet the Technical Guidance: Flora and Vegetation Surveys for Environmental Impact Assessment, 2016. This Report notes that the surveys were completed in 2012, 2016 and 2017, and most recently 2024 (for targeted flora). While the currency of the vegetation mapping data extends beyond five years, the findings can be confidently assessed for the following reasons:

– The experience of the Botanist Malcolm Trudgen has been acknowledged by DBCA as a technical authority in the assessment in Coomberdale Chert vegetation community
– The survey extent and longitudinal data set
– The landscape is stable in terms of land and activity
– There have been no catastrophic events in the area that have impacted vegetation condition and flora populations within the 50 years, i.e. bushfire or cyclones.

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1. Introduction

SIMCOA Operations Pty Ltd (the **Proponent, (SIMCOA)**) currently operates the Moora Quartzite Mine (Moora Mine), approximately 15 km north of Moora, in the Wheatbelt of Western Australia (WA). Moora Mine has been operating for 30 years and is located on tenements M70/191, G70/91, G70/92, G70/93 and M70/1292 (with activities on M70/1292 limited to mine dewater discharge to Kyaka Brook). Quartzite ore from Moora Mine is currently transported via covered truck to SIMCOA's Kemerton Smelter (Kemerton Smelter) located in Kemerton Strategic Industrial Area (KSIA), approximately 17 km north-east of Bunbury in the South-West of WA. Existing activities at Moora Mine and Kemerton Smelter (the Approved Proposal) are approved under Part IV of the *Environmental Protection Act 1986* (EP Act) and Ministerial Statement 813 (MS 813). The Approved Proposal has been operating since 1989.

SIMCOA is proposing to establish a new quartzite mine, referred to as North Kiaka Mine (the Project), immediately north of Moora Mine (with the mine pit located approximately 1.5 to 2 km north of Kiaka Road) (Figure 1.1). The proposed development of the North Kiaka Mine is located within tenement M70/1292. The expansion covers an area of 216.42 hectares (ha) to the north of Kiaka Road which will be referred to as the North Kiaka Development Envelope (DE) as shown in Figure 1.2. The North Kiaka DE consists of remnant vegetation on parts of parallel low chert ridges. The dominant vegetation community is the Coomberdale Chert Threatened Ecological Community (TEC) The Coomberdale Chert is a distinctive vegetation type that is found on low rocky hills between Moora and Watheroo. This vegetation type is the predominant vegetation type both with the North Kiaka DE and the broader regional extent.

SIMCOA commissioned Consultant Botanist, Malcom Trudgen to complete a series of botanical investigations over a six-year timeframe to map the flora and vegetation in a survey area that included both the proposed expansion area and a wider regional extent (Trudgen, Griffin, & Morgan, 2012).

The remnants surveyed as part of this survey effort are located on three ridges that trend from the north-north-west to the south-south-east. The southern end of the 1.4-kilometre-long area surveyed is 500 metres north of Kiaka Road and 2.2 kilometres east of the Midlands Road. The ridges are separated by narrow strips of cleared farmland and are part of a larger group of ridges located north of Kiaka Road. Agriculture is the predominant land use in the Proposal area, with most of the landscape cleared for broadacre agriculture.

The landscape is very stable with no other land or industry development or activities occurring in the area other than farming and SIMCOA's mine operations. There are no records of bushfires having occurred in the areas of remnant vegetation and flora populations are stable and long established.

This Report notes that the surveys were completed in 2012, 2016 and 2017 and while the currency of the data extend beyond five years, the findings can be confidently assessed for the following reasons:

The experience of the Botanist. Malcolm Trudgeon has been acknowledged by DBCA as a technical authority in the assessment in Coomberdale Chert vegetation community

– The survey extent and longitudinal data set
– The landscape is stable in terms of land and activity
– There have been no catastrophic events in the area that have impacted vegetation condition and flora populations within the 50 years, i.e. bushfire or cyclones.

GHD (2024) Targeted survey for Threatened and Priority flora

SIMCOA commissioned GHD in 2024 to conduct an additional targeted flora survey of the Project area (including the North Kiaka Development Envelope, the Moora Mine Development Envelope, the Cairn Hill North Boundary and the Cairn Hill Reserve Boundary). The survey extent for GHD (2024) is represented in Figure 2.2.

The purpose of the survey was to provide clear evidence of survey effort for Threatened and Priority flora and provide an estimation of the number of plants that are present on site, to date.

This Report has been prepared to meet the Technical Guidance: Flora and Vegetation Surveys for Environmental Impact Assessment (EPA, 2016).

1.1 Scope and limitations

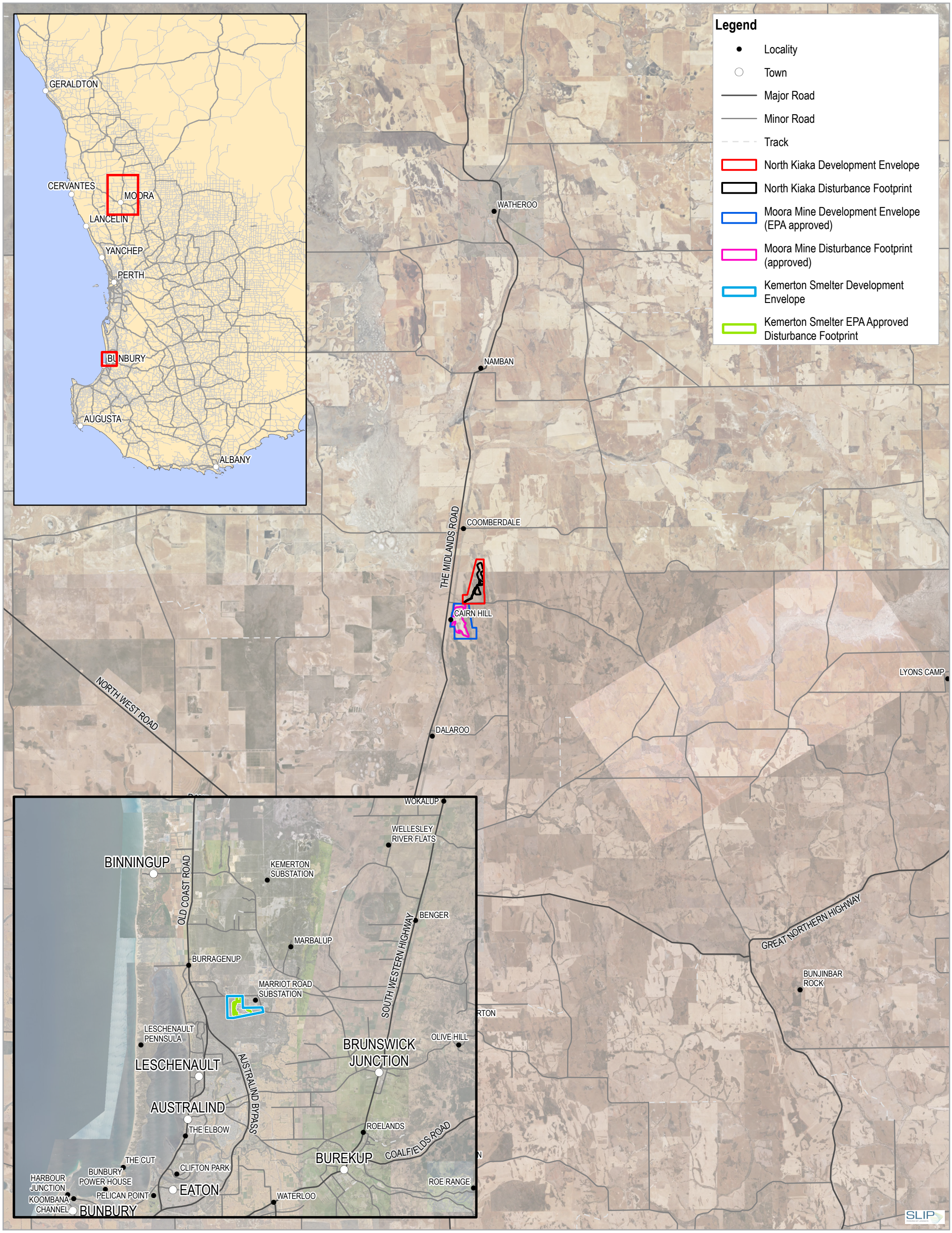
This report: has been prepared by GHD and M Trudgen for Simcoa Operations Pty Ltd and may only be used and relied on by Simcoa Operations Pty Ltd for the purpose agreed between GHD and Simcoa Operations Pty Ltd as set out in this report.

GHD otherwise disclaims responsibility to any person other than Simcoa Operations Pty Ltd arising in connection with this report. GHD also excludes implied warranties and conditions, to the extent legally permissible.

The services undertaken by GHD in connection with preparing this report were limited to those specifically detailed in the report and are subject to the scope limitations set out in the report.

The opinions, conclusions and any recommendations in this report are based on conditions encountered and information reviewed at the date of preparation of the report. GHD has no responsibility or obligation to update this report to account for events or changes occurring subsequent to the date that the report was prepared.

The opinions, conclusions and any recommendations in this report are based on assumptions made by GHD described in this report. GHD disclaims liability arising from any of the assumptions being incorrect.



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Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 50

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GHD

Simcoa Operations Pty Ltd
Simcoa Environmental Approvals s40AA ERD

Project Location

Project No. **12518217**
Revision No. **0**
Date **22/03/2024**

FIGURE 1.1

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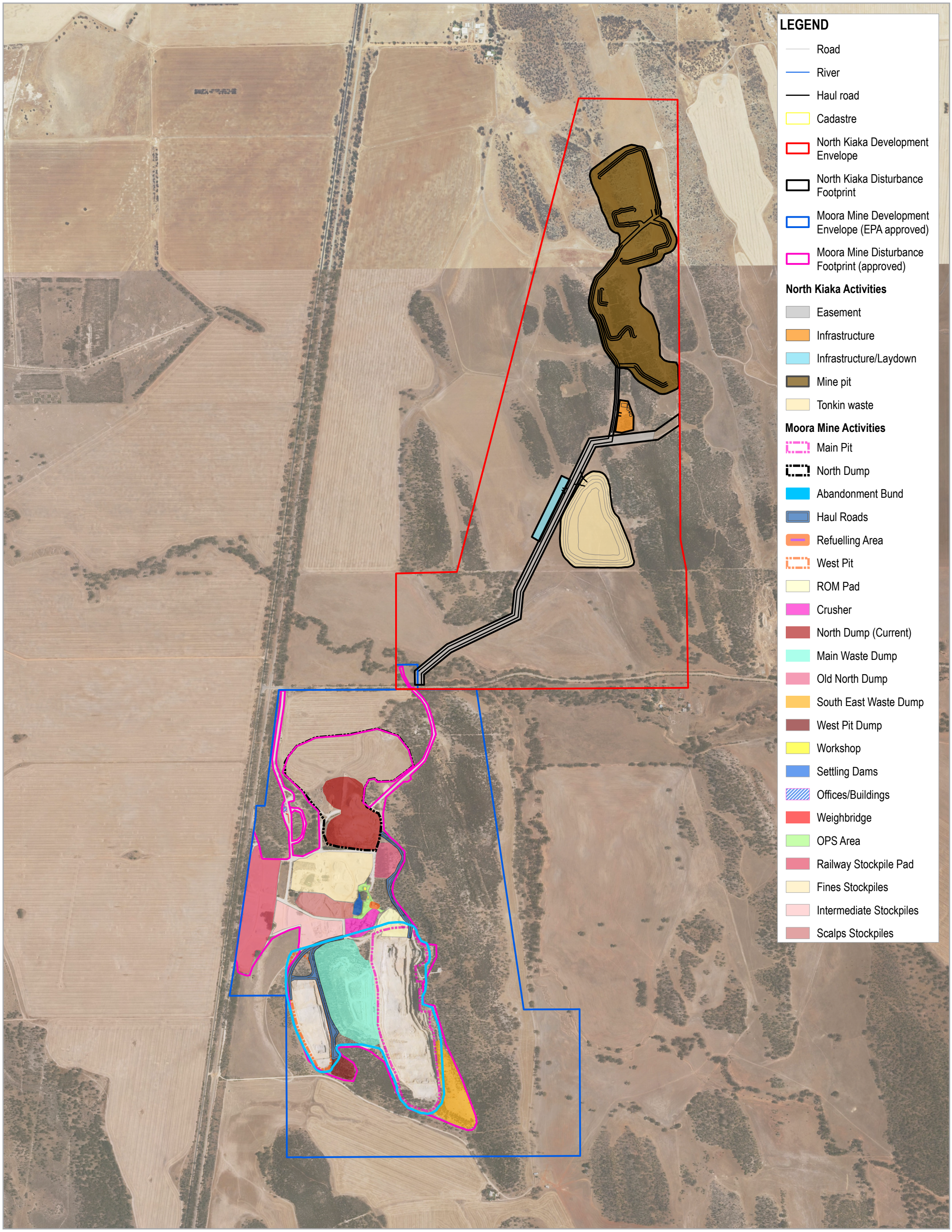

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Map Projection: Transverse Mercator
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Grid: GDA 1994 MGA Zone 50

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Simcoa Environmental Approvals s40AA ERD

Proposal Development Envelope and Disturbance Footprint

Project No. **12518217**
Revision No. **0**
Date **22/03/2024**

FIGURE 1.2

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1.2 Legislative Background

1.2.1 Relevant legislation, conservation codes and background information

Flora and fauna in Western Australia (WA) are protected formally and informally by various legislative and non-legislative measures, including:

- *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) – Commonwealth;
- *Biodiversity Conservation Act 2016* (BC Act) – WA;
- *Environmental Protection Act 1986* (EP Act) – WA;
- *Biosecurity and Agriculture Management Act 2007* (BAM Act) – WA.
- WA Department of Biodiversity, Conservation and Attractions (DBCA) Priority lists for flora, ecological communities and fauna;
- Weeds of National Significance; and
- Recognition of locally significant populations by the DBCA.

A short description of each legislative measure is provided below. Other definitions, including species conservation categories, are provided in Appendix A.

1.2.2 *Environmental Protection and Biodiversity Conservation Act 1999*

The EPBC Act aims to protect Matters of National Environmental Significance (MNES), which are detailed in Appendix A. Under the EPBC Act, the Commonwealth Department of Agriculture, Water and Environment (DAWE) lists protected species and Threatened Ecological Communities (TECs) by criteria set out in the Act. Species are conservation significant if they are listed as Threatened (i.e. Critically Endangered, Endangered and Vulnerable) or Migratory.

Bird species protected as Migratory under the EPBC Act include those listed under international migratory bird agreements relating to the protection of birds which migrate between Australia and other countries, for which Australia has agreed. This includes the Japan-Australia Migratory Bird Agreement (JAMBA), the China-Australia Migratory Bird Agreement (CAMBA), the Republic of Korea Australia Migratory Bird Agreement (ROKAMBA) and the Convention on the Conservation of Migratory Species of Wild Animals (Bonn Convention).

Some marine fauna or terrestrial fauna that use marine habitats are listed as Marine under the EPBC Act. These species are only considered conservation significant when a proposed development occurs in a Commonwealth marine area (i.e. any Commonwealth Waters or Commonwealth Marine Protected Area). Outside of such areas, the EPBC Act does not consider these species to be matters of national environmental significance and therefore are not protected under the Act.

1.2.3 *Biodiversity Conservation Act 2016*

DBCA lists taxa (flora and fauna) under the provisions of the Biodiversity Conservation Act 2016 (BC Act), as protected and are classified as according to their need for protection (see Appendix A). The BC Act makes it an offence to 'take' threatened species without an appropriate licence. There are financial penalties for contravening the BC Act. Under the BC Act, DBCA lists species as Threatened (T) (Declared Rare) or Priority Flora (P1, P2, P3 or P4).

1.2.4 Environmental Protection Act 1986

Threatened flora, fauna (and significant habitat necessary for the maintenance of indigenous fauna) and TECs are given special consideration in environmental impact assessments and have special status as Environmentally Sensitive Areas (ESAs) under the EP Act and the Environmental Protection (Clearing

of Native Vegetation) Regulations 2004. Exemptions for a clearing permit do not apply in, or within 50 m of, an ESA.

1.2.5 Biosecurity and Agriculture Management Act 2007

The *Biosecurity and Agriculture Management Act 2007* (BAM Act) provides for management and control of listed organisms, including introduced flora species (weeds). Species listed as declared pests under the BAM Act are classified under three categories:

– C1 Exclusion: Pests assigned under this category are not established in Western Australia, and control measures are to be taken to prevent them entering and establishing in the State.
– C2 Eradication: Pests assigned under this category are present in Western Australia in low enough numbers or in sufficiently limited areas that their eradication is still a possibility.
– C3 Management: Pests assigned under this category are established in Western Australia, but it is feasible, or desirable, to manage them in order to limit their damage. Control measures can prevent a C3 pest from increasing in population size or density or moving from an area in which it is established into an area that is currently free of that pest.

Under the BAM Act, land managers are required to manage populations of declared pests as outlined under the relevant category.

2. Methodology

The following methodology was undertaken to inform this flora and vegetation assessment.

1. Desktop assessment of vegetation mapping, vegetation condition mapping and flora survey reports, including Trudgen *et al*. (2001; 2006).
2. Detailed survey of vegetation and flora Trudgen *et* al (2012).
3. Targeted surveys of the survey area to map the occurrence of threated and priority flora (Trudgen, 2018); GHD, 2024).

2.1 Flora and Vegetation

2.1.1 Desktop assessment

A desktop assessment of the flora and vegetation was undertaken in accordance with current Environmental Protection Authority (EPA) guidance (EPA, 2016). A comprehensive review of contextual environmental information was undertaken including climate, biogeography, land systems, and pre-European vegetation. A search of available databases as listed in Table 2.1 was also undertaken (see Appendix D).

Table 2.1 Database searches conducted for the desktop assessment.

Custodian	Database	Taxonomic group	Buffer (km)
Department of Climate Change, Energy, Environment and Water (DCCEEW)	Protected Matters Search Tool	Flora, Vegetation	10
Department of Biodiversity, Conservation and Attractions (DBCA)	NatureMap	Flora	10
	West Australian Herbarium	Flora	10
	Threatened (Declared Rare) and Priority Flora (TPFL)	Flora	20
	Threatened and priority ecological communities (TEC/PEC)	Vegetation	20

2.1.2 Field assessments

The targeted surveys for threatened and priority flora accounted for the vegetation types and condition (including the level of weed invasion) within the area of the 2012 survey.

The 2016 targeted survey included transects at 30m intervals were used to maximise survey efficiency and were deemed appropriate to meet intensity required to recognise the species being targeted. A total of 72 transects were walked during the 2016 targeted survey.

Where conservation significant flora species were recorded, population extents were defined to inform the understanding of significance of the species within the Coomberdale Chert TEC. The 2017 targeted survey included a targeted threatened and priority flora survey of surrounding areas for Cairn Hill Reserve, a targeted *Banksia sphaerocarpa* form survey on the Gardiner property and an assessment of haul road options for the proposed impact area. The extent of the survey effort is shown in Figure 2.1 for the 2012, 2016 and 2017 Trudgen Flora and Vegetation Surveys.

GHD (2024) Targeted survey for Threatened and Priority flora

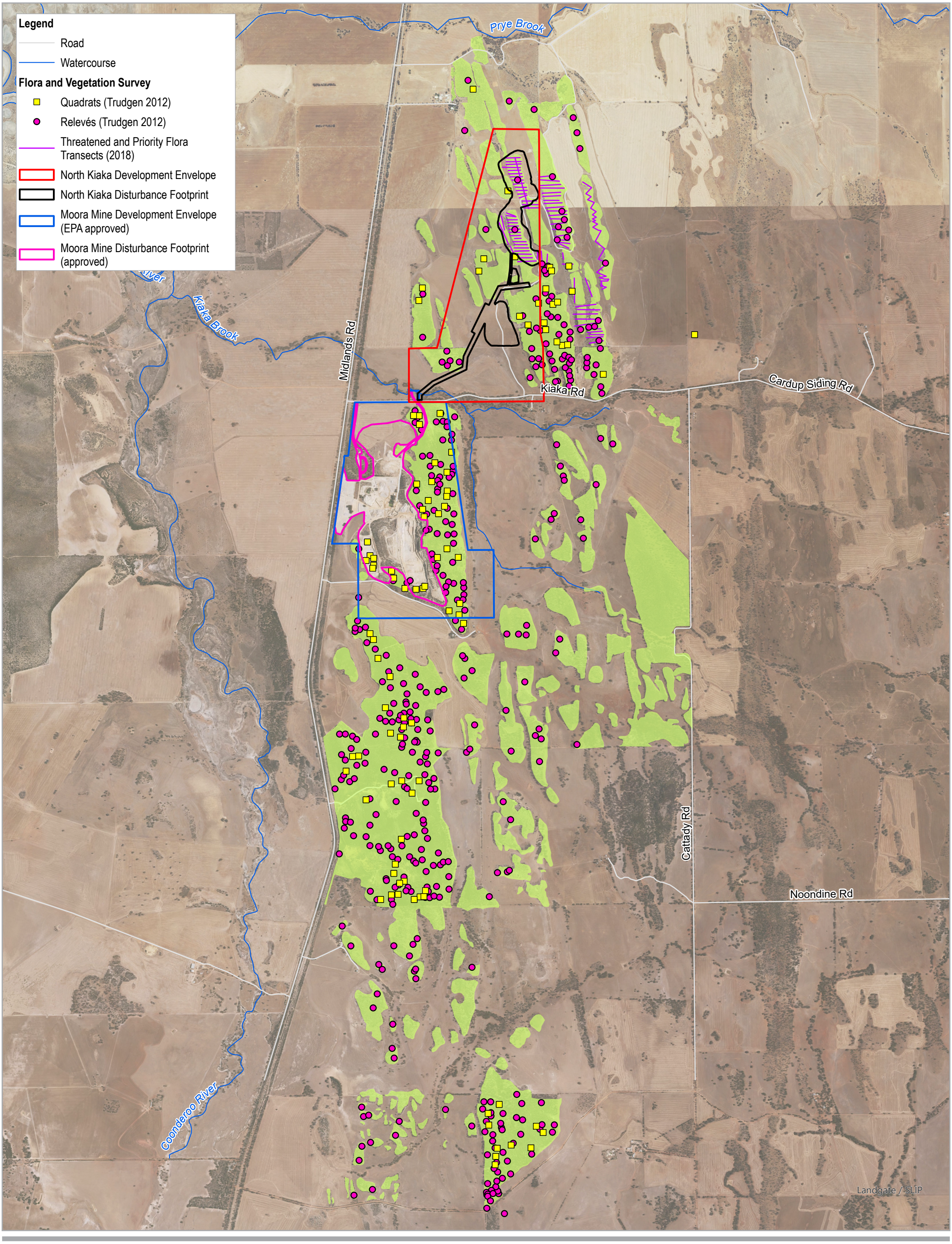
The GHD (2024) targeted flora survey was conducted by GHD botanists/ecologists; Joel Collins (flora collection license no. FB62000664), Sarah Flemington (flora collection license no. FB62000668), Lucas Hurst and Rachael Graham (flora collection license number FB62000666) between the 9th and 12th of April. The survey involved walking transects spaced at 30 meters apart to search for all potential Threatened and Priority flora. The intention of the survey was to mark and record all significant flora and count the number of plants recorded in the area, to accurately assess the quantity, and therefore the potential impact to these species. The survey effort for the GHD 2024 Threatened and Priority Flora survey is shown in Figure 2.2.

A summary of the flora and vegetation survey effort is shown in Table 2.2.

Table 2.2 Flora and Vegetation Survey effort

Survey year/ month		Season	Description of the survey including number of quadrats/ relevés
2000	September	Spring	40 quadrats
	October		
	November		
	December	Summer	
2002	October	Spring	40 quadrats
	November		
2003	March	Autumn	8 quadrats and 185 relevés
	April		
	August	Winter	
	October	Spring	
	November		
	December	Summer	
2004	January	Summer	169 relevés
	April	Autumn	
	November	Spring	
	December	Summer	
2005	February	Summer	29 relevés
2007	November	Spring	1 relevé

Survey year/ month		Season	Description of the survey including number of quadrats/ relevés
2010	September	Spring	11 quadrats and 13 relevés
	October		
	November		
2016	June	Winter	Targeted threatened and priority flora survey of proposed impact areas and adjacent vegetation – 72 transects Conservation significant flora; and Conservation significant ecological communities (TEC/PEC). **Threatened** *Acacia aristulata* *Daviesia dielsii* *Eucalyptus pruiniramis* *Goodenia arthrotricha* *Synaphea quartzitica* ***Priority*** P3 *Austrostipa nunaginensis* P3 *Babingtonia cherticola* P2 *Bossiaea moylei* P4 *Diuris recurva* P1 *Eremaea* sp. Cairn Hill P2 *Grevillea amplexans* subsp. semivestita P3 *Guichenotia tuberculata* P4 *Hemigenia conferta* P3 *Melaleuca sclerophylla* P4 *Regelia megacephala* P2 *Stylidium glabrifolium* P2 *Stylidium* sp. Moora P2 *Tricoryne* sp. Wongan Hills (B.H. Smith 794)
	July		
	August		
	September	Spring	
2017	July	Winter	Targeted threatened and priority flora survey of surrounding areas for Cairn Hill Reserve. Targeted *Banksia sphaerocarpa* form survey on the Gardiner property Assessment of haul road options for the proposed impact area Conservation significant flora; and Conservation significant ecological communities (TEC/PEC).
	November	Spring	
	December	Summer	
2024	April	Autumn	Targeted Threatened and Priority flora survey of all areas, including: North Kiaka Development Envelope, the Moora Mine Development Envelope (Eastern Ridge) and the Cairn Hill North Boundary and Cairn Hill Reserve Boundary.



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Simcoa Environmental Approvals s40AA ERD

Survey Effort (Trudgen 2012 Flora and Vegetation Survey, Trudgen 2016 Targeted Threatened and Priority Transects)

Project No. **12518217**
Revision No. **0**
Date **22/03/2024**

FIGURE 2.1

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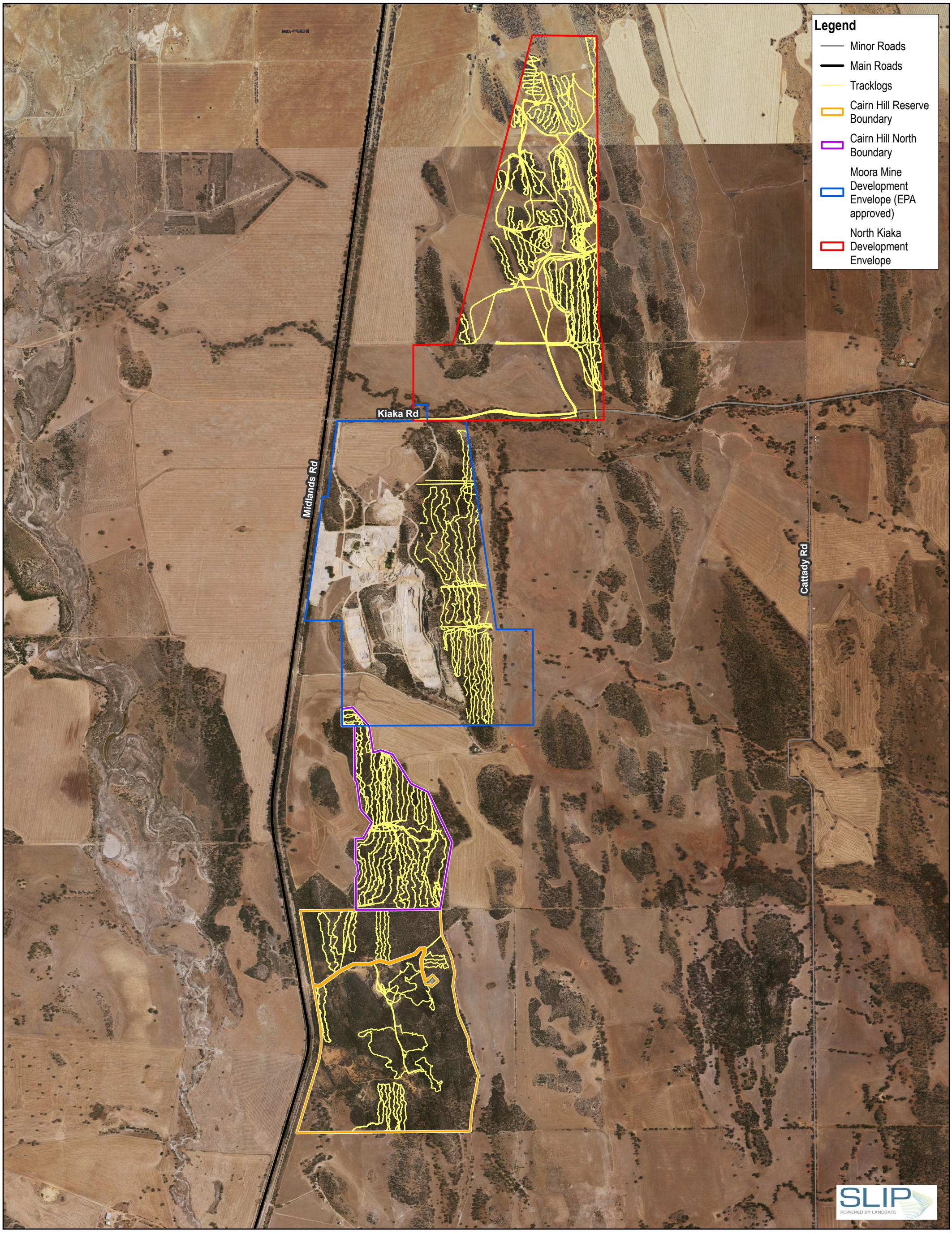

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Simcoa Operations Pty Ltd
North Kiaka Project Approval
Support - Sites Assets

Survey Effort (GHD 2024)

Project No. **12627587**
Revision No. **0**
Date **12/06/2024**

FIGURE 2.2

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Data source: World Topographic Map: Esri, HERE, Garmin, FAO, NOAA, USGS
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2.1.2.1 Field survey, floristic analysis, vegetation description and mapping

Prior to the flora and vegetation surveys detailed in the Trudgen *et al* (2012) report, aerial photographs were examined to assist in the selection of sites for the recording of quadrats. They were also used in the field for vegetation mapping. Nested quadrats measuring 10x10 m (i.e. 100 m^2) within a 30 x 30 m area were used. The smaller is commonly used in regional surveys in the south-west of Western Australia (e.g., Griffin (1992), Gibson et al (1994)) and its use would allow comparison of the data collected to previously collected data where appropriate. The 30x30 m (900 m2) quadrat surrounding the smaller quadrat was used as the vegetation in the TEC tends to be species poor. The larger size quadrats provided data less likely to have stochastic variation and therefore more rigorous floristic analyses. Species accumulation curves (Figure 2.3 and Figure 2.4) indicate that the quadrats recorded quite thoroughly sample the flora of the area surveyed by Trudgen *et al* (2012).

99 quadrat sites were selected to represent the range of the vegetation types present in the survey sub-areas sampled. The 10x10 m quadrats were pegged at all four corners with galvanised fence droppers. The geographic position of at least two diagonally opposite pegs was recorded with a hand-held GPS unit. The 30x30 m areas were defined around the smaller area with tape measures but were not pegged or locations recorded with the GPS, as location of the pegs for the 10x10 m quadrat would adequately locate the 30x30 m quadrat. Where it was not possible to fit the 30x30 m quadrat in exactly because of stand size or disturbance, the boundaries were modified to include 900 m^2 where possible.

At each of the quadrats, the structure and dominance of the vegetation was recorded using Aplin's (1979) modification of Specht's table. When a stratum was floristically diverse, only the most abundant species were included in the vegetation description. The quadrats were carefully searched to record as many of the species present as possible, all species observed were recorded for the site with an estimate of their height and cover. A "+" sign was used to indicate a cover assessment of significantly less than 1%. The quadrats were recorded twice to provide a comprehensive list of species.

The floristic (species list) data from the quadrats was used to provide a floristic analysis of the vegetation. The vegetation descriptions from the quadrats were used to define the vegetation of the vegetation mapping polygon they were recorded in. The vegetation in other polygons was described during the 2012 vegetation mapping field work.

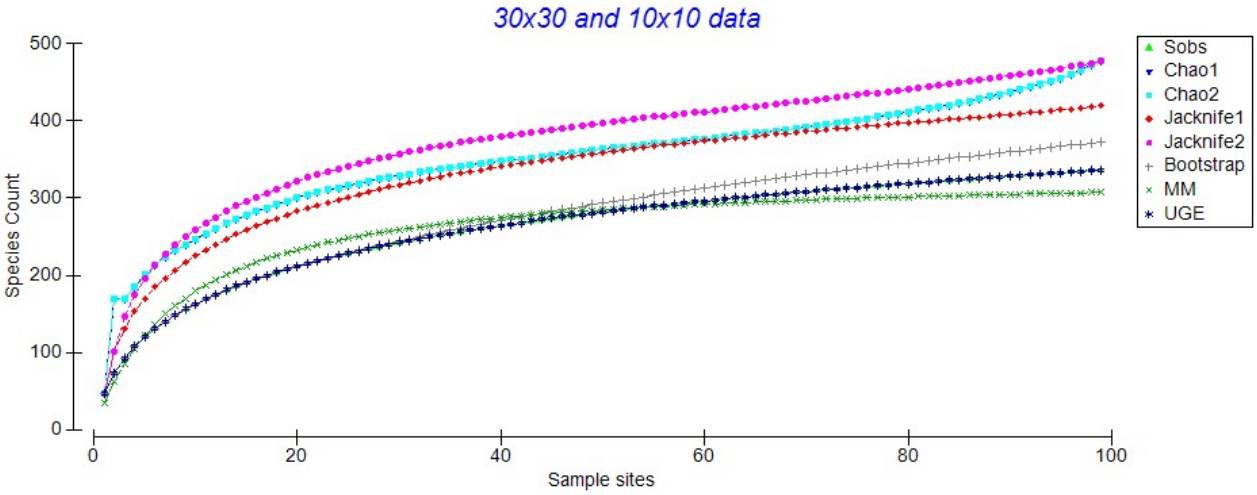


Figure 2.3 Species accumulation curves of combined 30x30m and 10x10m quadrats

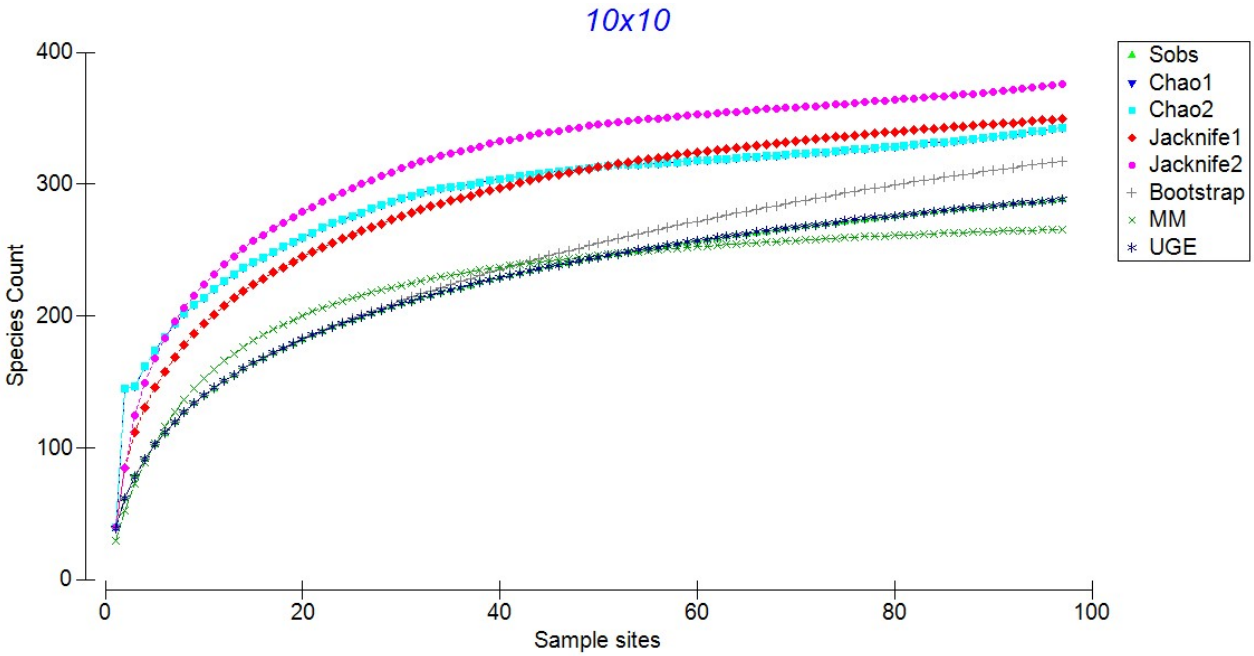


Figure 2.4 Species accumulation curves of 10x10m quadrats only

2.1.2.2 Targeted Threatened and Priority Flora survey

Trudgen (2012-2018) surveys

While much information on the distribution of conservation significant flora in the Trudgen *et al* (2012) survey area was available in that report, it was considered desirable to resurvey the proposed impact area for threatened and priority flora. A targeted search during Winter and Spring was undertaken 2016 (June, July, August, and September) as outlined in Trudgen (2018). Given the mostly open and poorer condition of the vegetation remnants, transects 30 metres apart were used. The transects were walked in a zig-zag manner rather than a straight line and were across the shorter dimension of the vegetation remnants searched (Figure 2.1). If conservation significant flora was encountered along the transect, then an area around the location was searched.

Prior to the survey, a list of conservation significant flora with the potential to occur was compiled. Field personnel familiarised themselves with photographs, reference samples and descriptions of these taxa before conducting the survey.

For occurrences of taxa of or possibly of conservation significant, a GPS location and a count of the individuals present were recorded. If there was any doubt as to the identification, a specimen was collected. However, no threatened or priority flora samples were collected during the 2016 search, as the species in the area are readily identifiable. During 2017 a further survey was undertaken during Winter and Spring, during which other flora species were also collected and some areas south of Kiaka Road were also searched for comparative data. Searches were undertaken to check surrounding areas for extent of populations of the *Banksia sphaerocarpa* form found in the proposed impact area during Summer of 2017.

The 72 transects walked in 2016 are shown in Figure 2.1, with alternate transects being searched twice during the survey.

All plants collected were taken under flora collecting permits, pursuant to Regulation 62 of the Biodiversity Conservation Regulations 2016 (or previous regulations). The vegetation mapping and floristic analysis used in Trudgen *et al.* (2012) are represented in this report to ensure comparability (Appendix E).

GHD (2024) survey

The survey methodology and data collection by GHD (2024) was consistent with relevant aspects of:

– EPA Technical Guidance – Flora and Vegetation Surveys for Environmental Impact Assessment (EPA 2016).

Field data collection for the survey was undertaken using Global Positioning System (GPS) enabled Samsung tablets using electronic forms in Collector. Data was synced to the cloud at the conclusion of each field day. GPS devices were used to capture survey effort (track logs). Field photographs were stored and where applicable have been provided as part of the deliverables.

The survey effort per survey area for GHD (2024) is presented in Figure 2.2.

2.1.2.2.1 Flora Identification and nomenclature

Species well known to the botanist were identified in the field; all other species were collected and assigned a unique collection number to facilitate tracking. Specimens collected during the field assessment were identified by comparison to previously identified reference specimens, or the use of taxonomic literature, electronic keys and online electronic databases.

The conservation status of all recorded flora was compared against the current lists available on *Florabase* (WA Herbarium, 1998-) and the EPBC Act Threatened species database provided by (DCCEEW, 2023b). Nomenclature used in this report follows that used by the Western Australian Herbarium as reported on *Florabase* (WA Herbarium, 1998-).

Prior to the GHD (2024) survey, the botanists familiarised themselves with the target flora species through photographs of WA Herbarium specimens, and taxon information from *Florabase* (WA Herbarium, 1998-). This information was saved to the Tablet devices used in the field, to assist in the identification of taxa. No flora collections were made for this survey, as all flora were able to be identified in the field.

2.1.2.3 Vegetation types and condition

Trudgen *et al.* (2012) classified the vegetation of their survey area into three levels that go from low order to fairly high order of synthesis. The lowest order units are mostly defined near the *plant community* level.

This level of vegetation classification has units with very similar structure, species dominance and floristics. The next level of grouping was into 104 *vegetation associations*. This level still has stands with similar structure and dominant species, but more variation than the plant community level. The highest level of classification grouped the vegetation associations into 31 *vegetation alliances*.

Figure 4.7 and Figure 4.8 show the vegetation alliances using different colours and vegetation associations and plant communities have used alpha numerical codes.

The alliances vary in the number of associations they contain, with some having only one association. Individual polygons show the distribution of one stand of a plant community. Vegetation alliances of the Coomberdale Chert TEC have been classified into Core and Buffer vegetation. Of the eight alliances located within the Survey Area, 4 are Core and 2 are buffer (DPAW, 2013b). Further detail on the significance of these categories can be found in Trudgen et al. 2012 and shown in Figure 4.1.

Trudgen *et al.* (2012) assessed the condition of the vegetation using the scale of Trudgen (1988) (Table 2.3). This information was used in conjunction with aerial photograph interpretation to produce a condition map of the remnant vegetation in the survey area. Table 2.3 shows the descriptors for vegetation condition.

Table 2.3 Vegetation Condition Scale for Southwest and Interzone Botanical Provinces (Trudgen M. E., 1988)

Vegetation Condition	Description
Excellent	Pristine or nearly so, no obvious signs of damage caused by the activities of European man.
Very Good	Some relatively slight signs of damage caused by the activities of European man. E.g. some signs of damage to tree trunks caused by repeated fire and the presence of some relatively nonaggressive weeds such as *Ursinia anthemoides* or *Briza* spp., or occasional vehicle tracks.
Good	More obvious signs of damage caused by the activities of European man, including some obvious impact on the vegetation structure such as caused by low levels of grazing or by selective logging. Weeds as above, possibly plus some more aggressive ones
Poor	Still retains basic vegetation structure or ability to regenerate to it after very obvious impacts of activities of European man such as grazing or partial clearing (chaining) or very frequent fires. Weeds as above, probably plus some more aggressive ones such as *Ehrharta* spp.
Very Poor	Severely impacted by grazing, fire, clearing or a combination of these activities. Scope for some regeneration but, not to a state approaching good condition without intensive management. Usually with a number of weed species including aggressive species
Completely Degraded	Areas that are completely or almost completely without native species in the structure of their vegetation. I.e. areas that are cleared or "parkland cleared" with their flora comprising weed or crop species with isolated native trees or shrubs.

The condition scale from Trudgen (1988) was modified so that ‘Completely Degraded’ areas included parkland cleared areas (areas with only scattered native plants in pasture) and areas where the vegetation had been removed to mine for gravel. Areas in the Cairn Hill reserve, which had been mined for gravel and consequently had some apparently spontaneous regrowth, were also included in the ‘Completely Degraded’ category. Post-mining regrowth, severely disturbed areas and areas with only scattered trees remaining were also classified as ‘Completely Degraded’.

Levels of weed invasion and brief notes on the surface soil were recorded in the Survey Area at the time of recording of quadrats and of vegetation condition mapping (See Trudgen *et al.* (2012)).

2.1.3 Previous surveys

The vegetation and flora information in this report incorporates vegetation mapping, vegetation condition mapping and flora survey from Trudgen *et al* (2012). The 2012 report incorporates information from several earlier reports documenting the vegetation and flora of areas of the Coomberdale Chert Threatened Ecological Community (TEC) and covers a group of properties from north of Kiaka Road south to Dalaroo East Road. These reports have provided detailed vegetation mapping, a floristic analysis of the vegetation, the results of searches for threatened and priority flora and a flora inventory (Trudgen et al. 2012, 2006, 2001, and Trudgen 1985). The area surveyed is a polygon on the east side of the Midlands Road that varies from 3.5 to 4.95 kilometres wide and is 11.1 kilometres long. This information in the Trudgen *et al* (2012) report is supplemented for the proposed impact areas with searches for Threatened and Priority flora carried out in 2016 and 2017.

The series of studies of the Coomberdale Chert TEC area that has been previously surveyed for flora and vegetation mean that is one of the best known areas of its size in Western Australia for its vegetation and flora values. However, the earlier surveys did not focus the effort on the proposed impact areas. To ensure this area was adequately known for assessment of the proposed impact area, further survey work was carried out.

As the vegetation had been mapped in some detail by Trudgen *et al* (2012), the further work was largely targeted flora surveys on transects across the remnants of the TEC in the proposed impact area and a review of the knowledge of the flora of the Coomberdale TEC. This included reviewing the naming of specimens collected for the earlier surveys. Since the earlier work was carried out, more detailed information on the distribution of flora species has become available, and a greater understanding of the flora of the larger survey area is available to be considered in this assessment (see revised flora list in Appendix B).

The relevant points from this earlier work for the current assessment are:

1. The area surveyed in the earlier surveys is large in relation to the proposed impact area and the area north of Kiaka Road (which would have been a logical survey area if a new survey was required);
2. The number of quadrats is quite high for the size of the overall area surveyed and they have been recorded to a high standard;
3. The number of relevés is large, indicating the significant level of detail in the vegetation mapping (which has three classification layers);
4. The dominant species in the vegetation types have not changed since the surveys were carried out (there have been minor changes to scientific names, but these have been updated);
5. The floristic analyses carried out comparing parts of the TEC and parts of the survey area have been done by a person with significant experience in such analyses (Griffin, 1992) and new data and analyses would not change the results;
6. The standard for naming the flora in the earlier surveys is high and naming of most of the specimens from earlier surveys was checked to ensure correct determinations (see Appendix B);
7. The naming of native flora in the data has been updated where taxonomic changes have occurred, with an extensive review of the flora recorded for the overall survey area (see Appendix C).
8. Any structural and floristic change in the vegetation (except for some areas mined south of Kiaka Road) since the earlier surveys were carried out, is due to grazing, weed invasion, climate change or spray drift.
9. Some additional areas of the TEC south of Kiaka Road were mapped and searched for flora in 2017 to look for populations of species of conservation significance;
10. The earlier surveys were based on 111 person days in the field, indicating significant effort in the surveys. The initial recording of the quadrats was based on 49 field days.

As noted above, the current report will supplement Trudgen et al. (2012) by providing targeted flora searches of the proposed impact area, an updated flora list, and a comparison of the vegetation values of the proposed impact areas to the other parts of the Coomberdale Chert Threatened Ecological Community that have been surveyed.

Table 2.4 Field survey timing in the Moora Mine, proposed North Kiaka DE and proposed offset areas

Title	Survey extent	Survey year/ month		Season	Number of field survey days	Number of quadrats/ relevés
Comparison of the flora and vegetation of the proposed North Kiaka mine area to other parts of the Coomberdale Chert Threatened Ecological Community (Trudgen, 2018)	North Kiaka DE, adjacent areas	2016	June	Winter	1	Targeted threatened and priority flora and flora survey of proposed North Kiaka Mine impact areas and adjacent vegetation – 72 transects
			July		4	
			August		4	
			September	Spring	4	
		2017	July	Winter	2	Targeted *Banksia sphaerocarpa* form survey Threatened and Priority survey in 2017
			November	Spring	3	
			December	Summer	1	
Proposed Discharge Evaluation Conderoo River Wetlands (Actis, 2011)	Kyaka Brook	2011	November	Spring	1	Survey of vegetation fringing Kyaka Brook for Moora Mine
An extension of a flora survey, floristic analysis and vegetation survey of areas of the Coomberdale Chert TEC to include a further area (Trudgen, Griffin, & Morgan, 2012)	North Kiaka DE, Moora Mine DE, adjacent areas	2000	September	Spring	1	40 quadrats
			October		4	
			November		1	
			December	Summer	2	
		2002	October	Spring	9	40 quadrats
			November		1	
		2003	March	Autumn	1	8 quadrats and 185 relevés
			April		1	
			August	Winter	2	
			October	Spring	1	
			November		17	
			December	Summer	13	
		2004	January	Summer	14	169 relevés
			April	Autumn	1	
			November	Spring	4	
			December	Summer	7	
		2005	February	Summer	3	29 relevés
		2007	November	Spring	1	1 relevé
		2010	September	Spring	2	11 quadrats and 13 relevés
			October		2	
			November		5	

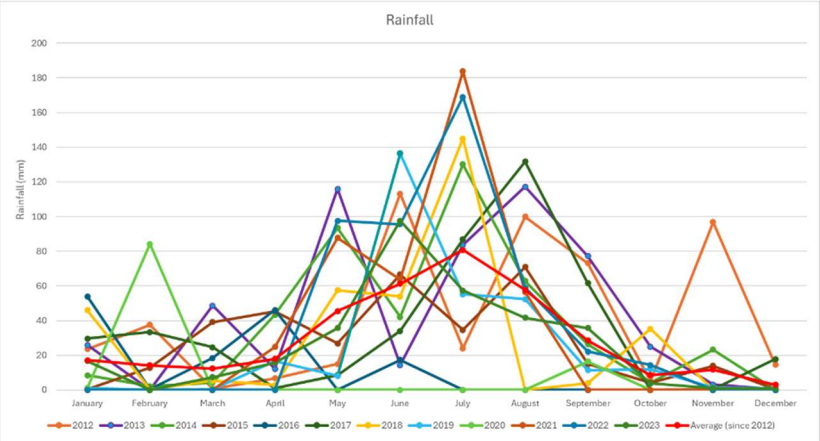
2.1.4 Survey limitations

There are possible limitations and constraints that can impinge on the adequacy of flora and vegetation surveys. The flora and vegetation survey was evaluated as part of this assessment, against a range of potential limitations (Table 2.5).

Table 2.5 Field survey limitations

Aspect	Constraint	Comment
Sources of information and availability of contextual information.	No constraint	The proposed North Kiaka Mine is located in the northern part of a large area of the Critically Endangered Coomberdale Chert Threatened Ecological Community that has been vegetation mapped at three levels, has vegetation condition mapping and detailed information for the flora of the area (Trudgen *et al* 2012). Information from this earlier work is incorporated in the current report and allows detailed comparison of the vegetation and flora of the proposed mine area to this larger area and to the part north of Kiaka Road where the project is located. The regional floristic survey (Griffin 1992) provided the floristic classification on which the TEC is based and places the TEC in a regional floristic context. The broad scale (1:250,000) mapping by Beard (1979) provides regional vegetation mapping context. Adequate information is available for the survey area including: – Broad scale (1:250,000) mapping by Beard 1979 – Previous flora surveys within and adjacent to the survey area – DBCA Threatened and Priority ecological community desktop information.
Proportion of flora collected and identified (based on sampling, timing and intensity)	No constraint	*Sampling timing* The vegetation and flora surveys collated in the Trudgen (2012) incorporates reports flora records from a multi-year, multi-season survey undertaken over 111 survey days (not person days) during Summer (45 days, these days vegetation mapping), Autumn (3 days), Winter (13 days) and Spring (50 days). The majority of survey days were in Spring which is considered the most optimal time to undertake vegetation surveys in the bioregion. Targeted surveys were undertaken during the flowering periods of the various species as per the likelihood of occurrence post survey assessment (Appendix D). The timing was considered appropriate for the purpose of the assessment. Specimens were collected at 99 quadrats, 397 vegetation mapping relevés and opportunistically. *Sampling intensity* For the Trudgen et al (2012 and earlier) report 3,715 flora collections were made for the identification of species occurring in the quadrats, approx. 1,500 collections were made during the vegetation mapping, on route between quadrats and relevés and during conservation flora searches. A further 266 collections were made while surveying M70/1292. This gives a total of about 5,460 collections made for the approximate 988 ha survey area covered by Trudgen *et al.* (2012). The resulting flora list also incorporates records from the original survey of Trudgen (1985) and data from Griffin (1992) from his sites located within the Trudgen *et al.* (2012) survey area. For the proposed North Kiaka Mine survey area the intensity of search would have found any flora taxon not previously recorded unless present in very small numbers. Given the above limitations, it is likely that the data from various surveys incorporated in this report has more than 95% of the flora of the areas of the TEC surveyed and more than 90% of the flora of the proposed North Kiaka Mine survey area." The portion of flora collected and identified was considered suitable for the purposes of the assessment and the condition of the survey area.

Aspect	Constraint	Comment
Flora determination	Minor constraint	The flora specimens collected for the surveys included in Trudgen *et al* (2012) and for the current project have all been identified by Malcolm Trudgen who has extensive experience in identification of Western Australian flora specimens. Additionally, more than 200 specimens from the earlier surveys have been vouchered to the Western Australian Herbarium with current nomenclature available electronically to assist with updating names where taxonomic changes have occurred. Most specimens (except those donated to the Western Australian Herbarium as voucher specimens) collected for the earlier surveys were reviewed together to provide consistency of naming. The collection and vouchering of specimens has been undertaken in accordance with Western Australian Herbarium requirements at the time of collection, including: Specimens of new populations of threatened and priority flora. Specimens that appear to represent new species. Specimens representing range extensions, including introduced (weed) species. The taxonomy and conservation status of the WA flora is dynamic and the survey reports have been prepared with reliance on taxonomy and conservation status current at the time of report development (2024).
Completeness and further work which might be needed (e.g. was the relevant area fully surveyed)	Minor constraint	The areas of remnant vegetation of the Coomberdale TEC vegetation that the proposed North Kiaka Mine will remove for mining have been mapped at three levels, vegetation condition mapped, and included in floristic analyses of quadrat data as part of a larger area of the TEC (Trudgen *et al* 2012). This area has been extensively surveyed by M.E. Trudgen and Associates in 2000, 2002, 2003, 2004, 2010, 2016 and 2017 (Trudgen, Griffin, & Morgan, 2012; 2018). The vegetation and flora surveys collated in Trudgen *et al* 2012 and the current report provide a multi-year, multi-season survey undertaken over 111 survey days (not person days) during Summer (45 days), Autumn (3 days), Winter (13 days) and Spring (50 days) recording 99 quadrats (10 x 10 metre nested in 30 x 30 m; most recorded twice) and 397 relevés. Most of survey days were in Spring which is considered the optimal time to undertake vegetation and flora surveys in the bioregion. Targeted surveys were undertaken during the flowering periods of the various species as per the likelihood of occurrence post survey assessment (Appendix E). For the North Kiaka Mine targeted searches in 2016 and 2017 for threatened and priority flora of the then proposed mine area were carried out. A total of 73 traverses were walked at 30 m intervals within areas proposed to be disturbed in Winter (nine days over June, July and August). A subset of the transects in the Survey Area from 2016/2017 searched a second time in Spring (4 days in September). The impact area is smaller than the area searched in 2016 with 38 transects in this area. The vegetation mapping and description is detailed, with 217 plant communities identified in the broader 988-ha survey area. The 217 vegetation communities were grouped into 104 vegetation associations and those into 33 alliances (Trudgen, Griffin, & Morgan, 2012). The majority of the vegetation alliances were surveyed with a minimum three quadrats and/ or relevés however of the 33 alliances, due to a small area of a vegetation alliance/ community, nine were surveyed by only one or two quadrats and/ or relevés. Vegetation recording quadrats were placed in the larger areas of remnant vegetation as these are in better condition. The quadrat, relevé and conservation significant flora searches have all contributed to a comprehensive species list for the survey area and the larger area surveyed.

