

**PROPOSED CLEARING OF NATIVE VEGETATION
LOT 52 OLD GINGIN RD, MUCHEA
ENVIRONMENTAL ASSESSMENT**

Prepared for

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1.0 INTRODUCTION

Temma Nominees Pty Ltd operates a sand quarry at Lot 52 Old Gingin Rd, Muchea, supplying fill sand to the construction of the Perth - Darwin Highway. The quarry has been in operation since July 2014 and is expected to operate until approximately April 2019. The quarry consists of three sand pits, A, B and C, as shown on Figure 1. All three pits are currently in operation.

The contractor operating the pits, CPB Contractors, has identified an additional significant sand resource at the northern end of Pit A. This area was excluded from the originally approved pit because it was vegetated and because it was within the then 50m boundary setback. The neighbouring landowner has agreed for the 50m setback to be reduced to 10m. Temma Nominees Pty Ltd has applied for a clearing permit to extend Pit A north to within 10m of the property boundary. Figure 2 shows the application area, which measures 1.8 hectares.

Bayley Environmental Services was commissioned in April 2018 to prepare a report assessing the vegetation in the application area and to submit an application to the DWER for a permit to clear the vegetation.

The clearing will take place as soon as possible to allow sand extraction to proceed seamlessly into the extension area and maintain the construction schedule for the Perth-Darwin Highway.

The Perth-Darwin Highway is a project of national significance whose schedule depends on the ready availability of construction sand. A letter from the principal contractor, CPB Contractors, is attached in Appendix A.

The clearing will be temporary in order to permit the extraction of the sand resource. Following sand extraction the area will be rehabilitated to native vegetation.

2.0 EXISTING ENVIRONMENT

2.1 Topography

The application area is located on the lower western face of the Gingin Scarp. The land falls south-west from an elevation of about 83m AHD at the eastern side to 63m at the western side, at an average gradient of 8%.

East of the application area, the land rises to a maximum height of about 170m AHD at the top of the scarp. To the west, a broad flat palusplain at about 55m AHD extends west to the coastal dunes. Figure 2 shows the topography.

2.2 Geology and Soils

The Geological Survey of Western Australia (Gozzard, 1982) maps the application area as Colluvium (Qc/S5) and Colluvial Sands (Qs/S6) formed by erosion from the face of the scarp.

The soils consist of colluvial sands with grey to grey-brown sandy topsoil and yellow or orange sandy subsoil to between 4 and 10 metres, underlain by pebbly and clayey sand.

2.3 Hydrology

2.3.1 Groundwater

Department of Water & Environmental Regulation (DWER) mapping shows that groundwater in the superficial aquifer flows in a south-westerly direction beneath the application area in line with the topography. West of the application area, the groundwater flow turns south-southeast towards Ellen Brook. Figure 3 shows the regional hydrology.

The DWER mapping shows the minimum groundwater level beneath the application area at about 58 – 60m AHD with a south-westerly gradient of 0.005. Measurement of bores installed in and around Pit A (Figure 2) in August to October 2017, combined with simultaneous measurements in DWER bores located 14km north and 2.9km south-west, gave estimated maximum groundwater levels of 59-63m AHD beneath the application area.

On the palusplain to the west, the groundwater table intersects the ground surface in winter and discharges to swamps, drains and creeks. This effectively limits the maximum groundwater level to the ground surface west of the application area, and also limits the maximum groundwater level reached beneath the pit.

2.3.2 Surface Water

There is no surface water in the application area due to the slope and the porous soils. Surface runoff would be unlikely to occur except over short distances under extreme rainfall conditions.

Surface drainage in the wider area is generally south-west from the scarp to the palusplain and then south into Ellen Brook. Small creeks (Yalyal Brook to the north and Rocky Creek to the south) drain off the scarp and meander across the palusplain before flowing south into Ellen Brook (Figure 3).

2.3.3 Wetlands

An extensive area of palusplain (seasonally waterlogged plain) occurs to the west of the application area (Figure 3). Most of the palusplain is mapped as Multiple Use category, but the part closest to Pit A is mapped as Resource Enhancement (REW). Aerial photography suggests that most of this area consists of cleared paddocks and should be mapped as Multiple Use. The closest occurrence of the mapped REW is 160m from the edge of the application area.

Extensive surface saturation occurs on the palusplain, with numerous soaks, seeps and tracks becoming saturated or inundated in winter. Four small soak dams west and south-west of Pit A hold permanent water.

2.4 **Vegetation and Flora**

2.4.1 Vegetation Surveys

Bennett Environmental Consulting carried out a Level 1 (EPA, 2004) botanical survey of the application area as part of an overall survey of the three sand extraction areas on Lot 52 in October 2011. The survey included one 10x10m quadrat within the application area. The Bennett (2011) report is attached in Appendix B.