Aspect	Constraint	Comment
		It is considered the survey area was adequately surveyed at a detailed survey level as per EPA (2016) guidance for *Flora and Vegetation Surveys for Environmental Impact Assessment*. However, while most of the proposed impact areas were searched for conservation significant flora in 2016; some quite small areas of the TEC (9.8ha in total) within the impact area were not searched at that time. These will be included in any future flora and vegetation surveys of the area north of Kiaka Rd. GHD (2024) conducted a targeted flora survey of all the survey areas using the appropriate methodology as outlined in EPA (2016) which requires transects at suitably spaced intervals for the target species. Targeted transects on foot spaced at 30 meters apart was the chosen methodology and is appropriate for the type of flora (i.e. size of target plants for visibility) and survey requirements (an approximate estimation of the number of plants in a given area). GHD (2024) were able to survey approximately 90% of the survey area within the time frame and staff allocation. Some areas did not contain full coverage of transects, but areas of higher importance, and more likely to contain significant flora, were targeted first.
Mapping reliability	Minor constraint	The survey was conducted using aerial imagery, topographical features, previous vegetation mapping, and field data (Trudgen, Griffin, & Morgan, 2012). GPS locations of quadrats and relevés has been provided in the flora and vegetation reports (Appendix E). Data were recorded in the field using hand-held GPS tools. Certain atmospheric factors and other sources of error can affect the accuracy of GPS receivers. Therefore, the data points consisting of coordinates recorded from the GPS may contain minor inaccuracies.
Timing/ weather/ season/ cycle	No constraint	The field surveys were conducted during Summer, Autumn, Winter and Spring over 111 survey days (not person days) between 2000 and 2017 with the majority of survey days in undertaken in Spring and Summer (Trudgen *et al* 2012 and this report). Given that the majority of survey data was collated over seven years during a 17-year period it is considered that the weather conditions recorded during the survey periods are unlikely to have significantly impacted upon the vegetation and flora surveys. Rainfall levels appear to have been higher than average in 2012, 2017 and 2018, however were below average during 2016 and 2020 (refer to plate below) (BoM, 2023).  Plate 1: Monthly rainfall levels between 2012 and 2023 compared to average monthly rainfall for the timeframe at Badgingarra Research Station (number 9037) (BoM, 2023). The GHD (2024) survey was conducted in April and can be considered appropriate survey timing for supplementary surveys (after Autumn rains) as per the EPA (2016) guidelines. The survey conditions were dry, however the

Aspect	Constraint	Comment
		weather conditions did not impact the ability to detect most of the target significant flora, particularly the perennial species. Some existing records of *Stylidium* sp. Moora, *Diuris recurva*, and *Goodenia arthrotricha*, were not detectable at this time. However, it was not required that these annual species be targeted, as previous survey effort has recorded these.
Disturbances (e.g. fire, flood, accidental human intervention)	No constraint	The remnants of the TEC in the Trudgen (2012) survey area (including the current project area) are surrounded by cleared paddocks. They are subject to weed invasion, edge effects (increased wind speeds), grazing by stock, rabbits and kangaroos and herbicide drift. These all impact the vegetation and flora but have not affected the survey of the remnants. None of the remnants surveyed have been burnt either before or during the period of the surveys. There were no disturbances in the GHD (2024) survey that would impact the results.
Intensity (in retrospect, was the intensity adequate)	Minor constraint	The intensity of survey of the Trudgen *et al* (2012) survey is quite high for the size of their survey area. The number of quadrats (99) and vegetation mapping relevés (397) reflects this. This was required because of the significant number of plant communities in this survey area, a result of the variation in the underlying soil, geology and topography. While the EPA Technical Guidance encourages a minimum of three quadrats per vegetation unit, the following statement from the EPA's Technical Guidance is highly pertinent: "the number of quadrats required within a vegetation unit is proportional to the area (hectares) of the unit". Many of the plant communities described have very small area and it would be of no significant value for environmental assessment to have recorded a greater number of quadrats. Therefore, the number of quadrats sampled by Trudgen *et al* is considered adequate to record floristic variation in their survey area and with the relevés to describe the vegetation. It is considered that the survey carried out by suitably qualified botanists during the field surveys and the vascular flora of the survey area was sampled in accordance with EPA (2016) Guidance. First searches of transects in the proposed impact area (and some adjoining areas, but not the eastern ridge on the J. Tonkin property) were searched on 30/6/2016, 1/7/2016, 6/7/2016, 7/7/2016, 13/7/2016, 7/7/2016, 1/8/2016, 1/8/2016 and 2/8/2016. The eastern ridge on the J. Tonkin property was added to the proposed mine area after the visits above were made, this area was searched on the 17/7/2017 and 18/7/2017. For additional information on species distribution in the Coomberdale Chert TEC searches were made of some areas south of Kiaka Road on 18/8/2016, 19/8/2016 (on the "Eastern Ridge" of Trudgen *et al.* 2012). Searches were made on Simcoa Block Two south of Kiaka Road to look for other populations of the *Banksia sphaerocarpa* form found in the Coomberdale Chert TEC on 10/11/2017 and 11/11/2017. On the 11/11/2017 and 12/11/2017 searches for rare flora were made on the two haul road options for the proposed impact area. On the 13/12/2017 the *Banksia sphaerocarpa* population on Phil Gardiner's property (east of Cairn Hill Reserve) was surveyed to document the population size and condition. The GHD (2024) survey involved walking fine scale transects at 30 m intervals, which is considered adequate for the detection of flora, and approximation of the number of plants.
Resources	No constraint	Adequate resources were employed during the field survey. 111 survey days were spent by suitably qualified botanists undertaking the field survey in 2000, 2002, 2003, 2004, 2005, 2007, 2010, 2016 and 2017. The GHD (2024) survey spent four days with four personnel equating to 16 person days.

Aspect	Constraint	Comment
Access restrictions	No constraint	There were no access restrictions for the purpose of this assessment.
Experience levels	No constraint	Trudgen and Associates, who conducted the field surveys, are considered suitably qualified and experienced as they have worked on the flora and vegetation surveys in the TEC for SIMCOA since 2000. GHD botanists and ecologists are highly experienced and qualified, and included: -Joel Collins, the team lead and senior botanist with 20+ years experience -Sarah Flemington, ecologist with 7 years experience -Lucas Hurst, ecologist with 5 years experience -Rachael Graham, graduate ecologist/botanist with 2 years experience.

2.1.5 Summary

This Flora and Vegetation Report is a culmination of data from the following data sets and reports.

- A Report on the Vegetation and Flora of the Proposed Moora Silica Minesite (Trudgen, 1985).
- A flora survey, floristic analysis and vegetation survey of the Coomberdale Chert TEC Trudgen *et al* (2001).
- A flora survey, floristic analysis and vegetation survey of the Coomberdale Chert TEC Trudgen *et al* (2006).
- An extension of a flora survey, floristic analysis and vegetation survey of areas of the Coomberdale Chert TEC to include a further area (Trudgen, Griffin, & Morgan, 2012).
- Collection of flora specimens during the 2012 and 2016 surveys
- Collection of flora specimens from 2012 relevés
- Opportunistic search areas around each flora species located during the 2016 transects
- Opportunistic collections of flora specimens between the quadrats and relevés during the 2012 surveys, especially of species not previously recorded;
- Collection of flora specimens during a systematic survey during 2016 of the distribution of threatened and priority flora within the area surveyed for vegetation during 2012
- GHD (2024) targeted Threatened and Priority flora survey data.

3. Environmental Setting

This section provides the environmental setting of the Moora region and outlines the stable landscape of the area, with very minimal changes to the vegetation observed over time.

3.1 Climate

The region including the Survey Area has a Mediterranean climate, with a cool wet winter and summer drought. The summers are warm to hot, with average maxima of approximately 30° Celsius (°C) and extremes of over 40°C. The winters are cooler and milder with average maximum temperatures between 15° and 20°C and minimums of around 5°C.

The average annual rainfall is 463 mm, the majority of which falls from May to September. Figure 1 of Griffin (1992) report shows rainfall and temperature graphs for the survey area and compares them with other regional centres.

3.2 Land systems and soils

These are two landscape divisions of the Moora Group. The first is the Coorow Landscape (Chert subsystem) this has gentle topography with low stripping of the soils by erosion. It occurs to the north of the current survey area and does include some chert outcrop (and has some smaller occurrences of the Coomberdale Chert TEC outside the areas mapped by Trudgen *et al* 2012). The second is the Coomberdale Landscape (Chert subsystem). This has gentle to moderate topography with moderate stripping of the soils by erosion. The 2012 survey area lies within areas of the Coomberdale Landscape (Chert subsystem). The surface in the Coomberdale Landscape (Chert subsystem) generally has outcropping chert on the higher parts and colluvium with chert gravel on the slopes. The Coomberdale Chert Threatened Ecological community mainly occurs on these ridges and the adjoining colluvium.

The key landform within 2012 survey area is the Noondine Chert Formation, which outcrops as north-north-west trending parallel ridges, elevated approximately 75 m above the adjacent valleys. The Noondine Chert (previously Coomberdale Chert), outcrops across a 150 km stretch between Moora and Three Springs.

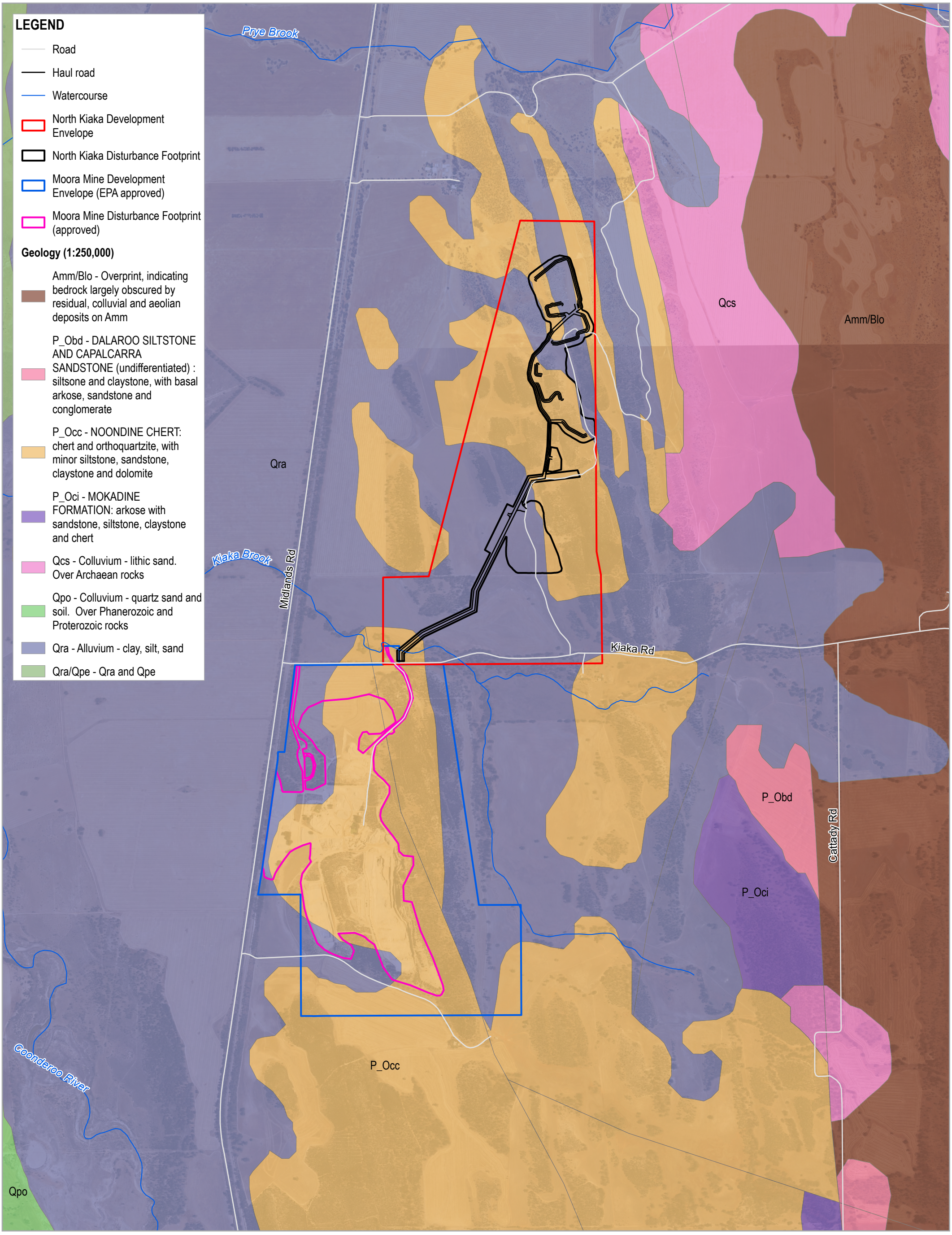
SIMCOA currently mines the quartzite mineral resource present in the Noondine Chert, which occurs as unweathered and massive dolerite/quartzite intrusions at Moora Mine and proposes to mine this resource in an area to the north of Kiaka Road.

The Noondine Chert Formation has a total extent of 14,586 ha.

3.2.1 Geology

The underlying rocks of the survey area belong to the Middle Proterozoic Moora Group These sedimentary rocks are separated from the Darling Plateau by a series of poorly defined faults (Griffin, 1992). The Noondine (Coomberdale) Chert Formation, which outcrops frequently in the survey area, is part of the Moora Group. "*It consists of bedded chert, chert breccia, orthoquartzite, silicified limestone and dolomite and contains significant siliceous siltstone and sandstone beds, and minor claystone*." (Carter and Lipple 1982 in (Griffin, 1992)).

The largest and most extensive area of outcrops of the Noondine Chert is between Dalaroo and Coomberdale and includes Cairn Hill, a highpoint approximately fifteen kilometres north of Moora. This area has several faults present, perhaps most notably the Kiaka Fault, which runs NW-NE near Kiaka Road south of the survey area for this report. Figure 3.1 shows the regional geology.



Paper Size ISO A3

0 100 200 300 400

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 50

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GHD

Simcoa Operations Pty Ltd
Simcoa Environmental Approvals s40AA ERD

Regional Geology

Project No. **12518217**
Revision No. **0**
Date **22/03/2024**

FIGURE 3.11

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Print date: 22 Mar 2024 - 12:17

Data source: Simcoa: Mining Development Shape Areas is derived from client recieved 2020; Langate: Slip Imagery - April 2017 to November 2018 (accessed - 20191023), Cadastre, Road - 20180601; DoW: River - 201108. Created by: rbrown3

3.2.2 Topography

The survey area contains parts of a series of parallel northerly-southerly trending ridges of the Noondine Chert, with swales between them. The ridges are formed from the higher, more resistant to erosion, parts of the Noondine Chert Formation. There is a larger valley just east of the survey area and more chert ridges to the west. The ridges vary in cross section, some having gentle slopes on both sides, or steeper slopes on one side. There were some steep rocky areas, but the slopes are mainly gentle to moderate, with a few being quite steep.

3.2.3 Soils

The soils on the chert ridges vary in depth from skeletal on the blocky outcropping chert, to gravelly, loamy sands lower down the slopes (Griffin, 1992). The surface soil was often pale grey, silty, fine sand. The soils in the valleys between the ridges are deeper over clay and broken rock (A. Tonkin per. com. and personal observation).

Of particular interest is the existence of two soil-landscape mapping units in the region that both occur on the Noondine Chert. These are two landscape divisions of the Moora Group:

– Coorow Landscape (Chert subsystem). This has gentle topography with low stripping of the soils by erosion. It occurs to the north of the current survey area and does include some chert outcrop (and has some smaller occurrences of the Coomberdale Chert TEC outside the areas mapped by Trudgen *et al* 2012).
– Coomberdale Landscape (Chert subsystem). This has gentle to moderate topography with moderate stripping of the soils by erosion. The survey area lies within areas of the Coomberdale Landscape (Chert subsystem). The surface in the Coomberdale Landscape (Chert subsystem) generally has outcropping chert on the higher parts and colluvium with chert gravel on the slopes. The Coomberdale Chert Threatened Ecological community mainly occurs on these ridges and the adjoining colluvium.

Figure 3.2 gives a regional scale visual summary of the topography, distribution of soils-landscape mapping units and the extent of remnant vegetation in an area containing the current survey area. There is a set of adjoining sheets in Trudgen *et al.* (2012) showing variation along the extent of the Coomberdale Chert.

3.2.3.1 Soil types

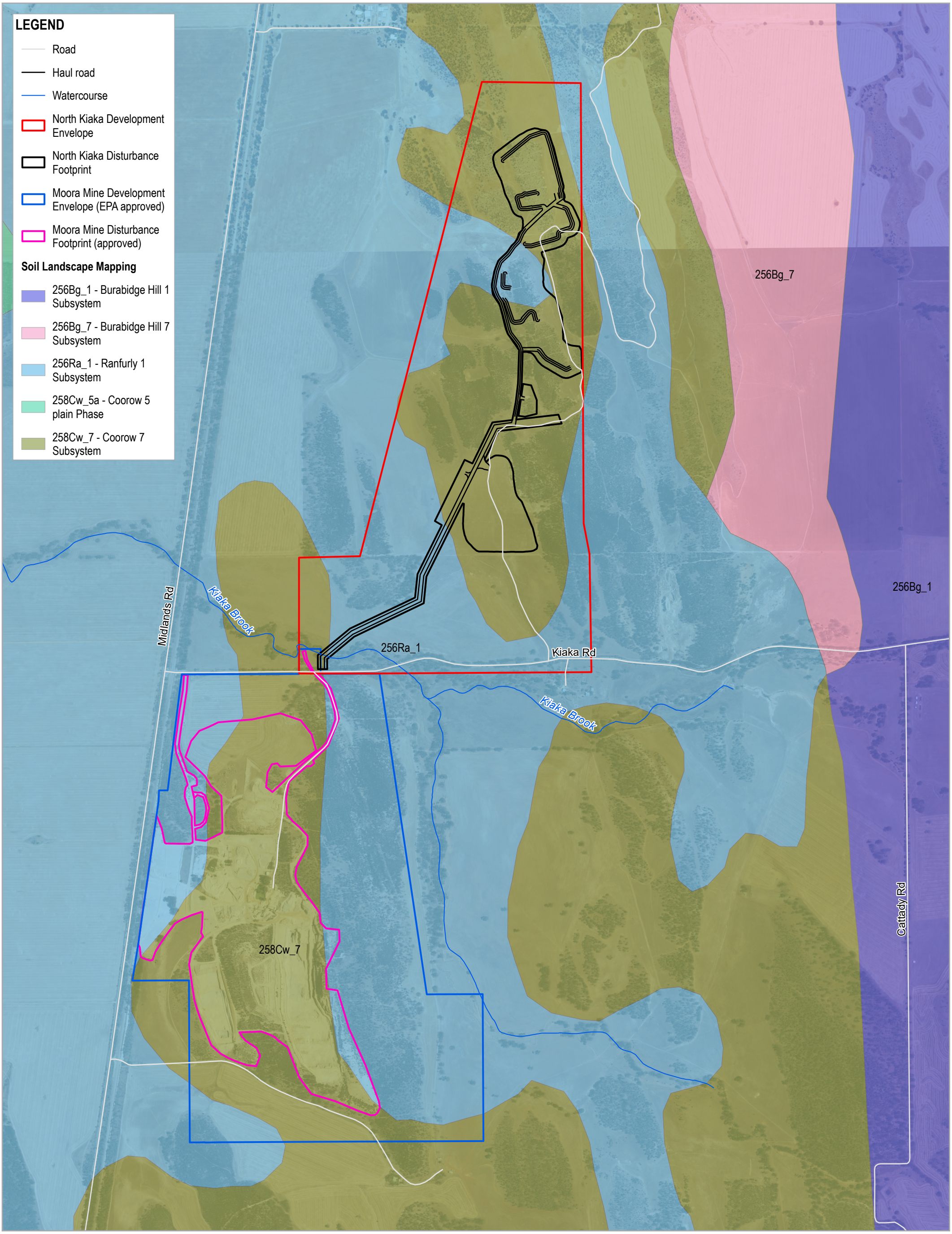
Figure 3.2 shows the soil landscapes occurring across the area to the north of Kiaka Rd (GoWA, 2023).

The primary soil types are SMU 2 and SMU 3 as mapped by Soilwater Consultants (2019) as shown in Figure 3.3. Both SMU 2 and SMU 3 have three distinct soil horizons:

– Topsoil – friable sandy gravels, with minor organic accumulation (transported)
– Subsoil – friable sandy gravels, with negligible organic accumulation (transported)
– Overburden – granitic (mottled) saprolite (*in-situ*).

All soil horizons are slightly- to- moderately acidic, non-saline, and non-sodic. The sandy gravels (topsoil and subsoil) present in SMU 2 and SMU 3, are friable and structurally stable, with high saturated permeabilities. These materials are ideal for use in rehabilitation, particularly as an outer surface material on the WRD. The underlying granitic saprolite (fine fraction) is structurally unstable, dispersive and highly erodible.

It is noted the Moora Mine DE was not included in the Soilwater Consultants (2019) survey area which is shown in Figure 3.3.



Paper Size ISO A3

0 100 200 300 400 500

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 50

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Soil Landscapes

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Revision No. **0**
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FIGURE 3.2

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Print date: 22 Mar 2024 - 14:30

Data source: Simcoa: Mining Development Shape Areas is derived from client received 2020; DPIRD: Soil Landscape Mapping - 20190803; Langate: Slip Imagery - April 2017 to November 2018 (accessed - 20191023), Cadastre, Road - 20180601; DoW: River - 201108. Created by: rbrown3

LEGEND

- Road
- Haul road
- Watercourse
- North Kiaka Development Envelope
- North Kiaka Disturbance Footprint
- Moora Mine Development Envelope (EPA approved)
- Moora Mine Disturbance Footprint (approved)

Soil Mapping Units

- 1 - Skeletal Stony Soil
- 2 - Shallow Gravelly Duplex
- 3 - Deep Gravelly Duplex

Midlands Rd

Kiaka Brook

Kiaka Rd

Kiaka Brook

Paper Size ISO A3

0 100 200 300 400

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 50

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Soil Types (Soilwater 2019)

Project No. **12518217**
Revision No. **0**
Date **22/03/2024**

FIGURE 3.3

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Print date: 22 Mar 2024 - 14:31

Data source: DPIRD - Soil Mapping Units; Simcoa: Mining Development Shape Areas is derived from client received 2020; Langate: Slip Imagery - April 2017 to November 2018 (accessed - 20191023), Cadastre, Road - 20180601; DoW: River - 201108. Created by: rbrown3

3.3 Hydrology

3.3.1 Surface water

The survey area is located within the Moore River catchment and Coonderoo / Marchagee sub-catchment (Figure 3.4). The Moora River catchment covers an area of 13,600 km^2. The major drainage lines within the catchment include the Moore River, the Coonderoo River and Gingin Brook (Department of Agriculture 2002). The Coonderoo / Marchagee sub-catchment covers an area of approximately 6,500 km^2 and in the vicinity of the North Kiaka DE drains from southeast to northwest. Drainage occurs via Pyre Brook Creek (approximately 4 km north of the North Kiaka DE), Kyaka Brook (located on the southern boundary of the North Kiaka DE) and their tributaries into the clay pans and samphire flats of the Coonderoo River (Saprolite Environmental, 2012).

Kyaka Brook extends east and north of the Kiaka Road, flowing in a north-west direction where it terminates in the Coonderoo River Wetlands. The Brook has a well-defined course with banks up to a meter deep. Water flows are seasonal and episodic, characterised by fast flowing water and short-lived pools (Actis, 2011).

3.3.2 Groundwater

The main groundwater aquifer in the region is hosted by the Noondine Chert, which is extensively fractured and cavernous, typically providing high bore yields. Local groundwater is used to supply the townships of Moora and Watheroo. Groundwater recharge occurs via infiltration of rainwater (GHD, 2019). The interpreted groundwater contours suggest a north-south groundwater flow direction consistent with the site topography with a water table between 6 and 9 m below ground level (mbgl).

LEGEND

- Road
- Haul road
- Watercourse
- North Kiaka Development Envelope
- North Kiaka Disturbance Footprint
- Moora Mine Development Envelope (EPA approved)
- Moora Mine Disturbance Footprint (approved)
- Moora Mine Disturbance Footprint (amended)
- Wheatbelt Wetland - Basin

Coomberdale East Rd
Prye Brook
Midlands Rd
Kiaka Rd
Cardup Siding Rd
Kyaka Brook
Cattady Rd
Noondine Rd
St Helena Rd
Coonderoo River
Noondine Gully

Paper Size ISO A3

0 250 500 750 1,000

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 50

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Revision No. **0**
Date **05/03/2024**

Surface Hydrology

FIGURE 3.4

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Print date: 05 Mar 2024 - 13:21

Data source: Simcoa: Mining Development Shape Areas is derived from client received 2020; DBCA: Wheatbelt wetland - 20191211; Landgate: Watercourses, Roads - 20190128, Imagery - 20171202 (accessed: 20190212). Created by: dchan3

3.3.3 Wetlands

Thera are no Ramsar listed or nationally important wetlands that occur within the survey area Trudgen et al (2012). The closest Ramsar wetland is Forrestdale and Thomson Lakes, located more than 200 km south and the closest nationally important wetland is Guraga Lake, located approximately 71 km south-west.

The Coonderoo River Wetlands is a historic saline wetland system located approximately 4.5 km north-west of Kiaka Road. The system is made up of a main channel as well as a series of periodic ponds and wetlands (Actis, 2011).

Based on the GHD (2023c) review of available data, none of the vegetation types recorded are considered to be groundwater dependent ecosystems reliant on the surface expression of groundwater or sub-surface presence of groundwater within the rooting depth of the ecosystem based on their species composition and location within the landscape. Most of the vegetation within the survey area (including the Coomberdale Chert TEC) occurs on ridges and upper slopes on shallow soils over chert. The depth of groundwater on these areas of ridges and slopes ranges from 16 to 20 mbgl (Saprolite Environmental 2016). Although there is limited to no data available on maximum root depths of these species, it is unlikely that they are accessing groundwater at this depth. Trudgen (2012) noted in the assessment of ridges that there were a number of deaths of *Regelia megacephala* at the time. This was attributed to a drier than average winter season, indicating that this species is not accessing the water table.

The zone of groundwater drawdown anticipated to occur as a result of mine dewatering operations is expected to be confined by the eastern and western ridges which are likely to form impenetrable barriers to groundwater movement (Saprolite Environmental 2016). To the north and south a maximum 1.5 km radius of influence would potentially extend, however remnant vegetation that occurs in these areas is also on hilltops and ridges, with the exception of the flow line to the north which is a seasonally inundated channel with narrow fringing band of vegetation (dominated by *Acacia acuminata*) within cleared farmland, the species composition of which indicates that it is unlikely to be reliant on ground water levels.

3.4 Land Use

The proposed impact area is located on mining tenements M70/1292 within a region with a long history of broad-acre agricultural use, primarily cropping and livestock (sheep) farming. Areas of remnant native vegetation within the survey area are generally not fenced off from paddocks where stock, predominantly sheep, graze. The lower lying areas have been cleared, with native vegetation replaced with introduced grasses. Native vegetation has been retained on areas of rocky outcrops and the surrounding area supports agricultural land uses.

The remnant vegetation has high conservation value (as noted above it is classified as a Threatened Ecological Community). The ongoing agricultural use of the cleared areas mean that the remnant vegetation of the TEC is exposed to herbicide drift, weed invasion and grazing. The closest rural residential dwelling is located approximately 0.01 km south of the North Kiaka DE (Figure 3.5).

3.4.1 Conservation estates and reserves

Most of the Coomberdale Chert TEC is located on privately owned farms. The only conservation area in the Trudgen et al (2012) survey area is Cairn Hill Nature Reserve (R47694, Class A). This nature reserve and Cairn Hill North is located approximately 3.5 km south of Kiaka Road and has some of the best quality vegetation of the TEC. The reserve was established to offset clearing of the Coomberdale TEC (including DBCA-listed Priority flora *Regelia megacephala* (P4)) associated with development of Moora Mine. No DBCA managed areas occur within the North Kiaka DE. Table 3.1 lists the three DBCA managed lands located within approximately 20 km radius of the North Kiaka DE.

Table 3.1 DBCA managed lands within 20 km of the North Kiaka DE

ID	Classification	Name	Distance from North Kiaka DE boundary
R 47694	Class A nature Reserve	Cairn Hill Nature Reserve	1.5 km south
E 28674	Class A nature Reserve	Manaling Nature Reserve	10.9 km north-west
R 23316	Class A nature Reserve	Namban Nature Reserve	13.6 km north-west

3.4.2 Environmentally sensitive areas

The Trudgen et al (2012) survey area, the existing Moora Mine and proposed North Kiaka DE are all located within an Environmentally Sensitive Area (ESA). The ESA is associated with three TEC's including the Coomberdale TEC and known Threatened and Priority flora species (Figure 3.6). In the surrounding area there also two other TECs occurring within 2 km of the North Kiaka DE, these include:

– 'Eucalyptus Woodlands of the Western Australian Wheatbelt' TEC (also a WA State-listed PEC)
– 'Banksia Woodlands of the Swan Coastal Plain Community' TEC/ PEC (EN under the EPBC Act, Priority 3 State listed PEC)
– 'Vegetation alliances on ridges and slopes of the chert hills of the Coomberdale Floristic Region' (CR under the BC Act).

The assessment by Trudgen (2021) confirms isolated patches of Eucalypts such as *Eucalyptus salmonophloia, Eucalyptus loxophleba* and *Eucalyptus wandoo* persist within the regional mapped distribution of Coomberdale TEC, particularly where non-chert geologies are present within the region. *Eucalyptus loxophleba* is associated with the following vegetation communities in the survey area (Elo3 and El5).

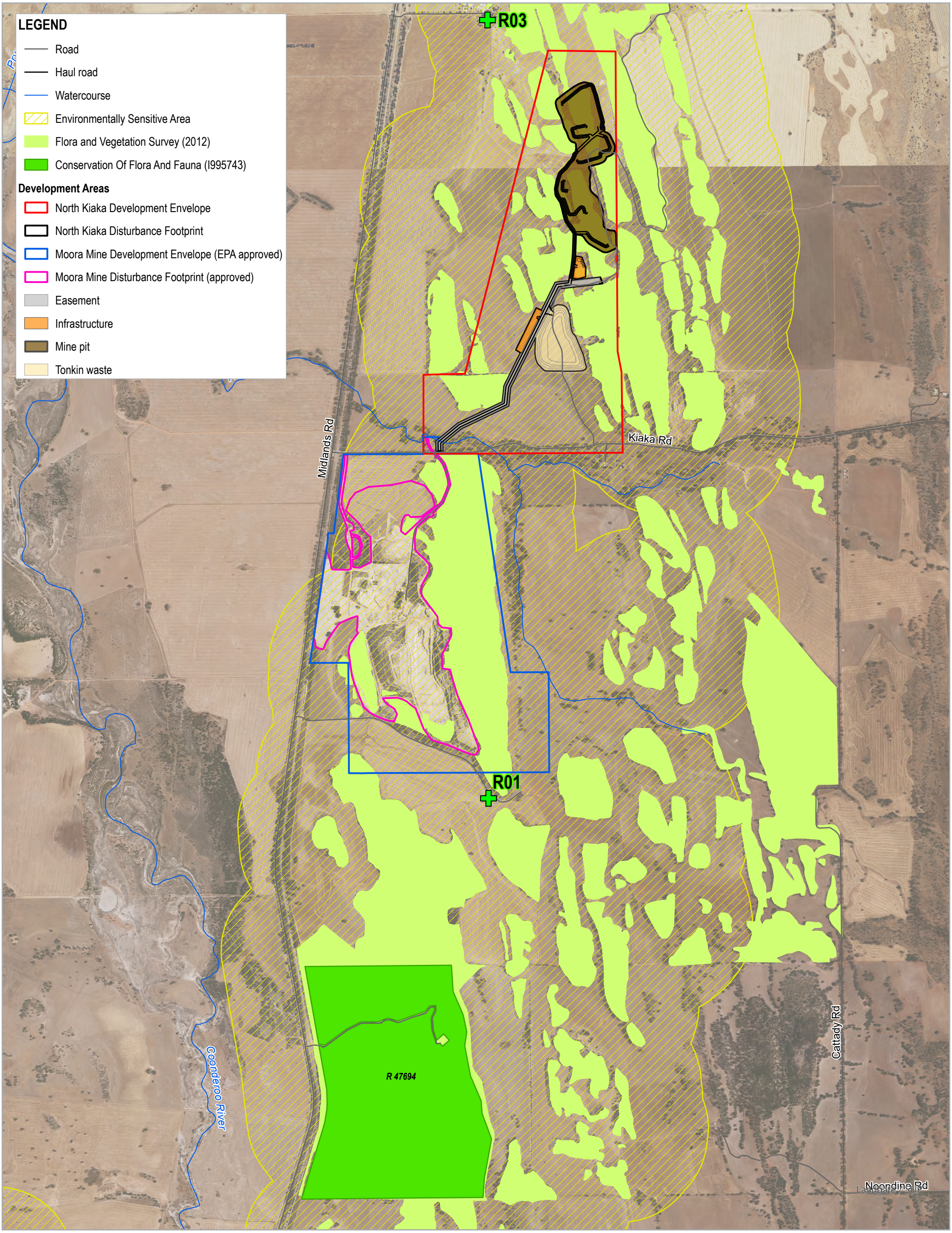
The Commonwealth of Australia (2016) Guidance[1] '*Eucalypt Woodlands of the Western Australian Wheatbelt: a nationally protected ecological community'* includes criteria that would exclude a patch of Eucalyptus woodlands from being classified as 'Eucalypt Woodlands of the Western Australian Wheatbelt' TEC:

– *Non-eucalypt woodlands, e.g. with jam, sheoak, banksia*
– *Woodlands limited to granite or rock outcrops and higher elevations*
– *Vegetation with a sparse tree canopy cover, under 10%.*
– *Isolated paddock trees, very small remnants and patches that are degraded and in poor low condition*
– *Minimum patch size of 2 ha where vegetation understorey comprises <30% invasive species (i.e. high quality)*
– *Minimum patch size of 5 ha where vegetation understorey comprises >30% invasive species (i.e. low quality).*

Based on the above listed criteria, it is unlikely that plant communities Elo3 and El5 would represent 'Eucalypt Woodlands of the Western Australian Wheatbelt' PEC/ TEC particularly the given the community occurs on the chert outcrop (high elevation) and is in Poor condition.

Trudgen (2021) reported that the closest native vegetation with potential to represent 'Eucalyptus Woodlands of the Western Wheatbelt' TEC is a linear corridor of vegetation within the Midlands Road/ Rail reserve approximately 1 km west of the North Kiaka DE.

[1] Commonwealth of Australia (2016). Guidance: Eucalypt Woodlands of the Western Australian Wheatbelt: a nationally protected ecological community. Available online: **https://www.dcceew.gov.au/environment/biodiversity/threatened/publications/guide-eucalypt-woodlands-wa-wheatbelt**



Paper Size ISO A3

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Metres

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Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 50

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ESA and Conservation Reserves

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Date **21//03//2024**

FIGURE 3.5

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Print date: 21 Mar 2024 - 11:30

Data source: Simcoa: Mining Development Shape Areas is derived from client recieved 2020; DBCA: Legislated lands and waters - 2019; Langate: Slip Imagery - April 2017 to November 2018 (accessed - 20191023), Road - 20180601; DoW: River - 201108. Created by: klabez

3.5 Vegetation and flora

3.5.1 Regional vegetation

The vegetation of the Moora region has been mapped by Beard during the 1970s (1979) at a very broad scale (1:1 000 000). This work formed the basis of several regional mapping systems, including physiographic regions defined by John Beard in 1984, which led to the delineation of botanical districts as described in Beard (1990). It was also part of the basis of the biogeographical region dataset (Interim Biogeographic Regionalisation for Australia, IBRA) for Western Australia (Department of the Environment and Energy, 2018). As noted above there is also the floristic analysis of Griffin (1992) that surveyed a smaller area and that led to the identification of the vegetation of the Coomberdale (Noondine) Chert as a Threatened Ecological Community.

3.5.1.1 IBRA 7 biogeographic regions

The Interim Biogeographic Regionalisation of Australia (IBRA) describes a system of 89 'biogeographic regions' (bioregions) and 419 subregions covering the entirety of the Australian continent (Department of the Environment and Energy, 2018). Bioregions are defined on the basis of climate, geology, landforms, vegetation and fauna. The Project is situated in the Avon Wheatbelt (AVW) bioregion and is solely located in the Katanning subregion (AVW02) (DCCEEW, 2023d).

The Avon Wheatbelt bioregion is a dissected plateau of Tertiary laterite on the western edge of the Yilgarn Craton. This is a very old landscape that has not been glaciated for a very long time. This has led to its rich flora which includes many endemics, particularly in *Grevillea, Hakea, Verticordia, Eucalyptus, Acacia, Dryandra, Lhotskya, Eriostemon, Wehlia, Baeckea, Melaleuca, Chamelaucium, Micromyrtus, Thryptomene* and the Asteraceae family. Approximately 25 per cent of the Threatened flora in WA occurs in eucalypt woodlands in this region (Beecham, Avon Wheatbelt Bioregion, 2001).

The Katanning (AV2) subregion has an erosional surface of gently undulating rises to low hills with abrupt breakaways. The vegetation includes woodland of Wandoo, York Gum and Salmon Gum with Jam and Casuarina (Beecham, 2001b), with heath or shrublands less common.

3.5.1.2 Pre-European vegetation

Shepherd, Beeston, & Hopkins (2002) mapped the extent of the pre-European vegetation types of Western Australia using the work of Beard as a basis, with recent updates reflecting the National Vegetation Information System (NVIS) Standards. Two vegetation associations correspond with the Survey Area. The pre-European and current extent of each vegetation association is available from the State-wide Vegetation Statistics Dataset (GoWA, 2019) and is provided in Table 3.2.

Broad scale (1:250,000) vegetation mapping undertaken by Beard (1979) indicates two vegetation associations are associated with the area north of Kiaka Rd. The "*Low woodland; Allocasuarina huegeliana and Jam*" (association 1041) and "*Medium woodland; York gum and Salmon gum*" (association 142) in the south west of the area north of Kiaka Rd (GoWA, 2019). Whereas the south of Kiaka Rd would have comprised "*Low woodland; Allocasuarina huegeliana and Jam*" (association 1041) and "*Medium woodland; York gum and Salmon gum*" (association 142) (GoWA, 2019)

The remaining extent of these vegetation associations (last update March 2019 (GoWA, 2019)) is shown in Table 3.2 (GoWA, 2023). As shown in Table 3.2 there is less than 10% remaining at a IBRA subregional and local government authority (LGA) level and less than 30% at a State and IBRA regional level of the pre-European extent of vegetation association 142. There is less than 30% remaining at a IBRA subregional and LGA level for vegetation association 1041 (GoWA, 2019). It should be noted that these associations are very broadly defined and are not at a level to include the variation now recognised as the Coomberdale Chert TEC.

Table 3.2 Pre-European vegetation associations (GoWA, 2019)

Scale	Pre-European Extent (ha)	Current Extent (ha)	Remaining (%)	Remaining within DBCA Managed Lands (%)
Association 1041				
State: WA	4,781.12	1,507.46	31.53	6.66
Bioregion: Avon Wheatbelt	4,781.12	1,507.46	31.53	6.66
Sub-region: Katanning (AVW02)	2,545.46	729.06	28.64	3.03
LGA: Shire of Moora	2,274.88	688.62	29.39	2.10
Association 142				
State: WA	787,948.47	208,347.17	26.44	1.04
Bioregion: Avon Wheatbelt	637,707.53	79,309.95	12.44	0.37
Sub-region: Katanning (AVW02)	224,265.61	16,054.80	7.16	0.16
LGA: Shire of Moora	164,556.36	12,666.00	7.70	0.11

Note: orange indicates that less than 30% and red less than 10% of pre-European extent remains (EPA, 2000).

3.5.2 Conservation significant flora

Government spatial databases were queried to 10 and 20 km to identify conservation significant species and communities which might occur within the Survey Area. In conjunction with spatial records, habitat information, where described, was used to inform the likelihood of occurrence prior to attending the Survey Area. A total of 70 taxa of conservation significance were identified through the database searches as potentially occurring within the Survey Area (Table 7.1, Appendix G). Of these, 27 species are listed as Threatened under the BC Act and the EPBC Act (note that State and Federal rankings on individual taxa differ):

– Critically Endangered (CR) – 2 (EPBC Act) 11 (BC Act);
– Endangered (EN) – 21 (EPBC Act) 11 (BC Act); and
– Vulnerable (VU) – 4 (EPBC Act) 5 (BC Act).

The remaining 42 flora taxa identified are priority listed species under the BC Act:

– Priority 1 flora (P1) – 2 taxa;
– Priority 2 flora (P2) – 12 taxa;
– Priority 3 flora (P3) – 22 taxa; and
– Priority 4 flora (P4) – 6 taxa.

A likelihood of occurrence assessment has been reviewed for threatened and priority flora species potentially occurring within the Survey Area. The criteria listed in Of the 69 species listed as potentially occurring, 5 are listed as possibly occurring, 17 are known to occur in the 2012 survey area and the remaining are listed are unlikely or highly unlikely.

The likelihood of occurrence table can be found in Appendix D.

Table 3.3 were used to assess the likelihood of the occurrence of species and communities of conservation significance possibly in the proposed impact area identified as possibly or known to be in

the surrounding area from the desktop surveys. Of the 69 species listed as potentially occurring, 5 are listed as possibly occurring, 17 are known to occur in the 2012 survey area and the remaining are listed are unlikely or highly unlikely.

The likelihood of occurrence table can be found in Appendix D.

Table 3.3 Likelihood of occurrence criteria

Likelihood	Criteria
Recorded	Species recorded in current survey and/or previous recorded from desktop review
Likely	Species previously recorded within the study area and large areas of suitable habitat occur in the project area.
Possible	Species previously recorded within the study area and areas of suitable habitat occur/may occur in the project area.
Unlikely	Species previously recorded within the study area, but suitable habitat does not occur in the project area.
Highly unlikely	Species not previously recorded within the study area, suitable habitat does not occur in the project area and/or the project area is outside the natural distribution of the species.
Other considerations	Intensity of survey, availability of access, growth form type, recorded flowering times, cryptic nature of species

Two species of Threatened Flora (see below) have previously been identified within or in proximity to the Survey Area:

– *Acacia aristulata* (T-EN);
– *Daviesia dielsii* (T-EN).

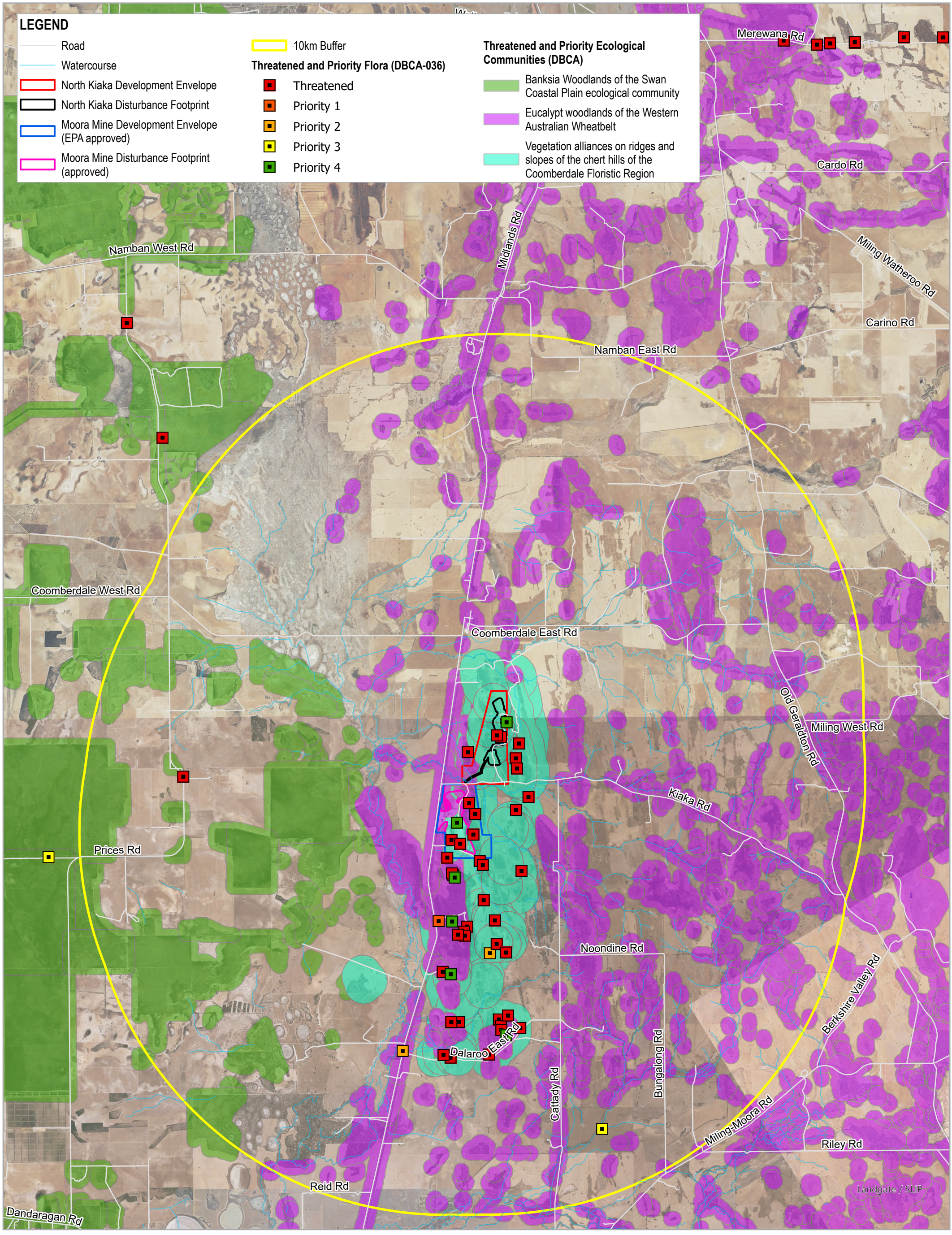
Of the priority species returned from the database searches, two have been previously recorded within (Appendix E) and 52 in proximity (Appendix G) to the Survey Area. A search using the Protected Matters Search Tool (PMST) of Matters of National Environmental Significance (MNES) identified 24 species that occur or may occur within the area (Appendix G). Of these, Table 3.4 lists the threatened and priority species historically recorded in proximity to the survey area.

Table 3.4 Historical threatened and priority species previously recorded within, or in proximity to the Survey Area

Taxon	Status	
	EPBC Act	WC Act /DBCA
Acacia aristulata	EN	EN
Acacia cochlocarpa subsp. *cochlocarpa*	EN	CR
Acacia congesta subsp. *cliftoniana*	-	P1
Acacia cummingiana	-	P3
Acacia flabellifolia	-	P3
Acacia splendens	EN	CR
Andersonia gracilis	EN	VU
Anigozanthos humilis subsp. Badgingarra (S.D. Hopper 7114)	-	P2
Austrostipa nunaginensis	-	P3
Babingtonia cherticola	-	P3
Babingtonia urbana	-	P3
Balaustion grande	-	P3
Banksia dallanneyi subsp. *pollosta*	-	P3
Banksia fuscobractea	CR	CR

Taxon	Status	
	EPBC Act	WC Act /DBCA
Beaufortia bicolor	-	P3
Boronia ericifolia	-	P2
Bossiaea moylei	-	P2
Caladenia drakeoides	EN	CR
Caladenia dundasiae	-	P1
Calothamnus accedens	-	P4
Chamelaucium lullfitzii	EN	VU
Chorizema humile	EN	CR
Conospermum densiflorum subsp. *unicephalatum*	EN	EN
Cryptandra glabriflora [Vouchers redetermined as C. myriantha]	-	P2
Dasymalla axillaris	CR	CR
Daviesia dielsii	EN	EN
Dicrastylis velutina	-	P3
Diuris recurva	-	P4
Eleocharis keigheryi	VU	VU
Eremaea sp. Cairn Hill (B. Morgan 532)	-	P2
Eremophila glabra subsp. *chlorella*	EN	EN
Eremophila scaberula	EN	CR
Eucalyptus absita	EN	CR
Eucalyptus crispata	VU	EN
Eucalyptus leprophloia	EN	EN
Eucalyptus macrocarpa x pyriformis	-	P3
Eucalyptus pruiniramis	EN	EN
Eucalyptus rhodantha var. *rhodantha*	VU	VU
Eucalyptus x carnabyi	-	P4
Frankenia conferta	EN	VU
Gastrolobium appressum	VU	EN
Gastrolobium hamulosum	EN	CR
Goodenia arthrotricha	EN	EN
Grevillea amplexans subsp. *semivestita*	-	P2
Grevillea christineae	EN	EN
Grevillea haplantha subsp. *recedens*	-	P3
Grevillea pythara	EN	CR
Grevillea saccata	-	P4
Guichenotia tuberculata	-	P3
Hemiandra gardneri	EN	CR
Hemigenia conferta	-	P4

Taxon	Status	
	EPBC Act	WC Act /DBCA
Hemigenia curvifolia	-	P2
Hydrocotyle spinulifera	-	P3
Isotropis cuneifolia subsp. *glabra*	-	P3
Melaleuca sclerophylla	-	P3
Persoonia chapmaniana	-	P3
Pertusaria trachyspora	-	P2
Petrophile biternata	-	P3
Regelia megacephala	-	P4
Stylidium glabrifolium	-	P2
Stylidium milleri	-	P2
Stylidium periscelianthum	-	P3
Stylidium sp. Moora (J.A. Wege 713)	-	P2
Styphelia allittii	-	P3
Styphelia tamminensis	-	P3
Synaphea quartzitica	EN	EN
Tricoryne sp. Wongan Hills (B.H. Smith 794)	-	P2
Verticordia insignis subsp. *eomagis*	-	P3
Verticordia muelleriana subsp. *muelleriana*	-	P3



Paper Size ISO A3

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Meters

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 50

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TEC/PEC locations from database searches and DBCA Threatened and Priority Flora records

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FIGURE 3.6

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Data source: Simcoa: Mining Development Shape Areas is derived from client recieved 2020; Langate: Slip Imagery - April 2017 to November 2018 (accessed - 20191023), River, Road - 20180601. Created by: klabez

3.5.3 Weeds

Available data on the presence of weeds in the Avon Wheatbelt region and their inherent characteristics were compiled to provide a list to determine presence and absence within the Survey Area during earlier works by Trudgen et al. 2012. For the 2016 survey, that information was contextualised against the Ecological Impact and Invasiveness Ratings from the Department of Parks and Wildlife Wheatbelt Region Species Prioritisation Process (2014), specifically related to the Wheatbelt region (last updated 27th April 2023), the West Australian Organism List (BAM Act 2007), and the Weeds of National Significance Register (WoNS) (Table 3.5).

Of the 56 weed species with potential to occur, 34 were found in the 2012 Survey Area (Trudgen *et al.* 2012). Of those, eight have a high ecological impact and rapid invasiveness rating. All are common, with wide distribution and are not novel to the area. All weeds are permissible under Section 11 of the BAM Act 2007, and none were determined to be Weeds of National Significance. Rehabilitation monitoring of the Moora Mine rehabilitated areas in 2022 provides recent insight into weed presence in the vicinity of the Coomberdale Chert TEC and Survey Area, with only 12 out of the original 56 species being recorded, four of which have a high ecological impact and rapid invasiveness rating (Trudgen, 2022) (Table 3.6).

Table 3.5 BAM Act 2007 WAOL factor description

Factor	Description	Score code
Ecological Impact	Impact of species within the Region, from low impact (causes minimal disruption to ecological processes or loss of biodiversity) to high (causes acute disruption of ecological processes, dominates and/or significantly alters vegetation structure, composition and function of ecosystems). Examples of impact attributes to consider: – changed fire regime – changed nutrient conditions – changed hydrological patterns – changed soil erosion patterns – changed geomorphological processes – changed biomass distribution – changed light distribution – loss of biodiversity – substantially reduces regeneration opportunities of native plants – allelopathic effects	L – Low M – Medium H – High U - Unknown
Invasiveness	Rate of spread of a weed in native vegetation, encompassing factors of establishment, reproduction and long distance dispersal (>100m). Examples of establishment factors include: – ability to outcompete (light, moisture, nutrients, rapid root growth) – sexual or asexual establishment – need for disturbance to establish Examples of reproduction factors include: – time to seeding – seed production – vegetative reproduction Examples of long distance dispersal mechanisms include: – wind – water – flying/ground animals – deliberate/accidental human spread – vehicles – produce contaminant	S – Slow M - Moderate R - Rapid U - Unknown

Table 3.6 List of weeds with potential to occur in the Survey Area and presence/absence data (data sourced Trudgen et al. 2012)

Plant family	WAOL (BAM Act)	Taxa	Presence North of Kiaka Road	Presence proposed impact area	Ecological impact	Invasiveness	Present in Moora Rehab 2022
Poaceae	s11 - Permitted	*Aira caryophyllea*	Recorded	Recorded	H	R	No
Poaceae	s11 - Permitted	*Avena barbata*	Recorded	Recorded	H	R	Yes
Poaceae	s11 - Permitted	*Brachypodium distachyon*	Recorded	-	U	U	Yes
Poaceae	s11 - Permitted	*Briza maxima*	Recorded	Recorded	H	R	Yes
Poaceae	s11 - Permitted	*Bromus diandrus*	Recorded	Recorded	H	R	Yes
Poaceae	s11 - Permitted	*Bromus madritensis*	Recorded	Recorded	H	R	No
Poaceae	s11 - Permitted	*Cynosurus echinatus*	Recorded	-	-	-	No
Poaceae	s11 - Permitted	*Ehrharta brevifolia* var. *cuspidata*	Recorded	Recorded	U	U	No
Poaceae	s11 - Permitted	*Ehrharta calycina*	Recorded	-	H	M	No
Poaceae	s11 - Permitted	*Ehrharta longiflora*	Recorded	Recorded	U	M	Yes
Poaceae	s11 - Permitted	*Hordeum leporinum*	Recorded	Recorded	U	R	No
Poaceae	s11 - Permitted	*Lamarckia aurea*	Recorded	Recorded	U	M	No
Poaceae	s11 - Permitted	*Lolium perenne*	Recorded	Recorded	U	M	No
Poaceae	s11 - Permitted	*Pentaschistis airoides*	Recorded	Recorded	-	-	No
Poaceae	s11 - Permitted	*Pentaschistis pallida*	Recorded	Recorded	-	-	No
Poaceae	s11 - Permitted	**Pentaschistis* sp.	-	-	-	-	No
Poaceae	-	*Pentaschistis* sp. Moora	Recorded	-	-	-	No
Poaceae	s11 - Permitted	*Schismus barbatus*	Recorded	Recorded	U	U	No

Plant family	WAOL (BAM Act)	Taxa	Presence North of Kiaka Road	Presence proposed impact area	Ecological impact	Invasiveness	Present in Moora Rehab 2022
Poaceae	s11 - Permitted	*Vulpia myuros*	Recorded	Recorded	U	R	No
Iridaceae	s11 - Permitted	*Moraea setifolia*	Recorded	Recorded	H	R	No
Iridaceae	s11 - Permitted	*Romulea rosea*	Recorded	Recorded	H	R	No
Polygonaceae	s11 - Permitted	*Emex australis*	Recorded	Recorded	-	-	No
Caryophyllaceae	s11 - Permitted	*Petrorhagia dubia*	Recorded	Recorded	U	R	No
Caryophyllaceae	-	*Petrorhagia prolifera*	Recorded	-	-	-	No
Caryophyllaceae	s11 - Permitted	*Polycarpon tetraphyllum*	Recorded	Recorded	U	M	No
Caryophyllaceae	s11 - Permitted	*Silene gallica* var. *gallica*	Recorded	Recorded	U	R	No
Caryophyllaceae	s11 - Permitted	*Spergula arvensis*	-	-	-	-	No
Brassicaceae	s11 - Permitted	*Brassica barrelieri* subsp. *oxyrrhina*	Recorded	-	U	U	No
Brassicaceae	s11 - Permitted	*Lupinus angustifolius*	Recorded	Recorded	L	S	No
Papilionaceae	s11 - Permitted	*Trifolium arvense* var. *arvense*	Recorded	-	U	U	Yes
Papilionaceae	s11 - Permitted	*Trifolium campestre* var. *campestre*	Recorded	-	U	U	No
Papilionaceae	s11 - Permitted	*Trifolium hirtum*	Recorded	Recorded	U	U	No
Papilionaceae	s11 - Permitted	*Trifolium repens* var. *repens*	-	-	-	-	No
Papilionaceae	s11 - Permitted	*Trifolium subterraneum*	Recorded	Recorded	U	U	No
Geraniaceae	s11 - Permitted	*Erodium botrys*	Recorded	Recorded	L	M	Yes

Plant family	WAOL (BAM Act)	Taxa	Presence North of Kiaka Road	Presence proposed impact area	Ecological impact	Invasiveness	Present in Moora Rehab 2022
Oxalidaceae	s11 - Permitted	*Oxalis corniculata*	-	-	H	S	No
Linaceae	s11 - Permitted	*Linum trigynum*	Recorded	-	-	-	No
Primulaceae	s11 - Permitted	*Lysimachia arvensis*	Recorded	Recorded	U	R	No
Gentianaceae	s11 - Permitted	*Centaurium tenuiflorum*	-	-	U	U	No
Solanaceae	s11 - Permitted	*Solanum nigrum*	Recorded	Recorded	U	R	No
Scrophulariaceae	s11 - Permitted	*Dischisma capitatum*	-	-	U	U	No
Scrophulariaceae	s11 - Permitted	*Parentucellia latifolia*	Recorded	-	U	R	No
Scrophulariaceae	s11 - Permitted	*Zaluzianskya divaricata*	-	-	U	R	No
Orobanchaceae	s11 - Permitted	*Orobanche minor*	-	-	M	R	No
Rubiaceae	s11 - Permitted	*Galium murale*	Recorded	-	U	U	No
Campanulaceae	s11 - Permitted	*Wahlenbergia capensis*	Recorded	Recorded	U	R	No
Asteraceae	s11 - Permitted	*Arctotheca calendula*	Recorded	Recorded	H	R	Yes
Asteraceae	s11 - Permitted	*Cotula turbinata*	Recorded	Recorded	-	-	No
Asteraceae	s11 - Permitted	*Hedypnois rhagadioloides*	-	-	U	U	No
Asteraceae	s11 - Permitted	*Hypochaeris glabra*	Recorded	Recorded	U	R	Yes
Asteraceae	-	*Hypochaeris radiculata*	-	-	U	R	No
Asteraceae	s11 - Permitted	*Sonchus asper*	Recorded	Recorded	U	R	No

Plant family	WAOL (BAM Act)	Taxa	Presence North of Kiaka Road	Presence proposed impact area	Ecological impact	Invasiveness	Present in Moora Rehab 2022
Asteraceae	s11 - Permitted	*Sonchus oleraceus*	Recorded	Recorded	U	R	No
Asteraceae	s11 - Permitted	*Monoculus monstrosus*	Recorded	Recorded	U	R	Yes
Asteraceae	s11 - Permitted	*Urospermum picroides*	Recorded	-	U	R	Yes
Asteraceae	s11 - Permitted	*Ursinia anthemoides*	Recorded	Recorded	U	R	Yes

3.5.4 Threatened and Priority Ecological Communities

Three Threatened Ecological Communities (TECs) were recorded as potentially occurring within proximity to the Survey Area (Figure 3.6). The data and consideration of the guidance available has allowed an assessment of likelihood of these being present in the survey area.

The Eucalypt Woodlands of the Western Australian Wheatbelt **(Critically Endangered – EPBC Act only).**

The Eucalypt Woodlands are found on flatter landscapes and lower rises of the wheatbelt. The main trees are eucalypts that typically have a single trunk with a woodland crown cover of the canopy is less than 10%. The structure of the ecological community is a woodland in which the minimum crown cover of the tree canopy in a mature woodland is 10%. Native understorey is present but is of variable composition, being a combination of grasses, other herbs and shrubs. The nationally listed woodlands only include patches that are large and remain in good condition as outlined in the Commonwealth of Australia (2016) Guidance[2] '*Eucalypt Woodlands of the Western Australian Wheatbelt: a nationally protected ecological community'*. This community was identified as potentially occurring in the south-western portion of the search area through a DBCA database search. It was formerly extensive but now occurs as mostly small remnants, scattered across the wheatbelt with many patches being degraded.

Small pockets of isolated Eucalypts were recorded in Trudgen et al. 2012 in the Survey Area (plant communities Elo3 and El5), however were not of appropriate quality or size to be classified as this TEC, using the guidance from the Commonwealth Government.

Based upon the presence of underlying soils and landform, it is considered unlikely to occur within the Survey Area.

The Banksia Woodlands of the Swan Coastal Plain Ecological Community **(Endangered – EPBC Act only)**.

The Banksia Woodlands typically occurs on well drained, low nutrient soils on sandplain landforms, particularly deep Bassendean and Spearwood sands and occasionally on Quindalup sands; it is also common on sandy colluvium and aeolian sands of the Ridge Hill Shelf, Whicher Scarp and Dandaragan Plateau. The Community canopy is dominated or co-dominated by Banksia attenuata and/or *B. menziesii*. Other *Banksia* species that can dominate in the community are *B. prionotes* or *B. ilicifolia*.

Based on underlying soils and landform, it is considered unlikely to occur within the Survey Area.

The Vegetation alliances on ridges and slopes of the chert hills of the Coomberdale Floristic Region **(Critically Endangered – BC Act only).**

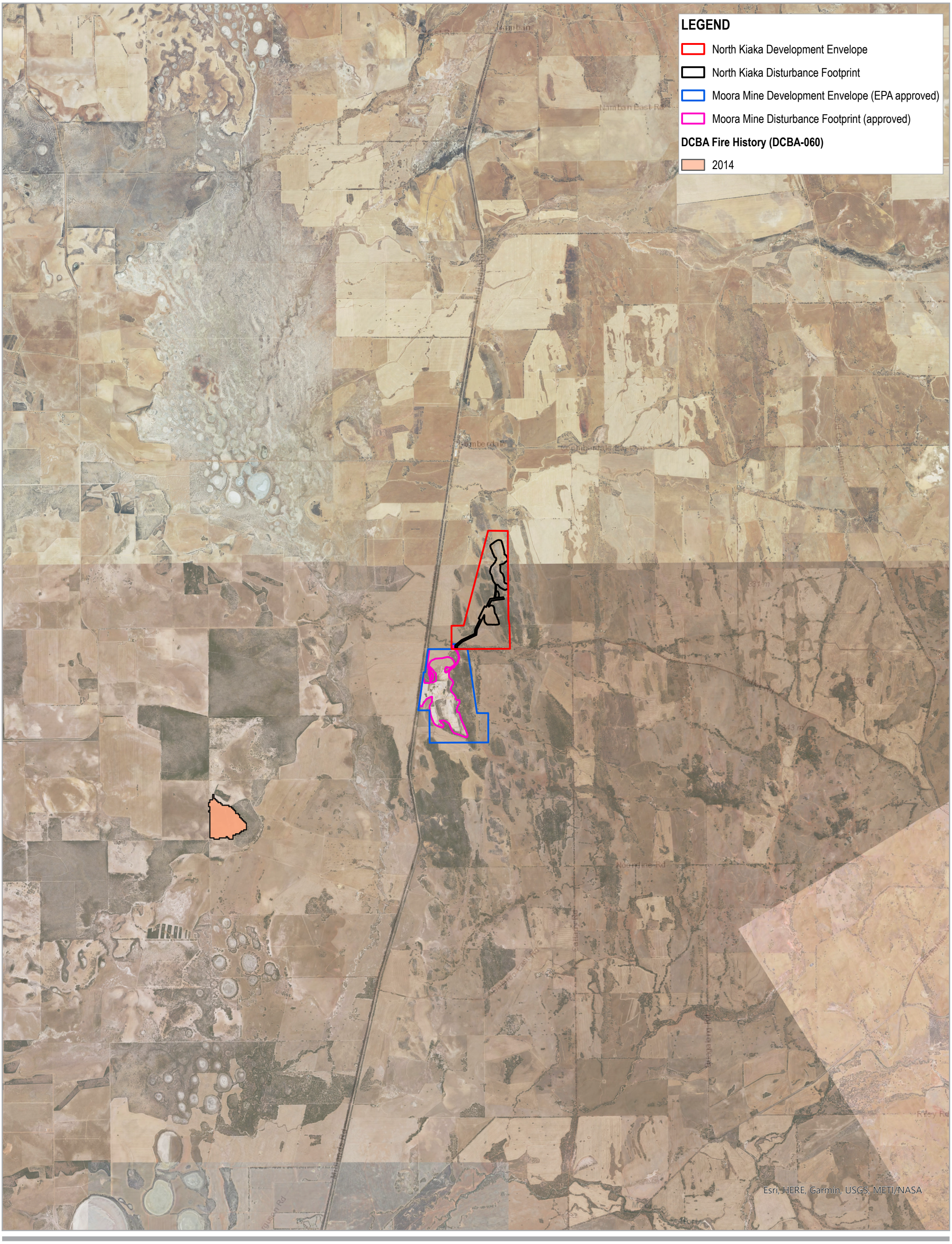
The community occurs on ridges and slopes of the chert hills of the Coomberdale floristic region. Noondine chert is a geological formation visible as a discontinuous, narrow band of low hills or outcroppings of the Moora group of Proterozoic rocks. The formation extends from near the town of Three Springs to Moora. It encompasses seven vegetation alliances including the core units and three vegetation alliances of the buffer units of the Coomberdale Chert community. Core vegetation alliances include *Allocasuarina campestris* (sheoak) shrubland, *Allocasuarina microstachya scrub*, *Regelia megacephala* (priority 4) shrubland, *Kunzea praestans* shrubland and scrub, *Melaleuca calyptroides* heath, *Hibbertia subvaginata* shrubland and *Xanthorrhoea drummondii* shrubland.

The community is restricted to exposed quartzite ridges of the Noondine chert geological formation and is known to occur within the impact area from previous survey work undertaken by Trudgen *et al. (*2012) and earlier works.

[2] Commonwealth of Australia (2016). Guidance: Eucalypt Woodlands of the Western Australian Wheatbelt: a nationally protected ecological community. Available online: **https://www.dcceew.gov.au/environment/biodiversity/threatened/publications/guide-eucalypt-woodlands-wa-wheatbelt**

3.6 Fire history

There have been no fire events in the area since 1981 (according to DBCA mapping and discussion with landowners located North of Kiaka Road) as shown in Figure 3.7.



Paper Size ISO A3

0 1 2 3

Kilometers

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 50

N

GHD

Simcoa Operations Pty Ltd
Simcoa Environmental Approvals s40AA ERD

Fire events in the area since 2014

Project No. **12518217**
Revision No. **0**
Date **22/03/2024**

FIGURE 3.7

\\ghdnet\ghd\AU\Perth\Projects\61\12518217\GIS\Maps\Working\12518217_Figures\12518217_Figures_RB.aprx
Print date: 22 Mar 2024 - 12:18

Data source: Simcoa: Mining Development Shape Areas is derived from client recieved 2020; Langate: Slip Imagery - April 2017 to November 2018 (accessed - 20191023), Cadastre, Road - 20180601; DoW: River - 201108;. Created by: rbrown3

4. Results

A large area of the Coomberdale Chert TEC has been surveyed for flora and vegetation that extends from Dalaroo East Road to north of Kiaka Road. The southern end of the 1.4-kilometre-long area surveyed is 500 metres north of Kiaka Road and 2.2 kilometres east of the Midlands Road (Figure 2.1).

The survey in 2012 considered vegetation data collected in previous surveys. The flora list compiled and incorporated records from the original survey of the Moora Mine site (Trudgen, 1985) and data from Griffin (1992) from sites located within the survey area. During the 2012 survey a total of 5,460 collections were made for the survey area. The 2012 survey area has been shown to be different from areas of the TEC further north in floristic analyses.

There are three areas which contribute to the assessment of significance of flora and vegetation values for different areas of the TEC including:

– The flora and vegetation data collected during earlier surveys, updated with current flora names and nomenclature (Appendix C).
– Data collected from the area north of Kiaka Road which was surveyed for Threatened and Priority flora in 2016 (Trudgen, 2018). This area has been found to have floristics from the area south of Kiaka Road (Trudgen *et al* 2012).
– The remnant vegetation found in the impact area. This is a subset of the area north of Kiaka Road and then of the area documented in Trudgen *et al* (2012). Additional survey work was carried out in this area in 2016 to further describe the Threatened and Priority flora species.

The survey results are outlined in the following sections with the recent GHD (2024) targeted flora survey data results provided under sections 4.1.1 and 4.1.2.

4.1 Flora

Surveys by Trudgen *et al.* (2012) have recorded 315 species of native flowering plants, one native pine (*Actinostrobus arenarius*) and five species of native ferns (three *Cheilanthes* species, *Pleurosorus rutifolius* and *Ophioglossum lusitanicum*) within the Survey Area. Additionally, four of five native fern species recorded from the Coomberdale Chert TEC survey (Trudgen, Griffin, & Morgan, 2012) are common to the areas surveyed, while the fifth (*Ophioglossum lusitanicum*) has only been found in the TEC at one location within the proposed impact area.

The survey by Trudgen *et al* (2012) of the Coomberdale Chert TEC recorded 332 native flora species and 56 weeds. The area north of Kiaka Road, which includes the proposed North Kiaka Mine Development Envelope, has an intermediate sized flora of 192 native flowering plant species and 46 weed species. The proposed impact area recorded 102 native flora species and 53 weed species. See Table 4.2 for a comparison of the floras of these three areas and Appendix B for the flora list. This appendix includes commentary for many of the species.

The composition of the native flora of the three areas is reasonably typical of the South West Botanical Province, with some minor deviation reflecting the TEC habitat, particularly few small shrub species recorded and five fern species present. The low number of small shrubs and number of ferns is unusual for the South West and is due to the fact that the TEC often has sub-outcrop of chert or outcrop. The families with most native species present groups represented in the Survey Area are *Asteraceae, Myrtaceae* and *Orchidaceae*. *Anthericaceae* (a Lily family), *Proteaceae, Cyperaceae* (sedges), *Mimosaceae* (Wattles), *Papilionaceae* and *Goodeniaceae* are also well represented and typical of the South West (Table 4.3).

A list of the native and introduced flora recorded in the survey area is given in Appendix B. To maintain consistency with earlier reports in documenting flora of the TEC, some changes in family boundaries (e.g. including *Mimosaceae* in *Papilionaceae* that have been proposed in recent years) have not been used in this report. Fewer monocotyledons than dicotyledons (a normal occurrence in south-western Australia) were recorded in the proposed impact area with 37 and 65 native species recorded,

respectively. The ratio is similar for the numbers of species in these two groups recorded for the area north of Kiaka Road (58 and 134, respectively) and the area of the Coomberdale Chert TEC surveyed by Trudgen *et al.* (2012) (90 and 225, respectively) (Table 4.2).

Although the Coomberdale Chert has been extensively surveyed for flora, new records of flora species were found during the 2016 survey, but do not include any species of significance (Table 4.1).

Table 4.1 Species found during the 2016 survey (no records from historical surveys conducted by Trudgen et al.)

Species	Common form	Regional extent
Ophioglossum lusitanicum,	fern	Widespread
Isoetopsis graminifolia,	daisy	Widespread
Hyalosperma demissum,	daisy	Widespread
Diuris brumalis,	orchid	Modest (Perth to Geraldton)
Diuris tinkeri;	orchid	Modest (Mandurah to Eneabba)
Podolepis capillaris and	daisy	Widespread
Salsola australis.	herb	Widespread

The largest family groups represented in the area surveyed in 2016 are Asteraceae, Myrtaceae and Orchidaceae (Table 4.1). Only one perennial native Asteraceae has been recorded in the TEC (an *Olearia*), which was not recorded in the proposed impact area. *Pterostylis* was the predominant Orchidaceae genus (nine species) recorded for the TEC, five of which were recorded north of Kiaka Road and two in the proposed impact area.

Table 4.2 Number of species in higher groups recorded for the TEC area surveyed in 2012, north of Kiaka Road and proposed impact area (Trudgen et al., 2012)

Group of plants	Number of flora species recorded for TEC survey area of Trudgen *et al.* 2012	Number of flora species recorded north of Kiaka Road by Trudgen *et al.* 2012	Number of species recorded for proposed impact area
Ferns	5	5	5
Pines	1	1	1
Native monocotyledons	90	58	37
Native dicotyledons	225	134	65
Total native Angiosperm species	315	192	102
Total native species	321	198	108
Weed species	53	46	36

Except for the bias towards cryptophyte species and annual Asteraceae noted, the proportion of different families of angiosperms (Table 4.3) in the flora of the proposed impact area and the TEC is broadly similar to other areas in the south-west of Western Australia. However, there is also a relative paucity of smaller shrubs, reducing the numbers of some families such as Proteaceae, Mimosaceae and *Papilionaceae* that might otherwise be expected. It is noticeable in this respect that most of the 33 Myrtaceae (*Eucalyptus* and *Melaleuca* family) that are recorded for the Coomberdale Chert TEC are large shrubs or trees, with only seven being small shrubs (and even some of these get to over a metre tall). Ten species from the Myrtaceae family have been recorded in the proposed impact area and twelve recorded north of Kiaka Road.

Table 4.3 Number of native species in families recorded for the proposed North Kiaka Mine area, TEC area surveyed by Trudgen et al. (2012) and north of Kiaka Road

Plant family	Number of species recorded for TEC survey area of Trudgen *et al.* 2012	Number of species recorded north of Kiaka Road by Trudgen *et al.* 2012	Number of species recorded for impact area (subset of North of Kiaka Road)
Pteridaceae	3	3	3
Ophioglossaceae	1	1	1
Aspleniaceae	1	1	1
Poaceae	20	10	7
Cyperaceae	11	4	2
Orchidaceae	24	16	10
Anthericaceae	14	10	5
Proteaceae	14	7	4
Amaranthaceae	7	4	2
Mimosaceae	15 (1 with 2 subspecies)	8	4
Papilionaceae	13	5	3
Myrtaceae	33 (1 with 2 forms)	12	10
Apiaceae	9	8	3
Goodeniaceae	11	2	1
Stylidiaceae	8	6	3
Asteraceae	35	23	20

The family *Anthericaceae* (part of the lilies group of monocotyledons) with fourteen species recorded for the TEC, ten for the area north of Kiaka Road and five for the proposed impact area is another family that has been suited by the harsh substrate of the Coomberdale Chert TEC, with six cryptophyte species and the remainder mostly herbs that can die back significantly and recover from the rootstocks or tubers. Changes in naming of native flora in the Coomberdale Chert TEC since Trudgen *et al.* (2012) are provided in Appendix C.

4.1.1 Threatened flora

Five flowering plant species gazetted as Threatened Flora under the *Biodiversity Conservation Act 2016* have been recorded by Trudgen in 2012 (**Error! Reference source not found.**). Only the first two of these five species were recorded in the area north of Kiaka Road and proposed impact area. For the area north of Kiaka Road and the proposed impact area, details are provided in **Error! Reference source not found.**, including records from 2016.

Within the area north of Kiaka Road the listed occurrences include those on the easternmost ridge on the J. Tonkin property where a population of one hundred and eighty-five (185) *Acacia aristulata* plants was recorded in 2017 (within the 63 locations north of Kiaka Rd listed in **Error! Reference source not found.**).

Table 4.4 Proposed impact to area of occurrence of threatened listed species

Species	Conservation Status		Proposal Impacts (previous record based (50m buffer clipped to vegetation extent)					Proposal Impacts (vegetation mapping based)				
	EPBC	BC / DBCA	Area of Occurrence (total known records) (ha)	Area of occurrence within DE (ha)	Area of occurrence within DF (ha)	% Impact within DE	% Impact mapped extent	Area of Occurrence (total known records) (ha)	Area of occurrence within DE (ha)	Area of occurrence within DF (ha)	% Impact within DE	% Impact mapped extent
Acacia aristulata	EN	EN	82.74	9.03	3.67	40.6	4.4	471.4	63.5	16.0	25.2	3.4
Daviesia dielsii	EN	EN	69.48	9.02	1.82	20.2	2.6	407.6	56.3	13.5	24.0	3.3
Goodenia arthrotricha	EN	EN	n/a	n/a	n/a	n/a	n/a	28.65	0.00	0.00	0.0	0.0

#The occurrences in the proposed impact area of *Acacia aristulata* include 2 clusters of significant numbers of plants.

Table 4.5 Likelihood of occurrence

Species	Conservation Status		Flowering period	Survey efficacy		Likelihood of occurrence within DE (post survey)		No. populations (individuals) recorded						
	EPBC	BC / DBCA		Description	Adequate?			Regional extent of Coomberdale TEC (2018)	North Kiaka DE (2018)	North Kiaka DF (2018)	Cairn Hill Reserve (2024)	Cairn Hill North (2024)	Moora Mine DE (2024)	North Kiaka DE (2024)	North Kiaka DF (2024)
Acacia aristulata	EN	EN	September to December	High coverage of all habitats in 2012 survey area with 99 quadrats, 398 releves and Rare/Priority search transects. DE and offset site re-surveyed in 2024.	**Yes,** while the 2024 survey was undertaken in Autumn, the species was readily observable during the targeted survey.	Known to occur, population well defined. After fire or disturbance may appear from soil stored seed at additional locations to those already known.	Known	220 locations with an estimated 1,100 plants	15 pop. 39 individuals	6 pop. (16 individuals)	27	6	1	2	**2**
Daviesia dielsii	EN	EN	July	High coverage of all habitats in 2012 survey area with 99 quadrats, 398 releves and DRF/Priority transects. Population well defined. DE and offset site re-surveyed in 2024.	**Yes,** while the 2024 survey was undertaken in Autumn, the species was readily observable during the targeted survey.	Known to occur in 2012 survey area; population well defined. After fire or disturbance may appear from soil stored seed at additional locations to those already known.	Known	111 locations with an estimated 365 plants	17 pop. (>91 individuals)	4 pop. (15 individuals)	72	9	1	0	**0**
Eucalyptus pruiniramis	EN	EN		Targeted survey in 2024	**Yes,** while the 2024 survey was undertaken in Autumn, the species was readily observable during the targeted survey.	Recorded within Offset site only	Unlikely	0	0	0	9	0	0	0	**0**
Gastrolobium appressum	VU	EN	August to December	High coverage of all habitats in 2012 survey area with 99 quadrats, 398 releves and DRF/Priority transects.	**Yes,** while the 2024 survey was undertaken in Autumn, the species was readily observable during the targeted survey.	Highly unlikely to occur. Outside known range, soil, habitat not suitable	Unlikely	0	0	0	0	0	0	0	0

Species	Conservation Status		Flowering period	Survey efficacy		Likelihood of occurrence within DE (post survey)		No. populations (individuals) recorded							
	EPBC	BC / DBCA		Description	Adequate?			Regional extent of Coomberdale TEC (2018)	North Kiaka DE (2018)	North Kiaka DF (2018)	Cairn Hill Reserve (2024)	Cairn Hill North (2024)	Moora Mine DE (2024)	North Kiaka DE (2024)	North Kiaka DF (2024)
				DE and offset site re-surveyed in 2024.											
Gastrolobium hamulosum	EN	CR	August to October	High coverage of all habitats in 2012 survey area with 99 quadrats, 398 releves and DRF/Priority transects. DE and offset site re-surveyed in 2024.	**Yes,** while the 2024 survey was undertaken in Autumn, the species was readily observable during the targeted survey.	Highly unlikely to occur, due to survey intensity and size of the species.	Unlikely	0	0	0	0	0	0	0	0
Goodenia arthrotricha	EN	EN	October to November	High coverage of 2012 survey area with 99 quadrats, numerous relevés and transects. DE and offset site re-surveyed in 2024.	**Yes,** while the 2024 survey was undertaken in Autumn and the species likely not observable, the species was not recorded within the DE from previous surveys.	Known to occur in vegetation ~450m south of the DE. After fire or disturbance may appear from soil stored seed at additional locations to those already known. However, based on the level of disturbance to vegetation including weed incursion and grazing, this species is considered unlikely to occur.	Unlikely	0	0	0	0	0	0	0	0
Hemiandra gardneri	EN	CR	August to October	High coverage of all habitats in 2012 survey area with 99 quadrats, 398 releves and DRF/Priority transects. DE and offset site re-surveyed in 2024.	**Yes,** while the 2024 survey was undertaken in Autumn, the species was readily observable during the targeted survey.	Highly unlikely to occur. due to survey intensity. Apart from one old record in the Moora area known occurrences are more than 25 km away. Soil types in TEC remnants not suitable.	Unlikely	0	0	0	0	0	0	0	0
Synaphea quartzitica	EN	EN	July to August	High coverage of all habitats in 2012 survey area with 99 quadrats, 398 releves and DRF/Priority transects. DE and offset site re-surveyed in 2024.	**Yes,** while the 2024 survey was undertaken in Autumn, the species was readily observable during the targeted survey.	The occurrence in the TEC survey area is localised. Additional localities possible but unlikely. Unlikely to occur in TEC north of Kiaka Road due to habitat differences.	Unlikely	0	0	0	0	0	0	0	0
Acacia congesta subsp. *cliftoniana*		P1	August to September	High coverage of all habitats in 2012 survey area with 99 quadrats, 398 releves and Rare/Priority search transects. DE and offset site re-surveyed in 2024.	**Yes,** while the 2024 survey was undertaken in Autumn, the species was readily observable during the targeted survey.	Highly unlikely to occur. The putative record at Cairn Hill is likely to be mis-determined. All other records of Acacia congesta from Cairn Hill or the TEC area (including 4 determined by B. Maslin) are considered to be subspecies congesta.	Unlikely	0	0	0	0	0	0	0	0
Bossiaea moylei		P2	September	High coverage of all habitats in 2012	**Yes,** while the 2024 survey was	Known to occur in 2012 survey area, population well defined.	Unlikely	0	0	0	0	0	0	0	0

Species	Conservation Status		Flowering period	Survey efficacy		Likelihood of occurrence within DE (post survey)		No. populations (individuals) recorded							
	EPBC	BC / DBCA		Description	Adequate?			Regional extent of Coomberdale TEC (2018)	North Kiaka DE (2018)	North Kiaka DF (2018)	Cairn Hill Reserve (2024)	Cairn Hill North (2024)	Moora Mine DE (2024)	North Kiaka DE (2024)	North Kiaka DF (2024)
				survey area with 99 quadrats, 398 releves and DRF/Priority transects. DE and offset site re-surveyed in 2024.	undertaken in Autumn, the species was readily observable during the targeted survey.	*Bossiaea moylei* has a sporadic distribution in the TEC south of Kiaka Road. It has not been recorded north of Kiaka Road in any quadrat, relevé, or any rare flora search transect.									
Stylidium glabrifolium		P2	October to November	High coverage of all habitats in 2012 survey area with 99 quadrats, 398 releves and DRF/Priority transects. DE and offset site re-surveyed in 2024.	**Yes,** while the 2024 survey was undertaken in Autumn and the species likely not observable, the species was not recorded within the DE from previous surveys.	Known to occur in 2012 survey area. Not recorded north of Kiaka Road. Weed levels in the proposed mine area reduce the likelihood of occurrence there.	Unlikely	0	0	0	0	0	0	0	0
Stylidium milleri		P2	September to October	High coverage of all habitats in 2012 survey area with 99 quadrats, 398 releves and DRF/Priority transects. DE and offset site re-surveyed in 2024.	**Yes,** while the 2024 survey was undertaken in Autumn and the species likely not observable, the species was not recorded within the DE from previous surveys.	Highly unlikely to occur as soil types and vegetation types are not suitable.	Unlikely	0	0	0	0	0	0	0	0
Stylidium sp. Moora (J.A.Wege 713)		P2		High coverage of all habitats in 2012 survey area with 99 quadrats, 398 releves and DRF/Priority transects. DE and offset site re-surveyed in 2024.	**Yes,** while the 2024 survey was undertaken in Autumn when the species would not have been identifiable, the degraded condition of the areas of the historical record make it unlikely that the species would have persisted.	Known to occur historically, however, the poor condition of the vegetation due to weed incursion and grazing make the occurrence of this species unlikely.	Unlikely	42	8	5	0	0	0	0	0
Tricoryne sp. Wongan Hills (B.H. Smith 794)		P2	October and November	High coverage of all habitats in 2012 survey area with 99 quadrats, 398 releves and DRF/Priority transects. DE and offset site re-surveyed in 2024.	**Yes,** while the 2024 survey was undertaken in Autumn and the species likely not observable, the species was not recorded within the DE from previous surveys.	Known to occur in survey area. Population well defined, although some plants not in flower during surveys may be present in areas where not recorded.	Unlikely	0	0	0	0	0	0	0	0
Eremaea sp. Cairn Hill (B. Morgan 532)		P2	October to November	High coverage of all habitats in 2012 survey area with 99 quadrats, 398 releves and	**Yes,** while the 2024 survey was undertaken in Autumn, the species was readily observable	Occurs at one location in 2012 survey area. A distinctive medium sized shrub, unlikely to occur at other locations there. Suitable habitat does not occur north of Kiaka Road.	Unlikely	0	0	0	0	0	0	0	0

Species	Conservation Status		Flowering period	Survey efficacy		Likelihood of occurrence within DE (post survey)		No. populations (individuals) recorded							
	EPBC	BC / DBCA		Description	Adequate?			Regional extent of Coomberdale TEC (2018)	North Kiaka DE (2018)	North Kiaka DF (2018)	Cairn Hill Reserve (2024)	Cairn Hill North (2024)	Moora Mine DE (2024)	North Kiaka DE (2024)	North Kiaka DF (2024)
				DRF/Priority transects. DE and offset site re-surveyed in 2024.	during the targeted survey.										
Acacia flabellifolia		P3	August	High coverage of all habitats in 2012 survey area with 99 quadrats, 398 releves and Rare/Priority search transects. DE and offset site re-surveyed in 2024.	**Yes,** while the 2024 survey was undertaken in Autumn, the species was readily observable during the targeted survey.	Highly unlikely. The closest records for this species to the proposed North Kiaka Mine are from ca. 20 km to the north (near Watheroo). One collection from near Watheroo was collected on quartzite, but others were collected from Wandoo woodland. Acacia flabellifolia has not been collected in the 2012 survey area. Acacia ericksoniae, has been recorded, but is clearly different to Acacia flabellifolia.	Unlikely	0	0	0	0	0	0	0	0
Austrostipa nunaginensis		P3	Late Spring	High coverage of all habitats in 2012 survey area with 99 quadrats, 398 releves and DRF/Priority transects.	**Yes,** while the 2024 survey was undertaken in Autumn and the species likely not observable, the species was not recorded within the DE from previous surveys.	Given the small size of this taxon and the frequency of other Austrostipa of similar size in the TEC, it is possible that a small number of additional occurrences may occur. Weed levels in the proposed mine area reduce the likelihood of occurrence there.	Unlikely	0	0	0	0	0	0	0	0
Babingtonia urbana		P3	October to February	High coverage of all habitats in 2012 survey area with 99 quadrats, 398 releves and DRF/Priority transects. DE and offset site re-surveyed in 2024.	**Yes,** while the 2024 survey was undertaken in Autumn, the species was readily observable during the targeted survey.	Highly unlikely to occur. The lack of wetland habitat excludes any reasonable chance of this taxon occurring in the TEC survey area.	Unlikely	0	0	0	0	0	0	0	0
Babingtonia cherticola		P3		DE and offset site re-surveyed in 2024.	**Yes,** while the 2024 survey was undertaken in Autumn, the species was readily observable during the targeted survey.	Unlikely to occur as the DE was systematically surveyed and the species was not recorded.	Unlikely	77			2,224	2,499	0	0	0
Guichenotia tuberculata		P3	August to October	High coverage of all habitats in 2012 survey area with 99 quadrats, 398 releves and DRF/Priority transects.	**Yes,** while the 2024 survey was undertaken in Autumn and the species likely not observable, the species was not recorded within the DE from previous surveys.	The occurrence in the TEC survey area is localised. Additional localities possible but unlikely. Unlikely to occur in TEC north of Kiaka Road	Unlikely	0	0	0	0	0	0	0	0
Hemigenia conferta		P3	September to October	High coverage of all habitats in 2012 survey area with 99 quadrats, 398	**Yes,** while the 2024 survey was undertaken in Autumn, the species was	The occurrence in the TEC survey area is localised. Additional localities possible but unlikely. Unlikely to occur in TEC north of	Unlikely	0	0	0	0	0	0	0	0

Species	Conservation Status		Flowering period	Survey efficacy		Likelihood of occurrence within DE (post survey)		No. populations (individuals) recorded							
	EPBC	BC / DBCA		Description	Adequate?			Regional extent of Coomberdale TEC (2018)	North Kiaka DE (2018)	North Kiaka DF (2018)	Cairn Hill Reserve (2024)	Cairn Hill North (2024)	Moora Mine DE (2024)	North Kiaka DE (2024)	North Kiaka DF (2024)
				releves and DRF/Priority transects.	readily observable during the targeted survey.	Kiaka Road due to habitat differences.									
Melaleuca sclerophylla		P3	June to September	High coverage of all habitats in 2012 survey area with 99 quadrats, 398 releves and DRF/Priority transects.	**Yes,** while the 2024 survey was undertaken in Autumn, the species was readily observable during the targeted survey.	Known to occur in southern part of 2012 survey area. No suitable habitat north of Kiaka Road.	Unlikely	0	0	0	0	0	0	0	0
Petrophile biternata		P3	August to October	High coverage of all habitats in 2012 survey area with 99 quadrats, 398 releves and DRF/Priority transects.	**Yes,** while the 2024 survey was undertaken in Autumn, the species was readily observable during the targeted survey.	Highly unlikely to occur.	Unlikely	0	0	0	0	0	0	0	0
Diuris recurva		P4	July to August	High coverage of all habitats in 2012 survey area with 99 quadrats, 398 releves and DRF/Priority transects. DE survey in 2024	**Yes,** while the 2024 survey was undertaken in Autumn when the species would not have been identifiable, the degraded condition of the areas of the historical record make it unlikely that the species would have persisted.	Known to occur historically, however, the poor condition of the vegetation due to weed incursion and grazing make the occurrence of this species unlikely.	Unlikely	39	65 individuals	65 individuals	0	0	0	0	0
Regelia megacephala		P4	October to December	High coverage of all habitats in 2012 survey area with 99 quadrats, 398 relevés and DRF/Priority transects. DE and offset site re-surveyed in 2024.		Forms numerous stands in the 2012 survey area. Given the size of this taxon, it is likely all stands in the TEC survey area have been recorded.	Known	71 pop.	7 pop.	1 pop.	3,684	2,019	18	3,438	567
Other species of potential significance															
Banksia sphaerocarpa var. aff. *caesia*	-	Other		n/a	n/a		Known	3	2	2 (6 individuals)	-	-	-	-	-
Calothamnus aff. *quadrifidus* (Moora - Watheroo)	-	Other		n/a	n/a		Known	56	2	2	-	-	-	-	-
Calytrix sp. Coomberdale (M.E. Trudgen MET 21184)	-	Other		n/a	n/a		Known	197	7 (Sample underestimates the large population in the North Kiaka DE)	7 (Sample underestimates the large population in the North Kiaka DE)	-	-	-	-	-
Cristonia stenophylla	-	Other		n/a	n/a		Known	3	1	1	-	-	-	-	-

Species	Conservation Status		Flowering period	Survey efficacy		Likelihood of occurrence within DE (post survey)		No. populations (individuals) recorded						
	EPBC	BC / DBCA		Description	Adequate?			Regional extent of Coomberdale TEC (2018)	North Kiaka DE (2018)	North Kiaka DF (2018)	Cairn Hill Reserve (2024)	Cairn Hill North (2024)	Moora Mine DE (2024)	North Kiaka DE (2024)	North Kiaka DF (2024)
Gastrolobium acutum (previously State listed P3 species)	-	Other		n/a	n/a		Known	17	1	1	-	-	-	-	-
Kunzea praestans (previously a State listed P3 species)	-	Other		n/a	n/a		Known	219	10 (Underestimates the large population in the North Kiaka DE)	10 (Underestimates the large population in the North Kiaka DE)	-	-	-	-	-
Pterostylis exserta	-	Other		n/a	n/a		Known	3	1	1	-	-	-	-	-
Quoya (Pityrodia) dilatata	-	Other		n/a	n/a		Known	52	3 (Sporadic in the North Kiaka DE, data underestimates population)	3 (Sporadic in the North Kiaka DE, data underestimates population)	-	-	-	-	-
Wurmbea drummondii (previously a State listed P4 species)	-	Other		n/a	n/a		Known	2	2	2	-	-	-	-	-
Xanthorrhoea sp. Coomberdale (M.E. Trudgen MET 25047)	-	Other		n/a	n/a		Known	254	9 (Locally common; sample underestimates the population)	9 (Locally common; sample underestimates the population)	-	-	-	-	-

GHD (2024) Targeted survey for Threatened and Priority flora

GHD (2024) recorded three Threatened flora species, *Daviesia dielsii*, *Acacia aristulata* and *Eucalyptus pruiniramis*. All three of these species are Endangered under the EPBC Act (1999) and BC Act (2016). *Eucalyptus pruiniramis* was recorded within the offset site only. The number of plants recorded in the Revised Proposal (and zone) per species is presented in Table 4.6 below.

It was observed by GHD (2024) that *Acacia aristulata* and *Daviesia dielsii* were both growing in the gravel pits and previously cleared areas in high numbers, though these disturbed areas were not targeted for the survey so actual numbers have not been derived for areas previously mapped as disturbed and/or highly degraded areas.

Table 4.6 ***Number of occurrences (plants) of Threatened Flora recorded in the Revised Proposal and Offset Areas (GHD, 2024)***

Taxon	Cairn Hill Reserve	Cairn Hill North	Moora Mine DE	North Kiaka DE	North Kiaka DF (subset of the DE)	Total
Acacia aristulata (EN)	27	6	1	2	**2**	**38**
Daviesia dielsii (EN)	72	9	1	0	**0**	**82**
Eucalyptus pruiniramis (EN)	9	0	0	0	**0**	**9**

The locations of Threatened flora recorded by GHD (2024) are represented in Figure 4.4.

LEGEND

- *Acacia aristulata*
- *Daviesia dielsii*
- *Diuris recurva*
- *Regelia megacephala*
- Road
- Watercourse
- North Kiaka Development Envelope
- North Kiaka Disturbance Footprint
- Moora Mine Development Envelope (EPA approved)
- Moora Mine Disturbance Footprint (approved)
- Vegetation Survey Area

Vegetation Alliances

- Core Vegetation Alliances
- Buffer Vegetation Alliances
- Other Vegetation Alliances

Midlands Rd
Kiaka Rd
Cattady Rd
Noondine Rd
Dalaroo West Rd
Dalaroo East Rd
Landgate / SLIP

Paper Size ISO A3

0 300 600 900 1,200 1,500

Metres

N

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 50

GHD

Simcoa Operations Pty Ltd
Simcoa Environmental Approvals s40AA ERD

Conservation significant flora locations with Core and Buffer TEC vegetation alliances

Project No. **12518217**
Revision No. **0**
Date **21/03/2024**

FIGURE 4.1

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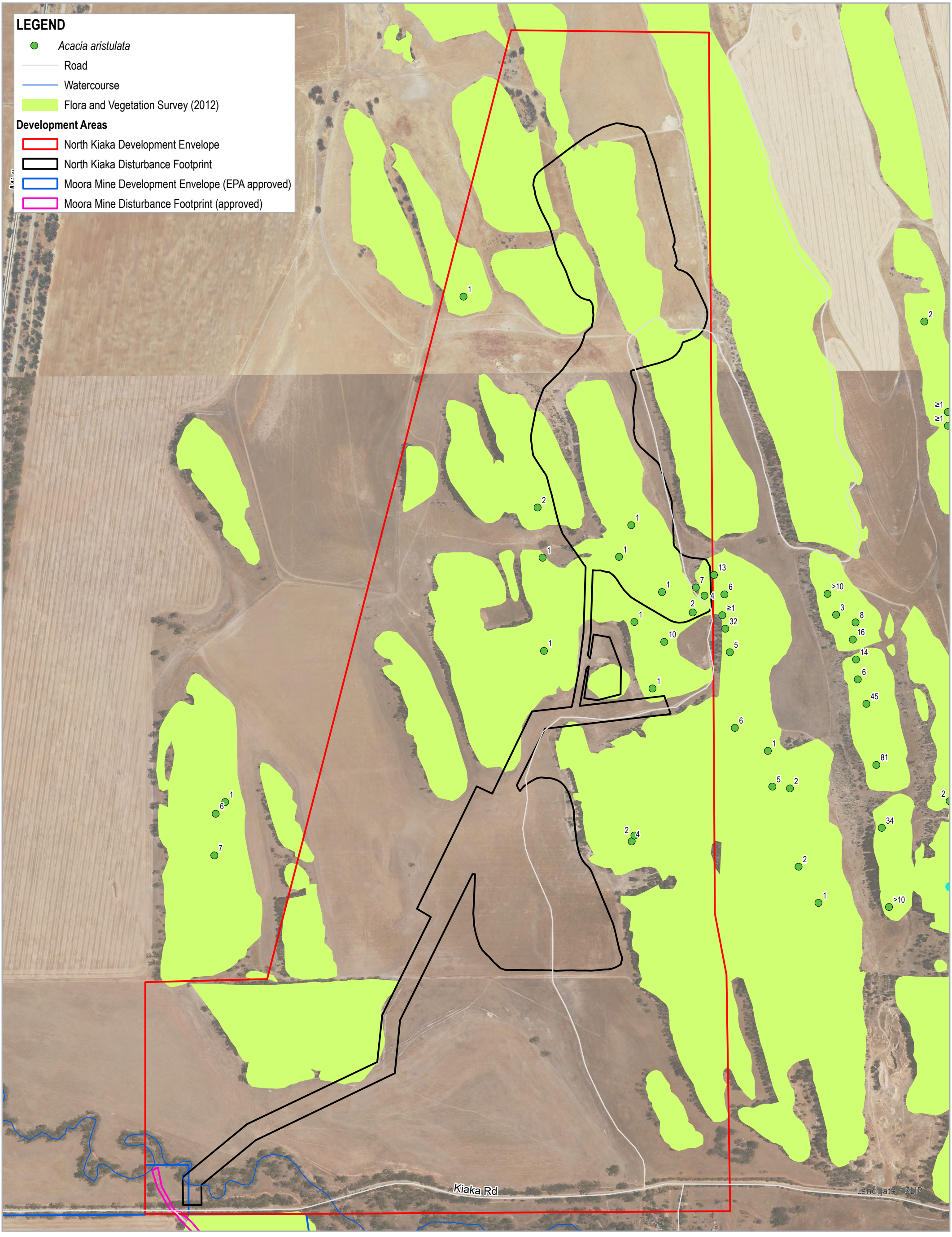
\ghdnet\ghd\AU\Perth\Projects\61\12518217\GIS\Maps\Working\12518217_Figures\12518217_Figu
Print date: 21 Mar 2024 - 11:21

Data source: Simcoa: Mining Development Shape Areas is derived from client recieved 2020; Langate: Slip Imagery - April 2017 to November 2018 (accessed - 20191023), River, Road - 20180601. Created by: klabez



Paper Size ISO A3

0 100 200 300 400

Metres

N

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 50

GHD

Simcoa Operations Pty Ltd
Simcoa Environmental Approvals s40AA ERD

***Acacia aristulata* Locations**

Project No. **12518217**
Revision No. **0**
Date **21/03/2024**

FIGURE 4.2

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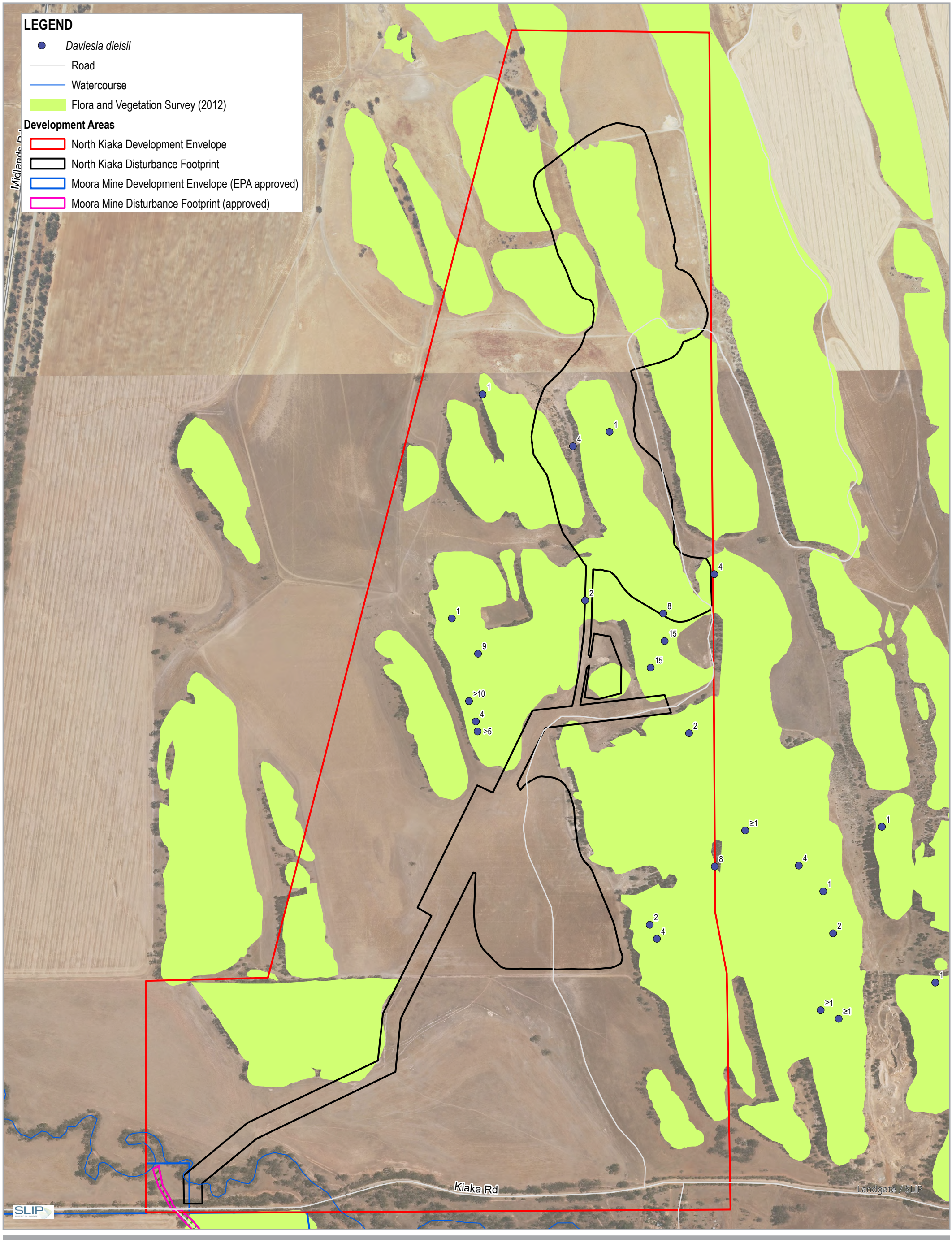
Print date: 21 Mar 2024 - 11:35

Data source: Simcoa: Mining Development Shape Areas is derived from client recieved 2020; Langate: Slip Imagery - April 2017 to November 2018 (accessed - 20191023), River, Road - 20180601. Created by: klabez



Paper Size ISO A3

0 100 200 300 400 N

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 50

GHD

Simcoa Operations Pty Ltd
Simcoa Environmental Approvals s40AA ERD

***Daviesia dielsii* Locations**

Project No. **12518217**
Revision No. **0**
Date **21/03/2024**

FIGURE 4.3

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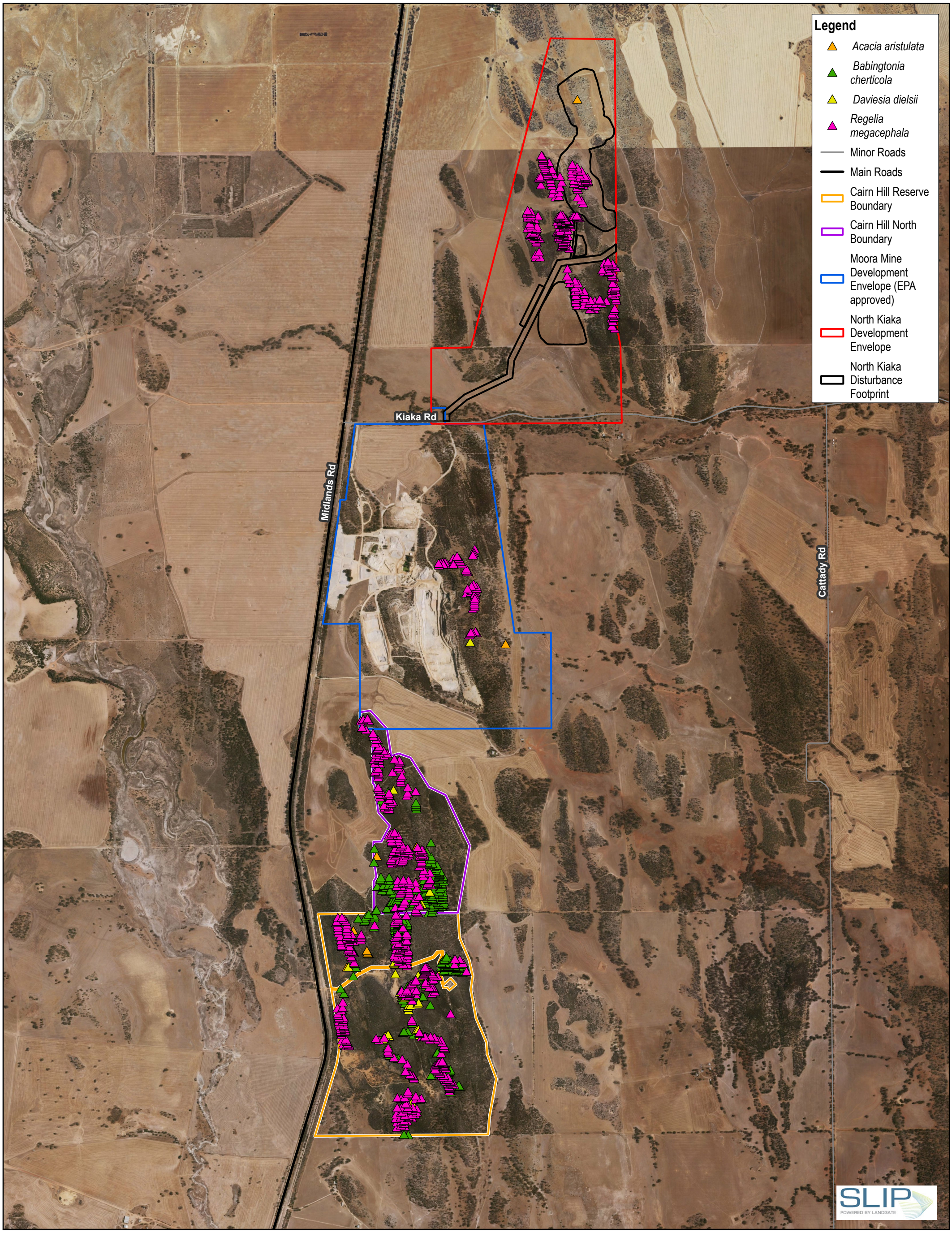
Print date: 21 Mar 2024 - 11:41

Data source: Simcoa: Mining Development Shape Areas is derived from client recieved 2020; Langate: Slip Imagery - April 2017 to November 2018 (accessed - 20191023), Cadastre, River, Road - 20180601; DMIRS: Mining Tenements - 20180601; DoW: River - 201108. Created by: klabez



Paper Size ISO A3

0 200 400 600 800

Meters

Map Projection: Transverse Mercator
Horizontal Datum: GDA2020
Grid: GDA2020 MGA Zone 50

N

GHD

Simcoa Operations Pty Ltd
North Kiaka Project Approval Support - Sites Assets

Project No. **12627587**
Revision No. **0**
Date **12/06/2024**

Significant Flora Locations

FIGURE 4.4

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Print date: 12 Jun 2024 - 12:25

Data source: World Topographic Map: Esri, HERE, Garmin, FAO, NOAA, USGS
WMS: . Created by: rbrown3

4.1.2 Priority flora

Thirteen priority flora species were recorded in the Trudgen *et al* (2012) survey area with three recorded in the area north of Kiaka Road and in the proposed impact area (Table 4.7). Historically, two priority species were known to occur (recorded in the impact area (2018)) *Diuris recurva* and *Stylidium* sp. Moora. However, the poor condition of the vegetation due to weed incursion and grazing make the occurrence of these species unlikely.