Bayley Environmental Services (BES) resurveyed the application area in April 2018. The resurvey comprised:

- a foot reconnaissance search of the application area, with all observed species collected for identification;
- identification to species level by taxonomist Shane Chalwell of Plantecology; and
- floristic community analysis using the combined species lists of the Bennett (2011) and BES (2018) surveys, the published work of Gibson *et al.* (1994), Coffey (2015) and statistical analysis by Shane Chalwell of Plantecology.

2.4.2 Vegetation Types

The vegetation of the application area is mapped by Heddle *et al.* (1980) as Coonambidgee Complex in the western half and Reagan Complex in the east. Both complexes are characterised by a low open-forest to low woodland of *Eucalyptus todtiana*-*Banksia attenuata*-*B. menziesii*. The understoreys of the two complexes are similar and include *Nuytsia floribunda*, *Stirlingia latifolia*, *Mesomelaena pseudostygia*, *Casuarina humilis* and species of *Hibbertia*, *Eremaea*, *Conospermum* and *Conostephium*.

Beard (1981) mapped the application area as Pinjarra 4: Medium Woodland – Marri and Wandoo. There is no Wandoo in or near the application area.

Bennett (2011) described the vegetation of the application area as Sparse Low Woodland of *Eucalyptus todtiana*, *Banksia attenuata* and *Nuytsia floribunda* over *Xanthorrhoea preissii* Mid-Dense Heath over Sparse Dwarf Scrub of mixed species.

The resurvey by BES (2018) found a very open woodland of *E. todtiana* with a few *Corymbia calophylla*, *N. floribunda* and *B. attenuata* over a very sparse understorey of *X. preissii* and mixed low shrubs.

2.4.3 Vegetation Condition

Bennett (2011) described the condition of the application area as Good according to the rating scale used by Keighery (1994). Bennett noted that the area was subject to ongoing disturbance by cattle grazing, weed invasion, changed fire frequency and edge effects.

The resurvey by BES in 2018 found that the condition of the vegetation had deteriorated since the Bennett (2011) survey, and is now assessed as Degraded to Good. The major causes of disturbance observed were grazing and trampling by cattle (which roamed freely through the area until October 2017), a fire which burnt through the area between October and December 2016, weed invasion and possibly drought. There were extensive areas of bare sand showing visible signs of cattle trampling. There were many dead or dying Banksias, possibly due to drought. Many of the understorey species were stunted and showing signs of grazing. Nevertheless, the vegetation included a reasonably diverse range of species and would appear able to regenerate successfully if protected from grazing.

Figure 4 shows photographs of the vegetation taken in April 2018.

2.4.4 Flora

Bennett (2011) found 38 native and 8 introduced species in the application area. BES (2018) found 36 native and 4 introduced species, giving a total of 54 native and 10

introduced species for the two surveys. Table 2.1 lists the species found in the application area.

Table 2.1 Flora Species List

Native Species	Eremaea pauciflora	Patersonia occidentalis
Acacia pulchella	Eucalyptus marginata	Petrophile linearis
Alexgeorgea nitens	Eucalyptus todtiana	Podotheca angustifolia (BEC)
Allocasuarina humilis	Gastrolobium capitatum (BEC)	Podotheca gnaphalioides
Anigozanthos humilis (BEC)	Gompholobium knightianum (BEC)	Scaevola canescens (BEC)
Banksia attenuata	Gompholobium marginatum (BEC)	Stirlingia latifolia (BEC)
Banksia dallanneyi ssp. dallanneyi	Haemodorum laxum	Stylidium amoenum (BEC)
Banksia menziesii	Hakea costata	Synaphea spinulosa
Bossiaea eriocarpa	Hakea ruscifolia	Trachymene pilosa (BEC)
Brachyloma preissii	Hibbertia huegelii	Xanthorrhoea brunonis (BEC)
Calandrinia pink (BEC)	Hibbertia hypericoides	Xanthorrhoea preissii
Calothamnus quadrifidus	Jacksonia floribunda	Introduced Species
Calytrix flavescens	Jacksonia sternbergiana (BEC)	*Aira cupaniana (BEC)
Cassytha racemosa (BEC)	Kunzea glabrescens	*Briza maxima (BEC)
Conostephium preissii (BEC)	Lagenophora huegelii (BEC)	*Ehrharta calycina
Conostylis aculeata	Lepidobolus preissianus	*Hypochaeris glabra (BEC)
Conostylis setigera (BEC)	Lepidosperma angustatum (BEC)	*Hypochaeris radicata
Corymbia calophylla	Lyginia barbata (BEC)	*Lolium temulentum (BEC)
Corynotheca micrantha	Lyginia imberbis	*Pentameris airoides
Daviesia divaricata ssp. divaricata	Macrozamia riedlei	*Solanum nigrum
Daviesia triflora	Mesomelaena pseudostygia	*Ursinia anthemoides (BEC)
Desmocladus flexuosus	Nuytsia floribunda	*Wahlenbergia capensis (BEC)

BEC = Bennett Environmental Consulting (2011)

The BES (2018) survey took place at the end of summer and would likely have missed a number of ephemeral species. The two surveys occurred in two different seasons and are considered likely to have captured most of the species present.