Diuris recurva has been recorded at 39 locations in the Trudgen *et al.* 2012 survey area. 10 of these occurrences are in the proposed impact area, with 65 flowering stems recorded between them. The concept of (and identifications of) *Diuris recurva* have changed significantly over the period of the surveys in the Trudgen *et al* (2012) survey area and it is likely that the high number of occurrences in the impact area compared to other parts of the 2012 area are due to this and possibly a good year for flowering of the species 2016.

Regelia megacephala was recorded in 71 locations during the 2012 survey. At most of these sites the *Regelia* was dominant in a stand of *Regelia megacephala* vegetation type, although some stands are quite small. Of the 71 stands, eight are north of Kiaka Road and one is in the proposed impact area. The *Regelia megacephala* vegetation alliance has an area of about 75.39 hectares in the survey area of Trudgen *et al.* (2012). The stands in the impact area have a combined area of 2 hectares.

Table 4.7 Priority flora species recorded (Trudgen, 2018)

Taxon	Number of occurrences for TEC survey area of Trudgen *et al.* 2012	Number of occurrences north of Kiaka Road	Number of occurrences or counts for proposed impact area
P3 *Babingtonia cherticola*	77	0	0
P4 *Diuris recurva*	39	10 occurrences, 65 flowering stems	10 occurrences; 65 flowering stems
P4 *Regelia megacephala*	71 stands [75.39 hectares]	7 stands [14.07 hectares]	1 stand [2.00 hectares]
P2 *Stylidium glabrifolium*	3	0	0
P2 *Stylidium* sp. Moora	42	8	5 occurrences

GHD (2024) Targeted survey for Threatened and Priority flora

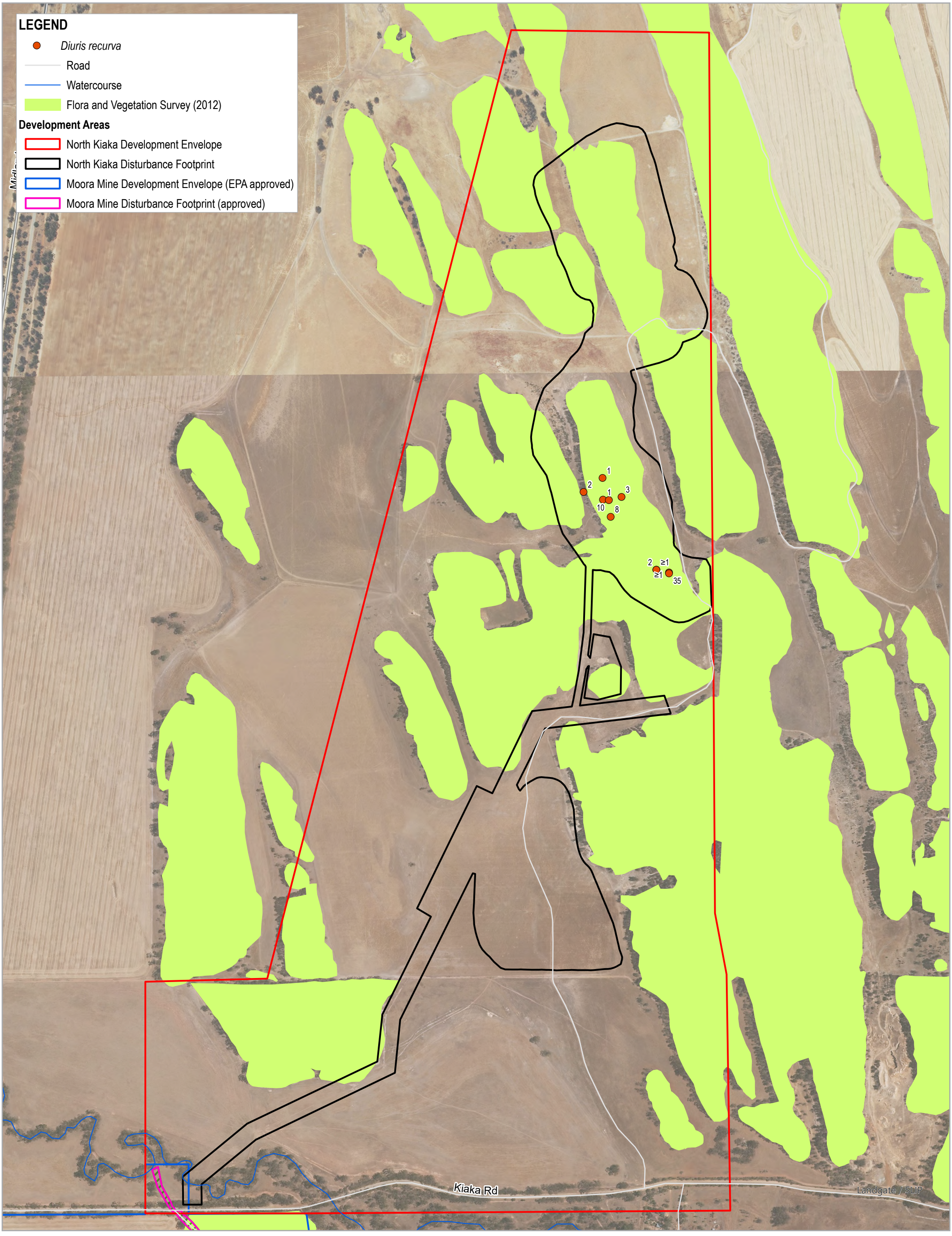
GHD (2024) recorded two Priority species, *Regelia megacephala* (P4) and *Babingtonia cherticola* (P3). The number of plants recorded per species is presented in Table 4.8 below.

Table 4.8 Proposed impacts to conservation significant species

Species	Conservation Status		Proposal Impacts					
	EPBC	BC / DBCA	Directly Impacted	Potential Indirect Impacts (within 10m of DF)	Potential Indirect Impacts (within 10-50m of DF)	% Impact within DE	Number regionally	% Impact regionally
Acacia aristulata	EN	EN	2	0	0	100	1,100	0.2
Daviesia dielsii	EN	EN	0	0	0	0	365	0
Stylidium sp. Moora	-	P2	5[1]	1	1	62.5	42	11.9
Babingtonia cherticola	-	P3	0	0	0	0	77	0
Diuris recurva	-	P4	65[3]	0	0	0	104	62.5
Regelia megacephala	-	P4	567	25	660	16.5	9,159	6.2

The locations of Priority flora recorded by GHD (2024) are represented in are represented in Figure 4.4.

[3] Trudgen 2018



Paper Size ISO A3

0 100 200 300 400

Metres

N

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 50

GHD

Simcoa Operations Pty Ltd
Simcoa Environmental Approvals s40AA ERD

Diuris recurva locations nth of Kiaka Rd

Project No. 12518217
Revision No. 0
Date 21/03/2024

FIGURE 4.5

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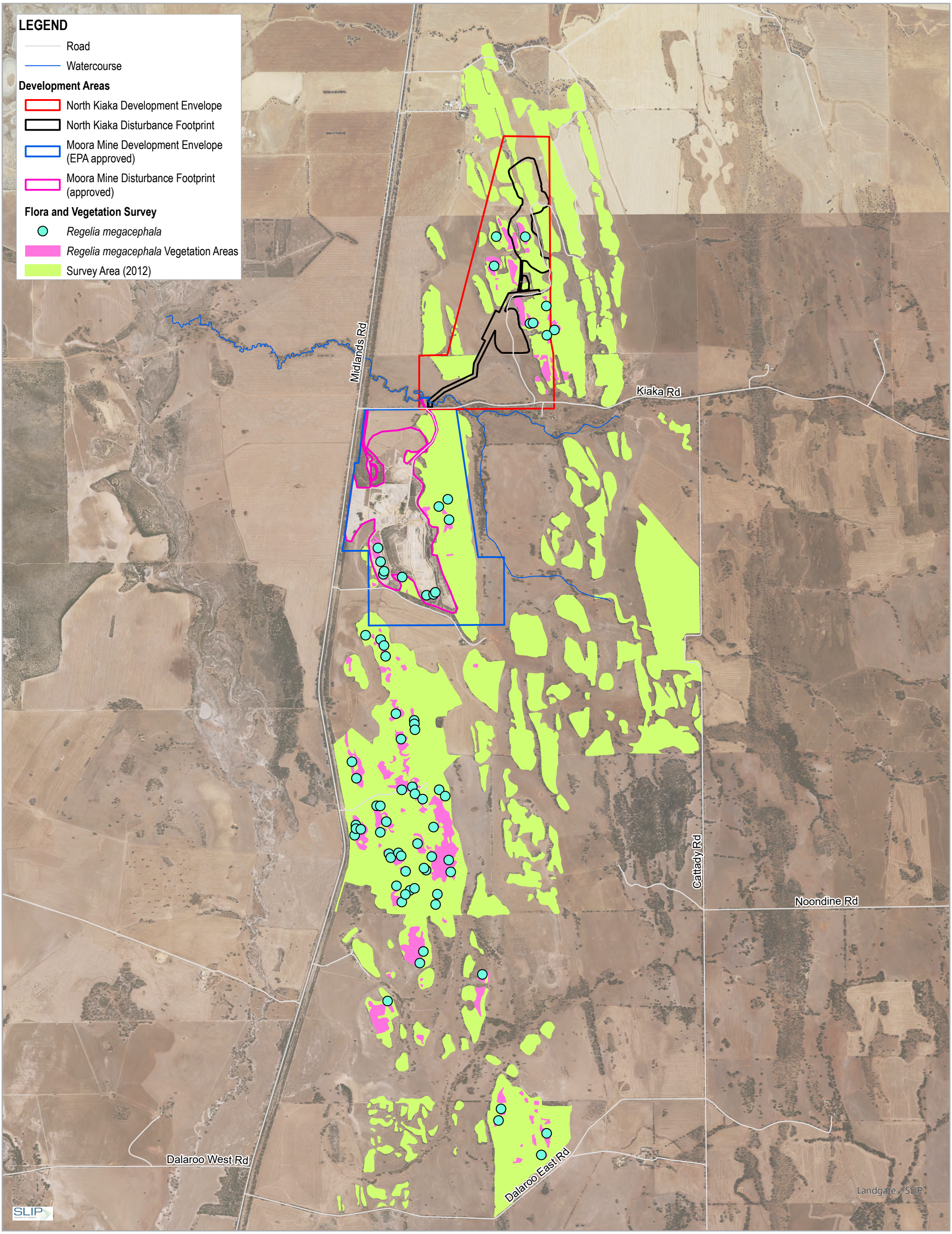
\ghdnet\ghd\AU\Perth\Projects\61\12518217\GIS\Maps\Working\12518217_Figures\12518217_Figures_2024Con
Print date: 21 Mar 2024 - 11:42

Data source: Simcoa: Mining Development Shape Areas is derived from client recieved 2020; Langate: Slip Imagery - April 2017 to November 2018 (accessed - 20191023), River, Road - 20180601. Created by: klabez



Paper Size ISO A3

0 400 800 1,200 1,600 Metres

N

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 50

GHD

Simcoa Operations Pty Ltd
Simcoa Environmental Approvals s40AA ERD

***Regelia megacephala* locations**
(as a component of vegetation alliances)

Project No. **12518217**
Revision No. **0**
Date **21/03/2024**

FIGURE 4.6

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Print date: 21 Mar 2024 - 11:57

Data source: Simcoa: Mining Development Shape Areas is derived from client recieved 2020; Langate: Slip Imagery - April 2017 to November 2018 (accessed - 20191023), River, Road - 20180601. Created by: klabez

4.1.3 Other flora of conservation interest

Some species may be of particular conservation interest while not on threatened flora or priority flora lists. Some examples are:

– newly discovered or very poorly known species;
– outlying populations of common species or of unrecognised taxa.

Several such species have been recorded in the 2012 survey area including:

– *Wurmbea drummondii;*
– *Stenanthemum tridentatum;*
– *Gastrolobium acutum;* and
– *Austrostipa exilis*

These species were priority species at the time of earlier reports but have subsequently been removed from these lists. The population of some species that have been removed from the priority list may still be significant. For example, while *Gastrolobium acutum* is no longer a priority species, the populations of this species observed in the 2012 survey area have significance because of they are at the northern extent of the known distribution.

Species of interest are listed in Table 4.9, including detail on distribution and significance of the population.

Table 4.9 Other flora of conservation interest recorded from the Coomberdale Chert TEC

Taxon	Significance of TEC population of taxon	Occurrences in TEC survey area of Trudgen et al. 2012	Occurrences in north of Kiaka Road by Trudgen et al. 2012	Occurrences in the proposed impact area
Agrostocrinum scabrum aff. *ssp. scabrum*	TEC population disjunct from ssp. scabrum and specimen atypical.	3	0	0
Austrostipa exilis (Previously P2 species)	Near range limit in Western Australia, widespread but not common.	3	1	0
Banksia sphaerocarpa var. aff. *caesia*	Range edge, atypical habit & habitat if var. sphaerocarpa. Range extension and atypical habitat for var. caesia. Needs further study.	3	1	2 (6 plants)
*Calothamnus quadrifidus subsp. angustifolius (*Chert form*)*	Moderately geographically restricted, edaphically restricted not very common.	56 (Including 1 from data of E.A. Griffin)	9	2
Calytrix sp. Coomberdale (M.E. Trudgen MET 21184)	Geographically restricted, common in some habitats in the TEC. Not recognised as distinct in earlier surveys of the TEC. Common in the TEC and abundant in some vegetation types.	197 (Locally common)	34 (Locally common)	7
Cristonia stenophylla	TEC population outlying from main population by 60 km. Very uncommon in the 2012 TEC survey area. Needs taxonomic review.	3	3	1
Cyrtostylis huegelii	TEC population outlying by ca. 80 km from coastal part of population north of Perth.	3	0	0
Gastrolobium acutum (Previously P3 species)	Near northern limit, has disjunctions that may indicate unrecognised variation.	17	3	1
**Kunzea praestans (Previously a P3 species)*	More restricted than herbarium collections show (due to identification errors). May have unrecognised subspecies. The occurrences for this species are stands it occurs in.	219	47	10
Lepidosperma aff. leptostachyum (Moora: ERG18-7)	*Possibly restricted to the TEC. The status of this taxon is unclear due to the poor state of knowledge of Lepidosperma taxonomy.*	16	1	0

Taxon	Significance of TEC population of taxon	Occurrences in TEC survey area of Trudgen et al. 2012	Occurrences in north of Kiaka Road by Trudgen et al. 2012	Occurrences in the proposed impact area
Leptospermum aff. erubescens (Moora Chert; B. Morgan 133).	Apparently very rare (2 known collections) and very restricted.	2	0	0
Pauridia aff. occidentalis var. occidentalis	Probably an undescribed species, but the genus needs revision and the material needs further study. Locally common in parts of the Coomberdale Chert TEC.	40	4	0
Petrophile brevifolia (forma)	Possible new taxon. Not in impact area. Needs further study.	2	0	0
Pterostylis exserta	Known from less than ten locations.	3	1	1
Quoya (Pityrodia) dilatata	Has three centres of occurrence (may indicate subspecies), the southern one disjunct on current knowledge.	52	10	3
Stenanthemum tridentatum (Previously a P3 species)	Has disjunctions, possibly has subspecies.	6 (All in the Gardiner property adjacent to Dalaroo East Road.)	0	0
Trichocline sp.	Material sterile, if Trichocline (formerly Amblysperma) then undescribed.	1	0	0
Wurmbea drummondii (Previously a P4 species)	No longer a priority species, but not very common.	2	2	2
Xanthorrhoea sp. Coomberdale	Quite geographically restricted, only observed on the Coomberdale Chert south of Coomberdale and one location near Moora. Not recognised as distinct in earlier surveys of the TEC.	254 (Locally common)	36 (Locally common)	9 (Locally common; sample underestimates the population)
Agrostocrinum scabrum aff. ssp. scabrum	TEC population disjunct from ssp. scabrum and specimen atypical.	3	0	0
Austrostipa exilis (Previously P2 species)	Near range limit in Western Australia, widespread but not common.	3	1	0

Taxon	Significance of TEC population of taxon	Occurrences in TEC survey area of Trudgen et al. 2012	Occurrences in north of Kiaka Road by Trudgen et al. 2012	Occurrences in the proposed impact area
Banksia sphaerocarpa var. aff. caesia	Range edge, atypical habit & habitat if var. sphaerocarpa. Range extension and atypical habitat for var. caesia. Needs further study.	3	1	2 (6 plants)
Calothamnus quadrifidus subsp. angustifolius (Chert form)	Moderately geographically restricted, edaphically restricted not very common.	56 (Including 1 from data of E.A. Griffin)	9	2
Calytrix sp. Coomberdale (M.E. Trudgen MET 21184)	Geographically restricted, very common in some habitats in the TEC. Not recognised as distinct in earlier surveys of the TEC.	197 (Locally common)	34 (Locally common)	7 (Sample underestimates the large population in the proposed impact area.)
Cristonia stenophylla	TEC population outlying from main population by 60 km. Locally very uncommon. Only juvenile seen in 2016.	3	3	1

Notes: The numbers in the table are occurrences at vegetation recording sites in the data of Trudgen et al. (2012) and some other data, unless noted as numbers of plants. For *Kunzea praestans*, the number of “occurrences” represents stands of vegetation with the species often important in the structure

4.2 Vegetation Survey

4.2.1 Context of vegetation alliances found in the survey area

The proposed impact area is located in the northern part of a large area of the vegetation of the Critically Endangered Coomberdale Chert Threatened Ecological Community (TEC) vegetation and flora surveyed by Trudgen *et al* (2012) between Dalaroo East Road and north of Kiaka Road. The vegetation of that TEC in the 2012 survey area is in vegetation remnants found on low ridges of Chert that are separated by strips of cleared farmland. The Chert habitat (with small areas of other types) is very variable and has resulted in very diverse vegetation in numerous small stands. Trudgen *et al* (2012) provides a detailed description of the vegetation of the survey area. The Trudgen *et al* (2012) survey area is floristically different to areas of the TEC further north.

The description of vegetation units in this section is congruent with Trudgen *et al* (2012) mapping and data analysis. The DBCA Coomberdale Chert fact sheet classifies some of the vegetation types found within the TEC as “core” and others as “buffer” (2013) however, this division does not reflect the relative abundance of the different vegetation types in the TEC or their conservation status.

4.2.2 Vegetation classification of the Trudgen *et al* survey

Trudgen *et al.* (2012) classified the vegetation of the survey area into three levels that go from low order (grouping very similar vegetation) to fairly high order (grouping related but not very similar vegetation) of synthesis. Their lowest order units are mostly defined near the *plant community* level the sites in such units having very similar structure, dominance and floristics. Ther plant communities were grouped into 104 *vegetation associations* that have similar structure and dominant species and then into 31 *vegetation alliances* as a third level of classification. The mapping presented plant communities and vegetation associations with a combined code (see Table 4.10 for the vegetation alliances abbreviations).

The codes for the Trudgen *et al* (2012) vegetation units are alpha-numeric, with the names for dominant or subdominant species indicated by the codes for species in Table 4.10. These codes are used on the vegetation map and in tables in this report.

Table 4.10 Abbreviations used for the species in the vegetation association/plant community codes.

Code for species	Species	Code for species	Species
Aa	*Acacia acuminata*	Ep	*Eucalyptus pruiniramis*
Ac	*Allocasuarina campestris*	Es	*Eucalyptus salmonophloia*
Ah	*Allocasuarina huegeliana*	Ew	*Eucalyptus wandoo* subsp. *wandoo*
Ahu	*Allocasuarina humilis*	Ha	*Hypocalymma angustifolium*
Am	*Allocasuarina microstachya*	Hr	*Hakea recurva* subsp. *recurva*
As	*Acacia scirpifolia*	Hs	*Hibbertia subvaginata*
B	*Babingtonia cherticola* [Previously: *Baeckea* sp. *Moora* (R. Bone 1993/1)]	Id	*Isopogon divergens*
Bp	*Banksia prionotes*	Kp	*Kunzea praestans*
Cd	*Calytrix depressa*	Lp	*Lepidosperma pubisquameum*
Cl	*Calytrix* sp. *Coomberdale*	Mc	*Melaleuca calyptroides*
Cq	*Calothamnus quadrifidus* subsp. *angustifolius (Chert form)*	*Mco*	*Melaleuca concreta*

Code for species	Species	Code for species	Species
Co	*Casuarina obesa*	Mcor	*Melaleuca coronicarpa*
Df	*Dryandra fraseri*	Mr	*Melaleuca radula*
Di	*Dodonaea inaequifolia*	Ms	*Melaleuca sclerophylla*
Dp	*Dodonaea pinifolia*	Pd	*Quoya (Pityrodia) dilatata*
Ds	*Dryandra sessilis* var. *flabellifolia*	Rv	*Ricinocarpos velutinus*
Ec	*Eucalyptus camaldulensis*	Rm	*Regelia megacephala*
Ee	*Eucalyptus eudesmioides*	Rmu	*Ricinocarpos muricatus*
Eh	*Eucalyptus horistes*	Td	*Trymalium daphnifolium*
El, Elo	*Eucalyptus loxophleba* subsp. *loxophleba*	Tl	*Trymalium ledifolium* subsp. *rosmarinifolium*
Eo	*Eucalyptus obtusiflora*	Xd	*Xanthorrhoea* sp. *Coomberdale*

Note: The abbreviations are used on the vegetation map and in tables.

The vegetation of the proposed impact area is a subset of eight vegetation alliances (Table 4.11) of the 33 vegetation alliances described for the Coomberdale Chert TEC by Trudgen *et al.* (2012). Within the eight alliances there are 19 vegetation associations and 23 plant communities. Descriptions of the eight vegetation alliances can be found in Appendix J, including associated dendrograms.

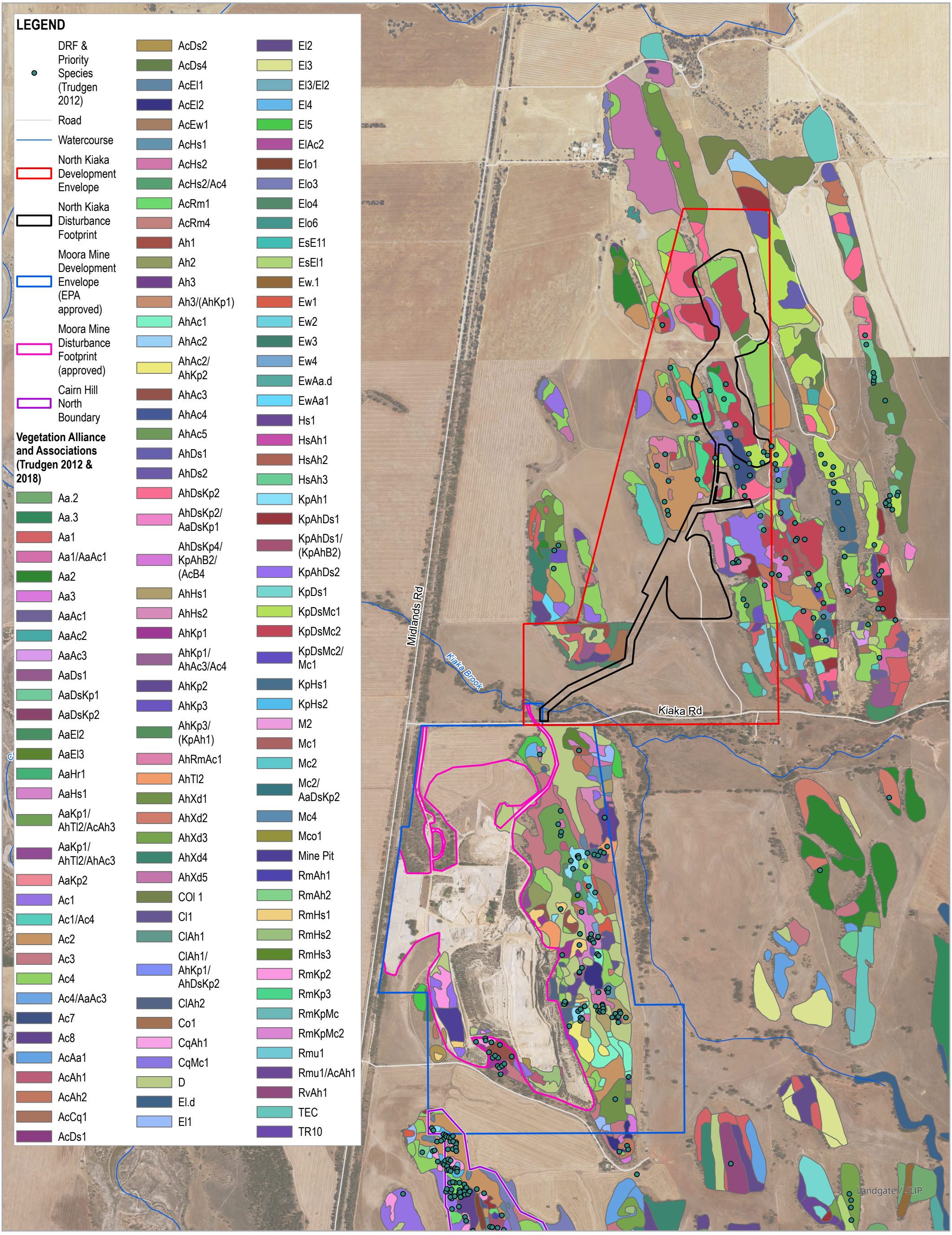
Kunzea praestans, and *Regelia megacephala* vegetation alliances are particularly relevant to the assessment of significance in a local or regional context. The *Regelia megacephala* vegetation is of particular importance, because the species is restricted to the Coomberdale Chert TEC. On the current application of the name *Kunzea praestans*, this species is less restricted in area, but there is some doubt over the proper application of the name (see Appendix B) and the form in the Coomberdale Chert TEC may be restricted in distribution.

Table 4.11 Proposed impacts to other potentially important species

Species	Conservation Status		Proposal Impacts						Offset site	
	EPBC	BC / DBCA	Directly Impacted	Potential Indirect Impacts (within 10m of DF)	Potential Indirect Impacts (within 10-50m of DF)	% Impact within DE	Number regionally	% Impact regionally	Number in reservation/ potential offset area	Ratio of offset to impact (direct)
Banksia sphaerocarpa var. aff. *caesia*	-	Other	6[1]	0	0	100	9	66.7	0	0
Calothamnus aff. *quadrifidus* (Moora - Watheroo)	-	Other	2[1]	0	0	100	56	3.4	0	0
Calytrix sp. Coomberdale (M.E. Trudgen MET 21184)	-	Other	7[1]	0	0	100	197	3.4	0	0
Cristonia stenophylla	-	Other	1[1]	0	0	100	3	25.0	0	0
Gastrolobium acutum (previously State listed P3 species)	-	Other	1	0	5	100	17	5.6	8	8:1
Kunzea praestans (previously a State listed P3 species)	-	Other	10[1]	0	0	100	219	4.4	0	0
Pterostylis exserta	-	Other	1[1]	0	0	100	3	25.0	1	1:1
Quoya (Pityrodia) dilatata	-	Other	3[1]	0	0	100	52	5.5	0	0
Stylidium sp. Moora	-	Other	0[1]	1	1	0	-	-	0	0
Wurmbea drummondii (previously a State listed P4 species)	-	Other	2[1]	0	0	100	2	50.0	0	0
Xanthorrhoea sp. Coomberdale (M.E. Trudgen MET 25047)	-	Other	9[1]	0	0	100	254	3.4	0	0

Table 4.12 Total area of the eight vegetation alliances found compared to total known areas in Trudgen 2012.

Vegetation alliances in the proposed North Kiaka Mine area	Area in proposed impact area (ha)	Total in the area mapped by Trudgen et al. 2012 (ha)
Kunzea praestans high shrubland to open and closed scrub	19.67	92.34
Allocasuarina campestris high shrublands to open and closed scrub	14.65	247.96
Allocasuarina huegeliana low woodlands to low open forests	3.88	128.71
Calothamnus quadrifidus subsp. *angustifolius* (Chert form) high shrubland	0.12	0.89
Acacia acuminata subsp. *acuminata* low woodlands	2.47	97.94
Eucalyptus loxophleba subsp. *loxophleba* low woodlands to low open forests	0.29	114.13
Melaleuca calyptroides open to closed heath	0.49	3.37
Regelia megacephala high shrubland to open and closed scrub	1.73	50.73



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Vegetation Type Mapping (Part 1)

FIGURE 4.7

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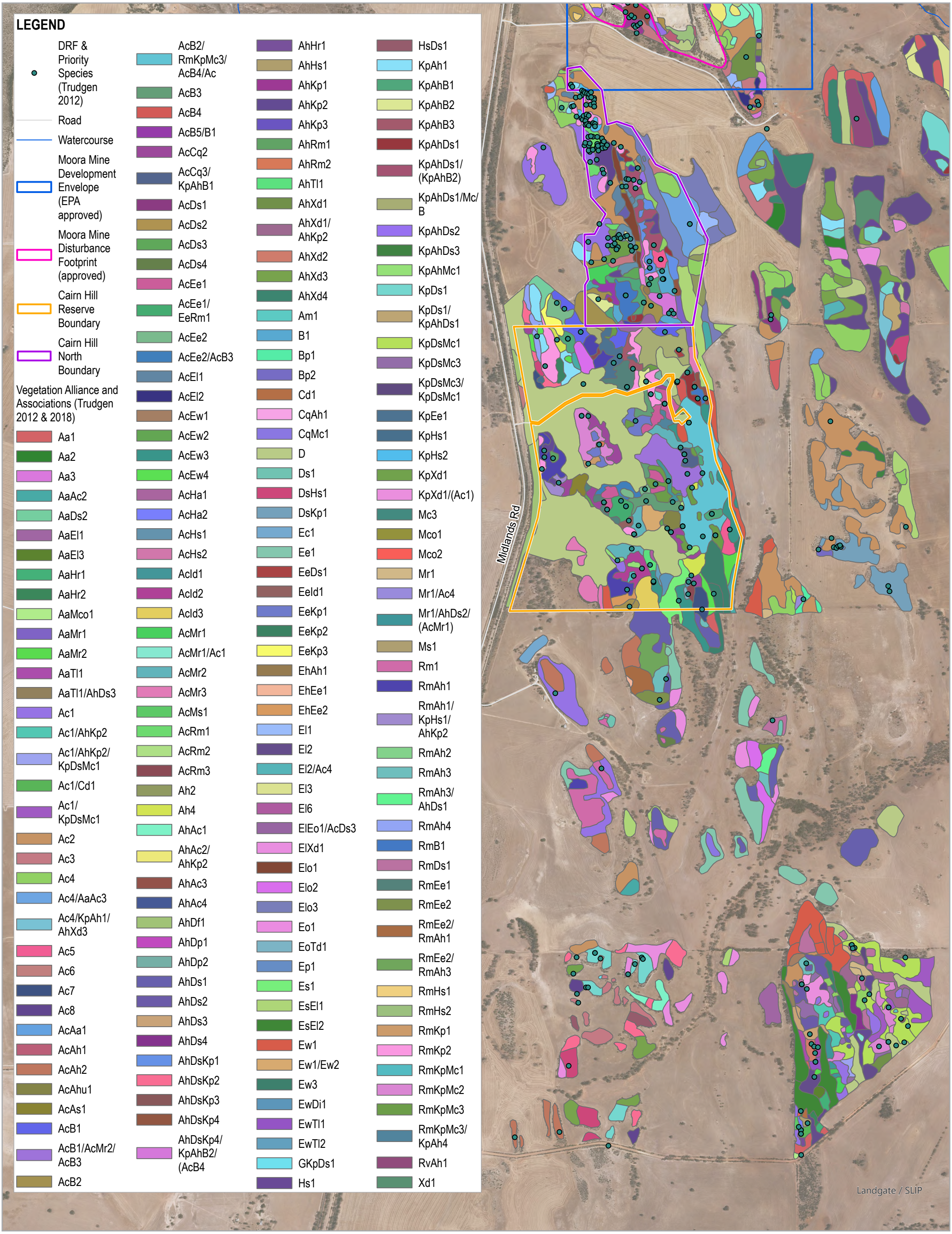
Data source: Simcoa: Mining Development Shape Areas is derived from client received 2020; Trudgen: Vegetation mapping - 2012 and 2018; Langate: Slip Imagery - April 2017 to November 2018 (accessed - 20191023), Road - 20180601. Created by: klabez



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Simcoa Operations Pty Ltd
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Project No. **12518217**
Revision No. **0**
Date **21/03/2024**

Vegetation Type Mapping (Part 2)

FIGURE 4.8

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4.2.3 Vegetation condition in the Trudgen *et al* 2012 survey area

4.2.3.1 Vegetation condition mapping

The condition of the vegetation of the survey area was mapped by Trudgen *et al* (2012) using condition assessments recorded at quadrats and relevés in conjunction with aerial photograph interpretation (the field observations guiding the image interpretation). The condition mapped is shown in Figure 4.9. The condition was mapped using the scale of Trudgen 1998 (see Table 2.3). As would be expected with the Critically Endangered Coomberdale Chert Threatened Ecological Community (TEC) remnants being of different sizes and surrounded by farmland they have a range of condition varying from Degraded to Very Good. Cairn Hill Nature Reserve has not been grazed and the parts of it which were not mined for gravel are in the best condition.

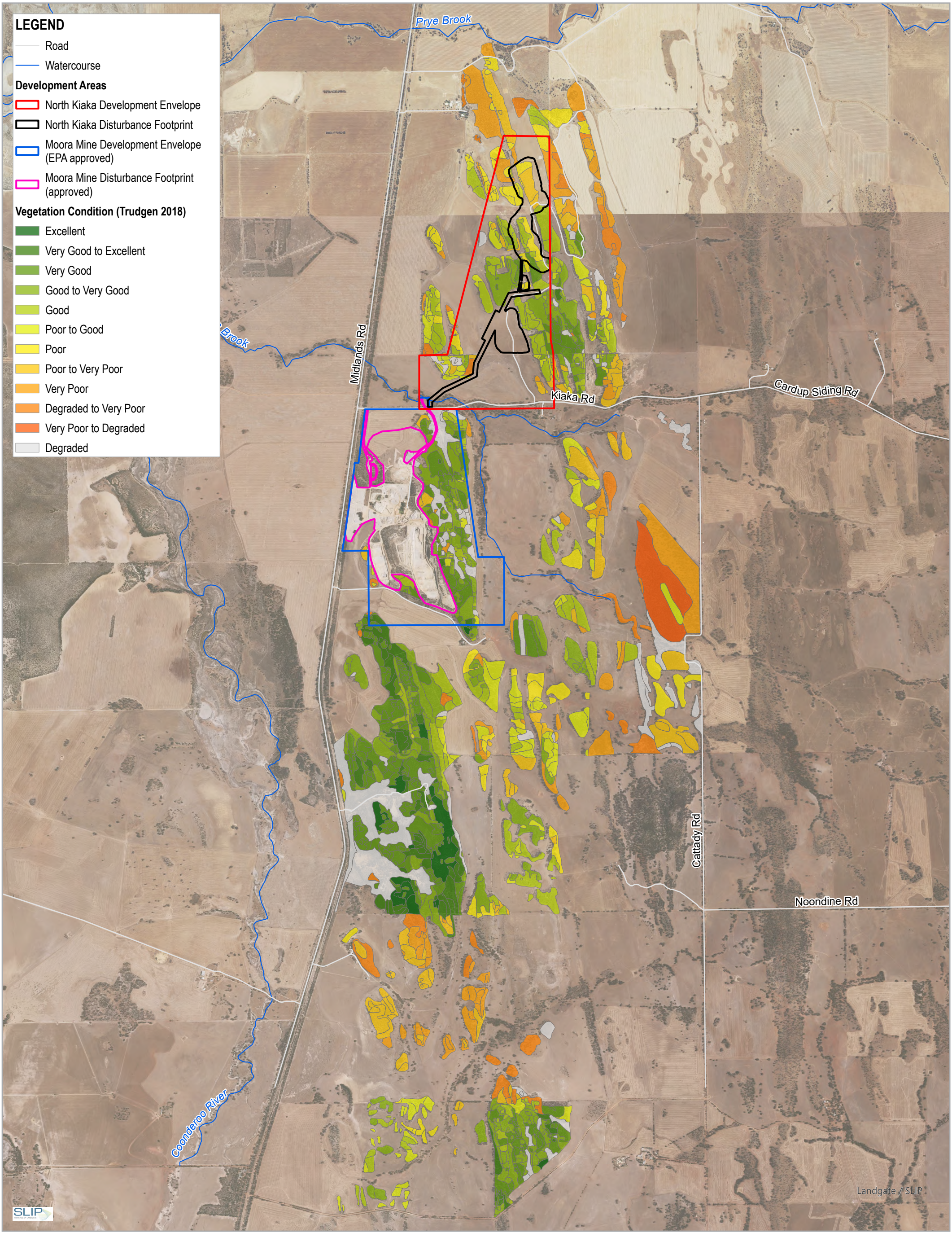
4.2.3.2 Changes in vegetation condition over time

The TEC remnants are subjected to ongoing changes in condition due to their size, farming activity and climate change. Increases in weed cover and changes in weed floristics have been recorded at some quadrats (Trudgen M. E., 2017) since they were originally recorded. However, field work in 2016 indicated that such changes did not affect the validity of the condition mapping of the Coomberdale Chert TEC to the extent that the mapping needed revision. Rather, a small decrease in condition can be assumed for areas with more open vegetation, while areas with denser vegetation are mostly not significantly changed at least in regard to weed invasion levels. In the longer term however, weed invasion, fertiliser drift and grazing are likely to continue to reduce the condition of areas of the TEC, particularly in areas that are not fenced off from stock.

One species in the Coomberdale Chert Threatened Ecological Community may be an indicator that change is more significant than is easily apparent. It was very noticeable during field work in 2016 that the adult population of *Xanthorrhoea* sp. Coomberdale is progressively dying and largely not being replaced. At some places ten or more dead plants (ranging from recently fallen plants to just the distinctive stumps with no stem remaining) were seen in areas with much fewer living plants. The obvious changes in the population structure of *Xanthorrhoea* sp. Coomberdale in the Coomberdale Chert TEC vegetation may be an indicator that there are other changes that are not so easily observed.

4.2.3.3 Condition of the TEC vegetation north of Kiaka Road

The vegetation of the TEC north of Kiaka Road (see Figure 4.9) varies from Completely Degraded (cleared farmland) to Very Good condition. Figure 5.8 shows that the better condition areas north of Kiaka Road are mainly in the southern part of the main central ridge system. Vegetation condition was generally better on rockier sites, steeper sites, and where *Regelia megacephala* or *Allocasuarina campestris* were denser. It is not clear how much some areas, especially on the property of A. & R. Tonkin have been affected by grazing, as they appeared (at the time of the condition mapping) to be in good or better condition but, have lower species numbers in quadrats than other areas.



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Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 50

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Simcoa Environmental Approvals s40AA ERD

Vegetation Condition Mapping

Project No. **12518217**
Revision No. **0**
Date **21/03/2024**

FIGURE 4.9

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Data source: Simcoa: Mining Development Shape Areas is derived from client recieved 2020; Langate: Slip Imagery - April 2017 to November 2018 (accessed - 20191023), River, Road - 20180601. Created by: klabez

4.2.4 Other significant vegetation types

Kunzea praestans vegetation associations occurred in all the main bushland areas in the Trudgen *et al.* (2012) survey area, but were most extensive north of Kiaka Rd. While *Kunzea praestans* was often a minor component of vegetation associations, it was also prominent in 14 associations.

Vegetation types dominated by *Regelia megacephala* are geographically restricted to the Coomberdale TEC and were recorded in all the main sub-areas of bushland in the survey area, however there are significant structural differences between *Regelia megacephala* units across the survey area. For example, in the southern part of the survey area, some *Regelia megacephala* open scrub stands occurred under an overstorey of *Allocasuarina huegeliana* low open woodland to low open forest (Cairn Hill, Cairn Hill North and Gardener's Hill) and *Regelia megacephala* open scrub occurred under *Eucalyptus eudesmioides* scattered low trees to low open woodland (Cairn Hill Reserve). The scale of this variation is self-evident from the list of 10 vegetation associations from the survey area with *Regelia megacephala* dominant or sub-dominant.

5. Discussion

5.1 Flora

Native fern species recorded from the Coomberdale Chert TEC are found spread across the area surveyed by Trudgen *et al* (2012). One species (*Ophioglossum lusitanicum*) was only found in the TEC at one location within the impact area, north of Kiaka Road. While they are small plants, the three of five ferns found in the TEC to the north of Kiaka Road is fairly high for the small area, as ferns are a small part of the flora of the south-west of Western Australia. The number of ferns in the TEC reflects the fact that the harsh substrate there, thin soil over rock, suits species that have a cryptophyte life form (perennial rootstock of some form) and annual above ground parts. This habitat also inhibits smaller shrubs, lowering competition for the small cryptophytes and annuals. As with the small ferns, the same factors suit annual Asteraceae (Daisy family) and Orchids.

Callitris arenaria is the only native pine in the Coomberdale Chert TEC. It has been recorded by the Trudgen *et al* (2012) survey at one location within the proposed impact area north of Kiaka Road. During the 2016 threatened and priority searches, this small population (of six small trees) was extant, and one dead tree was observed nearby. This *Callitris* species is more commonly found on yellow sand than on chert and is common on that habitat west of the Midlands Road. This species was also recorded in the TEC to the south of Kiaka Road by Griffin (1992) but was not recorded there by Trudgen *et al* (2012).

The remnant vegetation observed in the areas north of Kiaka Road, particularly the subset potentially impacted, has flora populations recorded which represent 108 of the 321 species found in the Coomberdale Chert TEC (Trudgen, Griffin, & Morgan, 2012).

Within the Avon Botanical District land clearing for agriculture has removed large tracts of vegetation, with the remaining patches of vegetation providing important refuges for fauna and to support flora populations. Species such as *Regelia megacephala*, *Calytrix* sp. Coomberdale and *Xanthorrhoea* sp. Coomberdale are restricted to the Coomberdale Chert TEC or have most of their known population in it. Thus, the significance of these remaining populations is higher, given the flora populations of the survey area persist in a context where the original extent has been extensively reduced by clearing of native vegetation, largely for agriculture. Additionally, the proportion of the original vegetation of the botanical district in secured conservation reserves is well below international and national objectives for secure reservation.

The overall assessment for the value of native flora in the areas of remnant vegetation in the proposed impact area is that it has moderate value for its size due to the flora present being of different composition to most other areas in the surrounding region. Note that the value is reduced somewhat because the vegetation has been degraded by grazing, weed invasion and spray drift.

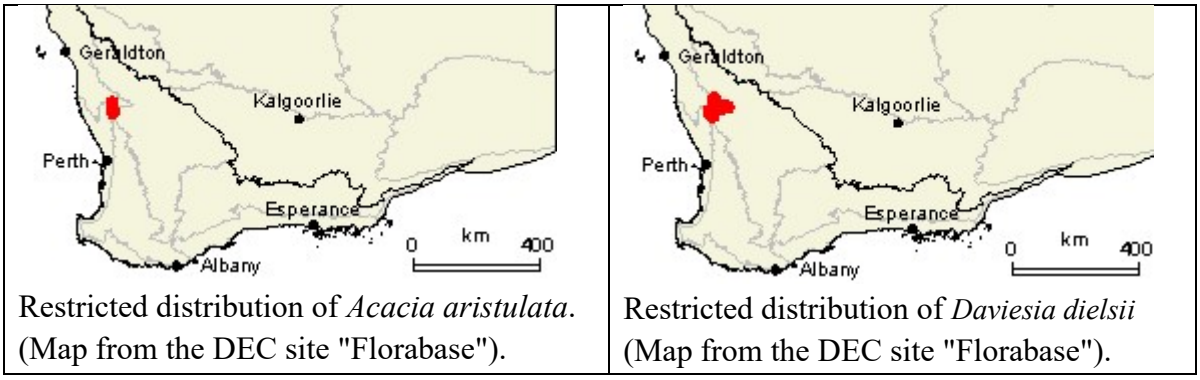
5.1.1 Threatened Flora

Of the 70 conservation significant species identified through DBCA and PMST database searches for areas surrounding the survey area, eighteen of these were recorded in the 2012 survey area (**Error! Reference source not found.**, Table 4.7). These recorded species include *Acacia aristulata* and *Daviesia dielsii* which are both listed as Threatened.

There are less species and fewer records of threatened flora north of Kiaka Road compared to the larger area south of that road, can be attributed to a combination of factors other than just the size of the respective areas. Firstly, there seems to be some difference in flora distribution north of Kiaka Road compared to south (see detailed floristic analysis in Trudgen *et al.* 2012). Differences in floristics and grazing history are considered to be the primary reason. For a few species the apparent absence may partly reflect fire history (i.e. species may be present as seeds, requiring fire or other disturbance to appear), although fire has not been recorded since 1981 in the 2012 survey area. The very northern part of A. & R Tonkin's property (private property studied in Trudgen *et al.* 2012) has woodland of

Allocasuarina huegelii, which has fewer shrub species and herbs in the understorey than other vegetation types in the Coomberdale Chert TEC. Additionally, the area adjacent to the north side of Kiaka Road has areas of *Acacia acuminata* woodland that also has fewer shrub species. Some remnants of the TEC north of Kiaka Road (e.g. the easternmost ridge on J. Tonkin's property) are also quite degraded, reducing the available space for species and numbers of occurrences.

The threatened flora species *Acacia aristulata* is almost certainly a pyrosere species and the other threatened species recorded in the impact area *Daviesia dielsii*, may also be one. This means these species cycle between a seed storage stage in the absence of fire (or other disturbance that removes competition) and a shrub phase for a period after fire (with plants dying out over time, but seed being stored in the soil). An example of this may be the presence of a large population of *Acacia aristulata* on the very degraded easternmost ridge north of Kiaka Road in 2016. The population recorded in 2016 was much larger than that recorded in 2006. No such increase in population was observed in other areas during searches in 2016. It was also observed to be absent from a quadrat (JT011) north of Kiaka Road when that quadrat was revisited opportunistically, suggesting a limited life span (or possibly death due to the dry period up to 2016). Additionally, it was observed by GHD (2024) that *Acacia aristulata* and *Daviesia dielsii* were both growing in the gravel pits and previously cleared areas, suggesting both species are disturbance opportunists.



Restricted distribution of *Acacia aristulata*. (Map from the DEC site "Florabase").

Restricted distribution of *Daviesia dielsii* (Map from the DEC site "Florabase").

Figure 5.1 Restricted distributions of Acacia aristulata and Daviesia dielsii (Florabase)

Acacia aristulata appears to be most common in vegetation dominated by *Kunzea praestans* but is also often found with *Regelia megacephala* and was observed to be often grazed (Trudgen *et al*. 2012). *Acacia aristulata* has a very restricted distribution (north of Moora to near Watheroo and appears to be largely restricted to the Coomberdale Chert TEC). It has a fairly small population, within the Coomberdale Chert TEC area surveyed by Trudgen *et al.* (2012). Including records from the 2016 survey, it has been recorded at 220 locations in this area, significantly more locations than the other threatened species known for the TEC. Thirty-two of these locations fall within the impact areas north of Kiaka Road, while some of the older locations south of Kiaka Road have been lost due to mining activity.

Most locations where *Acacia aristulata* was recorded single-digit populations; however some were found with more than 20 plants and an estimated total of 1100 plants. Of these, some 230 plants occur in the proposed impact area. This is about 20.9% of the population known from the survey area of Trudgen *et al.* (2012) and their loss would be significant for the population of the species.

With 135 locations in the 2012 survey area *Daviesia dielsii* was the second most frequently recorded threatened species by Trudgen *et al.* (2012) of the threatened flora species found in the Coomberdale Chert TEC. This species has a wider geographic distribution than *Acacia aristulata (*Figure 5.1) but is still geographically restricted. It was mostly found at the ecotone between *Kunzea* and *Allocasuarina campestris* communities by Trudgen *et al.* (2012). More detailed distribution of the species north of Kiaka Road based on vegetation site data and threatened flora search data is shown in Figure 5.2. Outlying records of this species on The Australasian Virtual Herbarium are in eastern states herbaria and are probably mis-determined.

Of the three threatened flora species recorded for the 2012 Coomberdale Chert TEC survey area but not recorded in the proposed impact area (or north of Kiaka Road), two are very unlikely to occur. If *Eucalyptus pruiniramis* occurred there it would have been recorded, as it is a mallee eucalypt species and very obvious. GHD (2024) did not record *E. pruinimaris* in the North Kiaka DE however 9 plants were recorded in the Cairn Hill Reserve Boundary.

Synaphea quartzitica is a small shrub, but is quite distinctive, and if present in any numbers it would have either been recorded by Trudgen *et al.* (2012), or by the targeted survey during 2016. In the 2012 survey area (Dalaroo East Road to 3.3 km north of Kiaka Road), *Synaphea quartzitica* has only been recorded in Cairn Hill Reserve. Both of these species have geographically restricted distributions as well as being very uncommon as shown in Figure 5.2.

Distribution of *Eucalyptus pruiniramis*. (Map from the site "Florabase").

Distribution of *Synaphea quartzitica.* (Map from the site "Florabase").

Distribution of *Goodenia arthrotricha.* (Map from the site "Florabase").

Figure 5.2 Restricted distributions of Eucalyptus pruiniramis, Synaphea quartzitica and Goodenia arthrotricha

Goodenia arthrotricha was possibly confused in the field with *Scaevola phlebopetala* at times during the Trudgen *et al.* (2012) survey and may be a little more common in the 2012 survey area than the records indicate. It was not recorded during field work in the proposed impact area in 2016. However, there is a possibility that it occurs there as seed. This is because of two factors, firstly it has been recorded just south of Kiaka Road and secondly it appears to be a pyrosere species and there has been no recent fire activity in the area north of Kiaka Road.

During field work in 2016, *Goodenia arthrotricha* was present in a vegetation quadrat on the Moora Mine Eastern Ridge (south of Kiaka Road). This quadrat was originally recorded in 2002 at which time *Goodenia arthrotricha* was not recorded. The dry years prior to 2016 had caused death of *Allocasuarina campestris*, opening the vegetation. In the gap in the (previously very dense) overstorey, several *Goodenia arthrotricha* had germinated and established (Trudgen M. E., 2017) as well as some seedlings of *Acacia aristulata*. Similar vegetation is present in the proposed impact area.

While records are available for the locations of *Acacia aristulata* and *Daviesia dielsii* have been recorded from threatened searches and vegetation site data, Trudgen noted there is some uncertainty as to the populations of these species in the proposed impact area due to their long persistence as seeds and shorter persistence as shrubs. GHD (2024) recorded 35 plants of *Acacia aristulata* and 81 plants of *Daviesia dielsii* in the Project area. Only two records of *Acacia aristulata* were present in the North Kiaka Development Envelope, and no records of *Daviesia dielsii* were recorded within it.

5.1.2 Priority flora

Fewer priority flora species have been recorded in the area surveyed north of Kiaka Road than south of it. This is partly due to the smaller size of the area north of Kiaka Road, but vegetation condition, grazing history and some difference in vegetation floristics are all relevant factors. Of the priority flora species recorded north of Kiaka Road, only three current priority flora species have been recorded in the proposed impact area, these are *Regelia megacephala, Diuris recurva* and *Stylidium* sp. Moora.

Unlike the other priority flora found in the Coomberdale Chert TEC, *Regelia megacephala* is a large shrub that dominates areas of the tall shrublands of the *Regelia megacephala* vegetation alliance. It is

found in small to moderately large areas where it is locally abundant as the dominant in the stand. The size of these stands is an indication of the number of plants of this species in them.

Regelia megacephala is one of the defining species of the Coomberdale Chert TEC and is known to be restricted in habitat and distribution to the Coomberdale Chert. There are 77 records for *Regelia megacephala* in the Trudgen *et al.* (2012) survey area. The species is significantly geographically restricted, but usually dominant in the vegetation it occurs in.

GHD (2024) recorded a significant number (9159) of *Regelia megacephala* plants across the Revised Proposal and Offset Areas. A total of 3,438 plants were recorded in the North Kiaka DE, with a slightly higher number of plants recorded in the Cairn Hill Reserve Boundary (3,684), and fewer plants in the Cairn Hill North Boundary (2,019).The distribution of this priority four species in the Trudgen *et al.* (2012) survey area is shown on Figure 4.1.

In contrast to *Regelia megacephala*, *Diuris recurva* is a small herb that is found as scattered individuals or small clusters of a few plants. It is a cryptophyte with a small basal rosette of leaves that when flowering also has a short stem with the flowers. *Diuris recurva* occurs sporadically in the Coomberdale Chert TEC. The distribution of this species has disjunctions that suggest it may have subspecies or varieties. Note, *Diuris recurva* was referred to *Diuris* aff. *recurva* in Trudgen *et al.* (2012), however the name *Diuris recurva* is now applied to material from the Moora area.

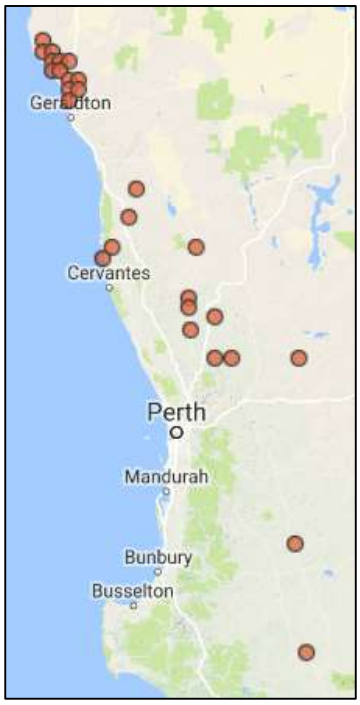


Figure 5.3 Distribution of Diuris recurva showing disjunct populations (Australasian Virtual Herbarium 3/2018)

GHD (2024) recorded *Babingtonia cherticola* (P3) in numerous quantities (total 4,723 plants) in the Project Area. However, none of these records were located within the North Kiaka DE. A total of 2,224 plants were recorded in the Cairn Hill Reserve Boundary, and a further 2,499 plants were recorded in the Cairn Hill North Boundary.

The following priority species were not recorded during the survey, however may possibly be present seasonally (Table 5.1).

Table 5.1 Priority species not recorded but possibly present

Taxa	Cons Status	Comment
Austrostipa nunaginensis	P3	The small size of this taxon and its similarity to other species when sterile may mean that it is present, but not recorded. However, the level of weed invasion

Taxa	Cons Status	Comment
(previously sp. Cairn Hill)		in much of the proposed impact area reduces this possibly significantly. Recorded three times in the TEC south of Kiaka Road, but not restricted to it. The three records are one in Cairn Hill Nature Reserve and two in Moora Mine rehabilitation areas. The range of the species extends from near Geraldton to east of Perth, but there are only 11 eleven records on The Australasian Virtual Herbarium, indicating it is not a common species.
Tricoryne sp. Wongan Hills (previously *Tricoryne arenicola* MS)	P2	Recorded at three quadrats and three relevés south of Kiaka Road in by Trudgen et al. (2012) in their survey area and appears to be uncommon there. However, as it was not known to be in the survey area prior to one of the earlier reports in this series (Trudgen et al. 2006), it was not searched for during the systematic rare flora surveys carried out at that time. It was not recorded during searches of the proposed North Kiaka Mine impact areas carried out in 2016 although one occurrence was found north of Kiaka Road at that time.
Stylidium glabrifolium	P2	Recorded three times in the area of the Coomberdale Chert Threatened Ecological Community surveyed by Trudgen et al. (2012). Two were located on the Eastern Ridge, and the other in the remnant of native vegetation at the south end of the existing main mine (the Eastern Ore Body – note that some of this area has been mined since the collection was made). This species has not been recorded north of Kiaka Road.

The shrub priority species listed in Appendix B, except *Regelia megacephala*, can reasonably confidently be excluded from occurring in the proposed North Kiaka Mine area. None of them have been recorded north of Kiaka Road by Trudgen *et al* (2012) and they were not recorded in the proposed impact area during the 2016 threatened and priority flora searches.

The remaining three priority species are smaller and/or are available for collection less of the year. Therefore, there is a small possibility that the grass *Austrostipa* sp. Cairn Hill, the lily *Tricoryne* sp. Wongan Hills and the trigger-plant *Stylidium glabrifolium* are in the proposed impact area. However, if they were to be present the populations would be very small to have escaped notice given the intensity of botanical work carried out in that area.

5.1.3 Other flora of conservation interest

The Coomberdale Chert Threatened Ecological Community has a number of other flora species that are of particular conservation interest due to:

– Very small populations;
– Restricted distribution
– distribution suggesting potential undescribed subspecies; or
– The populations at extent of known ranges of the species.

Table 4.9 lists the species that occur in the Coomberdale Chert TEC and summarises the reason why they are of interest. As they are discussed individually in Appendix H, most will not be discussed in detail here, although brief comment will be made on the more significant species.

Xanthorrhoea sp. Coomberdale is a species restricted to the Coomberdale Chert Threatened Ecological Community except for a small occurrence near Moora where it occurs on sand over other siliceous rock. It is prominent in the Coomberdale Chert TEC, although its population is declining (see Section 4.1.3). The decline is likely to be due to climate change, grazing and weed invasion (the latter two factors reducing recruitment) but, other factors may be involved. There are 9 plants located within the impact area, with more than 250 observed in the TEC remnant vegetation during the 2012 survey. The population in the proposed impact area is of moderate size, but not disproportionate to other areas of the Coomberdale Chert TEC, so the conservation value of the population there is of note, but not significant in a regional context.

While the species *Banksia sphaerocarpa* var. aff. *caesia* needs further taxonomic study to define its status, it is at least a range extension of an unusual form of variety *caesia*. It is likely that the population

on the Coomberdale Chert is part of a geographically restricted and uncommon taxon. The overall population seems likely to be quite small and the taxon needs additional surveys to define its population and probably needs special management. The value of the Coomberdale Chert TEC population, particularly the population on the Gardiner property is significant. Of less significance is the population recorded in the proposed impact area (six plants) and about 65 plants in the Gardiner property population.

Calytrix sp. Coomberdale (M.E. Trudgen MET 21184) is prominent in some vegetation types in the Coomberdale Chert TEC, to which it is largely restricted (it appears to have the same distribution as *Xanthorrhoea* sp. Coomberdale). The population does not seem to be declining significantly at present, but most plants observed during surveys were quite old (the species seems to be fairly long lived) and young plants were rarely seen during field work. The population in the proposed impact area is quite large and the species is more common there than in some many other parts of the Coomberdale Chert TEC. Consequently, the proposed North Kiaka Mine area has significant value for this species, although the population there is not a large part of the overall population.

5.2 Vegetation

5.2.1 Vegetation type

The vegetation alliances defined for the Trudgen *et al* (2012) survey area of the Coomberdale Chert TEC vary in the areas remaining. This partly reflects varying original extent, but is certainly affected by differential clearing for agriculture of different habitat types. As is common in much of the Western Australian Wheatbelt, areas not cleared are those largely not suitable for broad scale agriculture. Areas of the Coomberdale Chert TEC which still remain are those with chert at or near the surface making them unsuitable for agriculture. This has meant that communities on the lower slopes of the chert ridges tend to have been cleared and communities on the upper slopes and crests have remained uncleared. There is also substrate variation (such as fragmentation of the chert, depth of topsoil) that affects the areas of individual vegetation alliances and their constituent vegetation associations and plant communities.

The remnants of the Coomberdale Chert TEC reflect this clearing history. The alliances found in the proposed impact area are described by Trudgen *et al.* (2012). There is some variation, the most significant of which is that the '*Kunzea praestans* high shrubland to open and closed scrub vegetation' alliance has 31.5% of its known area in the proposed impact area. This is in the context that the 41.86 hectares of remnant vegetation of the TEC in the proposed impact area is 5.74% of the 728.81 hectares of remnants of the Coomberdale Chert TEC mapped by Trudgen *et al.* (2012).

The vegetation alliances dominated by *Calothamnus quadrifidus* subsp. *angustifolius* (Chert form) and *Melaleuca calyptroides* both have limited extent with overall areas of 0.89 hectares and 3.37 hectares respectively in the areas mapped by Trudgen *et al.* (2012).

The areas of these vegetation alliances in the proposed impact area are 0.12 hectares (13.5%) and 0.49 hectares (14.5%) respectively. The areas of these two vegetation alliances in the proposed impact area are roughly three times higher proportionally than their extent in the TEC overall. The two species these two vegetation alliances are named for are also present as the dominant (or co-dominant) of shrub layers in other vegetation types and as associated species in yet others.

5.2.2 Vegetation condition

There have been changes in the condition of some parts of the Coomberdale Chert TEC since the mapping was carried out. Trudgen (2017) noted when surveying to assess weed levels, increases in weed cover and changes in weed floristics have been recorded at some quadrats. However, there was no indication during the 2016 rare flora searches that such changes affected the validity of the condition mapping of the Coomberdale Chert TEC to the extent that the mapping needed revision. Rather, a small decrease in condition can be assumed for areas with more open vegetation, while areas with denser vegetation won't show changes in weed invasion levels. In the longer term however, weed

invasion and grazing are likely to continue to reduce the condition of areas of the TEC, particularly in areas that are not fenced off from stock and at the edge of remnants.

The condition of different stands of vegetation in the Coomberdale Chert TEC varies significantly. This is largely because of grazing intensity of stock, rabbits and kangaroos, as well as weed encroachment. The vegetation of the area surveyed by Trudgen (2012) is shown in Figure 4.9 and ranges from *Completely Degraded* (cleared farmland) to *Very Good* condition. The better condition areas north of Kiaka Road are mainly in the southern part of the main central ridge system. The proposed impact area mainly avoids the better condition areas.

It is not clear how much some areas, especially on the property of A. & R. Tonkin (western portion of the area north of Kiaka Rd) have been affected by grazing, as they appeared (at the time of the condition mapping in 2012 and earlier) to be in good or better condition but have lower species numbers than other areas. It is likely that some of these areas naturally have lower species numbers and that the recording of quadrats on A. & R. Tonkin's during the 2010 drought accentuated this somewhat. Vegetation condition was generally better in the vegetation on rockier sites, steeper sites and where *Regelia megacephala* or *Allocasuarina campestris* was denser.

Table 5.2 Vegetation condition for native vegetation recorded (as mapped by Trudgen 2012)

Vegetation condition rating	Total area in Trudgen et al. 2012 survey area (ha.)	Impact area (subset of 2012 survey area)
Excellent	22.52	0
Very Good to Excellent	45.60	0
Very Good	137.68	2.63
Good – Very Good	146.13	1.15
Good	106.4	7.285
Poor – Good	63.63	3.86
Poor	56.97	4.29
Very Poor – Poor	71.08	7.41
Very Poor	68.08	12.07
Degraded – Very Poor	35.41	5.27
Degraded	94.13	1.53
Total native vegetation	**641.83**	**42.86**

5.2.3 Coomberdale Chert TEC

DBCA have calculated the known extent of the Coomberdale Chert TEC to cover an area of 785 ha (Threatened Ecological Community Fact Sheet: Vegetation alliances on ridges and slopes of the chert hills of the Coomberdale floristic region (DBCA, 2013)).The area of TEC which was surveyed by Trudgen *et al.* (2012) and subsequently totalled 728.85 ha.

Some of the area included in the TEC area (north of Coomberdale, in the Jingemia area). These areas have somewhat different floristics to the areas of the TEC surveyed by Trudgen *et al* as shown in their floristic analysis.

While it may seem unnecessary to discuss rarity in relation to a threatened ecological community such as the Coomberdale Chert TEC, it needs to be remembered that this is a composite unit that contains multiple vegetation alliances and within them vegetation associations and within these plant communities that have varying areas and numbers of occurrences and hence varying rarity.

The classification of the vegetation of the Coomberdale Chert as a critically endangered ecological community means that it has been accepted by Government as:

– A vegetation of restricted distribution that has a level of difference from other native vegetation and therefore is of conservation significance; and
– Vegetation which is subject to processes such as grazing, clearing, weed invasion and climate change that endanger its ongoing existence.

The fact that the Coomberdale Chert TEC is restricted in area means that all parts of it have high conservation value. The threatening processes noted above combined with the restricted area of occurrence are the rationale for giving this vegetation the status of endangered.

The high conservation value for vegetation of the Coomberdale Chert TEC does not mean that at a detailed level there are not differences in the conservation value of the different plant communities, or even of different stands of the same plant community, found in the TEC. This TEC has a very significant range of vegetation alliances, vegetation associations and plant communities that vary greatly in number of occurrences and size.

While some of the vegetation types found in the TEC are dominated by species that themselves have restricted occurrence, others are dominated by species that are more common but have different floristic composition to stands outside the TEC with the same species dominant. This difference in composition often includes species that are of restricted distribution. Such differences in composition mean that some stands will have somewhat higher conservation value than others, but the difference will not be great as all are part of an endangered ecological community.

The implication of floristic analysis conducted in Trudgen *et al.* 2012 is that the proposed impact area includes vegetation that is part of the Critically Endangered Coomberdale Chert TEC, but of floristic types only found north of Kiaka Road. Of importance here is that the floristic variation in the TEC vegetation north of Kiaka Road is not currently represented in the conservation estate.

The proposed impact area has conservation value for the area of the three levels of vegetation units found there which are not found in abundance elsewhere in the 2012 survey area. Currently the most significant threats in this area are grazing and climate change.

6. Conclusion

The flora and vegetation surveys and reporting for North Kiaka were undertaken over many years, beginning in 2012. The surveys have included the detailed survey (2012) and targeted surveys completed in 2016 and 2017. The dominant vegetation community is the Coomberdale Chert Threatened Ecological Community (TEC) The Coomberdale Chert is a distinctive vegetation type that is found on low rocky hills between Moora and Watheroo.

This vegetation type is the predominant vegetation type both with the North Kiaka DE and the broader regional extent. The North Kiaka DE consists of remnant vegetation on parts of parallel low chert ridges. The remnants surveyed as part of this survey effort are located on three ridges that trend from the north-north-west to the south-south-east. The southern end of the 1.4-kilometre-long area surveyed is 500 metres north of Kiaka Road and 2.2 kilometres east of the Midlands Road. The ridges are separated by narrow strips of cleared farmland and are part of a larger group of ridges located north of Kiaka Road.

Agriculture is the predominant landuse in the Proposal area, with most of the landscape cleared for broadacre agriculture. The landscape is very stable with no other land or industry development or activities occurring in the area other than farming and SIMCOA's mine operations. There are no records of bushfires having occurred in the areas of remnant vegetation and flora populations are stable and long established.

The vegetation was classified into three levels. The lowest order units are defined near the plant community level with similar structure, dominance and floristics. The plant communities were grouped into 104 vegetation associations that have similar structure and dominant species and then into 31 vegetation alliances as a third level of classification. It is floristically different from other vegetation in the region and has differences between the areas north and south of Kiaka Road and between these areas and areas of the TEC further north. This floristic difference is partly driven by species such as *Regelia megacephala*, *Xanthorrhoea* sp. Coomberdale, *Acacia aristulata* and *Calytrix* sp. Coomberdale which are restricted to or mostly restricted to the TEC. The TEC has a significant sized list of flora that includes populations of threatened flora (including *Acacia aristulata* and *Daviesia dielsii*), priority flora (including *Regelia megacephala* and *Bossiaea moylei*) as well as species that range from not very common to quite common.

Vegetation condition ranges from Completely Degraded (cleared farmland) to Very Good condition. The better condition areas north of Kiaka Road are mainly in the southern part of the main central ridge system.

The surveys reported 102 species of native flowering plants, one native pine (*Actinostrobus arenariu*s) and five species of native ferns. This is a significant subset of the 315 native flowering plants recorded for the area of the Coomberdale Chert TEC (2012) and the 192 native flowering plant species recorded north of Kiaka Road within that area. The survey area also reports 332 native flora species and 56 weeds.

Five threatened flora species occur in the survey area. Two of these were found north of Kiaka Rd and in the proposed impact area (*Acacia aristulata* and *Daviesia dielsii*). Thirteen priority flora species have been recorded in the survey area with three recorded north of Kiaka Road and in the proposed impact area (*Regelia megacephala, Diuris recurva* and *Stylidium* sp. Moora.).

In total, GHD (2024) recorded two Threatened flora species in the survey area including *Acacia aristulata, Daviesia dielsii. Eucalyptus pruinimaris.* was recorded in the offset site only. A total of 38 plants of *Acacia aristulata* were recorded, including 27 of these in the Cairn Hill Reserve Boundary, 6 in the Cairn Hill North Boundary, Moora Mine Development Envelope 1 and 2 in the North Kiaka DE. A total of 82 plants of *Daviesia dielsii* were recorded including in the Cairn Hill Reserve Boundary (72) and Cairn Hill North Boundary (9). *Eucalyptus pruinimaris* was only recorded in the Cairn Hill Reserve Boundary (9 plants in total).

GHD (2024) also recorded two Priority species, *Regelia megacephala* (P4) and *Babingtonia cherticola* (P3). An approximate number of 4,723 plants of *Babingtonia cherticola* were recorded in the Cairn Hill Reserve Boundary (2,224) and Cairn Hill North Boundary (2,499). Approximately 9,159 plants of *Regelia megacephala* was recorded across all the survey boundaries including in the Cairn Hill Reserve Boundary (3,684), Cairn Hill North Boundary (2,019), Moora Mine Development Envelope (18) and the North Kiaka Development Envelope (3,438).

A post survey likelihood of occurrence assessment for all significant flora species identified in the desktop review. Of the 69 species listed as potentially occurring within this table, five are listed as possibly occurring, 17 are known to occur and the remaining are listed are unlikely or highly unlikely.

The significance of the vegetation and flora found in the Trudgen (2012) survey and transects (2016) compared to the remaining TEC is:

– **Flora** – The proposed impact area will affect the populations of all the flora species present in a region (the Avon Botanical District) where flora populations have been significantly reduced by clearing for agriculture;
– **Significant Flora** – The area has significant value for one threatened species *(Acacia aristulata),* moderate value for three priority species (*Regelia megacephala*, *Diuris recurva* and *Stylidium* sp. Moora) and minor value for one other threatened species (*Daviesia dielsii)*.
– **Vegetation type** – The area north of Kiaka Road is different floristically compared to south of Kiaka Road. This increases the significance of the loss of areas of the TEC, as there is limited area north of Kiaka Road and there is no representation in the conservation estate in this area.
– **Vegetation Condition** – Most of the vegetation on the TEC remnants within the impact area is in Poor to Degraded condition. This somewhat reduces the significance of that change in flora and vegetation condition on conservation values.
– **Coomberdale Chert TEC** – The impact area contains vegetation representing less than 2.5% of the 2012 TEC area surveyed.

This Report has been prepared to meet the *Technical Guidance: Flora and Vegetation Surveys for Environmental Impact Assessment, 2016*. This Report notes that the surveys were completed in 2012, 2016, 2017, and most recently 2024 (for targeted flora). The currency of the vegetation mapping data extends beyond five years but the findings can be confidently assessed for the following reasons:

– The experience of the Botanist. Malcolm Trudgen has been acknowledged by DBCA as a technical authority in the assessment in Coomberdale Chert vegetation community
– The survey extent and longitudinal data set
– The landscape is stable in terms of land and activity
– There have been no catastrophic events in the area that have impacted vegetation condition and flora populations within the 50 years, i.e. bushfire or cyclones

7. References

Actis. (2011). *Proposed Discharge Evaluation: Coonderoo River Wetlands.* Report prepared for SIMCOA Operations Pty Ltd.

ALA. (2023). *Atlas of Living Australia*. Retrieved from https://www.ala.org.au/

Beard, J. (1979). *Vegetation Survey of Western Australia. The Vegetation of the Hill River and Moora Areas Western Australia. Explanatory Notes and Map Sheet, 1:250000 series. Vegetation Survey of Western Australia, map and explanatory memoir 1:250,000 series.* Applecross: Vegmap Publications.

Beard, J. S. (1979). *Vegetation Survey of Western Australia. The Vegetation of the Hill River and Moora Areas Western Australia. Explanatory Notes and Map Sheet, 1:250000 series. Vegetation Survey of Western Australia, map and explanatory memoir 1:250,000 series.* Applecross: Vegmap Publications.

Beard, J. S. (1990). *Plant Life of Western Australia.* Perth: Kangaroo Press.

Beecham, B. (2001). *Avon Wheatbelt Bioregion.* Department of Biodiversity, Conservation and Attractions.

Beecham, B. (2001b). *Avon Wheatbelt 2 (AW@ - Rejuvenated Drainage subregion) Bioregion.* Department of Biodiversity, Conservation and Attractions.

BoM. (2023). *Climate statistics for Australian locations - Badgingarra Research Station number 9037.* Retrieved from http://www.bom.gov.au/climate/averages/tables/cw_009037.shtml

Centre for Invasive Species Solutions. (2021). *Centre for Invasive Species Solutions*. Retrieved from https://invasives.com.au/

Churchward, H. M., & McArthur, W. M. (1980). *Landforms and Soils of the Darling System, Western Australia.* Perth: Department of Conservation and Environment.

DBCA. (2007-). *NatureMap: Mapping Western Australia's Biodiversity.* Retrieved July 2018, from Department of Biodiversity, Conservation and Attractions: https://naturemap.dbca.wa.gov.au/

DBCA. (2013). *Threatened Ecological Community Fact Sheet: Vegetation alliances on ridges and slopes of the chert hills of the Coomberdale floristic region.* GoWA.

DBCA. (2019). *Tuart Woodlands and Forets of the Swan Coastal Plain: A Nationally Significant Ecological Community.*

DBCA. (2022a). *Priority Ecological Communities for Western Australia Version 34, 21 December 2022.* Retrieved January 2019, from Department of Biodiversity, Conservation and Attractions: https://www.dpaw.wa.gov.au/images/images/documents/plants-animals/threatened-species/Listings/Priority%20Ecological%20Communities%20list.pdf

DBCA. (2022b). *Threatened and Priority Flora and Ecological Communities Database.* Department of Biodiversity, Conservation and Attractions.

DBCA. (2023). *Threatened and Priority Flora (TPFL) and Western Australian Herbarium Specimen (WAHERB) databases - 15 km buffer.* Department of Biodiversity, Conservation and Attractions. Retrieved from Department of Biodiversity, Conservation and Attractions.

DCCEEW. (2022). *EPBC Protected Matters Search Tool.* Retrieved from Department of Climate Change, Energy, the Environment and Water: https://www.dcceew.gov.au/environment/epbc/protected-matters-search-tool

DCCEEW. (2023b). *Species Profile and Threats Database, Department of Climate Change, Energy, the Environment and Water.* Department of Climate Change, Energy, the Environment and Water. Retrieved from https://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=64822

DCCEEW. (2023d). *Interim Biogeographic Regionalisation for Australia, Version 7*. Retrieved from Department of Climate Change, Energy, the Environment and Water: https://www.dcceew.gov.au/environment/land/nrs/science/ibra/australias-bioregions-maps

DEC. (2008). *Woolly Foxglove (Pityrodia axillaris) Interim Recovery Plan 2008-2013.* Department of Environment and Conservation.

DEC. (2009). *Silky Frankenia (Frankenia conferta).* Department of Environment and Conservation.

DoE. (2016). *Eucalypt Woodlands of the Western Australian Wheatbelt: a nationally protected ecological community.* Department of the Environment.

DPAW. (2013b). *Interim Recovery Plan 2013 – 2018, Interim Recovery Plan No. 338 – Heath dominated by one or more of Regelia megacephala, Kunzea praestans and Allocasuarina campestris on ridges and slopes of the chert hills of the Coomberdale Floristic Region.* Government of Western Australia.

DPIRD. (2023). *Soil Landscape Mapping - Best Available (DPIRD-027).* Retrieved from data.wa.gov.au: https://maps.slip.wa.gov.au/datadownloads/SLIP_Public_Services/Soil_Landscape/SoilLandscapeMapping_BestAvailableDPIRD_027/SoilLandscapeMapping

EPA. (2000). *Position Statement No. 2: Environmental Protection of native Vegetation in Western Australia: Clearing of Native Vegetation, with Particular Reference to the Agricultural Area.* Environmental Protection Authority.

EPA. (2016). *Technical Guidance: Flora and Vegetation Surveys for Environmental Impact Assessment.* Government of Western Australia.
GHD. (2019). *North Kiaka Approvals and Supporting Studies - Geotechnical Desktop Study.* Report prepared for SIMCOA Operations Pty Ltd.
GHD. (2023c). *Desktop Assessment of Groundwater Dependent Ecosystems of Moora Quartzite Mine.* Report prepared for SIMCOA Operations Pty Ltd.
GHD. (2023d). *North Kiaka Mine Hydrogeological Assessment.* Report prepared for SIMCOA Operations Pty Ltd.
GHD. (2023e). *North Kiaka Mine Hydrological Assessment.* Report prepared for SIMCOA Operations Pty Ltd.
Gibson, N., Keighery, B. J., Keighery, G. J., Burbridge, A. H., & Lyons, M. N. (1994). *A Floristic Survey of the Southern Swan Coastal Plain.* Perth: Report for the Australian Heritage Commission prepared by Department of Conservation and Land Management and Conservation Council of Western Australia (Inc).
GoWA. (2019). *2018 Statewide Vegetation Statistics incorporating the CAR (Full Report). Current as of March 2019.* WA Department of Biodiversity, Conservation and Attractions. Retrieved from https://catalogue.data.wa.gov.au/dataset/dbca-statewide-vegetation-statistics
GoWA. (2023). *Spatial datasets*. Retrieved from data.wa.gov.au: https://catalogue.data.wa.gov.au/dataset
Griffin, E. A. (1992). *Floristic survey of remnant vegetation in the Bindoon to Moora area, Western Australia.* Resource Management Technical Report 142.
Griffin, E. A. (1994). *Floristic survey of Northern Sandplains between Perth and Geraldton. .* Department of Agriculture Western Australia.
Hearn, S., Williams, K., Comer, S., & Beecham, B. (2002). *A Biodiversity Audit of Western Australia's 53 Biogeographical Subregions.* Perth: Department of Conservation and Land Management.
Heddle, E. M., Loneragan, O. W., & Havel, J. J. (1980). *Vegetation Complexes of the Darling System, Western Australia, in Atlas of Natural Resources, Darling System Western Australia.* Perth: Department of Conservation and Environment.
Hussey, B. J., Keighery, G. J., Dodd, J., Lloyd, S. G., & Cousens, R. D. (2007). *Western Weeds: A Guide to the Weeds of Western Australia* (2nd ed.). Victoria Park, WA: The Weeds Society of WA (Inc.).
Marchant, N. G. (2019). Circumscription of Chamelaucium (Myrtaceae: Chamelaucieae), with validation of six species names and two new combinations. *Nuytsia, 30*, 317–334.
Mitchell, D., Williams, K., & Desmond, A. (2002). *Swan Coastal Plain 2 (SWA2 - Swan Coastal Plain Subregion).* Perth: Department of Conservation and Land Management.
NVIS Technical Working Group. (2017). *Australian Vegetation Attribute Manual: National Vegetation Information System, Version 7.0.* (M. P. Bolton, C. deLacey, & K. B. Bossard, Eds.) Canberra: Department of the Environment and Energy.
Perkins, A. J. (2018). Hydrocotyle spinulifera and H. dimorphocarpa (Araliaceae), two new Western Australian species with dimorphic mericarps. *Nuytsia, 29*, 57-65.
Rye, B. L. (2015). A revision of the south-western Australian genus Babingtonia (Myrtaceae: Chamelaucieae). *Nuytsia, 25*, 219-250.
Rye, B. L. (2022). An expanded circumscription and revision of the Western Australian genus Balaustion (Myrtaceae: Chamelaucieae: Hysterobaeckeinae). *Nuytsia, 33*, 149-204.
Saprolite Environmental. (2012). *Moora Quartzite Mine - Phase 2 Hydrogeological Investigations.* Report prepared for SIMCOA Operations Pty Ltd.
Shepherd, D. P., Beeston, G. R., & Hopkins, A. J. (2002). *Native Vegetation in Western Australia – Extent, Type and Status, Resource Management Technical Report 249.* Perth: Department of Agriculture WA.
Soilwater Consultants. (2019). *North Kiaka Soil Characterisation.* Report prepared for SIMCOA Operations Pty Ltd.
State of Western Australia. (2022). Biodiversity Conservation (Listing of Native Species) (Flora) Order 2022. *Western Australian Government Gazette 2022 , 144*, 4763–4768. Retrieved from https://www.legislation.wa.gov.au/legislation/statutes.nsf/gazettes2022.html
Trudgen. (1985). *A Report on the Vegetation and Flora of the Proposed Moora Silica Minesite.* Prepared for Cliffs International Inc.
Trudgen. (2018). *Comparison of the flora and vegetation of the proposed North Kiaka Mine Area to other parts of the Coomberdale Chert Threatened Ecological Community.* Report prepared for SIMCOA Operations Pty Ltd.
Trudgen. (2023). *A report on the rehabilitation of mine waste at the Simcoa Moora Chert Mine based on monitoring in December 2022.* Internal report for Simcoa by M.E Trudgen and Associates.
Trudgen, M. E. (1988). *A Report on the Flora and Vegetation of the Port Kennedy Area.*
Trudgen, M. E. (2017). *Weed invasion levels and weed species composition in the rehabilitation at the Simcoa Moora Chert Mine and in the Coomberdale Chert TEC.* Internal Simcoa report.
Trudgen, M. E., Griffin, E. A., & Morgan, B. (2012). *An extension of a flora survey, floristic analysis and vegetation survey of areas of the Coomberdale Chert TEC to include a further area.* Report prepared for SIMCOA Operations Pty Ltd.

Trudgen, M. E., Henson, M., & Morgan, B. M. (2001). *A flora survey, floristic analysis and vegetation survey of the Coomberdale Chert TEC. Volumes 1 and 2.* Internal report prepared for Simcoa Operations Pty Ltd.
Trudgen, M. E., Morgan, M., & Griffin, E. A. (2006). *A flora survey, floristic analysis and vegetation survey of the Coomberdale Chert TEC.* Perth: Internal report prepared for Simcoa Operations Pty Ltd.
TSSC. (2016). *Approved Conservation Advice (incorporating listing advice) for the Banksia Woodlands of the Swan Coastal Plain ecological community.* Canberra: Department of Environment and Energy.
WA Herbarium. (1998-). *Florabase-the Western Australian Flora, Department of Biodiversity, Conservation and Attractions.* Western Australian Herbarium. Retrieved from http://florabase.dpaw.wa.gov.au
Webb, A., Kinloch, J., Keighery, G., & Pitt, G. (2016). *The Extension of Vegetation Complex Mapping to Landform Boundaries with the Swan Coastal Plain Landform and Forested Region of South-west Western Australia.* Perth: Department of Biodiversity, Conservation and Attractions.
Wege, J. A. (2022). Stylidium milleri (Stylidiaceae), a striking discovery from south-western Australia. *Nuytsia, 33*, 15-18.
Williams, A. R. (2022). Austrostipa (Poaceae) in Western Australia: new species, new records, keys, and character notes. *Nuytsia, 33*, 39-101.

Appendices

Appendix A

Conservation codes and definitions

Threatened and Priority Flora Categories

Definition of CALM Threatened and Priority Flora categories (from Atkins 1998).

Threatened Flora – Extant Taxa

Taxa which have been adequately searched for and are deemed to be in the wild either rare, in danger of extinction, or otherwise in need of special protection, and have been gazetted as such.

Threatened Flora – Presumed Extinct Flora

Taxa which have not been collected, or otherwise verified, over the past 50 years despite thorough searching, or of which all known wild populations have been destroyed more recently, and have been gazetted as such.

Priority One – Poorly Known Taxa.

Taxa which are known from one or a few (generally < 5) populations which are under threat, either due to small population size, or being on lands under immediate threat, e.g. road verges, urban areas, farmland, active mineral leases, etc., or the plants are under threat, e.g. from disease, grazing by feral animals, etc. May include taxa with threatened populations on protected lands. Such taxa are under consideration for declaration as ‘rare flora’, but are in urgent need of further survey.

Priority Two – Poorly Known Taxa.

Taxa which are known from one or a few (generally < 5) populations, at least some of which are not believed to be under immediate threat (ie. Not currently endangered). Such taxa are under consideration for declaration as “rare flora”, but are in urgent need of further survey.

Priority Three – Poorly Known Taxa.

Taxa which are known from several populations, and the taxa are not believed to under immediate threat (i.e. not currently endangered), either due to the number of known populations (generally > 5), or known populations being large, and either widespread or protected. Such taxa are under consideration for declaration as 'rare flora' but are in need of further study.

Priority Four - Rare Taxa.

Taxa which are considered to have been adequately surveyed and which, whilst being rare (in Australia), are not currently threatened by any identifiable factors. These taxa require monitoring every 5-10 years.

Appendix B

Flora List (updated 2024)

Higher group or plant family	NAME [See distribution column for highlight coding]	Weed *	North Kiaka Mine and haul road	North of Kiaka Road	John Tonkin Property JT (12)	A & R Tonkin property ART (11)	Distribution, conservation status, comments Green highlight indicates a new record for the TEC. Light blue highlight indicates a conservation taxon light orange highlight indicates a taxon needing assessment for priority or rare flora status. Wsd = widespread. Grey highlight indicates inadequate material.	Cairn Hill Reserve CAH (20)	Cairn Hill North CHN (10)	Current mine [= E Ore Body] EOR (3)	Eastern Ridge ERG (23)	Gardiner's Hill GH (10)	Waste Dump Area WDM (3)	Western Ridge WOR (6)	Other areas surveyed
FERNS															
Adiantaceae	Cheilanthes adiantoides		Obs/16	Recorded	11q, 15r	4q	Wsd in WA W of Ravensthorpe, N of Perth to Shark B & some outlying records.	17q, 37r	9q, 21r	3q	23q, 40r	8q, 21r	3q, 1r	6q, 1r	32r
Adiantaceae	Cheilanthes austrotenuifolia		1q	Recorded		5q, 1o	Wsd in SW WA, some outlying records, disjunct to SA, NSW, Vict. & Tas.								
Adiantaceae	Cheilanthes distans			Recorded	1q	3q, 3r	Wsd in SW, Eastern States & NZ!	1q		1q					
Aspleniaceae	Pleurosorus rutifolius			Recorded	1q		Wsd in Aust. S of tropics			1q	2q	1q			
Ophioglossaceae	Ophioglossum lusitanicum		Coll/16	Recorded	o		Wsd in Aust. mainly S of tropics with some disjunctions. Also in NZ.								
PINES															
Cupressaceae	Callitris arenaria		Obs/16 (dead)	Recorded	1q		Small population (six plants) on the Chert at quadrat JT010. One dead tree seen nearby. Griffin record from North Cairn Hill not refound during surveys. Population apparently in decline.								
ANGIOSPERMS Monocotyledons															
Poaceae	Aira elegantissima	*		Recorded	5q			10q			5q	1q			
Poaceae	Amphipogon caricinus var. caricinus						Wsd in Aust. S of tropics.	5q, 2r	1r		4q	1q, 3r		2q	
Poaceae	Aristida contorta						Occurs over most of Aust.	1q						1q	
Poaceae	Aristida holathera var?						Occurs over much of Aust. The species needs revision (there are undescribed varieties).						1q		
Poaceae	Austrostipa compressa						Coastal from Geraldton area to Perth, then scattered in far SW. TEC record small inland range extension.		8q						
Poaceae	Austrostipa elegantissima		Obs/16	Recorded	2q	1q, 1r,	Wsd in SW WA & nearby Eremaean, also SA, NSW & Vict.	8q, 5r	2q	1q	8q	6q, 5r	2q	2q	2r
Poaceae	Austrostipa eremophila						Wsd in southern Aust.	1r							
Poaceae	Austrostipa exilis						Sporadic in SW WA, also in SA, Vict.	2r							
Poaceae	Austrostipa hemipogon			Recorded	1q	1q	Wsd in SW WA, also SA, Vict, 1 record Tas.				1q	2q	1q	3q	
Poaceae	Austrostipa macalpinei						Common in a band from N of Geraldton to Perth, disjunct to S coast & disjunct to SA & Vict.					2q			
Poaceae	Austrostipa mollis						Wsd in SW WA, disjunct to SE Aust. & Tas.				1r				1r
Poaceae	Austrostipa nitida			Recorded	5q		Wsd in southern Aust.	2q			4q, 3r	2q			3r
Poaceae	Austrostipa scabra			Recorded	1q		Wsd in southern Aust. & Tas.	3q				4q			1r
Poaceae	Austrostipa sp.			Recorded	1q, 2r			1q	1q		1q				
Poaceae	Austrostipa nunaginensis						Priority 3 species. Sporadic from Geraldton area to Perth & E of Perth. (formerly Austrostipa sp. Cairn Hill (M.E. Trudgen 21176))	1q							
Poaceae	Austrostipa tenuifolia						Wsd in SW WA & nearby Eremaean, also near coastal SA & 2 records in Vict.			1q	1q		1q		
Poaceae	Austrostipa trichophylla		3q	Recorded	1q	8q, 1r	Wsd in SW WA & nearby Eremaean, also NT, SA, NSW & Vict., 1 record in Q.	8q	5q	1q	12q	3q, 2r	2q	5q	
Poaceae	Austrostipa variabilis			Recorded	3q, 2r		Wsd in SW WA & nearby Eremaean, few records in SA, NSW.	4q		1q	3q	6q		1q	
Poaceae	Avellina micheli	*		Recorded	3q			1q			2q				
Poaceae	Avena barbata	*	3q	Recorded	11q, 20r	9q, 7r		8q	5q	3q	23q, 17r	9q, 10r	2q	6q	67r
Poaceae	Brachypodium distachyon	*	1q	Recorded		3q									
Poaceae	Briza maxima	*	1q	Recorded	12q, 6r	7q		10q	8q	3q	23q, 8r	8q, 35r	3q	6q	17r
Poaceae	Bromus diandrus	*		Recorded	9q, 2r	5q, 1o		3q	2q	3q	12q, 5r	4q, 1r	1q	5q	9r
Poaceae	Bromus madritensis	*		Recorded											
Poaceae	Cynosurus echinatus	*	1r	Recorded	f	1q, 1r									
Poaceae	Ehrharta brevifolia var. cuspidata	*	1q	Recorded		1q									
Poaceae	Ehrharta calycina	*													2r
Poaceae	Ehrharta longiflora	*	2q	Recorded	9q, 5r	10q, 3r		12q	6q	3q	19q,6r	7q, 5r	1q	6q	1q,25r
Poaceae	Eriachne ovata						Wsd in WA W of Esperance, disjunct to SA, NT & Q.	1q							
Poaceae	Hordeum leporinum	*	2q	Recorded		1q									
Poaceae	Lamarckia aurea	*	1q	Recorded		1q									

Higher group or plant family	NAME [See distribution column for highlight coding]	Weed *	North Kiaka Mine and haul road	North of Kiaka Road	John Tonkin Property JT (12)	A & R Tonkin property ART (11)	Distribution, conservation status, comments Green highlight indicates a new record for the TEC. Light blue highlight indicates a conservation taxon light orange highlight indicates a taxon needing assessment for priority or rare flora status. Wsd = widespread. Grey highlight indicates inadequate material.	Cairn Hill Reserve CAH (20)	Cairn Hill North CHN (10)	Current mine [= E Ore Body] EOR (3)	Eastern Ridge ERG (23)	Gardiner's Hill GH (10)	Waste Dump Area WDM (3)	Western Ridge WOR (6)	Other areas surveyed
Poaceae	Lolium perenne	*		Recorded	1q	2q		1q				1q			1r
Poaceae	Neurachne alopecuroidea		2q	Recorded	12q, 10r	7q, 4r	Wsd in SW WA disjunct to SA & Vict.	16q, 55r	10q, 34r	2q, 1r	20q, 38r	10q, 33r	3q, 2r	6q, 1r	1q, 21r
Poaceae	Pentameris airoides subsp. airoides	*	2q	Recorded		8q, 1r	Formerly Pentaschistis airoides	3q	7q	3q	15q		3q	5q	2r
Poaceae	Pentameris pallida	*		Recorded	7q, 6r		Formerly Pentaschistis pallida	1q			3q	7q, 6r		1q	11r
Poaceae	Pentameris sp.	*				2q					1q	1q			
Poaceae	Polypogon monspeliensis	*	1r			1r									
Poaceae	Rytidosperma acerosum		1q	Recorded	3q	2q	Wsd in SW WA. But not common..	4q,2r			2q, 4r	4q, 1r	2q	4q	1r
Poaceae	Rytidosperma caespitosum			Recorded		1q, 1o	Wsd in SW WA, continuous to SA, Vict, NSW & Tas. Also NZ.	5q	1q		8q, 7r	3q, 3r		1q	4r
Poaceae	Rytidosperma setaceum			Recorded	2q, 1r		Wsd in S Aust. TEC population somewhat isolated..	7q, 3r	7q	3q	10q, 4r	3q, 1r	1q	4q	2r
Poaceae	Rytidosperma sp.			Recorded	1q	1r,		1q				2q			7r
Poaceae	Schismus barbatus	*	1q	Recorded		1q 1o									
Poaceae	Vulpia myuros	*	3q	Recorded	11q, 7r	11q, 3r		17q, 1r	8q	2q	5q	9q, 3r	3q	5q	
Cyperaceae	Gahnia drummondii						Moderate distribution in SW W.A.								1r
Cyperaceae	Lepidosperma aff. leptostachyum (Moora: ERG18-7)			Recorded	1q		Probably a restricted species. The genus is in need of detailed revision.	5q	1q		4q	5q		1q	
Cyperaceae	Lepidosperma costale						Wsd in SW WA W of Ravensthorpe.	4q, 1r			2q	1q, 2r			
Cyperaceae	Lepidosperma leptostachyum						Wsd in SW WA S of Gingin. The Moora area records are disjunct from the main population. The TEC records are on unusual habitat. Three other records from surrounding areas are on different soils, or are very old collections with poor localisation. Genus needs revision.	4q, 14r	4r	2q	13q, 3r	2q, 1r	1q	4q	5r
Cyperaceae	Lepidosperma pubisquameum			Recorded		1o	Moderately Wsd in SW WA S of Lancelin. The TEC records are part of a disjunct population that extends to near Coorow (3 records on The AVH).		1r		1q	1r			
Cyperaceae	Lepidosperma sp.			Recorded	2r			1q	1q, 1r		1q	1r	1q		
Cyperaceae	Lepidosperma sp. P1 small head (M.D. Tindale 166A)						Moderately Wsd in SW WA south of Cervantes, 6 records N of there.	2r							
Cyperaceae	Lepidosperma tenue			Recorded	3r	1q, 1r	Wsd in SW WA.	8q, 10r	1q, 4r		5q, 35r	8r	1r	2q, 1r	7r
Cyperaceae	Schoenus brevisetis						Wsd in SW WA.	1q, 4r	1q						
Cyperaceae	Schoenus clandestinus		Obs/16	Recorded	5q, 8r	1o	Wsd from Mandurah to S of Shark B.	4q, 13r	1q, 9r		3q, 7r	28r	2q, 1r	1q, 1r	
Cyperaceae	Schoenus nanus						Wsd in SW WA, disjunct to SA & Vict.	1r	1q						
Cyperaceae	Schoenus pleiostemoneus						Moderately Wsd in SW WA.	1q						1q	
Restionaceae	Desmocladus asper		2q	Recorded	11q, 24r	8q, 2r, 1o	Wsd in SW WA W of Ravensthorpe. (TEC material referred to D. flexuosus in earlier reports)	14q, 39r	7q, 15r	1q, 1r	5q, 10r	9q, 19r	2q, 1r	4q, 1r	17r
Restionaceae	Lepidobolus chaetocephalus		Obs/16	Recorded	2r		Moderately Wsd in SW WA.	4q, 8r	1q, 1r			4r	1q		
Centrolepidaceae	Centrolepis drummondiana						Wsd in SW WA mainly near the coast. TEC population shortly disjunct.	2q	1q						
Centrolepidaceae	Centrolepis pilosa						Wsd in SW WA W of Bremer Bay. TEC population shortly disjunct.	1q		1q			1q		
Centrolepidaceae	Centrolepis sp.								1q						
Dasypogonaceae	Lomandra sp. (Moora twisty)			Recorded	2q	2q	May be the same as *Lomandra micrantha*.	1q			4q	1q			
Dasypogonaceae	Lomandra aff. micrantha subsp. micrantha			Recorded		1q	Wsd in SW W.A. also in eastern states.	3q			3q	1q	1q		
Dasypogonaceae	Lomandra effusa			Recorded			Wsd in SW & SE Aust.	1q, 5r	1q			3q, 5r			1r
Dasypogonaceae	Lomandra sp.							1q							1r
Xanthorrhoeaceae	Xanthorrhoea sp. Coomberdale		2q	Recorded	10q, 15r	7q, 4r	Geographically restricted. Population declining significantly. Referred to X. drummondii in earlier reports.	16q, 39r	9q, 22r	2q, 1r	10q, 27r	8q, 20r	3q	6q, 1r	1q
Phormiaceae	Dianella revoluta var. divaricata			Recorded		1o	Wsd in southern WA and in SA.	6q, 2r	3q, 1r		2r	3q, 2r	2q	3q	
Phormiaceae	Stypandra glauca		Coll/16	Recorded	4q, 2r	5q, 2r	Common in SW WA, NSW and Vict, few records in SA.	12q, 39r	5q, 15r	3q	17q, 19r	3q, 5r	2q, 1r	5q	
Anthericaceae	Agrostocrinum scabrum aff. subsp. scabrum			Recorded		1q	Agrostocrinum scabrum subsp. scabrum has clusters of occurrence in the SW of WA that suggests variation. Needs review. TEC material atypical.	1q				2q			

Higher group or plant family	NAME [See distribution column for highlight coding]	Weed *	North Kiaka Mine and haul road	North of Kiaka Road	John Tonkin Property JT (12)	A & R Tonkin property ART (11)	Distribution, conservation status, comments Green highlight indicates a new record for the TEC. Light blue highlight indicates a conservation taxon light orange highlight indicates a taxon needing assessment for priority or rare flora status. Wsd = widespread. Grey highlight indicates inadequate material.	Cairn Hill Reserve CAH (20)	Cairn Hill North CHN (10)	Current mine [= E Ore Body] EOR (3)	Eastern Ridge ERG (23)	Gardiner's Hill GH (10)	Waste Dump Area WDM (3)	Western Ridge WOR (6)	Other areas surveyed
Anthericaceae	Dichopogon preissii			Recorded	5q		Called *Caesia* sp. Moora & *Caesia* (Moora hairy stem) in Trudgen *et al.* (2012). Common in proposed mine area.	4q	1q		1q			1q	
Anthericaceae	Caesia sp. Wongan (K.F. Kenneally 8820)			Recorded	1q		This species (complex?) has disjunct southern and norther populations, the TEC population is a small range extension for the southern population. It is also disjunct. Called *Caesia alfordii* [MS] in earlier reports.	1q, 1r			5q	2q			
Anthericaceae	Chamaescilla versicolor		Obs/16	Recorded	11q, 4r		Patchy distribution from Geraldton area to east of Perth. Specimens referred to *C. corymbosa* in earlier reports.	15q, 13r	9q, 10r	1q, 1r	22q, 15r	10q, 4r	3q	6q	7r
Anthericaceae	Dichopogon capillipes			Recorded	9q, 2r	7q, 1r	Has a moderate distribution in the west of SW W.A. with some disjunctions.	17q, 42r	7q, 16r	3q	22q, 28r	10q, 10r	3q, 1r	6q	1q,22r
Anthericaceae	Laxmannia omnifertilis						On NE edge of range.	1q							
Anthericaceae	Laxmannia ramosa subsp. ramosa		Coll/16	Recorded	2q	1q	Small disjunction within range.								
Anthericaceae	Sowerbaea laxiflora						Wsd in SW W.A, but with disjunctions, the TEC population is at the N end of the main area. Needs revision.		1q		5q, 1r	5q			
Anthericaceae	Thysanotus dichotomus			Recorded		1o	Wsd in SW W.A, but with disjunctions. TEC population part of a small disjunct group of records. Needs revision.	1q			2q, 3r	1q, 1r			1o
Anthericaceae	Thysanotus manglesianus			Recorded	11q	3q, 1r	Wsd, common in W.A. west of Kalgoorlie and south of Pilbara.	18q, 5r	9q, 9r	3q	20q, 2r	8q, 1r	3q	4q	
Anthericaceae	Thysanotus multiflorus			Recorded	1q		Disjunct population, needs taxonomic study.	1q							
Anthericaceae	Thysanotus patersonii						Wsd, common in SW W.A. disjunct to eastern states.				1q				
Anthericaceae	Thysanotus sp.							1q			1q				
Anthericaceae	Tricoryne sp. Wongan Hills (B.H. Smith 794)			Recorded			Priority 2 species [Referred to Tricoryne arenicola (MS) previously.] Sporadic, moderate distribution in SW W.A.	1q	1q, 3r				1q		
Anthericaceae	Tricoryne elatior			Recorded		2o	Wsd in SW WA, E Aust., also CA Kimb., & northern NT. Needs revision.		3q, 2r		3q, 2r	1q			
Colchicaceae	Burchardia bairdiae [Probably B. congesta.]						Determination unlikely on habitat grounds. One collection from the Eastern Ridge [specimen not refound in 2016].				1q				
Colchicaceae	Burchardia congesta		Obs/16	Recorded	7q, 1r	2q	TEC population at the edge of the main population, small disjunction, unusual habitat.	15q, 21r	9q, 8r	3q, 1r	18q, 16r	8q, 6r	1q	6q	3r
Colchicaceae	Wurmbea drummondii		Coll/16	Recorded	2q		Previously P4, moderately Wsd in SW WA.								
Boryaceae	Borya laciniata			Recorded		3q, 1o	Genus needs review.	1q	1q						
Boryaceae	Borya sphaerocephala		Obs/16	Recorded	7q, 1r	1r,	Genus needs review.	10q, 29r	5q, 15r	1r	7q, 19r	76q, 35r	3q, 1r	1q	15r
Haemodoraceae	Conostylis androstemma						TEC population has short disjunction from main population.	1q							
Haemodoraceae	Haemodorum paniculatum		Obs/16	Recorded	1q		Sporadic from Green Head to forests E of Bunbury, one record near Geraldton. TEC population outlying.	2q	1q				1q		
Haemodoraceae	Haemodorum simulans			Recorded	2q	1o	Occurs in a band from S of Shark B to N of Albany.	4q	2q				1q	1q	1r
Hypoxidaceae	Pauridia aff. occidentalis var. occidentalis		Obs/16	Recorded	5q		Genus needs review in W.A. Appears to be undescribed, but the taxonomy of the group needs significant work.	5q	5q	1q	20q	9q	4q	1q	1q
Dioscoreaceae	Dioscorea hastifolia		1q	Recorded	4q, 3r	9q, 4r	Occurs in a band parallel to the coast from Shark B to south of Perth.	15q 19r	7q, 5r	3q	23q, 24r	7q, 4r	2q	6q	1q, 8r
Iridaceae	Moraea setifolia	*	1q	Recorded		1q, 1o									
Iridaceae	Orthrosanthus laxus var. gramineus						Occurs in a band from S of Geraldton to S of Perth. Species needs review.	1r,1q				4q, 2r		2q	
Iridaceae	Romulea rosea	*		Recorded	1q				1q	2q	7q		3q	2q	
Orchidaceae	Caladenia denticulata subsp. denticulata			Recorded	6q		Moderately Wsd, but records sporadic.			1q	9q		2q	1q	
Orchidaceae	Caladenia flava subsp. flava		Obs/16	Recorded	9q	3q	Wsd in SW W.A. Common in the Coomberdale Chert TEC.	9q	9q	3q	17q	9q	1q	4q	
Orchidaceae	Caladenia paradoxa						Moderately Wsd, outlying record.	1q					1q		
Orchidaceae	Caladenia sp.						These records are of sterile specimens (leaves).		3r						
Orchidaceae	Caladenia vulgata			Recorded		1q	Very Wsd in SW W.A.				1q	1q			
Orchidaceae	Cyanicula gemmata		Coll/16	Recorded	4q		Very Wsd in SW W.A.		1q		1q				
Orchidaceae	Cyrtostylis huegelii						Moderately Wsd in SW W.A. but sporadic occurrence north of Perth.	1q		1q	1q				
Orchidaceae	Diuris brumalis		Coll/16	Recorded	o		Moderate distribution from the Eneabba area to east of Bunbury.								
Orchidaceae	Diuris recurva		Coll/16	Recorded	3q		A priority 4 species. Moderate distribution, but of disjunct small areas and a few outlying records. Called *Diuris* aff. *recurva* in earlier reports.	5q	6q		6q	5q	1q	1q	
Orchidaceae	Diuris tinkeri		Coll/16	Recorded	o		Fairly small distribution from north of Kalbarri to north of Perth. TEC records a small range extension to the east.								

Higher group or plant family	NAME [See distribution column for highlight coding]	Weed *	North Kiaka Mine and haul road	North of Kiaka Road	John Tonkin Property JT (12)	A & R Tonkin property ART (11)	Distribution, conservation status, comments Green highlight indicates a new record for the TEC. Light blue highlight indicates a conservation taxon light orange highlight indicates a taxon needing assessment for priority or rare flora status. Wsd = widespread. Grey highlight indicates inadequate material.	Cairn Hill Reserve CAH (20)	Cairn Hill North CHN (10)	Current mine [= E Ore Body] EOR (3)	Eastern Ridge ERG (23)	Gardiner's Hill GH (10)	Waste Dump Area WDM (3)	Western Ridge WOR (6)	Other areas surveyed
Orchidaceae	Elythranthera brunonis			Recorded	1q		Moderately Wsd in SW W.A.		1q					2q	
Orchidaceae	Eriochilus dilatatus subsp. undulatus		Obs/16	Recorded			Wsd in SW W.A. One plant seen in North Kiaka Mine area.	1q		1q	2q		3q	1q	
Orchidaceae	Eriochilus helonomos			Recorded			Moderate distribution in SW W.A. but not common north of Perth. Small range extension.	7q	4q		1q	4q			
Orchidaceae	Leporella fimbriata						Fairly Wsd in SW W.A.	1q	1q			2q	1q		
Orchidaceae	Paracaleana hortiorum			Recorded	1q		Specimen not refound. Would be a long range extension. Not recorded during 2016 field work. On geography possibly *P. nigrita*.								
Orchidaceae	Pheladenia deformis			Recorded	10q		Very Wsd in SW W.A. with a large disjunction to the eastern states.	3q	9q	3q	17q	8q	3q	1q	
Orchidaceae	Prasophyllum gracile						Very Wsd in SW W.A. extending into adjacent Eremaean.				1q	1q			
Orchidaceae	Pterostylis aff. nana								2q		1q				
Orchidaceae	Pterostylis exserta			Recorded	1q		Small range extension.	1q				1q			
Orchidaceae	Pterostylis recurva			Recorded	1q			6q	2q	1q				1q	
Orchidaceae	Pterostylis sanguinea		Coll/16	Recorded	4q			12q		2q	9q	8q	2q	1q	
Orchidaceae	Pterostylis sargentii						Small range extension.					1q			
Orchidaceae	Pterostylis scabra							3q		1q	1q				
Orchidaceae	Pterostylis setulosa		Coll/16	Recorded	2q			5q	8q	3q	7q	1q	2q		
Orchidaceae	Pterostylis sp.			Recorded	2q		These records are of sterile specimens (leaves).	1q, 2r	1q		1q				
Orchidaceae	Pterostylis spathulata			Recorded		1o		1q							
Orchidaceae	Pterostylis vittata								1q					2q	
ANGIOSPERMS Dicotyledons															
Casuarinaceae	Allocasuarina campestris		2q	Recorded	8q, 18r	3q, 6r	Wsd.	15q, 62r	9q, 33r	2q, 1r	17q, 40r	1q, 22r	3q, 1r	4q, 1r	40r
Casuarinaceae	Allocasuarina huegeliana		1q	Recorded	8q, 25r	6q, 6r	Wsd.	10q, 51r	7q, 29r	3q, 1r	19q, 48r	9q, 26r	2q, 1r	3q, 1r	59r
Casuarinaceae	Allocasuarina humilis			Recorded		2q	Wsd.	1q, 5r							
Casuarinaceae	Allocasuarina microstachya						Wsd.					1r			
Casuarinaceae	Casuarina obesa		1r	Recorded		3r	Wsd.								3r
Urticaceae	Parietaria debilis						Wsd.	2q							
Proteaceae	Banksia prionotes														2r
Proteaceae	Banksia sphaerocarpa var. aff. caesia		1r, Coll/16	Recorded		1r, 1o	The material needs expert determination, it may represent a new taxon, a range extension of var. caesia (but atypical) or atypical var. sphaerocarpa. The species has five varieties and needs revision.								1r
Proteaceae	Banksia fraseri var. fraseri		Obs/16	Recorded	1q	1o	Wsd	1q, 5r				1q, 3r			1o
Proteaceae	Banksia nivea subsp. nivea						Wsd in SW W.A.								1r
Proteaceae	Banksia sessilis var. flabellifolia		1q, 1r	Recorded	6q, 19r	2q, 1r	Wsd [A complex?]	5q, 17r	3q, 14r	1r	4q, 2r	6q, 9r	1q	5q, 1r	33r
Proteaceae	Grevillea amplexans subsp. semivestita						Priority 2 taxon.								2r
Proteaceae	Grevillea biternata						Wsd				1q				1o
Proteaceae	Hakea incrassata						Wsd	4q, 6r							
Proteaceae	Hakea lissocarpha		Coll/16	Recorded			Wsd.	5r	1r		4r	3r			1r
Proteaceae	Hakea preissii			Recorded		1r	Wsd.								
Proteaceae	Hakea recurva subsp. recurva			Recorded		1o	Wsd.		1r			7r			1r, 1o
Proteaceae	Isopogon divergens			Recorded	1r		Wsd	7q, 7r	1q			2q, 3r			1o
Proteaceae	Petrophile brevifolia						Material atypical. The distribution of this Wsd suggests more than 1 taxon..								1r
Proteaceae	Synaphea quartzitica						Threatened (Declared rare) flora. Very restricted. Known for TEC, but not in the North Kiaka Mine area.								
Santalaceae	Leptomeria preissiana						Wsd. Distribution suggests variation	1r							
Santalaceae	Santalum acuminatum			Recorded		4o	Extremely Wsd	1q, 2r	1r						1o
Santalaceae	Santalum spicatum			Recorded		1o	Very Wsd				1q				

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Loranthaceae	Amyema miraculosa subsp. miraculosa			Recorded		1r, 1o	Wsd				1q				
Loranthaceae	Amyema preissii		2q	Recorded		2q, 1r, 1o	Extremely Wsd				2q, 1o				1o
Loranthaceae	Lysiana casuarinae						Wsd				1q				
Loranthaceae	Nuytsia floribunda		1q, 1r	Recorded	1q, 1r	2q, 1r	Wsd	5r	2q			2r		1q	6r
Polygonaceae	Emex australis	*	1q	Recorded		1q									
Polygonaceae	Muehlenbeckia adpressa			Recorded	1q		Very Wsd			1q	1q				
Chenopodiaceae	Atriplex suberecta		1q	Recorded		1q, 1r	Very scattered records in WA, but very Wsd					1r			
Chenopodiaceae	Dysphania melanocarpa forma melanocarpa		1q	Recorded		1q	Very Wsd. The record is a small range extension.								
Chenopodiaceae	Enchylaena tomentosa var. tomentosa		1q	Recorded		2q	Extremely Wsd, on the SW edge of distribution.	1r							
Chenopodiaceae	Maireana brevifolia			Recorded		1r	Wsd in WA, disjunct to ES					1r			
Chenopodiaceae	Maireana enchylaenoides						Moderate distribution in WA; disjunct to ES Small range extension.					2r			
Chenopodiaceae	Maireana marginata		1q	Recorded		1q	Moderate to large distribution in WA	2q				2r			
Chenopodiaceae	Rhagodia drummondii						Large distribution in WA South of Shark Bay, just into SA.	3q, 1r							
Chenopodiaceae	Rhagodia preissii subsp. preissii			Recorded			Wsd WA & SA [Recorded on JT property 2017.]	2q, 1r	1q						
Chenopodiaceae	Salsola australis	*?		Recorded	o	o	At edge of remnant. Probably weedy.								
Amaranthaceae	Ptilotus declinatus			Recorded		1o	Moderate distribution in WA	2r							
Amaranthaceae	Ptilotus divaricatus						Large distribution in WA	2q, 1r	2r			2r			1o
Amaranthaceae	Ptilotus drummondii var. drummondii			Recorded		1q, 2o	Large distribution in WA	2r	1r			1r			
Amaranthaceae	Ptilotus gaudichaudii			Recorded		1q	Wsd across Australia, except tropics and southern ES.				1q				
Amaranthaceae	Ptilotus holosericeus						Moderate to large distribution in WA.		1q						
Amaranthaceae	Ptilotus manglesii						Moderate to large distribution in WA.	1r							
Amaranthaceae	Ptilotus polystachyus		1r	Recorded	1q	1q, 1r	Extremely Wsd, all mainland states.	1r			1q, 2r			1q	
Amaranthaceae	Ptilotus spathulatus		1q	Recorded		1q, 1r	Moderate to large distribution in WA.		1q			1q			
Nyctaginaceae	Boerhavia coccinea			Recorded		1o	Extremely Wsd, all mainland states. A complex.								
Gyrostemonaceae	Gyrostemon ramulosus						Very Wsd, WA, SA, NT & Q.								1o
Portulacaceae	Calandrinia calyptrata		1q	Recorded	3q	5q, 1o	Wsd, WA to NSW, but disjunct in WA.	4q			5q	5q			
Portulacaceae	Calandrinia eremaea			Recorded	1q		Extremely Wsd, all mainland states & Tasmania.	1q	1q						
Portulacaceae	Calandrinia remota			Recorded		1q	Fairly large distribution in WA, disjunction to NT & SA, another to Q.		1q						
Portulacaceae	Calandrinia sp.						Inadequate material, mostly seedlings.	5q, 1r	4q	1q	8q	2q, 3r	1q	1q	1r
Portulacaceae	Calandrinia baccata			Recorded	1q		Moderate distribution in WA, scattered records.								
Caryophyllaceae	Petrorhagia dubia	*	1q	Recorded	8q	3q, 1r,			1q		10q	1q	1q	1q	
Caryophyllaceae	Petrorhagia velutina	*		Recorded		6q									
Caryophyllaceae	Polycarpon tetraphyllum	*	1q	Recorded		1q									
Caryophyllaceae	Silene gallica var. gallica	*	1q	Recorded	9q	5q			3q		5q	4q		1q	1q
Caryophyllaceae	Spergula arvensis	*												1q	
Lauraceae	Cassytha pomiformis			Recorded		1o		3q	1q			1q, 1r			
Brassicaceae	Brassica barrelieri subsp. oxyrrhina	*		Recorded	1q						1q				
Brassicaceae	Lepidium rotundum						Wsd in southern WA, extends to SA.	1r							
Droseraceae	Drosera aff. macrantha			Recorded	6q	4q	Fairly Wsd?	13q	5q	2q	3q	6q	2q	6q	
Droseraceae	Drosera sp. Branched styles (S.C. Coffey 193)			Recorded	6q	1q	Very widespread.	8q	4q		1q	6q	2q		
Droseraceae	Drosera hirsuta			Recorded	7q		Large distribution in SW WA, disjunct to SA & Vict.	10q	4q	1q	20q	9q	2q	2q	1q
Droseraceae	Drosera macrophylla		Obs/16	Recorded	6q	1q		8q	4q		1q	6q	2q		
Droseraceae	Drosera pallida						Moderate to large near coastal distribution Geraldton area to E of Albany.	1q	5q	1q	3q				

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Crassulaceae	Crassula colorata (ssp. indet.)			Recorded	2r	1q		1r							6r
Crassulaceae	Crassula colorata var. acuminata		1q	Recorded		3q, 1r	Extremely Wsd, all mainland states.								
Crassulaceae	Crassula colorata var. colorata			Recorded	11q	2q	Very Wsd, WA, SA, NT, NSW.	7q, 4r	4q	3q	9q	5q, 3r		1q	2r
Crassulaceae	Crassula decumbens var. decumbens			Recorded	1q		Very Wsd, WA, SA, NSW, Tas.	1q							
Crassulaceae	Crassula exserta			Recorded	5q	3q	Quite Wsd, WA, SA, Vict.	3q	3q	1q	7q	2q	2q	2q	
Pittosporaceae	Billardiera heterophylla						Wsd in southern WA, also in SA, Vict, NSW & Tas. Range extension in TEC. Formerly in Sollya.	2r				1q, 1r			1o
Surianaceae	Stylobasium australe						Common from south of Shark B to east of Perth.	3r							1o
Mimosaceae	Acacia acuminata		2r	Recorded	10q, 20r	6q, 5r, 3o	Wsd in SW WA.	5q, 33r	3q, 31r		20q, 40r	7q, 22r	1q	2q	72r
Mimosaceae	Acacia aestivalis						Moderate range in SW WA.		1q						
Mimosaceae	Acacia aristulata		DRS/06	Recorded	5q, 3r	1o	Threatened (Declared Rare) Flora. Very limited range from just N of Moora to NW of Watheroo.	9q, 9r	4q	2q	6q, 3r	4q, 2r	1q	5q	
Mimosaceae	Acacia congesta subsp. congesta			Recorded	1q	1o	Patchy distribution between Geraldton and E of Perth. Species distribution suggests needs review	5q, 10r	1q, 1r	3q, 1r	5q, 8r		1q	2q	1r
Mimosaceae	Acacia daphnifolia										1o				
Mimosaceae	Acacia ericksoniae						Patchy distribution between Geraldton and E of Perth.					1r			
Mimosaceae	Acacia erinacea			Recorded		1r,	Wsd in SW WA.	2q, 2r	1q, 1r			1r			2o
Mimosaceae	Acacia hemiteles			Recorded	2q		Wsd in SW WA.								1o
Mimosaceae	Acacia lasiocarpa var. aff. sedifolia						There are two forms of Acacia lasiocarpa var. sedifolia in the collections for the survey area, both have been determined as this by B. Maslin, the authority for the group. The records for this form are mixed with the records for var. sedifolia.								
Mimosaceae	Acacia lasiocarpa var. sedifolia						Wsd in SW WA.	1q	1q, 1r	1q, 1r	2q, 2r	1q, 1r	1q	2q	1r
Mimosaceae	Acacia ligustrina		1q	Recorded		1q, 1r	Moderate distribution from SW of Geraldton to E of Perth.	1q							
Mimosaceae	Acacia microbotrya			Recorded		1o	Wsd in SW WA.	1q, 2r			1o	1r			1r
Mimosaceae	Acacia pulchella var. glaberrima						Wsd in SW WA. Needs review.								1r
Mimosaceae	Acacia pulchella var. goadbyi						Wsd in SW WA. Needs review.	1q, 1r							
Mimosaceae	Acacia restiacea		Obs/16	Recorded	2q, 3r	1o	Wsd in SW WA north of Perth. Needs review.	3r					1q		1r
Mimosaceae	Acacia saligna (ssp?)						Very Wsd in SW WA & in ES. P	1r							
Mimosaceae	Acacia scirpifolia						Common from Geraldton area to E of Perth.	1r							1o
Mimosaceae	Acacia stenoptera						Common from Geraldton area to Albany.			2q	1q			5q	
Papilionaceae	Bossiaea moylei						Very restricted, only known from the Coomberdale Chert TEC.	6q, 13r	4q, 2r		2q			6q	1r
Papilionaceae	Cristonia stenophylla			Recorded	3q		Disjunct, possibly a restricted form, needs investigation.								
Papilionaceae	Daviesia benthamii						Moderately Wsd, needs review.	1q							
Papilionaceae	Daviesia dielsii			Recorded	2q, 1r	1o	Threatened (Declared Rare). Quite restricted	7q, 6r	1q	1r	1q	3r	1q		5r
Papilionaceae	Daviesia hakeoides subsp. subnuda			Recorded	1q		Wsd in a band from Kalbarri to Albany.	1r							1o
Papilionaceae	Gastrolobium acutum			Recorded	2q, 1r		The Coomberdale Chert TEC population is disjunct from the main population, not large and likely to be a variety or subspecies.	6q, 1r	1q	1q [Since mined]		3q, 1r	1q		1r
Papilionaceae	Gastrolobium obovatum						Fairly Wsd in SW WA.					4r			
Papilionaceae	Gompholobium glutinosum						Moderately localised with two populations.	2r							1o
Papilionaceae	Isotropis drummondii						Wsd in SW WA.								1o
Papilionaceae	Jacksonia floribunda						Common between Geraldton & SE of Perth.								1r
Papilionaceae	Jacksonia foliosa						Modest range, Mingenew to Goomalling.								1r
Papilionaceae	Kennedia prostrata			Recorded		1q	Wsd in SW WA & SE Australia.			1q	7q	1q			2r
Papilionaceae	Lupinus angustifolius	*		Recorded					3q		2q				
Papilionaceae	Templetonia smithiana						Small range extension, Gairdner's Property.					1r			

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Papilionaceae	Trifolium arvense var. arvense	*		Recorded	1q	2q			2q	2q	3q		3q	3q	
Papilionaceae	Trifolium campestre var. campestre	*		Recorded		1q									
Papilionaceae	Trifolium hirtum	*		Recorded	8q	1q			1q		1q	1q			
Papilionaceae	Trifolium repens var. repens	*								1q	6q			1q	
Papilionaceae	Trifolium subterraneum	*		Recorded	2q				2q		11q			1q	1q
Geraniaceae	Erodium botrys	*	2q, 1r	Recorded	5q	4q, 1r					5q	3q			3r
Geraniaceae	Erodium cygnorum		Obs/16	Recorded	1q		Very Wsd, all mainland states.	4q	2q	1q	4q	1q		1q	1q
Geraniaceae	Pelargonium littorale						Wsd in a band // to the coast from Cervantes to Cape Arid, then disjunct to ES. TEC population disjunct.				1o				
Oxalidaceae	Oxalis corniculata	*						1q	1q			1q			
Linaceae	Linum trigynum	*		Recorded		1q					4q	1q			1r
Rutaceae	Cyanothamnus coerulescens subsp. spinescens						Wsd in SW WA.		2r		2q				1o
Rutaceae	Cyanothamnus ramosa subsp. anethifolius						Wsd in SW WA.	1q	3q					3q	
Polygalaceae	Comesperma integerrimum			Recorded	3q	1q, 1o	Wsd in SW WA, also SA & NSW.	7q, 1q	1q, 1r	2q	8q	3q	3q	6q	1r
Euphorbiaceae	Beyeria lechenaultii		Coll/16				Fairly common SW WA, also SA, Vict, NSW & Tas. Near NW range end.								1o
Euphorbiaceae	Euphorbia drummondii subsp. drummondii			Recorded	1q	1q	Wsd WA.								
Euphorbiaceae	Phyllanthus calycinus			Recorded			Wsd SW WA, also in SA.				4r				1o
Euphorbiaceae	Poranthera microphylla			Recorded	1q		Very Wsd in Aust., except Eremaean	1q			2q				
Euphorbiaceae	Ricinocarpos muricatus		1r	Recorded		1q, 5r, 1o	Moderate distribution. Small range extension.								
Euphorbiaceae	Ricinocarpos velutinus						Only recorded at vegetation releve RM2								1r
Stackhousiaceae	Stackhousia monogyna			Recorded	3q		Wsd in SW WA & in ES.	2q				3q, 1r			
Stackhousiaceae	Tripterococcus brunonis			Recorded	1q		Wsd in SW WA.	5q	4q		1q	3q		2q	
Sapindaceae	Diplopeltis huegelii subsp. lehmannii		1q,1r	Recorded	4q, 1r	4q, 1r, 1o	TEC record isolated from other records. Moderate distribution. Species needs review.								
Sapindaceae	Dodonaea inaequifolia			Recorded		1o	Wsd SW WA No f Perth.	4q, 19r							1o
Sapindaceae	Dodonaea pinifolia						Wsd SW WA.	1q,7r	1r			2r			
Rhamnaceae	Cryptandra myriantha						Wsd SW WA. [Vouchers redetermined as C. myriantha]	3q, 1r			1q		1q	2q	
Rhamnaceae	Stenanthemum tridentatum						Moderate distribution in SW WA.					1q, 5r			
Rhamnaceae	Trymalium daphnifolium						Moderate distribution in SW WA.	2q	1q, 1r						
Rhamnaceae	Trymalium ledifolium var. rosmarinifolium			Recorded	2r	1q, 1r, 1o	Wsd from Hill River to E of Albany.	3q, 6r			4q, 4r	3q, 6r			
Malvaceae	Alyogyne hakeifolia			Recorded		1o	Wsd in SW WA & SA, rare Vict.		1o						1o
Malvaceae	Alyogyne sp. Hutt River (B.J.Lepschi & T.R.Lally 2310							1r							
Sterculiaceae	Guichenotia micrantha						Wsd in SW WA.		1q		1o				
Sterculiaceae	Guichenotia sarotes						Wsd in SW WA.				1q				
Sterculiaceae	Guichenotia tuberculata						Priority 3 species. Known from Morawa to inland from Lancelin, sporadic.								1o
Sterculiaceae	Thomasia grandiflora						Fairly Wsd in SW WA. TEC population disjunct.	2q, 3r		1q	1r			2q	
Dilleniaceae	Hibbertia acerosa						Wsd in SW WA.	1q							
Dilleniaceae	Hibbertia subvaginata		1q, 2r	Recorded	8q, 18r	6q, 6r	Fairly Wsd in SW WA. TEC population disjunct.	14q, 33r	8q, 13r	3q, 1r	19q, 6r	7q, 8r	2q, 1r	6q	24r
Thymelaeaceae	Pimelea imbricata var. piligera						Wsd in SW WA.	1q, 1r	3q						
Myrtaceae	Babingtonia cherticola						Priority 3. Restricted habitat and restricted to a small area inland from Jurien Bay & Cervantes.	8q, 28r	5q, 12r						

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Myrtaceae	Calothamnus quadrifidus subsp. angustifolia (Chert form)		Obs/16	Recorded	3q, 4r	1o	Included in Calothamnus quadrifidus ssp. angustifolius in a recent treatment, but a distinct taxon associated with chert from Moora to Watheroo.	8q, 23r	1q		1r	4q, 7r			3r
Myrtaceae	Calothamnus sanguineus			Recorded	1q	1o	Wsd in SW WA.	3q, 6r	2q			2q, 2r			
Myrtaceae	Calytrix depressa		Obs/16	Recorded			Wsd in SW WA.	2r	1q, 2r		1q	3r			
Myrtaceae	Calytrix sp. Coomberdale (M.E. Trudgen 21184)		1q, 2r	Recorded	10q, 15r	2q, 2r,	A geographically restricted species that is common in the Coomberdale Chert TEC, favouring more open areas. Old plants in more weedy areas. May regenerate mostly after fire.	14q, 34r	9q, 22r	1q, 1r	7q, 22r	9q, 23r	2q, 1r	4q	17r
Myrtaceae	Calytrix strigosa						Common from Shark B to SE of Perth.								1r
Myrtaceae	Eremaea beaufortioides var. lachnosanthe						Restricted to an area between Geraldton and Cervantes. TEC record is disjunct.								1r
Myrtaceae	Eremaea sp. Cairn Hill (B. Morgan BMor 351)						Priority 1 species. Very restricted distribution.								1o
Myrtaceae	Ericomyrtus serpyllifolia						A complex. Widespread in SW WA. One record from a very degraded area near Cairn Hill.								
Myrtaceae	Ericomyrtus tenuior						Moderately Wsd in SW WA, north of Perth.	5r			2r	2r			3r
Myrtaceae	Eucalyptus camaldulensis (forma)						The “forma” common from the Kalbarri area to E of Lancelin. The species extremely widespread.	1o							1r
Myrtaceae	Eucalyptus eudesmioides						Common from the Shark B area to E of Lancelin.	3q, 16r							3r
Myrtaceae	Eucalyptus horistes						Wsd in SW WA & nearby Eremaean.	1r	1r,2o						1r
Myrtaceae	Eucalyptus loxophleba subsp. loxophleba		1q	Recorded	1r	1q, 2r,	Common in a broad band from S of Shark B to near Albany.	6r	1q, 12r	1q	7q, 16r	1q, 8r	1q		21r
Myrtaceae	Eucalyptus obtusiflora						Common in a broad band from Carnarvon to E of Perth.	1q, 1r	1r						1o
Myrtaceae	Eucalyptus pruiniramis						Threatened (Declared Rare). Restricted to a few localities between Three Springs & Mogumber.								1r, 4o
Myrtaceae	Eucalyptus salmonophloia			Recorded		1o	Wsd in SW WA S of Geraldton.	1r				3r			1r
Myrtaceae	Eucalyptus wandoo subsp. pulverea			Recorded		1q, 1r	Wsd in the western part of the SW of WA.	5q, 12r			2q, 3r	2q, 3r			3r
Myrtaceae	Hypocalymma angustifolium						Common in the western half of the SW of WA. A complex.					4r			
Myrtaceae	Kunzea praestans		1q, 2r	Recorded	11q, 21r	4q, 3r	Limited distribution that suggests not one taxon. Needs review.	13q, 42r	8q, 16r	1r	7q, 15r	5q, 10r	1q, 1r	6q	25r
Myrtaceae	Leptospermum aff. erubescens (Moora Chert; B. Morgan 133)						Recorded for the TEC, but not in the North Kiaka Mine area. Very limited distribution. Specimen vouchered but taxon not on FloraBase.					1o			1o
Myrtaceae	Leptospermum erubescens						See: Leptospermum aff. erubescens (Moora Chert; B. Morgan 133)								3r. 1o
Myrtaceae	Melaleuca leuropoma		1q, 2r	Recorded	9q, 8r	2q, 3r,	Wsd in about half of the SW of WA. Distribution suggests needs review.	10q, 31r	5q			5q, 7r	1q		5r
Myrtaceae	Melaleuca concreta		1q	Recorded		1q	Common in a band from Shark B to near Perth.	1r	1q, 1r			1r			1o
Myrtaceae	Melaleuca coronicarpa						Common in a band from Shark B to Esperance. Needs review.					1r			1r
Myrtaceae	Melaleuca lateriflora						Wsd in SW of WA.		1o						
Myrtaceae	Melaleuca radula		Coll/16	Recorded		1o	Common in the N half of the SW, scattered otherwise.	6q, 16r	1q, 7r		1r	1q, 11r			1r
Myrtaceae	Melaleuca sclerophylla						Priority 3 species. Restricted to an area from Three Springs to E of Lancelin.					3r			
Myrtaceae	Melaleuca sp.			Recorded	1q										
Myrtaceae	Regelia megacephala		1r	Recorded	1q	2q, 5r	Priority 4 species. Very restricted range N of Moora.	9q, 26r	5q, 5r	3q	2q, 1r	3q, 1r	1q	4q	
Myrtaceae	Tetrapora preissiana						A complex, Wsd in W.A.								1r
Myrtaceae	Verticordia chrysanthella						Wsd in SW WA.	1q							
Myrtaceae	Verticordia densiflora var. densiflora						Wsd in SW WA.	1r				1r			1o
Myrtaceae	Verticordia huegelii var. stylosa						Fairly Wsd S of Moora, uncommon N of Moora.	1r							
Myrtaceae	Verticordia pennigera						Wsd from Kalbarri area to south of Perth and E of Albany.								1o
Haloragaceae	Glischrocaryon flavescens						Wsd in southern WA, also in SA.	1r				1q			1o
Haloragaceae	Gonocarpus nodulosus		Coll/16	Recorded	1q		Wsd in WA S of Carnarvon & E of Cape Arid.		1q		1q				
Apiaceae	Apium annuum			Recorded	1q		WA S of Shark B in a band then along coast to SA, Vic & Tas.	3q		2q	2q				
Apiaceae	Daucus glochidiatus			Recorded		3q	Wsd in Australia south of tropics.	2q			7q	3q		1q	

Higher group or plant family	NAME [See distribution column for highlight coding]	Weed *	North Kiaka Mine and haul road	North of Kiaka Road	John Tonkin Property JT (12)	A & R Tonkin property ART (11)	Distribution, conservation status, comments Green highlight indicates a new record for the TEC. Light blue highlight indicates a conservation taxon light orange highlight indicates a taxon needing assessment for priority or rare flora status. Wsd = widespread. Grey highlight indicates inadequate material.	Cairn Hill Reserve CAH (20)	Cairn Hill North CHN (10)	Current mine [= E Ore Body] EOR (3)	Eastern Ridge ERG (23)	Gardiner's Hill GH (10)	Waste Dump Area WDM (3)	Western Ridge WOR (6)	Other areas surveyed
Apiaceae	Homalosciadium homalocarpum			Recorded	1q		Common in a broad band from S of Shark B to near Albany and to cost.								
Apiaceae	Platysace cirrosa			Recorded	2q		From near Geraldton to E of Perth in a widening band, not common.	10q	6q	1q	14q	2q	1q	1q	
Apiaceae	Trachymene cyanopetala		1q	Recorded	9q	5q	Wsd in WA S of Shark B & E of Cape Arid, also in SA, Vict & NSW.	5q, 14r	7q, 5r		10q, 1r	5q, 1r	2q	2q	
Apiaceae	Trachymene ornata			Recorded	7q, 1r	6q	Wsd in WA S of Carnarvon & E of Cape Arid, also in SA, Vict & NSW.	14q, 6r	6q, 2r	3q	19q, 1r		3q	4q	1q
Apiaceae	Trachymene pilosa		Obs/16	Recorded	5q, 1r		Wsd in SW WA, also in SA, Vict & NSW	12q, 21r	1q, 7r		7q, 4r	7q, 6r		3q	
Apiaceae	Trachymene sp.							2q			1q	1q			
Apiaceae	Xanthosia fruticulosa						Sporadic from Green Head to S of Perth, uncommon.	14q, 33r	7q, 7r						
Epacridaceae	Styphelia serratifolia			Recorded	2q, 1r		Wsd in a broad band from Geraldton to Albany & Esperance.	4q, 8r	1r			3q, 2r	1q		
Epacridaceae	Styphelia retrorsa						Restricted distribution. TEC record an outlying record, but not greatly.								
Primulaceae	Lysimachia arvensis	*		Recorded		1q		5q	4q	3q	4q	5q	1q	3q	
Loganiaceae	Phyllangium sulcatum			Recorded	4q		Wsd in SW WA, disjunct to SA, Vict, NSW.	2q	3q		13q	2q			
Gentianaceae	Centaurium tenuiflorum	*												1q	
Asclepiadaceae	Rhyncharrhena linearis						Found over much of Australia.					1q			
Convolvulaceae	Convolvulus angustissimus subsp. angustissimus			Recorded		1q	Uncommon in SW WA, but common in ES. Needs review.								
Chloanthaceae	Quoya dilatata		1r	Recorded	5q, 2r	2q, 1r	Uncommon in a band from Three Springs to Wannamal, with 4 outlying records (2 in ES Herbaria need checking). Needs review.	6q, 4r	4q, 1r	1q, 1r	9q, 7r	3r	1q	5q	
Lamiaceae	Hemiandra incana						Sporadic distribution from E of Cervantes to E of Margaret River. Needs review.	1q							1o
Lamiaceae	Hemigenia conferta						Priority 4 species. Restricted to a very small area in the TEC (Cairn Hill NR and nearby).								
Solanaceae	Lycium australe						Wsd in S WA, SA, also in Vict & NSW.		1o						
Solanaceae	Solanum nigrum	*	1q	Recorded		1q						1q			
Solanaceae	Solanum oldfieldii			Recorded		1o	Common in a broad band from Shark B to N of Albany, some coastal records.				1q, 2r				
Scrophulariaceae	Dischisma capitatum	*									1o				
Scrophulariaceae	Parentucellia latifolia	*		Recorded	6q	2q		3q	4q	1q	17q	4q	3q	4q	1r
Scrophulariaceae	Zaluzianskya divaricata	*									1q				
Orobanchaceae	Orobanche minor	*												1q	
Myoporaceae	Eremophila lehmanniana						Occurs in an irregular broad band from S of Geraldton to N of Albany, some coast records. Needs review.	1q							
Plantaginaceae	Plantago debilis						Wsd in S WA, disjunct to CA & ES.	2q	1q				1q		
Rubiaceae	Galium murale	*		Recorded	1q						2q	1q			1q
Rubiaceae	Opercularia vaginata		1q	Recorded	6q, 2r	1q	Wsd in SW WA. A complex?	5q, 7r	6q, 1r		4q, 1r	5q, 14r		2q	7r
Campanulaceae	Wahlenbergia capensis	*		Recorded	1q			1q			1q				
Campanulaceae	Wahlenbergia gracilenta		Obs/16	Recorded	1q	1r	Wsd in the W of WA S of Carnarvon. Disjunct to SA, Vict, NSW, Tas.	6q		1q	1q			1q	
Lobeliaceae	Isotoma hypocrateriformis						Wsd in SW WA.	1q							
Lobeliaceae	Lobelia cleistogamoides						Sporadic in SW WA and nearby	3q			1q	3q			
Goodeniaceae	Brunonia australis						Wsd over Australia, a complex.				4q				1r
Goodeniaceae	Dampiera lavandulacea						Wsd in SW WA & nearby, uncommon in SA.	2q, 3r	1q			1q, 3r			
Goodeniaceae	Goodenia arthrotricha						Threatened (Declared Rare) Flora. Geographically restricted. Probably a pyrosere species.	1q	1q		1q	3q, 2r			1r
Goodeniaceae	Goodenia berardiana		Coll/16	Recorded	2q	1q	Common W WA, disjunct to NT, SA, NSW, Q.	4q	5q, 1r		13q, 3r	3q	1q	1q	
Goodeniaceae	Goodenia glareicola						Wsd in a broad band from Geraldton to Cape Arid. Needs review.	1r							
Goodeniaceae	Goodenia hassallii						Moderate occurrence from Kalbarri to Wannamal & Wongan Hills. Needs review.	1q, 1r	1q, 3r			1q, 3r			
Goodeniaceae	Goodenia sp.											2q	1q		
Goodeniaceae	Lechenaultia biloba						Wsd in SW WA.	2q				1q			
Goodeniaceae	Scaevola anchusifolia						Coastal from Carnarvon to Albany, with some inland records. Needs review.		1q						
Goodeniaceae	Scaevola glandulifera						Occurs in a broad band // to the coast from Geraldton to E of Albany.	1q			1r				

Higher group or plant family	NAME [See distribution column for highlight coding]	Weed *	North Kiaka Mine and haul road	North of Kiaka Road	John Tonkin Property JT (12)	A & R Tonkin property ART (11)	Distribution, conservation status, comments Green highlight indicates a new record for the TEC. Light blue highlight indicates a conservation taxon light orange highlight indicates a taxon needing assessment for priority or rare flora status. Wsd = widespread. Grey highlight indicates inadequate material.	Cairn Hill Reserve CAH (20)	Cairn Hill North CHN (10)	Current mine [= E Ore Body] EOR (3)	Eastern Ridge ERG (23)	Gardiner's Hill GH (10)	Waste Dump Area WDM (3)	Western Ridge WOR (6)	Other areas surveyed
Goodeniaceae	Scaevola phlebopetala			Recorded	1q		Occurs in a broad band // to the coast from Geraldton to Perth.	3q	4q					1q	
Goodeniaceae	Velleia cycnopotamica						Wsd in SW WA and nearby, disjunct to SA.	1r			1q				
Stylidiaceae	Levenhookia stipitata			Recorded	1q		Wsd in SW WA and nearby, disjunct to SA.	2q	1q						
Stylidiaceae	Stylidium calcaratum		Coll/16	Recorded			Wsd in SW WA and nearby, disjunct to SA.	1q	1q				1q		
Stylidiaceae	Stylidium caricifolium			Recorded	3q		Wsd in a widening belt from Geraldton to N of Stirling Range.	1q, 1r				2q		3q	
Stylidiaceae	Stylidium glabrifolium						Priority 2 species. Specimen sterile.			1q	2q				
Stylidiaceae	Stylidium miniatum						Moderate distribution from S of Geraldton to N & NE of Perth.	2q				1q			
Stylidiaceae	Stylidium repens			Recorded	6q	1r	Wsd in SW WA					3q			
Stylidiaceae	Stylidium sp. Moora (J.A. Wege 713)		Coll/16	Recorded	9q, 1r	2q	Priority 2. Sporadic from N or Geraldton to NE of Perth, needs review.	13q, 28r	9q, 7r		1q, 2r	6r		1q	
Asteraceae	Actinobole uliginosum					1o	Wsd in the southern 2/3 of Australia. A complex?								
Asteraceae	Arctotheca calendula	*	2q	Recorded	11q	6q		6q	8q	1q	15q	3q	3q+	1q	
Asteraceae	Blennospora drummondii			Recorded	1q. 1r		Wsd in SW WA, disjunct to SA & Vict.	7q, 11r	9q, 2r	2q	8q, 2r	2q, 4r		1q	
Asteraceae	Brachyscome perpusilla		1q	Recorded		1q	Wsd in SW WA, disjunct to SA, NSW & Vict.		1q						
Asteraceae	Calotis hispidula						Wsd over Aust. S of the tropics.		1q		1q				
Asteraceae	Cotula turbinata	*	1q	Recorded		1q									
Asteraceae	Erymophyllum tenellum						Wsd in SW WA & a few Eremaean records.		1r						
Asteraceae	Gilberta tenuifolia			Recorded	1q, 1r	1q, 1o	Wsd in SW WA & nearby Eremaean.	2q	1q, 5r		9q, 20r	4q, 3r	3q		13r
Asteraceae	Hedypnois rhagadioloides	*									3q	1q			
Asteraceae	Hyalosperma cotula			Recorded	1q	1o	Wsd Geraldton to Albany // to the coast, scattered records in NSW & Vict.		2q		2q	9q, 2r	2q	1q	4r
Asteraceae	Hyalosperma demissum			Recorded	1o										
Asteraceae	Hyalosperma glutinosum subsp. glutinosum			Recorded	1q		Wsd in SW WA, disjunct to SA, NSW & Q.		1r		1q				2r
Asteraceae	Hypochaeris glabra	*	2q	Recorded	12q, 13r	10q, 1r		17q	9q	3q	22q, 2r	7q, 4r	3q	4q	1q,10r
Asteraceae	Hypochaeris radicata	*						3q							
Asteraceae	Isoetopsis graminifolia			Recorded	Coll/16										1o
Asteraceae	Lagenophora huegelii						Wsd in W SW WA, disjunct to SA, NSW & Tas.	1q				3q			
Asteraceae	Lawrencella rosea			Recorded		1r	Wsd in SW WA, adjacent Eremaean.	8q, 19r	8q, 10r		9q, 5r	1q, 4r		1q	1r
Asteraceae	Millotia aff. tenuifolia (Moora: CH20-11)							1q							
Asteraceae	Millotia myosotidifolia			Recorded	2q	2q	Wsd in SW WA, disjunct to SA, NSW & Vict.					1q			
Asteraceae	Millotia tenuifolia var. tenuifolia			Recorded	2q, 1r	1q, 1r	Wsd in SW WA, disjunct to SA, Tas. & Vict.	4q, 5r		1q	4q	1q		1q	2r
Asteraceae	Olearia sp. Eremicola (Diels & Pritzel s.n. PERTH 00449628)			Recorded	1q, 1r	1o	Wsd in SW WA.				9q, 9r	6q, 11r			4r
Asteraceae	Podolepis canescens			Recorded	1q	1q, 1r, 2o	Wsd in Aust. S of tropics.	3q, 5r	2q		2q	5q, 20r			
Asteraceae	Podolepis capillaris			Recorded	o		Wsd in Aust. S of tropics, except far ES.								
Asteraceae	Podolepis gracilis						Wsd from Geraldton to Albany in a band // to the coast, scattered records to E.							1q	
Asteraceae	Podolepis lessonii			Recorded	10q, 14r	2q, 1r	Wsd in WA S of Carnarvon & E of Cape Arid, one SA record.	5q, 9r	8q, 11r		19q, 31r	8q, 15r	3q, 2r	6q	1q
Asteraceae	Podotheca aff. gnaphalioides (Moora WDM1-65)						Not uncommon, fairly Wsd (not restricted to TEC).						3q		
Asteraceae	Podotheca angustifolia		Coll/16	Recorded	4q, 3r		Wsd in SW WA, disjunct to SA, NSW & Vict, 1 record from Tas.	3q, 6r	6q, 3r		11q, 1r	7q, 5r	3q	1q	
Asteraceae	Podotheca gnaphalioides			Recorded	2q	1q	Wsd in WA S of Carnarvon & W of Ravensthorpe								
Asteraceae	Pterochaeta paniculata						Wsd in SW WA.	1q							
Asteraceae	Quinetia urvillei			Recorded	Coll/16		Wsd in SW WA, disjunct to SA, & Vict.		2q		4q				
Asteraceae	Rhodanthe laevis			Recorded	4q		Wsd in SW WA, disjunct to SA, NSW & Vict & 2 records each in Q & NT.				3q		1q		
Asteraceae	Rhodanthe manglesii			Recorded	1q		Wsd in SW WA, also in adjacent Eremaean.		1q						

Higher group or plant family	NAME [See distribution column for highlight coding]	Weed *	North Kiaka Mine and haul road	North of Kiaka Road	John Tonkin Property JT (12)	A & R Tonkin property ART (11)	Distribution, conservation status, comments Green highlight indicates a new record for the TEC. Light blue highlight indicates a conservation taxon light orange highlight indicates a taxon needing assessment for priority or rare flora status. Wsd = widespread. Grey highlight indicates inadequate material.	Cairn Hill Reserve CAH (20)	Cairn Hill North CHN (10)	Current mine [= E Ore Body] EOR (3)	Eastern Ridge ERG (23)	Gardiner's Hill GH (10)	Waste Dump Area WDM (3)	Western Ridge WOR (6)	Other areas surveyed
Asteraceae	Rhodanthe polycephala			Recorded		2q	Wsd in a band from Shark B to N of Albany, with a few records to the E.	5q, 3r	1q, 3r		1r	1r			
Asteraceae	Rhodanthe pygmaea			Recorded			Wsd in S WA & SA, Wsd in Vict & NSW		1q						
Asteraceae	Schoenia cassiniana			Recorded	1q	4q	Wsd in WA, S NT & SA.	3q			3q	3q		1q	
Asteraceae	Senecio glossanthus		1q	Recorded		1q	Wsd in Aust. S of Tropics.								
Asteraceae	Siloxerus humifusus						Wsd in a band parallel to coast from S of Geraldton to Cape Arid area.				1q				
Asteraceae	Sonchus asper	*		Recorded		1q									
Asteraceae	Sonchus oleraceus	*		Recorded	1q, 1r			1		1q	2q	1q	2q		
Asteraceae	Trichocline [Amblysperma] sp. Moora (GH7-57)						Specimen sterile. If Trichocline undescribed. Needs recollection.					1q			
Asteraceae	Monoculus monstrosus	*		Recorded	8q	1q		5q	2q	2q	7q	2q	1q	1q	1q
Asteraceae	Urospermum picroides	*	1q	Recorded	3q	8q, 1r		2q		2q	5q	4q		2q	1q
Asteraceae	Ursinia anthemoides subsp. anthemoides	*	1q, 1r	Recorded	12q, 2r	10q, 6r		18q, 1r	9q	3q	23q, 2r	10q, 4r	3q	6q	1q
Asteraceae	Waitzia acuminata						Wsd in Aust. S of tropics.					1q			
Asteraceae	Waitzia nitida			Recorded	5q	1q	Wsd in SW WA.	1q, 7r	1q, 4r		13q, 8r	4q, 9r			

Appendix C

Taxonomic name changes

Taxonomic name changes

This appendix has changes to botanical names used in Trudgen *et al.* 2012 and earlier reports where specimens have been redetermined, there have been nomenclatural changes published in taxonomic papers, or specimens previously referred to by an informal (geographic name) have been described in such papers.

Name used in earlier reports, particularly Trudgen *et al.* (2012)	**Name used in the current report**
Acacia lasiocarpa var. sedifolia *[This name still applied to some specimens, there are two forms]*	*Acacia lasiocarpa var. sedifolia* *AND* *Acacia lasiocarpa var. aff. sedifolia*
Aira caryophyllea	*Aira elegantissima*
Alyogyne huegeliana	*Alyogyne sp. Hutt River (B.J. Lepschi & T.R. Lally 2310)*
Baeckea crispiflora	*Ericomyrtus serpyllifolia*
Baeckea crispiflora (smaller leaf form) *Baeckea crispiflora var. tenuior*	*Ericomyrtus tenuior*
Baeckea preissiana	*Tetrapora preissiana*
Baeckea sp. Moora (R. Bone 1993/1)]	*Babingtonia cherticola*
Boronia ramosa ssp. anethifolia	*Cyanothamnus ramosus subsp. anethifolius*
Boronia coerulescens subsp. spinescens	*Cyanothamnus coerulescens subsp. spinescens*
Caesia alfordii [MS]	*Caesia sp. Wongan*
Caesia sp. (Moora hairy stem) & *Caesia (Moora hairy stem)*	*Dichopogon preissii*
Caladenia flaccida subsp. flaccida	*Caladenia paradoxa*
Chamaescilla corymbosa var. corymbosa	*Chamaescilla versicolor*
Comesperma virgatum	*Comesperma integerrimum*
Comesperma volubile	*Comesperma integerrimum*
Corynotheca micrantha var. micrantha	*Thysanotus dichotomus*
Cryptandra glabriflora	[Vouchers redetermined as C. myriantha]
Desmocladus flexuosus	*Desmocladus asper*
Diuris aff. recurva	*Diuris recurva*
Drosera erythrorhiza subsp. erythrorhiza *Drosera macrophylla subsp. macrophylla*	*Drosera macrophylla*
Drosera macrantha	*Drosera hirsuta*
Hemigenia sp.	*Hemigenia conferta*
Leucopogon sp. Moora *Leucopogon sp. Yanchep* *Leucopogon sp. Northern Scarp.*	*Styphelia retrorsa*
Lobelia sp. small flowers (K.F. Kenneally 7705)	*Lobelia cleistogamoides*
Melaleuca calyptroides	*Melaleuca leuropoma*

Name used in earlier reports, particularly Trudgen *et al.* (2012)	Name used in the current report
Olearia dampieri subsp. eremicola	*Olearia sp. Eremicola (Diels & Pritzel s.n. PERTH 00449628)*
Paracaleana carinata	*Paracaleana hortiorum*
Pterostylis aff. rufa	*Pterostylis exserta*
Schoenus clandestinus	*Schoenus latitans*
Stylidium septentrionale	*Stylidium sp. Moora (J.A. Wege 713)*
Tricoryne arenicola (MS)	*Tricoryne sp. Wongan Hills (B.H. Smith 794)*

Appendix D

Likelihood of Occurrence (Pre/Post Survey)

Likelihood of Occurrence (Pre/Post Survey)

Flora likelihood of occurrence assessment guidelines

Likelihood of occurrence	Guideline
Recorded	Species recorded in current survey and/or previous recorded from desktop review
Likely	Species previously recorded within the study area and large areas of suitable habitat occur in the project area.
Possible	Species previously recorded within the study area and areas of suitable habitat occur/may occur in the project area.
Unlikely	Species previously recorded within the study area, but suitable habitat does not occur in the project area.
Highly unlikely	Species not previously recorded within the study area, suitable habitat does not occur in the project area and/or the project area is outside the natural distribution of the species.
Other considerations	Intensity of survey, availability of access, growth form type, recorded flowering times, cryptic nature of species

Source information - desktop searches
PMST – DEE Protected Matters Search Tool (PMST) to identify flora listed under the EPBC Act potentially occurring within the study area
TPFL and WAHERB – records of threatened flora from TPFL and WAHERB database searches within the study area
NM – DBCA *NatureMap* (accessed February 2023)

Flora likelihood of occurrence assessment of conservation significant flora identified in the desktop assessment as potentially occurring in the survey area

Table 7.1 Likelihood of Occurrence – Pre and Post survey

Family	Taxon	Status		Description	Survey efficacy	Likelihood of occurrence		Source
		EPBC Act	WC Act /DBCA			Pre-Survey	Post-Survey	
Araliaceae	*Hydrocotyle spinulifera*	-	P3	Annual herbs consisting of a basal rosette of leaves and branched stems bearing leaves and umbellate inflorescences, 1–4 cm high. This species is a winter annual, with flowering and	High coverage of all habitats in 2012 survey area with 99 quadrats, 398 releves and Rare/Priority search transects.	Highly unlikely, no suitable habitat within the survey area. Area surveyed during flowering period.	Highly unlikely to occur.	WAHerb

Family	Taxon	Status		Description	Survey efficacy	Likelihood of occurrence		Source
		EPBC Act	WC Act /DBCA			Pre-Survey	Post-Survey	
				fruiting occurring from August to November (Perkins, 2018). Extends from near Moora north to Three Springs and further north-east to beyond Morawa. Plants grow along moist margins of seasonal wetlands, freshwater and saline lakes in this region (Perkins, 2018).				
Ericaceae	*Andersonia gracilis*	EN	VU	Slender erect or open straggly shrub, 0.1-0.5(-1) m high. Flowers: white-pink-purple, September to November. White/grey sand, sandy clay, gravelly loam. Winter-wet areas, near swamps (Trudgen, Morgan, & Griffin, A flora survey, floristic analysis and vegetation survey of the Coomberdale Chert TEC, 2006).	High coverage of all habitats in 2012 survey area with 99 quadrats, 398 releves and Rare/Priority search transects.	Unlikely, no suitable habitat within the survey area. Area surveyed during flowering period.	Highly unlikely to occur.	PMST
Ericaceae	*Styphelia allittii*	-	P3	Distribution: Gingin, Regans Ford, Boonanarring,	High coverage of all habitats in 2012 survey area with 99	Unlikely, area surveyed during flowering period. Little if any suitable habitat.	Highly unlikely to occur.	WAHerb

Family	Taxon	Status		Description	Survey efficacy	Likelihood of occurrence		Source
		EPBC Act	WC Act /DBCA			Pre-Survey	Post-Survey	
				Moora, Ajan, Yuna. Flowering period: April to June (State of Western Australia, 2022). One record approx. 15 km south within the Moora townsite (DBCA, 2023).	quadrats, 398 releves and Rare/Priority search transects.			
Ericaceae	*Styphelia tamminensis*	-	P3	Distribution: Wongan Hills, Marchagee, Watheroo, Moora, Tammin. Flowering period: June, October to December (State of Western Australia, 2022). One record approx. 15 km south within the Moora townsite in sandy soil (DBCA, 2023).	High coverage of all habitats in 2012 survey area with 99 quadrats, 398 releves and Rare/Priority search transects.	Unlikely, area surveyed during flowering period.	Highly unlikely to occur.	WAHerb
Fabaceae	*Acacia aristulata*	EN	EN	Erect or scrambling shrub, 0.25-1 m high. Flowers: cream-white, September to December. Loamy or clayey sand over chert. Low rocky ridges and hills, outcrops (Trudgen, Morgan, & Griffin, A flora survey, floristic analysis and	High coverage of all habitats in 2012 survey area with 99 quadrats, 398 releves and Rare/Priority search transects.	Recorded, suitable habitat known to occur within the survey area. Area surveyed during flowering period.	Known to occur, population well defined. After fire or disturbance may appear from soil stored seed at additional locations to those already known.	PMST, NatureMap, TPLF, WAHerb

Family	Taxon	Status		Description	Survey efficacy	Likelihood of occurrence		Source
		EPBC Act	WC Act /DBCA			Pre-Survey	Post-Survey	
				vegetation survey of the Coomberdale Chert TEC, 2006).				
Fabaceae	*Acacia cochlocarpa subsp. cochlocarpa*	EN	CR	Glabrous, sprawling shrub, 0.3-0.7(-1.5) m high. Flowers: yellow. Clayey, sandy, often gravelly soils (Trudgen, Morgan, & Griffin, A flora survey, floristic analysis and vegetation survey of the Coomberdale Chert TEC, 2006). Flowering period June to July (State of Western Australia, 2022). One record approx. 15 km south within the Moora townsite (DBCA, 2023).	High coverage of all habitats in 2012 survey area with 99 quadrats, 398 releves and Rare/Priority search transects.	Unlikely, limited suitable habitat within the survey area. Area surveyed during flowering period.	Highly unlikely to occur.	PMST, WAHerb
Fabaceae	*Acacia congesta subsp. cliftoniana*	-	P1	Spreading shrub, 0.5-1 m high. Flowers: yellow, August to September. Rocky or lateritic loam (Trudgen, Morgan, & Griffin, A flora survey, floristic analysis and vegetation survey of the Coomberdale Chert TEC, 2006).	High coverage of all habitats in 2012 survey area with 99 quadrats, 398 releves and Rare/Priority search transects.	Possible, suitable habitat known to occur within the survey area. Area surveyed during flowering period. There is one record in the TEC, but it is an outlier for the range of the taxon.	Highly unlikely to occur.. The putative record at Cairn Hill is likely to be mis-determined. All other records of *Acacia congesta* from Cairn Hill or the TEC area (including 4 determined by B. Maslin) are considered to be subspecies *congesta*.	NatureMap, TPLF, WAHerb

Family	Taxon	Status		Description	Survey efficacy	Likelihood of occurrence		Source
		EPBC Act	WC Act /DBCA			Pre-Survey	Post-Survey	
				One record at Cairn Hill (DBCA, 2023).				
Fabaceae	*Acacia cummingiana*	-	P3	Sprawling, straggly, rush-like shrub, 0.3-0.5 m high. Flowers: yellow, May to June or August. Grey or yellow sand, lateritic gravel. Sandplains, lateritic breakaways (Trudgen, Morgan, & Griffin, A flora survey, floristic analysis and vegetation survey of the Coomberdale Chert TEC, 2006). One record approx. 15 km southwest on the margin of lake/ wetland (DBCA, 2023).	High coverage of all habitats in 2012 survey area with 99 quadrats, 398 releves and Rare/Priority search transects.	Unlikely, limited suitable habitat within the survey area. Survey conducted during flowering period.	Highly unlikely to occur.	TPLF, WAHerb
Fabaceae	*Acacia flabellifolia*	-	P3	Erect, spreading, pungent shrub, 0.4-1 m high. Rocky loam, lateritic gravelly soils. Low hills and ridges (Trudgen, Morgan, & Griffin, A flora survey, floristic analysis and vegetation survey of the Coomberdale Chert TEC, 2006).	High coverage of all habitats in 2012 survey area with 99 quadrats, 398 releves and Rare/Priority search transects.	Possible, suitable habitat known to occur within the survey area.	Highly unlikely. The closest records for this species to the proposed North Kiaka Mine are from ca. 20 km to the north (near Watheroo). One collection from near Watheroo was collected on quartzite, but	TPLF, WAHerb

Family	Taxon	Status		Description	Survey efficacy	Likelihood of occurrence		Source
		EPBC Act	WC Act /DBCA			Pre-Survey	Post-Survey	
				Distribution: Arrino, Watheroo, Eneabba. Flowering period: August (State of Western Australia, 2022). Three records approx. 17 km north of the survey area on quartz hill/ chert (DBCA, 2023).			others were collected from Wandoo woodland. *Acacia flabellifolia* has not been collected in the 2012 survey area. *Acacia ericksoniae*, has been recorded, but is clearly different to *Acacia flabellifolia*.	

Family	Taxon	Status		Description	Survey efficacy	Likelihood of occurrence		Source
		EPBC Act	WC Act /DBCA			Pre-Survey	Post-Survey	
Fabaceae	*Acacia splendens*	EN	CR	Tree or shrub, to 8 m high. Flowers: yellow, May. White sand over clay, pale brown loam, cracked brown soil, gravel, laterite, ironstone. Slopes of breakaways, especially southern slopes, hills (Trudgen, Morgan, & Griffin, A flora survey, floristic analysis and vegetation survey of the Coomberdale Chert TEC, 2006). Distribution: Dandaragan. Flowering period: August to September (State of Western Australia, 2022). One record approx. 20 km south west of the survey area on a dry water course (DBCA, 2023).	High coverage of all habitats in 2012 survey area with 99 quadrats, 398 releves and Rare/Priority search transects.	Unlikely, limited suitable habitat within the survey area. Area surveyed during flowering period.	Highly unlikely to occur. Outside known range.	WAHerb
Fabaceae	*Bossiaea moylei*	-	P2	Distribution: Moora. Flowering period: September (State of Western Australia, 2022).	High coverage of all habitats in 2012 survey area with 99 quadrats, 398 releves and DRF/Priority transects.	Known to occur within the 2012 survey area.	Known to occur in 2012 survey area; population well defined. *Bossiaea moylei* has a sporadic	NatureMap, WAHerb

Family	Taxon	Status		Description	Survey efficacy	Likelihood of occurrence		Source
		EPBC Act	WC Act /DBCA			Pre-Survey	Post-Survey	
				Nine records within Cairn Hill and Moora Mine (DBCA, 2023).			distribution in the TEC south of Kiaka Road. It has not been recorded north of Kiaka Road in any quadrat, releve, or any rare flora search transect.	
Fabaceae	*Chorizema humile*	EN	CR	Sprawling, prostrate or decumbent shrub. Flowers yellow and red/brown, July to September. Sandy clay or loam. Plains (Trudgen, Morgan, & Griffin, A flora survey, floristic analysis and vegetation survey of the Coomberdale Chert TEC, 2006).	High coverage of all habitats in 2012 survey area with 99 quadrats, 398 releves and Rare/Priority search transects.	Unlikely, limited suitable habitat within the survey area. Area surveyed during flowering period.	Highly unlikely to occur. Outside known range.	PMST
Fabaceae	*Daviesia dielsii*	EN	EN	Divaricate shrub, 0.5-0.9 m high. Flower: orange and red, July. Sandy, often gravelly soils (Trudgen, Morgan, & Griffin, A flora survey, floristic analysis and vegetation survey of the Coomberdale Chert TEC, 2006).	High coverage of all habitats in 2012 survey area with 99 quadrats, 398 releves and DRF/Priority transects. Population well defined.	Recorded. Scattered records in the TEC, mostly south of Kiaka Road but also in the southern part of the area north of that road.	Known to occur in 2012 survey area; population well defined. After fire or disturbance may appear from soil stored seed at additional locations to those already known.	PMST, NatureMap, TPLF, WAHerb

Family	Taxon	Status		Description	Survey efficacy	Likelihood of occurrence		Source
		EPBC Act	WC Act /DBCA			Pre-Survey	Post-Survey	
				Distribution: Moora, Watheroo, Marchagee, Dalwallinu. Flowering period: July to August (State of Western Australia, 2022). Nineteen records within Cairn Hill and Moora Mine (DBCA, 2023).				
Fabaceae	*Gastrolobium appressum*	VU	EN	Erect shrub, to 0.3 m high. Flowers: Yellow and orange and red and purple, August to December. White/yellow sand with quartz gravel. Sandplains, low rises (Trudgen, Morgan, & Griffin, A flora survey, floristic analysis and vegetation survey of the Coomberdale Chert TEC, 2006).	High coverage of all habitats in 2012 survey area with 99 quadrats, 398 releves and DRF/Priority transects.	Small possibility of occurrence, but closest records 25 km to east and 40 km to north of Cairn Hill. Habitat largely not suitable.	Highly unlikely to occur. Outside known range, soil, habitat not suitable.	PMST
Fabaceae	*Gastrolobium hamulosum*	EN	CR	Low shrub, 0.2-0.45 m high. Flowers: yellow and orange and red and purple, August to October. Sandy, often gravelly soils or clay. Flats, slopes,	High coverage of all habitats in 2012 survey area with 99 quadrats, 398 releves and DRF/Priority transects.	Possible, suitable habitat occurs within the survey area.	Highly unlikely to occur, due to survey intensity and size of the species.	PMST, NatureMap, WAHerb

Family	Taxon	Status		Description	Survey efficacy	Likelihood of occurrence		Source
		EPBC Act	WC Act /DBCA			Pre-Survey	Post-Survey	
				ridges (Trudgen, Morgan, & Griffin, A flora survey, floristic analysis and vegetation survey of the Coomberdale Chert TEC, 2006). Two records approx. 2 km north west of the survey area (DBCA, 2023).				
Fabaceae	*Isotropis cuneifolia subsp. glabra*	-	P3	Prostrate to ascending, spreading perennial, herb or shrub, 0.05-0.15 m high. Flowers: yellow/orange and red, September. Sand, clay loam. Winter-wet flats (Trudgen, Morgan, & Griffin, A flora survey, floristic analysis and vegetation survey of the Coomberdale Chert TEC, 2006).	High coverage of all habitats in 2012 survey area with 99 quadrats, 398 releves and Rare/Priority search transects.	Unlikely, limited suitable habitat within the survey area. Area surveyed during flowering period.	Highly unlikely to occur. Survey area outside range of taxon.	WAHerb
Frankeniaceae	*Frankenia conferta*	EN	VU	Frankenia conferta is a small shrub and is widely distributed, growing in clayey soils on the edge of salt lakes, between Koorda, Dalwallinu, Perenjori and	High coverage of all habitats in 2012 survey area with 99 quadrats, 398 releves and Rare/Priority search transects.	Unlikely, no suitable habitat within the survey area. Area surveyed during flowering period.	Highly unlikely to occur. No saline habitats in survey area.	PMST

Family	Taxon	Status		Description	Survey efficacy	Likelihood of occurrence		Source
		EPBC Act	WC Act /DBCA			Pre-Survey	Post-Survey	
				Coorow. However, sites are localised and sparsely scattered within lake chains and major drainage lines in the Yarra Yarra, Ninghan and Avon catchments. Flowering October (DEC, 2009).				
Goodeniaceae	*Goodenia arthrotricha*	EN	EN	Erect perennial, herb, to 0.4 m high. Flower: blue, October to November. Gravel. Granite rocks, slopes (Trudgen, Morgan, & Griffin, A flora survey, floristic analysis and vegetation survey of the Coomberdale Chert TEC, 2006).	High coverage of 2012 survey area with 99 quadrats, numerous releves and transects.	Recorded in the TEC south of Kiaka Road.	Known to occur in survey area. After fire or disturbance may appear from soil stored seed at additional locations to those already known.	PMST, NatureMap, TPLF, WAHerb
Haemodoraceae	*Anigozanthos humilis* subsp. Badgingarra (S.D. Hopper 7114)	-	P2	Erect, hirsute rhizomatous, herb, to 0.9 m high. Grey-white sand, rich brown sandy loam, sandy clay, alluvial soils. Low plains, river-banks, winter-wet swamps (Trudgen, Morgan, & Griffin, A flora survey, floristic	High coverage of all habitats in 2012 survey area with 99 quadrats, 398 releves and Rare/Priority search transects.	Unlikely, no suitable habitat within the survey area. Area surveyed during flowering period.	Highly unlikely to occur.	WAHerb

Family	Taxon	Status		Description	Survey efficacy	Likelihood of occurrence		Source
		EPBC Act	WC Act /DBCA			Pre-Survey	Post-Survey	
				analysis and vegetation survey of the Coomberdale Chert TEC, 2006). Distribution: North east Cataby, flowering September to October (State of Western Australia, 2022).				
Hemerocallidaceae	*Tricoryne* sp. Wongan Hills (B.H. Smith 794)	-	P2	Multi-stemmed, open, caespitose rhizomatous, perennial, herb, to 0.2 m high. Yellow to grey sand, gravelly clay quartz, laterite, limestone. (Trudgen, Morgan, & Griffin, A flora survey, floristic analysis and vegetation survey of the Coomberdale Chert TEC, 2006). Seven known occurrences in Coomberdale TEC survey area (Trudgen, Griffin, & Morgan, 2012)	High coverage of all habitats in 2012 survey area with 99 quadrats, 398 releves and DRF/Priority transects.	Recorded in the TEC with most records south of Kiaka Road and one record north of Kiaka Road.	Known to occur in survey area. Population well defined, although some plants not in flower during surveys may be present in areas where not recorded.	NatureMap, WAHerb
Lamiaceae	*Dasymalla axillaris*	CR	CR	Previously known as Pityrodia axillaris (Trudgen, Morgan, & Griffin, A flora survey, floristic	High coverage of all habitats in 2012 survey area with 99 quadrats, 398 releves and Rare/Priority search transects.	Unlikely, limited suitable habitat within the survey area. Area surveyed during flowering period.	Highly unlikely to occur. Range is well to east of Moora.	PMST

Family	Taxon	Status		Description	Survey efficacy	Likelihood of occurrence		Source
		EPBC Act	WC Act /DBCA			Pre-Survey	Post-Survey	
				analysis and vegetation survey of the Coomberdale Chert TEC, 2006). Small shrub to 30 cm high, flowering period July to December, found in disturbed areas of deep yellow sand in *Allocasuarina* and *Acacia* shrubland approximately 200 km south-east of Geraldton (DEC, 2008).				

Family	Taxon	Status		Description	Survey efficacy	Likelihood of occurrence		Source
		EPBC Act	WC Act /DBCA			Pre-Survey	Post-Survey	
Lamiaceae	*Dicrastylis velutina*	-	P3	Shrub, 0.1-0.6 m high. Flowers: white, October to December. Sandy soils, gravelly loam (Trudgen, Morgan, & Griffin, A flora survey, floristic analysis and vegetation survey of the Coomberdale Chert TEC, 2006). Distribution: Watheroo National Park, Yorkrakine and Bindi (State of Western Australia, 2022). One previous record approx. 15 km north east in a sandy rise between salt lakes in Namban Nature Reserve (DBCA, 2023).	High coverage of all habitats in 2012 survey area with 99 quadrats, 398 releves and Rare/Priority search transects.	Unlikely, limited suitable habitat within the survey area. Area surveyed during flowering period.	Highly unlikely to occur. Range is well to north and east of Moora.	WAHerb
Lamiaceae	*Hemiandra gardneri*	EN	CR	Prostrate, pungent shrub, 0.1-0.2 m high, to 1 m wide. Flowers: red/pink-red, August to October. Grey or yellow sand, clayey sand. Sandplains (Trudgen, Morgan, & Griffin, A flora survey, floristic	High coverage of all habitats in 2012 survey area with 99 quadrats, 398 releves and DRF/Priority transects.	Unlikely as mostly grows on yellow sand and this soil cleared in survey area.	Highly unlikely to occur. due to survey intensity. Apart from one old record in the Moora area known occurrences are more than 25 km away. Soil types	PMST, WAHerb

Family	Taxon	Status		Description	Survey efficacy	Likelihood of occurrence		Source
		EPBC Act	WC Act /DBCA			Pre-Survey	Post-Survey	
				analysis and vegetation survey of the Coomberdale Chert TEC, 2006).			in TEC remnants not suitable.	
Lamiaceae	*Hemigenia conferta*	-	P4	Erect to spreading shrub, 0.3-1.4 m high. Flower: white-cream-purple, September to October. Shallow soils (Trudgen, Morgan, & Griffin, A flora survey, floristic analysis and vegetation survey of the Coomberdale Chert TEC, 2006). Two occurrences in Coomberdale TEC survey area(Trudgen 2012).	High coverage of all habitats in 2012 survey area with 99 quadrats, 398 releves and DRF/Priority transects.	Know to occur in the TEC survey area at two localities and nearby on a road verge.	The occurrence in the TEC survey area is localised. Additional localities possible but unlikely. Unlikely to occur in TEC north of Kiaka Road due to habitat differences.	Trudgen 2012
Lamiaceae	*Hemigenia curvifolia*	-	P2	Shrub, 0.2-0.7 m high. Flower: blue, September to October. Sandy soils (Trudgen, Morgan, & Griffin, A flora survey, floristic analysis and vegetation survey of the Coomberdale Chert TEC, 2006). Five records approx. 15-20 km southwest	High coverage of all habitats in 2012 survey area with 99 quadrats, 398 releves and Rare/Priority search transects.	Unlikely, limited suitable habitat within the survey area. Area surveyed during flowering period.	Highly unlikely to occur.	WAHerb

Family	Taxon	Status		Description	Survey efficacy	Likelihood of occurrence		Source
		EPBC Act	WC Act /DBCA			Pre-Survey	Post-Survey	
				of the survey area (DBCA, 2023).				
Malvaceae	*Guichenotia tuberculata*	-	P3	Erect, open shrub, (0.25-)0.6-0.9 m high. Flower: purple-pink, August to October. Sand clay over laterite, sand. (Trudgen, Morgan, & Griffin, A flora survey, floristic analysis and vegetation survey of the Coomberdale Chert TEC, 2006). One population recorded in regional mapped extent of Coomberdale TEC (Trudgen, Griffin, & Morgan, 2012)	High coverage of all habitats in 2012 survey area with 99 quadrats, 398 releves and DRF/Priority transects.	Know to occur in the TEC survey area at one locality.	The occurrence in the TEC survey area is localised. Additional localities possible but unlikely. Unlikely to occur in TEC north of Kiaka Road	NatureMap, WAHerb
Myrtaceae	*Babingtonia cherticola*	-	P3	Baeckea sp. Moora (R. Bone 1993/1) is more recently known as *Babingtonia cherticola* Rye & Trudgen (Trudgen, Morgan, & Griffin, 2006). Shrubs low-growing to erect, 0.3–1.5(–3) m high, flowering spring and summer, especially from October to February	Occurrence in TEC well defined by quadrats, releves and transects,	Occurs in the TEC. Known at 77 locations in TEC survey area (Trudgen 2012).	All occurrences in the 2012 survey area are in Cairn Hill or Cairn Hill North. Unlikely to occur north of Kiaka Road.	NatureMap, WA Herb

Family	Taxon	Status		Description	Survey efficacy	Likelihood of occurrence		Source
		EPBC Act	WC Act /DBCA			Pre-Survey	Post-Survey	
				(Rye, A revision of the south-western Australian genus Babingtonia (Myrtaceae: Chamelaucieae), 2015). 77 populations in regional mapped extent of Coomberdale TEC (Trudgen, Griffin, & Morgan, 2012).				
Myrtaceae	*Babingtonia urbana*	-	P3	Shrubs low-growing to erect, 0.3–1.5(–3) m high, flowering spring and summer, especially from October to February (Rye, 2015).	High coverage of all habitats in 2012 survey area with 99 quadrats, 398 releves and DRF/Priority transects.	Unlikely. Babingtonia urbana is only known from the Swan Coastal Plain, where it occurs in or adjacent to seasonal damplands or wetlands.	Highly unlikely to occur. The lack of wetland habitat excludes any reasonable chance of this taxon occurring in the TEC survey area.	TPLF
Myrtaceae	*Balaustion grande*	-	P3	Low-growing shrub, usually 0.4–0.5 m high, flowers recorded from July to October and mature fruits from September to November, commonly occurs on sandplains or in sand overlying laterite (Rye, 2022).	High coverage of all habitats in 2012 survey area with 99 quadrats, 398 releves and Rare/Priority search transects.	Unlikely, limited suitable habitat within the survey area. Area surveyed during flowering period.	Highly unlikely to occur.	NatureMap, WAHerb

Family	Taxon	Status		Description	Survey efficacy	Likelihood of occurrence		Source
		EPBC Act	WC Act /DBCA			Pre-Survey	Post-Survey	
Myrtaceae	*Beaufortia bicolor*	-	P3	Dense shrub, 0.3-1 m high. Flowers: red and yellow and orange, November to December. White sand over laterite. Sandplains (Trudgen, Morgan, & Griffin, 2006).	High coverage of all habitats in 2012 survey area with 99 quadrats, 398 releves and Rare/Priority search transects.	Unlikely, limited suitable habitat within the survey area. Area surveyed during flowering period.	Highly unlikely to occur.	NatureMap, WAHerb
Myrtaceae	*Calothamnus accedens*	-	P4	Erect and slender shrub, to 1.8 m high. Flowers: pink-red. Sandy soils over laterite. Road verge (Trudgen, Morgan, & Griffin, 2006). Flowering period: February (State of Western Australia, 2022).	High coverage of all habitats in 2012 survey area with 99 quadrats, 398 releves and Rare/Priority search transects.	Unlikely, limited suitable habitat within the survey area. Area surveyed during flowering period.	Highly unlikely to occur.	WAHerb
Myrtaceae	*Chamelaucium lullfitzii*	EN	VU	Listed as Endangered as Chamelaucium sp. Gingin (N.G.Marchant 6). Shrub 100 to 200 cm high, flowers from September to December, restricted to a very small area associated with the Gingin scarp, south of Gingin. Plants grow on white, grey, or yellow sands in	High coverage of all habitats in 2012 survey area with 99 quadrats, 398 releves and Rare/Priority search transects.	Unlikely, no suitable habitat within the survey area. Area surveyed during flowering period.	Highly unlikely to occur. Survey area well outside known range.	PMST

Family	Taxon	Status		Description	Survey efficacy	Likelihood of occurrence		Source
		EPBC Act	WC Act /DBCA			Pre-Survey	Post-Survey	
				low open Banksia woodland (Marchant, 2019).				
Myrtaceae	*Eleocharis keigheryi*	VU	VU	Rhizomatous, clumped perennial, grass-like or herb (sedge), to 0.4 m high. Flowers: green, August to November. Clay, sandy loam. Emergent in freshwater: creeks, claypans (Trudgen, Morgan, & Griffin, 2006).	High coverage of all habitats in 2012 survey area with 99 quadrats, 398 releves and Rare/Priority search transects.	Unlikely, NO suitable habitat within the survey area. Area surveyed during flowering period.	Highly unlikely to occur.	PMST
Myrtaceae	Eremaea sp. Cairn Hill (B. Morgan 532)	-	P2	Distribution: Avon Wheatbelt, Geraldton Sandplains, Swan Coastal Plain. Shires of Coorow, Dandaragan and Moora. Flowering period: October to November (State of Western Australia, 2022). One population recorded in regional mapped extent of Coomberdale TEC (Trudgen, Griffin, & Morgan, 2012).	High coverage of all habitats in 2012 survey area with 99 quadrats, 398 releves and DRF/Priority transects.	This taxon is known to occur at one location in the TEC survey area. Area surveyed during flowering period.	Occurs at one location in 2012 survey area. A distinctive medium sized shrub, unlikely to occur at other locations there. Suitable habitat does not occur north of Kiaka Road.	NatureMap, TPLF, WAHerb

Family	Taxon	Status		Description	Survey efficacy	Likelihood of occurrence		Source
		EPBC Act	WC Act /DBCA			Pre-Survey	Post-Survey	
Myrtaceae	*Eucalyptus absita*	EN	CR	(Mallee) or tree, 2.3-10 m high, bark rough, fibrous. Flowers: white, April to July. White lateritic sand. Paddocks (Trudgen, Morgan, & Griffin, A flora survey, floristic analysis and vegetation survey of the Coomberdale Chert TEC, 2006).	High coverage of all habitats in 2012 survey area with 99 quadrats, 398 releves and Rare/Priority search transects.	Unlikely, no suitable habitat within the survey area. Area surveyed during flowering period.	Highly unlikely to occur.	TPLF, WAHerb
Myrtaceae	*Eucalyptus x carnabyi*	-	P4	(Mallee), 1.5-6 m high. Flowers: pink-cream, October to November. Grey sand, sandy loam. Lateritic ridges (Trudgen, Morgan, & Griffin, A flora survey, floristic analysis and vegetation survey of the Coomberdale Chert TEC, 2006).	High coverage of all habitats in 2012 survey area with 99 quadrats, 398 releves and Rare/Priority search transects.	Unlikely, limited suitable habitat within the survey area. Area surveyed during flowering period.	Highly unlikely to occur.	WAHerb
Myrtaceae	*Eucalyptus crispata*	VU	EN	(Mallee), 3-7 m high. Flowers: yellow-cream, March to June. Sand, loam with lateritic gravel. Lateritic breakaways (Trudgen, Morgan, & Griffin, A flora survey, floristic analysis and	High coverage of all habitats in 2012 survey area with 99 quadrats, 398 releves and Rare/Priority search transects.	Unlikely, limited suitable habitat within the survey area. Area surveyed during flowering period.	Highly unlikely to occur. Well outside range of species.	PMST

Family	Taxon	Status		Description	Survey efficacy	Likelihood of occurrence		Source
		EPBC Act	WC Act /DBCA			Pre-Survey	Post-Survey	
				vegetation survey of the Coomberdale Chert TEC, 2006).				
Myrtaceae	*Eucalyptus leprophloia*	EN	EN	(Mallee), 2-5(-8) m high. Flowers: cream-white, August to October. White or grey sand over laterite. Valley slopes (Trudgen, Morgan, & Griffin, A flora survey, floristic analysis and vegetation survey of the Coomberdale Chert TEC, 2006).	High coverage of all habitats in 2012 survey area with 99 quadrats, 398 releves and Rare/Priority search transects.	Unlikely, no suitable habitat within the survey area. Area surveyed during flowering period.	Highly unlikely to occur. Well outside range of species.	PMST
Myrtaceae	*Eucalyptus macrocarpa x pyriformis*	-	P3	Erect, open mallee tree, 1.2-6 m high. Flowers: red, April or August to October. Sand, lateritic sandy soils. Hills, rocky ironstone ridges, sandplains (Trudgen, Morgan, & Griffin, A flora survey, floristic analysis and vegetation survey of the Coomberdale Chert TEC, 2006).	High coverage of all habitats in 2012 survey area with 99 quadrats, 398 releves and Rare/Priority search transects.	Unlikely, limited suitable habitat within the survey area. Area surveyed during flowering period.	Highly unlikely to occur.	TPLF, WAHerb
Myrtaceae	*Eremophila scaberula*	EN	CR	Low compact or sprawling to upright shrub, 0.15-0.7(-1.5) m high. Flowers:	High coverage of all habitats in 2012 survey area with 99 quadrats, 398 releves and Rare/Priority search transects.	Unlikely, NO suitable habitat within the survey area. Area surveyed during flowering period.	Highly unlikely to occur	PMST, TPLF, WAHerb

Family	Taxon	Status		Description	Survey efficacy	Likelihood of occurrence		Source
		EPBC Act	WC Act /DBCA			Pre-Survey	Post-Survey	
				purple-blue, August to October. Clay, sandy clay or loam. Winter-wet plains, inundated areas (Trudgen, Morgan, & Griffin, A flora survey, floristic analysis and vegetation survey of the Coomberdale Chert TEC, 2006).				
Myrtaceae	*Eucalyptus pruiniramis*	EN	EN	(Mallee) or tree, 2.5-7 m high. Flowers: cream, December. Skeletal soils over sandstone or laterite. Rocky hillslopes (Trudgen, Morgan, & Griffin, A flora survey, floristic analysis and vegetation survey of the Coomberdale Chert TEC, 2006).	High coverage of all habitats in 2012 survey area with 99 quadrats, 398 releves and Rare/Priority search transects.	Known to occur in the survey area. Area surveyed during flowering period.	Known to occur in 2012 survey area. Only occurs there in Cairn Hill NR.	PMST, TPLF, NatureMap
Myrtaceae	*Eucalyptus rhodantha var. rhodantha*	VU	VU	(Spreading mallee), 1.5-4 m high. Flowers: red/cream-white, July or September to December or January. Grey/yellow/red sand over laterite. Undulating country, hillslopes (Trudgen,	High coverage of all habitats in 2012 survey area with 99 quadrats, 398 releves and Rare/Priority search transects.	Unlikely, limited suitable habitat within the survey area. Area surveyed during flowering period.	Highly unlikely to occur. Outside range. Distinctive form means unlikely to not be observed.	PMST, WAHerb

Family	Taxon	Status		Description	Survey efficacy	Likelihood of occurrence		Source
		EPBC Act	WC Act /DBCA			Pre-Survey	Post-Survey	
				Morgan, & Griffin, A flora survey, floristic analysis and vegetation survey of the Coomberdale Chert TEC, 2006).				
Myrtaceae	*Melaleuca sclerophylla*	-	P3	Erect-spreading to prostrate shrub, 0.15-0.9 m high. Fl. purple-pink, June to September. Gravelly sand, clayey sand. Granite outcrops, rises (Trudgen, Morgan, & Griffin, A flora survey, floristic analysis and vegetation survey of the Coomberdale Chert TEC, 2006). Three populations recorded in regional mapped extent of Coomberdale TEC (Trudgen, Griffin, & Morgan, An extension of a flora survey, floristic analysis and vegetation survey of areas of the Coomberdale Chert TEC to include a further area, 2012).	High coverage of all habitats in 2012 survey area with 99 quadrats, 398 releves and DRF/Priority transects.	Three populations recorded in the southern part of the 2012 TEC survey area.	Known to occur in southern part of 2012 survey area. No suitable habitat north of Kiaka Road.	NatureMap, TPLF, WAHerb

Family	Taxon	Status		Description	Survey efficacy	Likelihood of occurrence		Source
		EPBC Act	WC Act /DBCA			Pre-Survey	Post-Survey	
Myrtaceae	*Regelia megacephala*	-	P4	Shrub, 2-5 m high. Flowers: purple-red, October to December. Red sand. Quartzite hills (Trudgen, Morgan, & Griffin, A flora survey, floristic analysis and vegetation survey of the Coomberdale Chert TEC, 2006). 71 populations recorded in regional mapped extent of Coomberdale TEC (Trudgen, Griffin, & Morgan, An extension of a flora survey, floristic analysis and vegetation survey of areas of the Coomberdale Chert TEC to include a further area, 2012).	High coverage of all habitats in 2012 survey area with 99 quadrats, 398 releves and DRF/Priority transects.	Recorded at 71 occurrences in the 2012 survey area. The occurrences are vegetation stands dominated by the species.	Forms numerous stands in the 2012 survey area. Given the size of this taxon, it is likely all stands in the TEC survey area have been recorded.	NatureMap, TPLF, WAHerb
Myrtaceae	*Verticordia insignis* subsp. *eomagis*	-	P3	Erect shrub, 0.2-1(-1.5) m high. Flowers white-pink/white, August to November. Sandy soils over laterite. Sandplains, rocky rises (Trudgen, Morgan, & Griffin, A flora survey, floristic	High coverage of all habitats in 2012 survey area with 99 quadrats, 398 releves and Rare/Priority search transects.	Unlikely, limited suitable habitat within the survey area. Area surveyed during flowering period.	Highly unlikely to occur.	WAHerb

Family	Taxon	Status		Description	Survey efficacy	Likelihood of occurrence		Source
		EPBC Act	WC Act /DBCA			Pre-Survey	Post-Survey	
				analysis and vegetation survey of the Coomberdale Chert TEC, 2006).				
Myrtaceae	*Verticordia muelleriana* subsp. *muelleriana*	-	P3	Spindly shrub, 0.45-2(-3.5) m high. Flowers: pink-purple-red/brown, September to December or January. White/grey or yellow sand. Sandplains (Trudgen, Morgan, & Griffin, A flora survey, floristic analysis and vegetation survey of the Coomberdale Chert TEC, 2006).	High coverage of all habitats in 2012 survey area with 99 quadrats, 398 releves and Rare/Priority search transects.	Unlikely, limited suitable habitat within the survey area. Area surveyed during flowering period.	Highly unlikely to occur.	TPLF, WAHerb
Orchidaceae	*Caladenia drakeoides*	EN	CR	Tuberous, perennial, herb, 0.12-0.3 m high. Flowers: green, September to October. Grey clayey sand, red sandy loam, in damp situations. Margins of salt lakes (Trudgen, Morgan, & Griffin, 2006). Flowering period: August to October (State of Western Australia, 2022).	High coverage of all habitats in 2012 survey area with 99 quadrats, 398 releves and Rare/Priority search transects.	Unlikely, no suitable habitat within the survey area. Area surveyed during flowering period.	Highly unlikely to occur.	PMST, TPLF

Family	Taxon	Status		Description	Survey efficacy	Likelihood of occurrence		Source
		EPBC Act	WC Act /DBCA			Pre-Survey	Post-Survey	
Orchidaceae	*Caladenia dundasiae*	-	P1	Herb, 0.15-0.35 m high, Poorly known species, appears to be confined to Watheroo area. Flowers: red/cream-yellow, July to August. Clayey loam. Well-drained soils under scattered wandoo (Trudgen, Morgan, & Griffin, A flora survey, floristic analysis and vegetation survey of the Coomberdale Chert TEC, 2006).	High coverage of all habitats in 2012 survey area with 99 quadrats, 398 releves and Rare/Priority search transects.	Unlikely, limited suitable habitat within the survey area. Area surveyed during flowering period.	Highly unlikely to occur.	TPLF, WAHerb
Orchidaceae	*Diuris recurva*	-	P4	Tuberous, perennial, herb, 0.2-0.3 m high. Flowers: yellow and brown, July to August. Loam. Winter-wet areas. (Trudgen, Morgan, & Griffin, A flora survey, floristic analysis and vegetation survey of the Coomberdale Chert TEC, 2006). 31 populations in regional mapped extent of Coomberdale TEC (Trudgen, Griffin, &	High coverage of all habitats in 2012 survey area with 99 quadrats, 398 releves and DRF/Priority transects.	Known from 35 occurrences in the 2012 survey area. The occurrences vary from single plants to small populations.	Known to occur. The small size of this taxon and flowering necessary for identification it is likely that a small increase in occurrences would be found if the whole TEC survey area was more intensively searched.	NatureMap, TPLF, WAHerb

Family	Taxon	Status		Description	Survey efficacy	Likelihood of occurrence		Source
		EPBC Act	WC Act /DBCA			Pre-Survey	Post-Survey	
				Morgan, An extension of a flora survey, floristic analysis and vegetation survey of areas of the Coomberdale Chert TEC to include a further area, 2012).				
Pertusariaceae	*Pertusaria trachyspora*	-	P2	Distribution: Camp Creek, Mitchell Plateau, Moora, Collie, Mount Chudalup, Walpole (State of Western Australia, 2022). One record approx. 8 km south of the survey area, on plain with littered dry semi saline brown clay. (DBCA, 2023).	Lichens were not collected during the survey.	Possible, limited suitable habitat within the survey area.	May occur.	NatureMap, TPLF, WAHerb

Family	Taxon	Status		Description	Survey efficacy	Likelihood of occurrence		Source
		EPBC Act	WC Act /DBCA			Pre-Survey	Post-Survey	
Poaceae	*Austrostipa nunaginensis*	-	P3	*Austrostipa nunaginensis* (A. sp. Cairn Hill) is known from seven sites in the northern wheatbelt (Greenough to Bruce Rock). Perennial tussock grass, 200–500 mm tall, flowering late spring, fruiting early summer (Williams, 2022). One population located in regional mapped extent of Coomberdale TEC (Trudgen, Griffin, & Morgan, An extension of a flora survey, floristic analysis and vegetation survey of areas of the Coomberdale Chert TEC to include a further area, 2012).	High coverage of all habitats in 2012 survey area with 99 quadrats, 398 releves and DRF/Priority transects.	One occurrence known in the TEC survey area native vegetation, also two from rehabilitation areas.	Given the small size of this taxon and the frequency of other Austrostipa of similar size in the TEC, it is possible that a small number of additional occurrences may occur. Weed levels in the proposed mine area reduce the likelihood of occurrence there.	NatureMap, WAHerb
Proteaceae	*Banksia fuscobractea*	CR	CR	Erect, prickly, non-lignotuberous shrub, ca 1 m high. Flower yellow, flowering period July to October. Lateritic gravel, grey sand over laterite	High coverage of all habitats in 2012 survey area with 99 quadrats, 398 releves and Rare/Priority search transects.	Unlikely, no suitable habitat within the survey area. Area surveyed during flowering period.	Highly unlikely to occur. Outside range. Distinctive form means unlikely to not be observed.	PMST

Family	Taxon	Status		Description	Survey efficacy	Likelihood of occurrence		Source
		EPBC Act	WC Act /DBCA			Pre-Survey	Post-Survey	
				(Trudgen, Morgan, & Griffin, A flora survey, floristic analysis and vegetation survey of the Coomberdale Chert TEC, 2006).				
Proteaceae	*Banksia dallanneyi* subsp. *pollosta*	-	P3	Prostrate, lignotuberous shrub. Flowers: yellow-brown, August to September. Grey/yellow sand. Flats, lateritic rises (Trudgen, Morgan, & Griffin, A flora survey, floristic analysis and vegetation survey of the Coomberdale Chert TEC, 2006).	High coverage of all habitats in 2012 survey area with 99 quadrats, 398 releves and Rare/Priority search transects.	Unlikely, limited suitable habitat within the survey area. Area surveyed during flowering period.	Highly unlikely to occur.	TPLF, WAHerb
Proteaceae	*Conospermum densiflorum* subsp. *unicephalatum*	EN	EN	Erect, much-branched shrub, 0.3-0.6 m high, inflorescence a spike. Flowers: cream/white and blue, September to November. Clay soils. Low-lying areas (Trudgen, Morgan, & Griffin, A flora survey, floristic analysis and vegetation survey of	High coverage of all habitats in 2012 survey area with 99 quadrats, 398 releves and Rare/Priority search transects.	Known to occursurveyed during flowering period.	Highly unlikely to occur.	PMST, NatureMap, WAHerb

Family	Taxon	Status		Description	Survey efficacy	Likelihood of occurrence		Source
		EPBC Act	WC Act /DBCA			Pre-Survey	Post-Survey	
				the Coomberdale Chert TEC, 2006).				
Proteaceae	*Grevillea amplexans* subsp. *semivestita*	-	P2	Erect, open, pungent shrub, 1-3 m high. Flowers: white-cream, August to October. Yellow clayey sand, laterite. Two populations recorded in regional mapped extent of Coomberdale TEC (Trudgen, Griffin, & Morgan, An extension of a flora survey, floristic analysis and vegetation survey of areas of the Coomberdale Chert TEC to include a further area, 2012).	High coverage of all habitats in 2012 survey area with 99 quadrats, 398 releves and Rare/Priority search transects.	Known to occur in 2012 survey area, but limited suitable habitat there. Surveyed during flowering period.	Occurs in one TEC remnant in eastern part of 2012 survey area. No suitable habitat north of Kiaka Road.	
Proteaceae	*Grevillea christineae*	EN	EN	Erect, wiry shrub, 0.5-0.6 m high. Flowers: white-cream, August to September. Clay loam, sandy clay, often moist (Trudgen, Morgan, & Griffin, A flora survey, floristic analysis and vegetation survey of the Coomberdale Chert TEC, 2006).	High coverage of all habitats in 2012 survey area with 99 quadrats, 398 releves and Rare/Priority search transects.	Unlikely, limited suitable habitat within the survey area. Area surveyed during flowering period.	Highly unlikely to occur.	PMST, TPLF

Family	Taxon	Status		Description	Survey efficacy	Likelihood of occurrence		Source
		EPBC Act	WC Act /DBCA			Pre-Survey	Post-Survey	
Proteaceae	*Grevillea pythara*	EN	CR	Suckering shrub, 0.06-0.3 m high. Flowers: orange and red and blue, May to October (possibly all year). Sand or sandy loam with gravel (Trudgen, Morgan, & Griffin, A flora survey, floristic analysis and vegetation survey of the Coomberdale Chert TEC, 2006).	High coverage of all habitats in 2012 survey area with 99 quadrats, 398 releves and Rare/Priority search transects.	Unlikely, limited suitable habitat within the survey area. Area surveyed during flowering period.	Highly unlikely to occur. Well outside known range.	PMST
Proteaceae	*Grevillea haplantha* subsp. *recedens*	-	P3	Erect or spreading shrub, 0.6-1 m high. Flowers red, June to August. Sand, sandy loam (Trudgen, Morgan, & Griffin, A flora survey, floristic analysis and vegetation survey of the Coomberdale Chert TEC, 2006).	High coverage of all habitats in 2012 survey area with 99 quadrats, 398 releves and Rare/Priority search transects.	Unlikely, limited suitable habitat within the survey area. Area surveyed during flowering period.	Highly unlikely to occur. Outside known range.	WAHerb

Family	Taxon	Status		Description	Survey efficacy	Likelihood of occurrence		Source
		EPBC Act	WC Act /DBCA			Pre-Survey	Post-Survey	
Proteaceae	*Grevillea saccata*	-	P4	Diffuse scrambling or trailing shrub, 0.25-0.5 m high, 1-2 m wide. Flowers: red, April or June to November. Yellow or brown sand, often with lateritic gravel (Trudgen, Morgan, & Griffin, A flora survey, floristic analysis and vegetation survey of the Coomberdale Chert TEC, 2006).	High coverage of all habitats in 2012 survey area with 99 quadrats, 398 releves and Rare/Priority search transects.	Unlikely, limited suitable habitat within the survey area. Area surveyed during flowering period.	Highly unlikely to occur.	WAHerb
Proteaceae	*Petrophile biternata*	-	P3	Stout, rigid, non-lignotuberous shrub, 0.8-1.5 m high. Flowers: yellow/cream-yellow, August to October. Yellow/grey sand and gravel, laterite, quartzite soils. Lateritic ridges, plains (Trudgen, Morgan, & Griffin, A flora survey, floristic analysis and vegetation survey of the Coomberdale Chert TEC, 2006)	High coverage of all habitats in 2012 survey area with 99 quadrats, 398 releves and DRF/Priority transects.	Possible, species habitat may occur within the survey area, but soil type probably not suitable.	Highly unlikely to occur.	WAHerb
Proteaceae	*Persoonia chapmaniana*	-	P3	Erect, spreading shrub, 1-2 m high. Flowers: yellow,	High coverage of all habitats in 2012 survey area with 99	Unlikely, no suitable habitat within the survey area. Area	Highly unlikely to occur.	NatureMap, WAHerb

Family	Taxon	Status		Description	Survey efficacy	Likelihood of occurrence		Source
		EPBC Act	WC Act /DBCA			Pre-Survey	Post-Survey	
				September to November. White sandy clay, yellow sand. Vicinity of salt lakes (Trudgen, Morgan, & Griffin, A flora survey, floristic analysis and vegetation survey of the Coomberdale Chert TEC, 2006).	quadrats, 398 releves and Rare/Priority search transects.	surveyed during flowering period.		
Proteaceae	*Synaphea quartzitica*	EN	EN	Small tufted shrub. Flowers: yellow, July to August. Rocky quartzite hill (Trudgen, Morgan, & Griffin, A flora survey, floristic analysis and vegetation survey of the Coomberdale Chert TEC, 2006).	High coverage of all habitats in 2012 survey area with 99 quadrats, 398 releves and DRF/Priority transects.	This species is known to occur at one location in the southern part of the survey area.	Known to occur at one location. Very distinctive and further occurrences in the survey area are unlikely. No suitable habitat north of Kiaka Road.	PMST, NatureMap, TPLF, WAHerb

Family	Taxon	Status		Description	Survey efficacy	Likelihood of occurrence		Source
		EPBC Act	WC Act /DBCA			Pre-Survey	Post-Survey	
Rhamnaceae	*Cryptandra glabriflora*	-	P2	Low shrub, (0.05-)0.1-0.5 m high. Flowers: white/pink, May to August. Yellow or grey sand, gravelly soils. Plains (Trudgen, Morgan, & Griffin, A flora survey, floristic analysis and vegetation survey of the Coomberdale Chert TEC, 2006). [Vouchers redetermined as C. myriantha]	High coverage of all habitats in 2012 survey area with 99 quadrats, 398 releves and Rare/Priority search transects.	Unlikely, limited suitable habitat occurs within the survey area. Area surveyed during flowering period.	Highly unlikely to occur. Well outside range.	Trudgen 2012
Rutaceae	*Boronia ericifolia*	-	P2	Erect shrub, 0.3-1.2 m high. Flowers: white/cream-yellow, April or June or August to September. Sandy loam, clay, laterite. Low-lying spots (Trudgen, Morgan, & Griffin, A flora survey, floristic analysis and vegetation survey of the Coomberdale Chert TEC, 2006).	High coverage of all habitats in 2012 survey area with 99 quadrats, 398 releves and Rare/Priority search transects.	Unlikely, no suitable habitat occurs within the survey area. Area surveyed during flowering period.	Highly unlikely to occur.	WAHerb
Scrophulariaceae	*Eremophila glabra* subsp. *chlorella*	EN	EN	Prostrate and spreading or sprawling shrub, 0.2-1 m high. Flowers: green-	High coverage of all habitats in 2012 survey area with 99 quadrats, 398 releves and Rare/Priority search transects.	Unlikely, limited suitable habitat occurs within the survey area. Area surveyed during flowering period.	Highly unlikely to occur.	WAHerb

Family	Taxon	Status		Description	Survey efficacy	Likelihood of occurrence		Source
		EPBC Act	WC Act /DBCA			Pre-Survey	Post-Survey	
				yellow, July to November. Sandy clay. Winter-wet depressions (Trudgen, Morgan, & Griffin, A flora survey, floristic analysis and vegetation survey of the Coomberdale Chert TEC, 2006). One previous record approx. 18 km south west of the survey area (DBCA, 2023).				
Stylidiaceae	*Stylidium glabrifolium*	-	P2	Rosetted perennial, herb, 0.2-0.3 m high. Flower: yellow, October to November. Grey brown clay loam over laterite. Hillslopes or gullies. Wandoo woodland (Trudgen, Morgan, & Griffin, A flora survey, floristic analysis and vegetation survey of the Coomberdale Chert TEC, 2006). Recorded from three quadrats in the survey, however has not been recorded	High coverage of all habitats in 2012 survey area with 99 quadrats, 398 releves and DRF/Priority transects.	Recorded from three quadrats in the central part of the TEC survey area,	Known to occur in 2012 survey area. Not recorded north of Kiaka Road. Weed levels in the proposed mine area reduce the likelihood of occurrence there.	Trudgen 2012 and 2018

Family	Taxon	Status		Description	Survey efficacy	Likelihood of occurrence		Source
		EPBC Act	WC Act /DBCA			Pre-Survey	Post-Survey	
				north of Kiaka Road (Trudgen, 2018)				

Family	Taxon	Status		Description	Survey efficacy	Likelihood of occurrence		Source
		EPBC Act	WC Act /DBCA			Pre-Survey	Post-Survey	
Stylidiaceae	*Stylidium milleri*	-	P2	Stilted perennial herb (10–)20–40 cm high. Flowering period: September to October. It favours upland habitats, growing in grey sand with lateritic gravel in *Allocasuarina* and *Lambertia* shrubland with Xanthorrhoea and scattered mallees, Proteaceous and Myrtaceous shrubland with *Allocasuarina* and scattered *Banksia attenuata*, or *B. carlinoides* heath. (Wege, 2022). Three populations recorded in regional mapped extent of Coomberdale TEC (Trudgen, Griffin, & Morgan, An extension of a flora survey, floristic analysis and vegetation survey of areas of the Coomberdale Chert TEC to include a further area, 2012).	High coverage of all habitats in 2012 survey area with 99 quadrats, 398 releves and DRF/Priority transects.	Unlikely as soil types not suitable and outside range.	Highly unlikely to occur as soil types and vegetation types not suitable.	WAHerb

Family	Taxon	Status		Description	Survey efficacy	Likelihood of occurrence		Source
		EPBC Act	WC Act /DBCA			Pre-Survey	Post-Survey	
Stylidiaceae	*Stylidium periscelianthum*	-	P3	Bulb-forming perennial, herb, 0.07-0.15 m high. Flower: pink, September to October. Loamy clay, moist soils pockets. Wet flats, low granitic hills (Trudgen, Morgan, & Griffin, A flora survey, floristic analysis and vegetation survey of the Coomberdale Chert TEC, 2006).	High coverage of all habitats in 2012 survey area with 99 quadrats, 398 releves and Rare/Priority search transects.	Unlikely, limited suitable habitat occurs within the survey area. Area surveyed during flowering period.	Highly unlikely to occur.	NatureMap
Stylidiaceae	*Stylidium* sp. Moora (J.A. Wege 713)	-	P2	Twenty-two records from the Gillingarra, Moora, Cairn Hill areas (ALA, 2023). Flowering period: October (State of Western Australia, 2022). Ten records within Cairn Hill to the south (DBCA, 2023).	High coverage of all habitats in 2012 survey area with 99 quadrats, 398 releves and DRF/Priority transects.	Relatively common in the 2012 survey area	Occurs north of Kiaka Road, including in the proposed mine footprint.	WAHerb

Appendix E

Vegetation Alliances and Dendrogram

Appendix F

Desktop Database searches

Appendix G

Vouchered specimens

Specimens vouchered from collections on the Coomberdale Chert TEC

More the 200 specimens have been vouchered from the studies of the Coomberdale threatened Ecological Community vegetation and flora. The list is incomplete as Priority Flora records were not delivered in the ALA occurrence download (some have been entered manually).

Note that since 2018 some *Lepidosperma* collections have been redetermined at the Western Australian Herbarium simply to genus (rather than the names originally vouchered as). This reflects the problem that *Lepidosperma* is notoriously poorly understood taxonomically. See limitations section.

Notes: All the specimens are held at the Western Australian Herbarium. Data derived from the following The Australasian Virtual Herbarium download: Atlas of Living Australia occurrence download. *Accessed on 03 February 2024.*

Table 7.2 Species vouchered from collections made for surveys of Coomberdale Chert TEC by M.E. Trudgen & Associates

Botanist	Voucher #	Species Name	Family
Morgan, B.	BM 142	Acacia daphnifolia	Fabaceae
Henson, M.	MJH 72	Acacia erinacea	Fabaceae
Henson, M.	MJH 71	Acacia hemiteles	Fabaceae
Henson, M.	MJH 70	Acacia hemiteles	Fabaceae
Morgan, B.	BM 143	Acacia hemiteles	Fabaceae
Henson, M.	MJH 16	Acacia lasiocarpa var. sedifolia	Fabaceae
Trudgen, M.	MET 21228	Acacia lasiocarpa var. sedifolia	Fabaceae
Henson, M.	MJH 68	Acacia scirpifolia	Fabaceae
Morgan, B.	BM 49	Acacia stenoptera	Fabaceae
Morgan, B.	BM 48	Acacia stenoptera	Fabaceae
Henson, M.	MJH 31	Aira elegantissima	Poaceae
Henson, M.	MJH 30	Aira elegantissima	Poaceae
Morgan, B.	BM 45	Allocasuarina campestris	Casuarinaceae
Morgan, B.	BM 44	Allocasuarina campestris	Casuarinaceae
Morgan, B.	BM 42	Allocasuarina campestris	Casuarinaceae
Morgan, B.	BM 43	Allocasuarina campestris	Casuarinaceae
Trudgen, M.	21234	Allocasuarina campestris	Casuarinaceae
Morgan, B.	BM 30	Alyogyne sp. Hutt River (B.J.Lepschi & T.R.Lally 2310)	Malvaceae
Trudgen, M.	MET 21203	Amphipogon caricinus var. caricinus	Poaceae
Trudgen, M.	MET 21204	Amphipogon caricinus var. caricinus	Poaceae
Morgan, B.	BM 35	Aristida contorta	Poaceae
Henson, M.	MJH 35	Aristida holathera var. holathera	Poaceae
Morgan, B.	BM 35	Banksia fraseri	Proteaceae

Botanist	Voucher #	Species Name	Family
Morgan, B.	BM 148	Banksia sphaerocarpa var. sphaerocarpa	Proteaceae
Henson, M.	MJH 24	Blennospora drummondii	Asteraceae
Trudgen, M.E.	MET 21227	Bossiaea moylei	Fabaceae
Trudgen, M.E.	MET 21226	Bossiaea moylei	Fabaceae
Trudgen, M.E.	MET 21225	Bossiaea moylei	Fabaceae
Morgan, B.	BM 50	Bossiaea moylei	Fabaceae
Morgan, B.	BM 50	Bossiaea moylei	Fabaceae
Henson, M.	MJH 2-28	Bossiaea moylei	Fabaceae
Morgan, B.	BMor 63	Blennospora drummondii	Asteraceae
Trudgen, M.	21215	Borya sphaerocephala	Boryaceae
Trudgen, M.	MET 21205	Brachypodium distachyon	Poaceae
Morgan, B.	BM 87	Bromus rubens	Poaceae
Henson, M.	MJH 47	Calothamnus quadrifidus subsp. angustifolius	Myrtaceae
Morgan, B.	s.n.	Calothamnus quadrifidus subsp. angustifolius	Myrtaceae
Morgan, B.	BM 122	Calothamnus quadrifidus subsp. angustifolius	Myrtaceae
Trudgen, M.	MET 21178	Calothamnus quadrifidus subsp. angustifolius	Myrtaceae
Trudgen, M.	MET 21182	Calothamnus quadrifidus subsp. angustifolius	Myrtaceae
Trudgen, M.	MET 21185	Calytrix depressa	Myrtaceae
Henson, M.	MJH 45	Calytrix leschenaultii	Myrtaceae
Morgan, B.	BM 119	Calytrix leschenaultii	Myrtaceae
Morgan, B.	BM 120	Calytrix leschenaultii	Myrtaceae
Morgan, B.	BM 118	Calytrix leschenaultii	Myrtaceae
Trudgen, M.	MET 21184	Calytrix leschenaultii	Myrtaceae
Henson, M.	MJH 12	Cassytha pomiformis	Lauraceae
Henson, M.	MJH 28	Centrolepis pilosa	Centrolepidaceae
Trudgen, M.	21213	Chamaescilla corymbosa	Asparagaceae
Henson, M.	MJH 39	Cheilanthes distans	Pteridaceae
Trudgen, M.	21223	Comesperma integerrimum	Polygalaceae
Trudgen, M.	21224	Comesperma integerrimum	Polygalaceae
Morgan, B.	BM 41	Crassula colorata var. acuminata	Crassulaceae
Trudgen, M.	21236	Crassula colorata var. acuminata	Crassulaceae
Henson, M.	MJH 8	Cryptandra myriantha	Rhamnaceae

Botanist	Voucher #	Species Name	Family
Henson, M.	MJH 7	Cryptandra myriantha	Rhamnaceae
Henson, M.	MJH 21	Cyanothamnus ramosus subsp. anethifolius	Rutaceae
Henson, M.	MJH 65	Cyanothamnus ramosus subsp. anethifolius	Rutaceae
Morgan, B.	BM 55	Cyanothamnus ramosus subsp. anethifolius	Rutaceae
Morgan, B.	BM 130	Daucus glochidiatus	Apiaceae
Morgan, B.	BM 52	Daviesia hakeoides subsp. subnuda	Fabaceae
Morgan, B.	BM 141	Daviesia hakeoides subsp. subnuda	Fabaceae
Morgan, B.	BM 73	Desmocladus asper	Restionaceae
Morgan, B.	BM 74	Desmocladus asper	Restionaceae
Morgan, B.	BM 72	Desmocladus asper	Restionaceae
Trudgen, M.	MET 21210	Desmocladus asper	Restionaceae
Henson, M.	MJH 27	Dianella revoluta var. divaricata	Hemerocallidaceae
Henson, M.	MJH 27	Dianella revoluta var. divaricata	Hemerocallidaceae
Morgan, B.	BM 68	Dichopogon capillipes	Asparagaceae
Trudgen, M.	21216	Dichopogon capillipes	Asparagaceae
Morgan, B.	BM 56	Dioscorea hastifolia	Dioscoreaceae
Morgan, B.	BM 57	Dioscorea hastifolia	Dioscoreaceae
Morgan, B.	BM 58	Dioscorea hastifolia	Dioscoreaceae
Henson, M.	MJH 79	Dodonaea inaequifolia	Sapindaceae
Morgan, B.	BM 29	Dodonaea pinifolia	Sapindaceae
Morgan, B.	BM 149	Dodonaea pinifolia	Sapindaceae
Henson, M.	MJH 13	Drosera hirsuta	Droseraceae
Henson, M.	MJH 14	Drosera hirsuta	Droseraceae
Trudgen, M.	21231	Drosera hirsuta	Droseraceae
Trudgen, M.	21233	Drosera sp. Branched styles (S.C.Coffey 193)	Droseraceae
Trudgen, M.	21232	Drosera sp. Branched styles (S.C.Coffey 193)	Droseraceae
Henson, M.	MJH 34	Ehrharta longiflora	Poaceae
Trudgen, M.	MET 21206	Ehrharta longiflora	Poaceae
Henson, M.	MJH 59	Eucalyptus eudesmioides	Myrtaceae
Henson, M.	MJH 46	Eucalyptus eudesmioides	Myrtaceae
Morgan, B.	BM 134	Eucalyptus eudesmioides	Myrtaceae
Trudgen, M.	MET 21183	Eucalyptus eudesmioides	Myrtaceae
Henson, M.	MJH 48	Eucalyptus loxophleba subsp. loxophleba	Myrtaceae
Henson, M.	MJH 57	Eucalyptus obtusiflora subsp. obtusiflora	Myrtaceae
Morgan, B.	BM 123	Eucalyptus wandoo subsp. pulverea	Myrtaceae

Botanist	Voucher #	Species Name	Family
Henson, M.	MJH 19	Gastrolobium acutum	Fabaceae
Henson, M.	MJH 18	Gastrolobium acutum	Fabaceae
Morgan, B.	BMor 64	Gilberta tenuifolia	Asteraceae
Morgan, B.	BMor 65	Gilberta tenuifolia	Asteraceae
Trudgen, M.	21220	Gilberta tenuifolia	Asteraceae
Henson, M.	BM 131	Glischrocaryon flavescens	Haloragaceae
Henson, M.	MJH 54	Glischrocaryon flavescens	Haloragaceae
Trudgen, M.E.	MET 21193	Goodenia berardiana	Goodeniaceae
Henson, M.	BM 138	Goodenia hassallii	Goodeniaceae
Henson, M.	MJH 61	Goodenia hassallii	Goodeniaceae
Henson, M.	MJH 75	Grevillea biternata	Proteaceae
Henson, M.	MJH 22	Haemodorum simulans	Haemodoraceae
Morgan, B.	BMor 59	Haemodorum simulans	Haemodoraceae
Trudgen, M.	21222	Haemodorum simulans	Haemodoraceae
Morgan, B.	BM 36	Hakea incrassata	Proteaceae
Trudgen, M.	21238	Hakea incrassata	Proteaceae
Morgan, B.	BM 140	Hemiandra incana	Lamiaceae
Morgan, B.	BM 32	Hibbertia subvaginata	Dilleniaceae
Trudgen, M.	21219	Hyalosperma cotula	Asteraceae
Trudgen, M.	21218	Hyalosperma cotula	Asteraceae
Trudgen, M.	MET 21173	Isopogon divergens	Proteaceae
Henson, M.	MJH 67	Isotropis drummondii	Fabaceae
Henson, M.	MJH 49	Kunzea praestans	Myrtaceae
Henson, M.	MJH 50	Kunzea praestans	Myrtaceae
Morgan, B.	BM 124	Kunzea praestans	Myrtaceae
Trudgen, M.E.	21179	Kunzea praestans	Myrtaceae
Morgan, B.	BMor 66	Lawrencella rosea	Asteraceae
Trudgen, M.	21217	Lawrencella rosea	Asteraceae
Trudgen, M.	21212	Laxmannia omnifertilis	Asparagaceae
Morgan, B.	BM 71	Lepidobolus chaetocephalus	Restionaceae
Trudgen, M.	MET 21211	Lepidobolus chaetocephalus	Restionaceae
Morgan, B.	BM 76	Lepidosperma	Cyperaceae
Morgan, B.	BM 135	Lepidosperma	Cyperaceae
Morgan, B.	BM 77	Lepidosperma	Cyperaceae
Morgan, B.	BM 80	Lepidosperma	Cyperaceae

Botanist	Voucher #	Species Name	Family
Trudgen, M.	MET 21175	Lepidosperma	Cyperaceae
Trudgen, M.	MET 21209	Lepidosperma	Cyperaceae
Morgan, B.	BM 75	Lepidosperma pubisquameum	Cyperaceae
Henson, M.	MJH 29	Lepidosperma tenue	Cyperaceae
Morgan, B.	BM 78	Lepidosperma tenue	Cyperaceae
Morgan, B.	BM 79	Lepidosperma tenue	Cyperaceae
Morgan, B.	BM 133	Leptospermum	Myrtaceae
Morgan, B.	BM 70	Lomandra	Asparagaceae
Henson, M.	MJH 40	Lysimachia arvensis	Primulaceae
Henson, M.	MJH 56	Melaleuca concreta	Myrtaceae
Morgan, B.	BM 125	Melaleuca leuropoma	Myrtaceae
Trudgen, M.	MET 21181	Melaleuca leuropoma	Myrtaceae
Morgan, B.	BM 126	Melaleuca radula	Myrtaceae
Trudgen, M.	MET 21188	Millotia myosotidifolia	Asteraceae
Trudgen, M.	MET 21189	Millotia tenuifolia var. tenuifolia	Asteraceae
Morgan, B.	BM 34	Muehlenbeckia adpressa	Polygonaceae
Morgan, B.	BM 82	Neurachne alopecuroidea	Poaceae
Morgan, B.	BM 81	Neurachne alopecuroidea	Poaceae
Morgan, B.	BM 83	Neurachne alopecuroidea	Poaceae
Morgan, B.	BMor 67	Olearia sp. Eremicola (Diels & Pritzel s.n. PERTH 00449628)	Asteraceae
Morgan, B.	BM 105	Opercularia vaginata	Rubiaceae
Trudgen, M.	MET 21194	Opercularia vaginata	Rubiaceae
Trudgen, M.	21235	Orthrosanthus laxus var. gramineus	Iridaceae
Morgan, B.	BM 104	Parentucellia latifolia	Orobanchaceae
Henson, M.	s.n.	Pentameris airoides	Poaceae
Morgan, B.	BM 85	Pentameris airoides subsp. airoides	Poaceae
Morgan, B.	BM 86	Pentameris airoides subsp. airoides	Poaceae
Morgan, B.	MJH 33	Pentameris airoides subsp. airoides	Poaceae
Morgan, B.	BM 84	Pentameris airoides subsp. airoides	Poaceae
Henson, M.	MJH 11	Petrorhagia dubia	Caryophyllaceae
Morgan, B.	BM 37	Petrorhagia dubia	Caryophyllaceae
Morgan, B.	BM 38	Petrorhagia dubia	Caryophyllaceae

Botanist	Voucher #	Species Name	Family
Morgan, B.	BM 39	Petrorhagia dubia	Caryophyllaceae
Morgan, B.	BM 100	Phyllangium sulcatum	Loganiaceae
Morgan, B.	BM 101	Phyllangium sulcatum	Loganiaceae
Morgan, B.	BM 33	Pimelea imbricata var. piligera	Thymelaeaceae
Trudgen, M.	21237	Pimelea imbricata var. piligera	Thymelaeaceae
Henson, M.	MJH 41	Podolepis gracilis	Asteraceae
Henson, M.	MJH 42	Podolepis lessonii	Asteraceae
Morgan, B.	BM 112	Podolepis lessonii	Asteraceae
Trudgen, M.	MET 21187	Podolepis lessonii	Asteraceae
Morgan, B.	BM 103	Quoya dilatata	Lamiaceae
Morgan, B.	BM 102	Quoya dilatata	Lamiaceae
Trudgen, M.	MET 21195	Quoya dilatata	Lamiaceae
Trudgen, M.	MET 21196	Quoya dilatata	Lamiaceae
Trudgen, M.	MET 21186	Rhodanthe laevis	Asteraceae
Henson, M.	MJH 38	Rytidosperma acerosum	Poaceae
Morgan, B.	BM 98	Rytidosperma acerosum	Poaceae
Morgan, B.	s.n.	Rytidosperma acerosum	Poaceae
Morgan, B.	s.n.	Rytidosperma setaceum	Poaceae
Morgan, B.	BM 95	Rytidosperma setaceum	Poaceae
Morgan, B.	BM 97	Rytidosperma setaceum	Poaceae
Morgan, B.	BM 150	Santalum acuminatum	Santalaceae
Henson, M.	MJH 60	Scaevola glandulifera	Goodeniaceae
Trudgen, M.	MET 21192	Scaevola glandulifera	Goodeniaceae
Morgan, B.	BM 109	Scaevola phlebopetala	Goodeniaceae
Morgan, B.	BM 107	Scaevola phlebopetala	Goodeniaceae
Morgan, B.	BM 108	Scaevola phlebopetala	Goodeniaceae
Trudgen, M.	MET 21207	Schoenus latitans	Cyperaceae
Trudgen, M.E.	MET 21208	Schoenus latitans	Cyperaceae
Morgan, B.	BM 40	Silene gallica var. gallica	Caryophyllaceae
Henson, M.	MJH 63	Solanum oldfieldii	Solanaceae
Trudgen, M.	21239	Stackhousia pubescens	Celastraceae
Morgan, B.	BM 62	Stylidium androsaceum	Stylidiaceae

Botanist	Voucher #	Species Name	Family
Henson, M.	MJH 23	Stylidium caricifolium	Stylidiaceae
Morgan, B.	BM 61	Stylidium caricifolium	Stylidiaceae
Morgan, B.	BM 60	Stylidium caricifolium	Stylidiaceae
Trudgen, M.	21221	Stylidium miniatum	Stylidiaceae
Morgan, B	BM 110	Stylidium sp. Moora (J.A.Wege 713)	Stylidiaceae
Henson, M.	MJH 26	Stypandra glauca	Hemerocallidaceae
Henson, M.	MJH 64	Styphelia retrorsa	Ericaceae
Trudgen, M.	MET 21197	Styphelia serratifolia	Ericaceae
Trudgen, M.	MET 21174	Styphelia serratifolia	Ericaceae
Henson, M.	MJH 10	Thomasia grandiflora	Malvaceae
Morgan, B.	BM 31	Thomasia grandiflora	Malvaceae
Henson, M.	MJH 25	Thysanotus manglesianus	Asparagaceae
Trudgen, M.	21214	Thysanotus multiflorus	Asparagaceae
Morgan, B.	BM 127	Trachymene ornata	Araliaceae
Henson, M.	MJH 52	Trachymene pilosa	Araliaceae
Morgan, B.	BMor 54	Trifolium arvense var. arvense	Fabaceae
Morgan, B.	BMor 53	Trifolium arvense var. arvense	Fabaceae
Henson, M.	MJH 20	Trifolium repens var. repens	Fabaceae
Henson, M.	MJH 6	Tripterococcus brunonis	Celastraceae
Morgan, B.	BM 28	Tripterococcus brunonis	Celastraceae
Morgan, B.	BM 26	Tripterococcus brunonis	Celastraceae
Trudgen, M.	21240	Tripterococcus brunonis	Celastraceae
Henson, M.	MJH 9	Trymalium ledifolium var. rosmarinifolium	Rhamnaceae
Morgan, B.	BM 113	Ursinia anthemoides subsp. anthemoides	Asteraceae
Henson, M.	MJH 58	Ustilago tepperi	Ustilaginaceae
Trudgen, M.	MET 21180	Verticordia chrysanthella	Myrtaceae
Henson, M.	MJH 55	Verticordia densiflora var. densiflora	Myrtaceae
Morgan, B.	BM 106	Wahlenbergia preissii	Campanulaceae
Morgan, B.	BM 137	Waitzia nitida	Asteraceae
Morgan, B.	BM 114	Waitzia nitida	Asteraceae
Morgan, B.	BM 116	Waitzia nitida	Asteraceae
Morgan, B.	BM 115	Waitzia nitida	Asteraceae
Henson, M.	MJH 53	Xanthosia fruticulosa	Apiaceae
Morgan, B.	BM 129	Xanthosia fruticulosa	Apiaceae
Morgan, B.	BM 128	Xanthosia fruticulosa	Apiaceae

Appendix H

Other flora of conservation interest

Other flora of conservation interest (Trudgen et al 2012)

Agrostocrinum scabrum aff. ssp. scabrum

The collections referred to *Agrostocrinum scabrum* aff. ssp. *scabrum* from the Coomberdale Chert Threatened Ecological Community represent a small population that lies half way between the north end of the main occurrence and one outlying record from north of Three Springs (see Map 11). The disjunction is more than eighty kilometres from the Coomberdale Chert TEC records to the northernmost record in the main population. The size of the disjunction and the uncommon geology the Coomberdale Chert TEC is located on suggests the population is likely to represent at least a different variety. The material is also somewhat atypical, but better collections are needed to examine the status of the population. Even if the material does not represent a new variety, the population has significance as an outlier. The taxon was recorded (see Map 12) at three quadrats by Trudgen *et al.* (2012), but has not been recorded north of Kiaka Road.

Map 11: Distribution of *Agrostocrinum scabrum* aff. ssp. *scabrum* north of Perth

Note: Map from records on the site The Australasian Virtual Herbarium.

Map 12: Records of *Agrostocrinum scabrum* aff. ssp. *scabrum* in the Coomberdale Chert TEC

Note: From data recorded by Trudgen *et al.* (2012) for areas of the Coomberdale Chert TEC surveyed.

Austrostipa exilis **(Former priority species, near range limit)**

Austrostipa exilis was formerly a Priority 3 species, but has been removed from the priority flora list. It is now considered (The Australasian Virtual Herbarium 7/2017)) to be quite widespread in the southwest of Western Australia, although most records are south of Perth and the species is not very common. Apart from two coastal records, the three Coomberdale Chert Threatened Ecological Community records are near the norther limit of the species in Western Australia (there is a disjunct population in South Australia). One of the three records in the TEC is from north of Kiaka Road, but is not from the proposed North Kiaka Road Mine area.

Banksia sphaerocarpa **var.** ***aff. caesia*** **(Atypical , range extension, range end)**

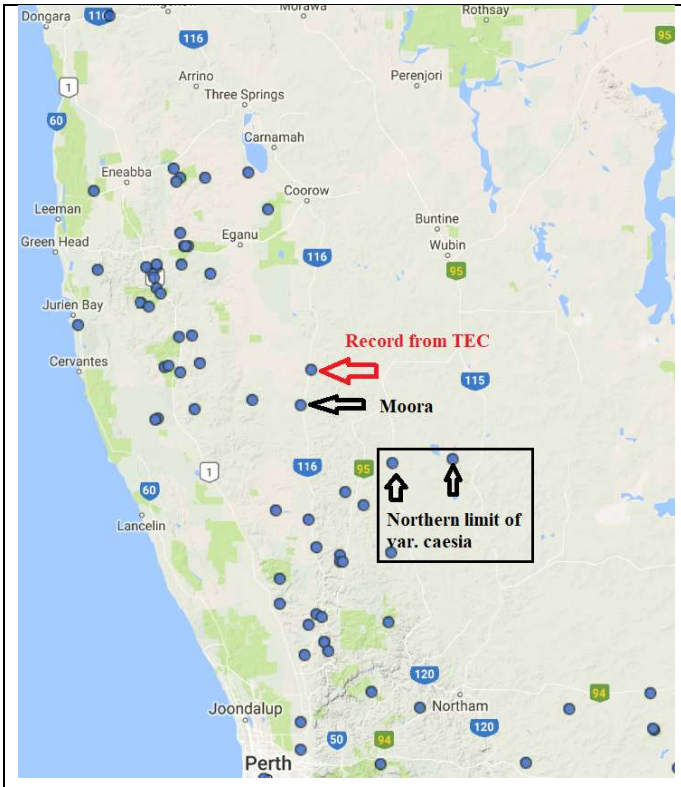
A form of *Banksia sphaerocarpa* has been recorded at three localities in the area of the Coomberdale Chert Threatened Ecological Community surveyed by Trudgen *et al.* (2012), with two of the localities in the proposed North Kiaka Mine area. The material needs further study to determine its taxonomic identity within the species, but is closest to var. *caesia.* Due to the uncertainty naming the material, it is referred to here as *Banksia sphaerocarpa* var. aff. *caesia*. After var. *caesia*, the material is closest to var. *sphaerocarpa*.

Banksia sphaerocarpa var. *sphaerocarpa* has a large distribution and is known to include several forms and there are some differences in the application of the name. The variety is still mapped as occurring to well north of Perth on Florabase (the Western Australian Herbarium species information portal), but is considered by A.S. George (2008) the authority on the genus, to occur “from the Darling Plateau east of Perth south to the Whicher Range and east to the Stirling Range and Cape Riche”. The apparent conflict in application may simply be that specimens have not been redetermined, meaning the map is outdated. In the same publication, George (2008) considered that most of the collections north of Perth belonged to a new variety, *Banksia sphaerocarpa* var. *pumilio*, which is usually a shrub less than one metre tall. A third variety, *Banksia sphaerocarpa* var. *caesia*, also occurs north of Perth, but the population there (three records) is disjunct from the main population and the nearest record to the occurrence in the Coomberdale Chert TEC is near Piawaning, fifty kilometres to the south-east.

The specimens from the Coomberdale Chert Threatened Ecological Community (see photographs and Map 13 below) key to a couplet with var. *sphaerocarpa* and var. *caesia*, so we can exclude var. *pumilio* (another two described varieties occur well south of Perth and can also be excluded).

Banksia sphaerocarpa var. *aff. caesia* has been recorded at three localities in the area of the Coomberdale Chert Threatened Ecological Community mapped by Trudgen *et al.* (2012). The three localities are shown on Map 14. George (1981) in his revision of the genus *Banksia* mentions an atypical specimen (Kenneally 5889) from 4 km east of Piawaning (see Map13A). George notes that this collection and others from the north and western part of the distribution of the variety have fruit more similar in size to var. *sphaerocarpa* than var. *caesia*. Map 13B shows all records on Australasia’s Virtual Herbarium of *Banksia sphaerocarpa* var. *caesia*, with Kenneally 5889 arrowed and the Coomberdale Chert population added. The map shows that the Kenneally collection, two other collections and the Chert localities are disjunct from other localities of var. *caesia* by some 70 kilometres, with all other collections south of Great Eastern Highway. The disjunction and the difference in fruit size indicate that the north-western populations referred to *Banksia sphaerocarpa* var. *caesia* and the Coomberdale Chert population should be treated as a distinct taxon. Inspection of the Piawaning population (a few plants on a disturbed roadside) suggests that this form is the same as the population n the Coomberdale Chert.

While the status of *Banksia sphaerocarpa* var. aff. *caesia* undoubtedly needs further investigation, Nistelberger *et al.* (2015) investigating genetic diversity in part of the distribution of var. *caesia* found “a stark and unexpected division of the landscape into two genetic subregions”. This was in an area of the varieties distribution with no disjunction, suggesting that the “variety” is somewhat more than it seems. Bearing in mind comments by George (2008) about other variation in *Banksia sphaerocarpa* it seems likely that the species as a whole needs a detailed revision. The Piawaning population grows on yellow sand, and the main chert population is on chert adjacent to an area of yellow sand.

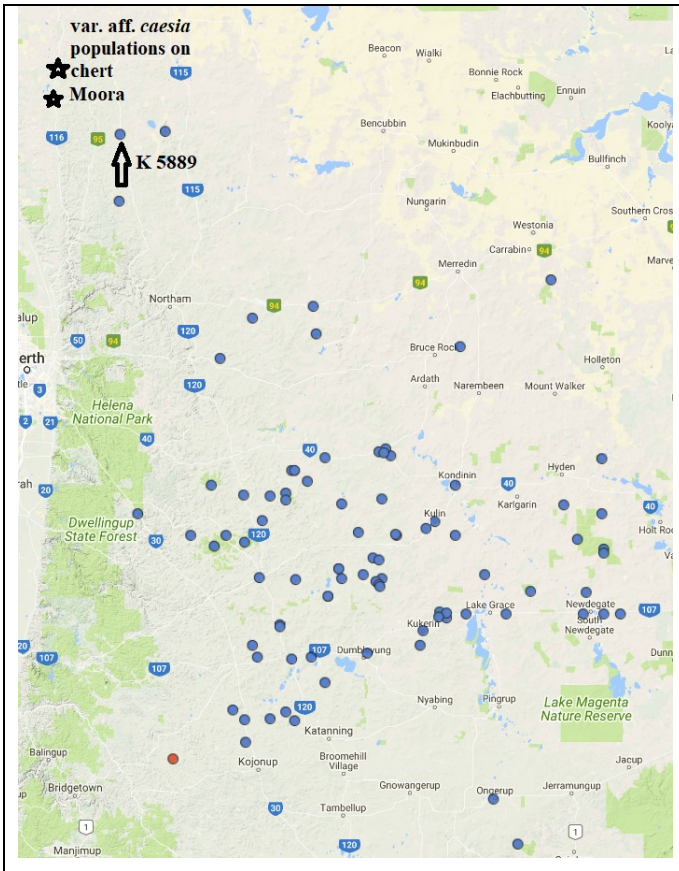


Map 13A: Records of all varieties of *Banksia sphaerocarpa* between Perth and Dongara.

Notes. The red arrow indicates the location of one of three occurrences of *Banksia sphaerocarpa* var. *aff. caesia* on the Coomberdale Chert (the others are nearby; see Map 14).

The black rectangle shows the three locations of the disjunct north-western occurrence of var. *caesia*, two of which are indicted by black arrows. The left hand arrow in the box indicates the locality of Kenneally 5889.

The map is from The Australasian Virtual Herbarium (accessed 8/2017).



Map 13B: All records of *Banksia sphaerocarpa* var. *caesia*

Notes. The black arrow indicates the location of Kenneally 5889. Also note the disjunction between the north-western locations and the locations between Northam and Bruce Rock. And, that the latter locations are disjunct from the main occurrence.

The map is from The Australasian Virtual Herbarium (accessed 3/2018).

Photographs 1 & 2: Two shrubs of *Banksia sphaerocarpa* var. *aff. caesia* showing variation in habitat. The right hand individual may have been affected by grazing of the lower branches.

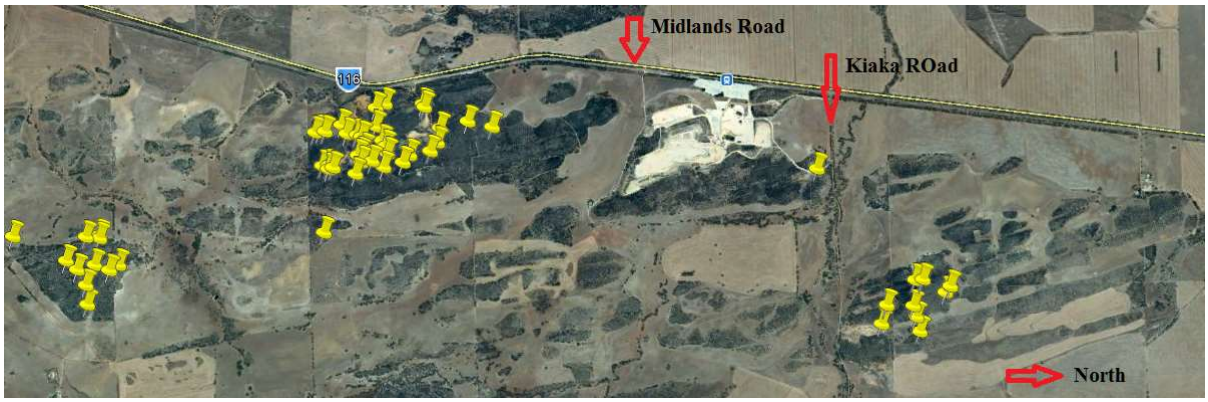
Map 14: Records of *Banksia sphaerocarpa* var. *aff. caesia* from quadrat and releve data of Trudgen *et al.* (2012) and from 2016 & 2017 field data.

The northern localities in the TEC are in the area of the proposed North Kiaka Mine. There are four plants of the *Banksia* at the northernmost locality and two at the nearby locality. These were the only localities found in the area of the proposed mine pits when they were searched in 2016. The southern locality is in a small remnant of native vegetation (one of a cluster in a paddock). It was visited in 2017 and the *Banksia* plants there counted, their condition noted and their locations recorded with a GPS unit. There are about 65 plants in the population, varying in size and condition. Smaller plants and the lower parts of larger plants were heavily grazed (probably by rabbits). The plants at this location were definitely lignotuberous and some plants were up to 1.9 metres tall.

Calothamnus quadrifidus subsp. angustifolius (Chert form)

This taxon was separated out from other variants of *Calothamnus quadrifidus* at the Western Australian Herbarium during preparation of earlier reports for Simcoa Operations Ltd. It was recorded at fifty-five (55) sites during the surveys. Since this taxon was separated out in Herbarium material at that time. Since then, material of it has been included in *Calothamnus quadrifidus* ssp. *angustifolius* by George and Gibson (2010). It has not been possible to examine this assignment in detail for this report, and it has been decided to leave the reference to the entity as in the earlier reports. This has been done as the author of this report has considerable experience in the taxonomy of the Myrtaceae, examined the material in the Western Australian Herbarium and came to the conclusion specimens from the geographic area including the Coomberdale Chert were a distinct entity. This is not necessarily

incompatible with the paper by George and Gibson, and this taxon and closely related ones need further taxonomic work to confirm their status.



Map 16: *Calothamnus quadrifidus* subsp. *angustifolius* (Chert form) from data of Trudgen *et al.* (2012) for the Coomberdale Chert TEC and data of E.A. Griffin.

Calothamnus quadrifidus subsp. *angustifolius* (Chert form) is restricted to the Coomberdale Floristic Region of Griffin (1992) and it should be treated as a geographically restricted taxon. There are about fifteen specimens in the collections at the Western Australian Herbarium, but this may over-estimate the abundance of the taxon as it is a large species (generally two to four metres tall) and thus more likely to be collected than smaller ones. It is moderately common (Map 16) in parts of the survey area of Trudgen *et al.* (2012), but is absent in others.

***Calytrix* sp. Coomberdale (M.E. Trudgen MET 21184)**

Calytrix sp. Coomberdale (M. Trudgen MET 21184) has previously been confused with *Calytrix leschenaultii*, a name that has been applied to a significant sized complex of species that occurs over much of the South West Botanical District of Western Australia. It is a small, purple flowered shrub belonging to the plant family Myrtaceae. It is quite common in the Coomberdale Chert Threatened Ecological Community (Map 17) and has been observed outside the areas of that community mapped by Trudgen *et al.* (2012), on soils with similar (silica rich) underlying rocks (just south of Moora), but does not seem to be common outside the TEC. It is more common in the proposed North Kiaka Mine area than the quadrat and releve mapping data indicate, this is partly due to the fact that much of the proposed mine area has vegetation in poorer condition and therefore fewer quadrats and releve sites were recorded in it.

Map 17: Records of *Calytrix* sp. Coomberdale from data of Trudgen *et al.* (2012) for areas of the Coomberdale Chert TEC surveyed by them.

Notes: This species is common in the area north of Kiaka Rd. The white areas on the image are the existing Simcoa mine, waste dumps and storage areas. For convenience north is to the right on the image.


Photographs 3 & 4: Flowers and flowering plant of *Calytrix* sp. Coomberdale.

In the Coomberdale Chert TEC, *Calytrix* sp. Coomberdale occurs in more open vegetation (that is not under dense *Allocasuarina campestris* or dense *Regelia megacephala*). It was observed to have regenerated fairly recently in one disturbed area that had low weed cover. It is common in disturbed areas with high weed cover, but in such places all the plants are older and may predate the weed invasion. It may mostly establish after fire and may have taken advantage of disturbance of the TEC to increase its population size. The population in the proposed North Kiaka Mine area is significantly larger than the quadrat and releve records on Map 17 indicate.

Given the geographical restriction of *Calytrix* sp. Coomberdale it is likely to warrant priority flora status, although it appears to be more resilient than *Xanthorrhoea* sp. Coomberdale to the pressures on the vegetation remnants of the Coomberdale Chert TEC.

Cristonia stenophylla **(Disjunct population)**

Three records of *Cristonia stenophylla* were made by Trudgen *et al.* (2012) during their survey, all on the J. Tonkin property north of Kiaka Road (Map 18). The material was identified in that report as *Cristonia biloba*. These are the only records from the Coomberdale Chert Threatened Ecological Community and are located 60 kilometres south-south-east of the main occurrence of the species. There is one record ninety kilometres further south-south-east, north of Bolgart. The TEC population has significance as an outlying record.

Map 18: Records of *Cristonia stenophylla* in the Coomberdale Chert TEC

Notes: Yellow pins records from data of Trudgen *et al.* (2012) green star from 2017 field survey. Two of the 2012 sites revisited and the *Cristonia* not found.

Two of the three quadrats *Cristonia stenophylla* was recorded at by Trudgen *et al.* (2012) were revisited in 2016 and again in 2017 and the species was not found on either occasion. It was also not found during any of the flora searches undertaken for the current report in 2016and 2017. However, one plant was observed in 2017 adjacent to the southern firebreak on the John Tonkin property. It seems likely that the species has become locally very rare due to a combination of climate change, grazing and other factors such as herbicide drift. However, it is possible that the species is still present as seed (which is likely to be long-lived) and might reappear after fire. One of the three quadrats the species was found in is in the proposed North Kiaka Mine area, the other two are nearby. The locality found in 2017 is part of one possible route for a haul road.

Cyrtostylis huegelii **(Outlying population)**

Cyrtostylis huegelii is the only *Cyrtostylis* recorded north of Perth, where the species, apart from the Coomberdale Chert Threatened Ecological Community records, is only recorded west of the Brand Highway. The TEC population is therefore a significant outlying record of the species. *Cyrtostylis huegelii* was recorded three times by Trudgen *et al.* (2012), once in Cairn Hill Reserve and twice adjacent to the current Simcoa mine (one of these records was in an area now mined). It was not recorded during flora searches of the proposed North Kiaka Mine area in 2016 and 2017.

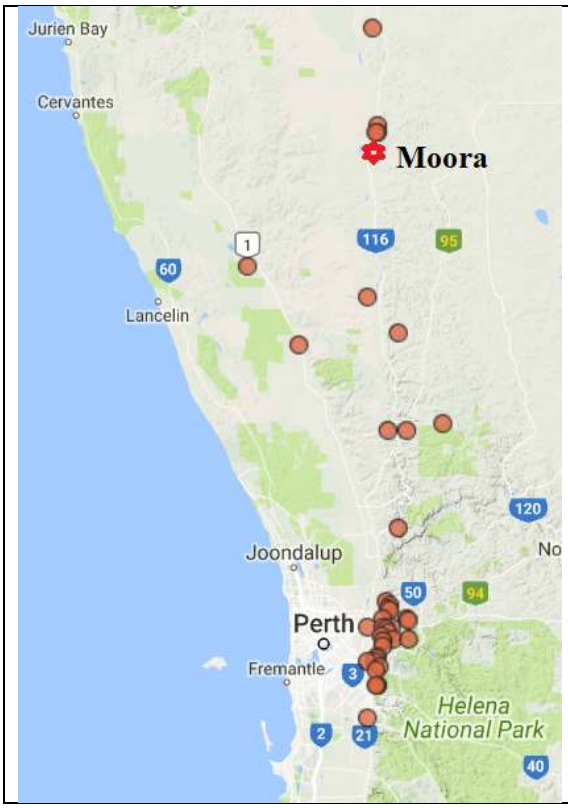
Gastrolobium acutum **(Disjunct population and near Northern limit)**

There are only five records of *Gastrolobium acutum* north of Mogumber in herbarium collections, of which three are from the Coomberdale Chert Threatened Ecological Community (Map 19). The population of *Gastrolobium acutum* in the Coomberdale Chert TEC is disjunct from the main population by ca. 53 kilometres. As Map 19 shows the main population extends southwards from that point to the east of Perth, but is fairly restricted. Twenty-four kilometres to the north of the Coomberdale Chert TEC population there is one record (noted as growing on yellow sand with chert outcrop) in Watheroo National Park.

While the population there is disjunct from the main population, *Gastrolobium acutum* is not uncommon in the Coomberdale Chert TEC with nineteen records (Map 20) at the quadrats and releves recorded for Trudgen *et al.* (2012). However, other observations indicate that *Gastrolobium acutum* is somewhat more common in the North Kiaka Mine area than the quadrat and releve records indicate. As Map 20 shows only three of these records were located north of Kiaka Road. Given the disjunction and the different geologies the two populations grow on, it is possible that the Coomberdale Chert TEC population is different at the variety or subspecies level from the main population. This issue needs

further study. The Watheroo record is likely to be the same taxon as the TEC population as it is associated with chert geology.

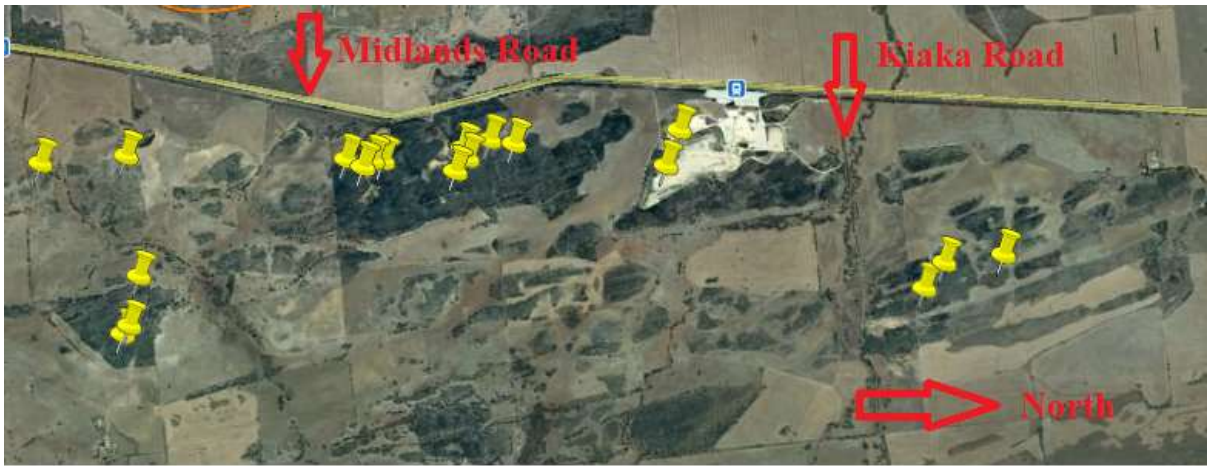
Gastrolobium acutum was once a Priority Species, however it was removed from the Priority Flora list after more information became available about its distribution and population status. If the Coomberdale Chert population is confirmed as different, it would deserve priority status because of its geographically limited extent and number of threatening factors. It is an erect, or occasionally straggly shrub to one metre tall. It was recorded in fourteen of their eighty-nine quadrats recorded in native vegetation and three vegetation recording releves by Trudgen *et al.* (2012). It was also observed as scattered individuals, or small groups of individuals, north of Kiaka Road.



Map 19: Distribution of *Gastrolobium acutum*

Notes. Map from The Australasian Virtual Herbarium, accessed 6/2017.

The Coomberdale Chert TEC records are the small cluster just north of Moora. Note the disjunction south from Moora



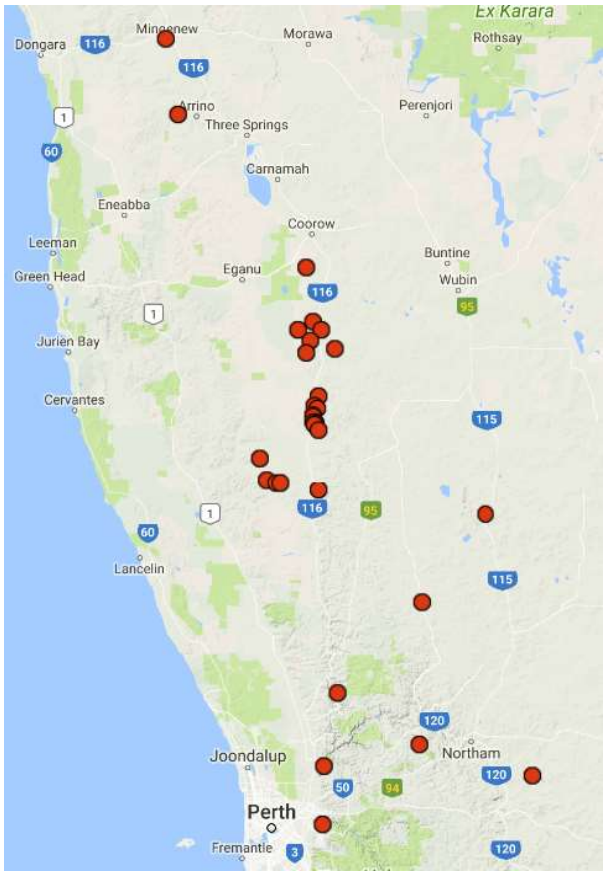
Map 20: Records of *Gastrolobium acutum* from quadrat and vegetation mapping releve data of Trudgen *et al.* (2012) for areas of the Coomberdale Chert TEC surveyed.

Notes: The white areas on the image are the existing Simcoa mine, waste dumps and storage areas.

[Records on The Australasian Virtual Herbarium for *Gastrolobium acutum* in the Kalbarri area are based on specimens held in eastern states herbaria which are likely to be wrongly named and these records are therefore not taken into account here.]

Kunzea praestans **(Has disjunctions, needs taxonomic review)**

The material from the Coomberdale Chert Threatened Ecological Community that has been identified as *Kunzea praestans* is a 1.5 to 2.5 metre tall shrub with pink flowers that in the TEC occurs mostly near the edges of chert outcrops on compacted gravelly soil (chert gravel colluvium) over chert. It was previously a Priority 3 species that was considered to have a fairly restricted distribution centred on the Coomberdale Chert, but was removed from the priority flora list on the basis of new collections from a broader range.



Map 21A: Distribution of *Kunzea praestans* based on herbarium records

Notes: Includes some mis-identified collections (see text). (Map from The Australasian Virtual Herbarium17/8/2017)

Map 21B: Records of *Kunzea praestans* in the Moora area from vegetation survey data.

The large cluster of sites is the Coomberdale Chert TEC survey area

Records (Map 21A) on The Australasian Virtual Herbarium (AVH) show a wider distribution than the Moora area, but with significant disjunctions. Some of the specimens on AVH are certainly not the same taxon as on the Coomberdale Chert. For example the record from near Arrino is from the margin of a wetland, the record from north of Wongan Hills is of a shrub to 30 cm with mauve flowers, one of the records near Dandaragan was recorded as having yellow flowers, the specimen from Mundaring was collected from adjacent to a river, the specimen from near Coorow was described as having mauve flowers, and two other collections were of shrubs under one metre tall.

The distribution of *Kunzea praestans* (or more correctly, the material placed under this name) from The Australasian Virtual Herbarium data (Map 21A) in the Moora area and the map from Moora area vegetation survey data of E.A. Griffin & M.E. Trudgen (Map 21B) have similar disjunctions and fairly restricted distributions. It therefore seems likely that the *Kunzea* on the chert is actually fairly restricted, but that further taxonomic work is needed to properly establish its limits as a species, whether or not it has subspecies, and from this its conservation status.

Lepidosperma aff. leptostachyum (Moora: ERG18-7)

Lepidosperma aff. leptostachyum (Moora: ERG18-7) is an informal name given to sixteen (16) specimens collected in the surveys of the Coomberdale Chert TEC. Fifteen of these were collected south of Kiaka Road and one north of Kiaka Road. The taxon has not been recorded from the proposed North Kiaka Mine impact areas. Four specimens of this taxon have been vouchered; they have been placed under Lepidosperma sp. at the Western Australian Herbarium.

Leptospermum aff. erubescens (Moora Chert; B. Morgan 133). (Rare, very restricted)

Two collections were known of this taxon prior to the field work for the current report. Both are from the Trudgen et al. (2012 etc.) survey area. One was collected during the rare flora survey of the Gardiner Hill bush area (on the property of P & J. Gardiner, at the same location as the Banksia sphaerocarpa form). The site was in a disturbed area on the edge of the vegetation remnant. The other (D.J.E. Whibley 4905) is from the gravel pit in Cairn Hill reserve. The two collections appear to represent a very uncommon undescribed taxon restricted to the Chert Hills at Moora (R. Davis pers. comm. 2006).

Until this taxon can be adequately surveyed, it should be treated as very rare. The earlier survey collection (Morgan 133) has been vouchered and is currently (30 January 2024) placed under Leptospermum sp. The taxon has not been recorded north of Kiaka Road (in fact, not north of Cairn Hill Reserve). The Morgan collection location on the Gardiner property was revisited in 2017 to survey the Banksia population; during the visit it was found that there was a moderate sized population of the Leptospermum present as well. The population was not counted, but certainly has more than 50 individuals.

Pauridia aff. occidentalis var. occidentalis (Probably an undescribed species)

The genus Pauridia (the Australian species were formerly placed in Hypoxis) consists of small herbaceous species that have few easy to use characters to define species. At least in Western Australia, the genus is in need of revision. In an earlier report (Trudgen et al. 2012) one specimen (CH12-11A from Cairn Hill Reserve) was referred to the name Hypoxis aff. glabella. Re-examination of this specimen has shown that it is a very poor specimen (one small old plant) of the taxon that was referred to Pauridia occidentalis var. occidentalis in the earlier report. Further examination of the collections has indicated that the material referred to Pauridia occidentalis var. occidentalis in Trudgen et al. (2012) does not fit well any described taxon and is likely to be undescribed. Given the state of the taxonomy of Pauridia, this must be a preliminary assessment. The important issue here is that in the area of the Coomberdale Chert Threatened Ecological Community that was surveyed by Trudgen et al. (2012) the taxon mainly occurs out of the proposed North Kiaka Mine area (Map 22).

The important characters are that the specimens have a pair of opposite bracteoles rather than a single bracteole and a different fruit shape to the two closest species, Pauridia occidentalis and Pauridia vaginata.

Photograph 5: Flowering plants of *Pauridia* aff. *occidentalis* var. *occidentalis*

Map 22: Records of *Pauridia* aff. *occidentalis* var. *occidentalis* from the quadrat and vegetation mapping releve records of Trudgen *et al.* (2012)

Note. These records underestimate the number of occurrences north of Kiaka Road due to the distribution of quadrats and timing of releve recording.

***Petrophile brevifolia* (forma) (Needs taxonomic study)**

A collection (G316-4) referred to *Petrophile brevifolia* (forma) by Trudgen *et al.* (2012) is atypical for that species (B. Rye pers. comm. 2006), but flowering material and expert identification are necessary before the status of the collection can be fully assessed. This taxon has not been recorded north of Kiaka Road.

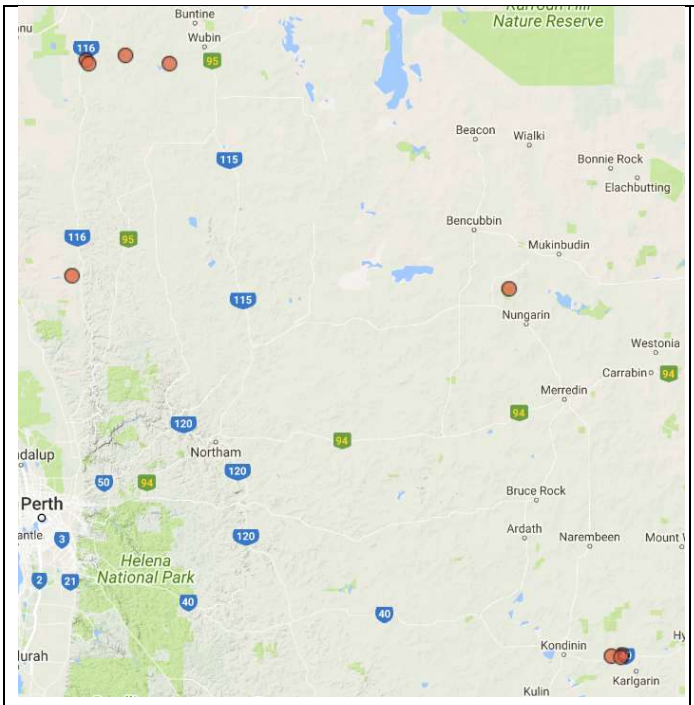
***Pterostylis exserta* (Known from few localities)**

There are three records for *Pterostylis exserta* in the vegetation site data of Trudgen *et al.* (2012), although two of them were original determined as *Pterostylis* aff. *rufa*. One of these records was from quadrat JT010 which is in the proposed North Kiaka Mine area. The species was refound there in 2017

and this was the only locality in the proposed North Kiaka Mine where it was recorded (Map 23B). *Pterostylis exserta* is a small Greenhood orchid that is known from nine localities apart from those in the Coomberdale Chert Threatened Ecological Community (Map 23A). It would seem to deserve priority flora status given it is known from few localities and most of its range has been cleared.

***Quoya* (formerly *Pityrodia) dilatata* (Disjunctions, possibly has subspecies)**

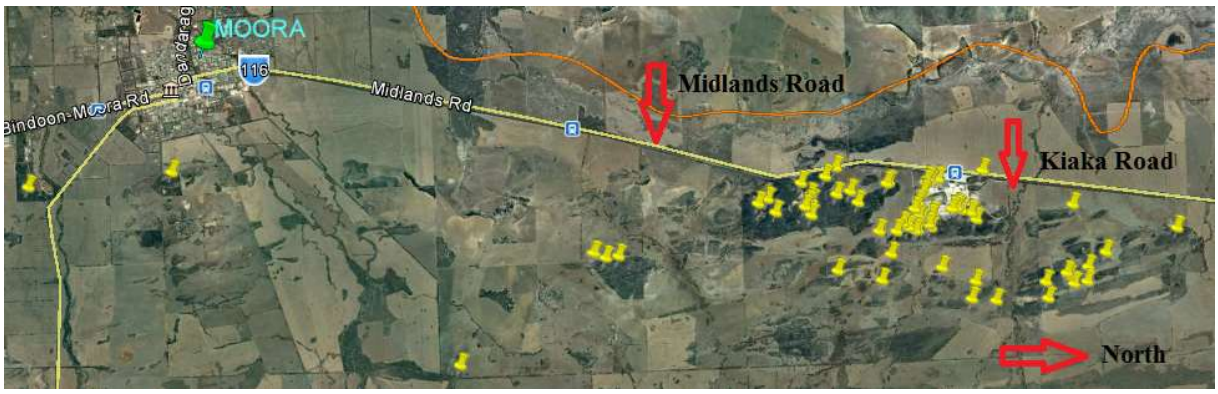
This species has a limited range from Three Springs to Wannamal, with most collections in a fairly narrow band. The distribution has three centres of distribution. The central one is in the Moora to Namban area and has a disjunction of forty-five kilometres to the southern population in the Mogumber area. The northern population is located south of Three Springs to the Coorow area. There are some scattered records between the northern and central populations and some other outlying records (of which some are much older with unlikely locations). The species needs investigation to see if there are sub-specific taxa. If there are, then this would mean that they could be of conservation concern.



Map 23A: Distribution of *Pterostylis exserta*.

Note. The small number of records and how they are spread through a largely cleared part of the wheat belt.

Map 23B: Location of the records for *Pterostylis exserta* in the proposed North Kiaka Mine area



Map 24: Records of *Quoya dilatata* from the quadrat and vegetation mapping releve records of Trudgen *et al.* (2012) and two records (near Moora) from data of E.A. Griffin.

Quoya dilatata is fairly common (Map 24) in the Coomberdale Chert TEC area surveyed by Trudgen *et al.* (2012) and a number of other locations were recorded in the proposed North Kiaka Mine area in 2016 and 2017.

Stenanthemum tridentatum **(Near northern limit of species, disjunction.)**

Stenanthemum tridentatum is a very small shrub that was formerly a Priority 3 species, but has been removed from the Priority Flora List. In the Trudgen *et al.* (2012) survey area it was only recorded from the Gardiner's Hill survey sub-area (at one quadrat and five releves). This species has a moderate sized distribution with the survey area close to the north-west limit of the species range, which is at Gunyidi. The records from the Coomberdale Chert Threatened Ecological Community, one to the east (near Miling) and one to the north near Gunyidi are disjunct from the main population by about 60 kilometres. The species has not been recorded north of Kiaka Road in the Coomberdale Chert Threatened Ecological Community area.

Trichocline **sp. (Uncertain determination, if *Trichocline* new taxon)**

A sterile specimen from site GH7-57 on the Gardiner property (Trudgen *et al*. 2012) is possibly a *Trichocline* (an alternative of *Ptilotus* has been excluded (Trudgen *et al*. 2012)). However, it does not match *Trichocline spathulata* the only *Trichocline* species currently accepted for Western Australia. The site needs to be re-visited to collect flowering material, to enable proper identification. The species has not been recorded north of Kiaka Road.

Wurmbea drummondii

Wurmbea drummondii is a very small herb (ca. 5 cm tall with one or two leaves and usually one or two small flowers) that occurs in seasonally damp areas with thin soil over rock. It was only recorded at two places on John Tonkin's property during the Trudgen *et al.* (2012) survey, both outside the impact area of the proposed North Kiaka Mine. While it is present north of Kiaka Road, it is very uncommon there. *Wurmbea drummondii* was a Priority 4 species, but has been removed from the Priority Flora list. It was also observed once (one plant) during rare flora searches carried out in 2016 for the proposed North Kiaka Mine, again outside the proposed mine area. This species has a moderate distribution that has a small disjunction (from New Norcia and Wyening) between possible northern and southern occurrences (possibly varieties?).

Xanthorrhoea **sp. Coomberdale (M.E. Trudgen MET 25047)**

Xanthorrhoea sp. Coomberdale has previously been confused with *Xanthorrhoea drummondii*, a name that has been applied to a complex of species that occurs from the Kalbarri area southwards to north of Albany. It is a grass tree to just over two metres tall with greyish-green leaves that is usually single headed, but can have several heads (see Photographs 6 & 7).

Photograph 6: *Xanthorrhoea* sp. Coomberdale on slopes adjacent to remnant vegetation.

Notes: Individuals vary from single headed (most plants) to multiple headed.

Photograph 7: *Xanthorrhoea* sp. Coomberdale in remnant vegetation.

Notes: Comparison to the photograph to the left shows significant variation in stipe and inflorescence length.

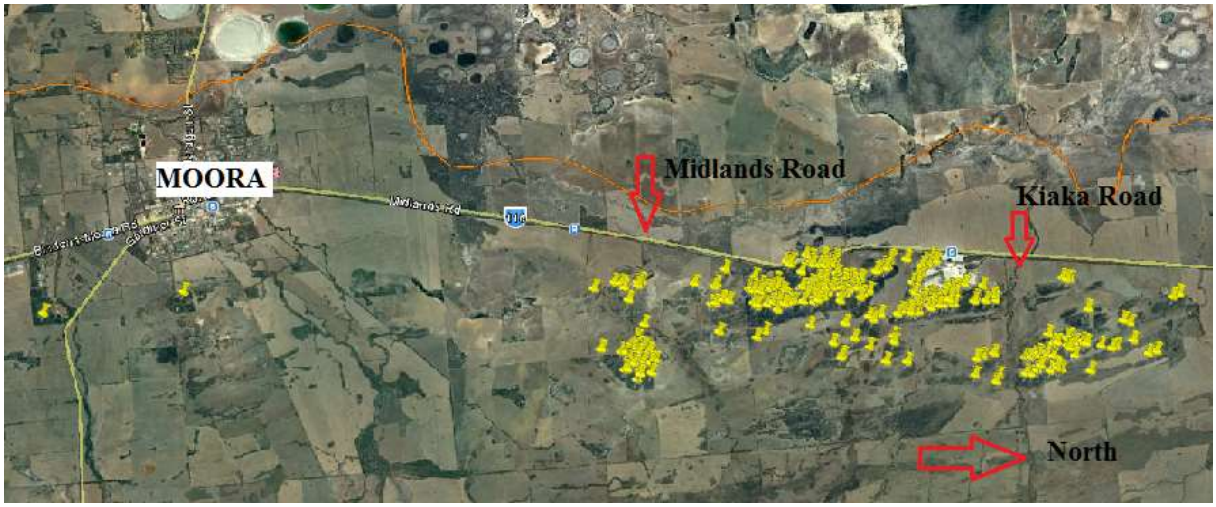
On current knowledge *Xanthorrhoea* sp. Coomberdale is restricted to an area from just south of Moora to the area north of Kiaka Road (see Map 25a), but south of Coomberdale. Almost all of the records are from the Coomberdale (Noondine) Chert, with the majority of them from the study area of Trudgen *et al.* (2012). The other records are on chert east and south-south-east of Moora, except for one from 3 kilometres south-south-east of Moora near the Moora wheat bins. The latter record is on a different substrate (although there could be chert at depth) that is still silica rich.

Map 25B puts the population of *Xanthorrhoea* sp. Coomberdale in a regional context. The two parts of the map show (left hand side) herbarium records that indicate the population is disjunct. The right hand side confirms this disjunction using vegetation site data records. Although, the disjunction is shown to be less than herbarium records show.

Photograph 8: *Xanthorrhoea* sp. Coomberdale with stumps of dead individuals.

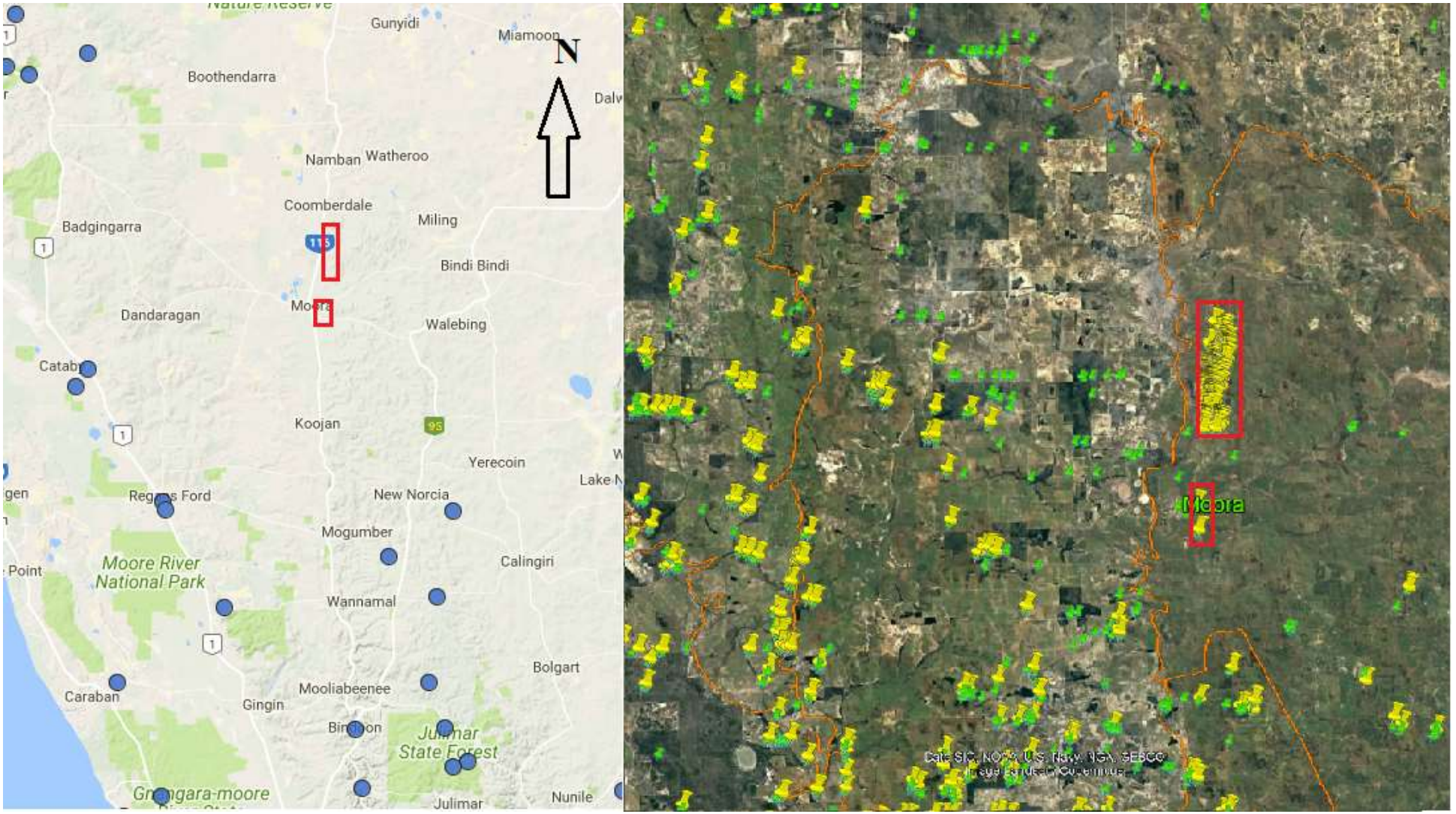
Notes: Within fifteen metres of the live plant of *Xanthorrhoea* sp. Coomberdale in the photograph there was one other live plant and the remains of ten (10) dead plants (two stumps arrowed). Such situations were not uncommon and a significant part of the population of *Xanthorrhoea* sp. Coomberdale has died in a relatively short time (< 10-20 years). Young plants were rarely seen during the flora searches for the proposed North Kiaka Mine or other work in the Coomberdale Chert TEC in 2016 and 2017.

Given the geographical restriction of *Xanthorrhoea* sp. Moora and the threatening factors affecting it (particularly climate change, but also factors preventing recruitment of new individual such as grazing and weed invasions), this species is likely to warrant priority flora status.



Map 25A: Records of *Xanthorrhoea* sp. Coomberdale from quadrat and vegetation mapping releve sites of Trudgen *et al.* (2012) for areas of the Coomberdale Chert TEC surveyed and from data collected by E.A. Griffin (the two southern records).

Notes: *Xanthorrhoea* sp. Coomberdale is more common in the areas mapped by Trudgen *et al.* (2012) than the quadrat and releve records indicate. The white areas on the image to the left of the Kiaka Road arrow are the existing Simcoa mine, waste dumps and storage areas. Image from Google Earth



Map 25B: Distribution of the genus *Xanthorrhoea* in the region around Moora showing the population of *Xanthorrhoea* sp. Coomberdale is disjunct

Notes: The left hand image shows all *Xanthorrhoea* records on The Australasian Virtual Herbarium (accessed 20/3/2018) in the region around Moora as blue dots, with *X.* sp. Coomberdale in the red rectangles. The right hand image shows records of *Xanthorrhoea* in vegetation data (mainly E.A. Griffins & M.E. Trudgen's data) as yellow pins. The RH image shows more accurately that the *Xanthorrhoea* sp. Coomberdale population (red rectangles) is disjunct from other *Xanthorrhoea* populations. The green pins indicate vegetation sites without *Xanthorrhoea*.

Xanthorrhoea sp. Coomberdale is common in the Coomberdale Chert TEC and is the only *Xanthorrhoea* recorded in the TEC. In the TEC it occurs in a range of habitat and vegetation types. The population has suffered a significant proportion of deaths of adult plants of the species in recent years. This may partly be due to declining rainfall and particularly the series of dry years between 2013 and 2016. There is almost no regeneration of this species occurring, with weed invasion likely to be a contributing factor, at least where weeds have higher cover.

To confirm that *Xanthorrhoea* sp. Moora is restricted to the Coomberdale Chert Threatened Ecological Community, searches were made along the Midlands Road and side roads from it from south of Moora to well north of Moora. Near Gillingarra (south of Moora) there is a similar entity that has different leaf cross section, slightly different fruit and grows on a different soil type.

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