2.4.5 Floristic Communities

Species data collected by Bennett (2011) and BES (2018) were compared to the Swan Coastal Plain dataset and the Northern Darling Scarp floristic dataset by Dr Shane Chalwell of Plantecology, using both hierarchical and non-hierarchical clustering approaches. The hierarchical clustering approach follows the original method used to define the FCTs but is often unsuitable to use when adding new data. The non-hierarchical approach allows for the addition of new data without disrupting the original groups, but requires the re-analysis of the original dataset using a different method.

The results of the FCT analysis were equivocal and not definitive. The hierarchical clustering for the SCP dataset indicated that FCTs 21a and 28 were most similar to the application area.. However, the fusion with these groups in the dendrogram was very high, indicating the relationship is very weak. Similarly, the non-hierarchical clustering

results for the SCP dataset indicated that FCTs 21c and 28 were the most similar to the application area, but the strength of membership was only 16% and 20% respectively. These values are too low to make a confident FCT assignment.

The correlation to the Northern Darling Scarp FCTs was also unclear. The hierarchical clustering results indicated similarity to FCTs 1c, 5 and 6, but these communities occur on granite substrates and are an unlikely result for the site. Some similarity was also indicated to FCT 7 (Woodlands on poorly drained colluvial deposits), which is found on the Ridge Hill Shelf, and a more likely result, although the application area is very well drained. The non-hierarchical clustering also showed some similarity to FCTs 1c, 5 and 6, but little relationship with FCT 7.

The numerical analyses cannot provide a confident assignment of the application area data to a Floristic Community Type. This is often seen on sites that are degraded or have been subject to disturbances such as grazing over a period of time.

Comparison of the species list for the site against the thirty-group classification and sorted two-way table in Gibson *et al.* (1994) and descriptions of a nearby site by Coffey (2015) indicated that the FCTs present at the site might be FCT 20a (*Banksia attenuata* woodland over species rich dense shrublands), FCT 28 (Spearwood *Banksia attenuata* or *Banksia attenuata* - *Eucalyptus marginata* woodlands) or FCT *Banksia* on Yellow-Orange Sands.

2.4.6 Rare and Significant Flora

A search of the DBCA Threatened Flora GIS Database found one Declared Rare Flora Species and three Priority Flora Species recorded within a 5km radius of the application area. These are:

- *Grevillea curviloba* ssp. *curviloba* (DRF) - Recorded at 18 locations in or near the Brand Highway road reserve. *G. curviloba* is described in Florabase as typically occurring in winter-wet heaths. English & Blyth (2000) described the species as growing on “typically winter-wet, deep peaty sands over limestone at depth...”. This habitat type does not occur in the application area, so the species is unlikely to be present.
- *Acacia drummondii* ssp. *affinis* (P3) - Recorded at two locations in the Great Northern Highway road reserve. Florabase describes *A. drummondii* as growing on “Sand, gravelly soils, laterite. Granite outcrops, gullies, low-lying areas, low ridges & hillsides.” It could potentially occur in the application area but was not found by either the Bennett (201) or BES (2018) surveys.
- *Verticordia lindleyi* ssp. *lindleyi* (P4) - Recorded at one location in the Great Northern Highway road reserve. *V. lindleyi* is described in Florabase as occurring on sand and sandy clay soils in winter-wet depressions. This habitat type does not occur in the application area so the species is unlikely to be present.

- *Verticordia serrata* var. *linearis* (P3) - Recorded in one location in Gulliente Road reserve. Also listed by Coffey (2015) as occurring in open Jarrah-Marri woodland approximately 500m north of the application area. Florabase describes *V. serrata* as growing on white sand and gravel in open woodland. It could potentially occur in the application area but was not found by either the Bennett (2011) or BES (2018) surveys.

Coffey (2015) listed one additional species, *Hypolaena robusta* (P3) as occurring in open Jarrah-Marri woodland approximately 800m east of the application area. *H. robusta* is described in Florabase as occurring on white sandplains. It could occur in the application area but was not found by either the Bennett (201) or BES (2018) surveys. As a herbaceous species, it would be likely to be heavily affected by grazing cattle.

2.4.7 Local and Regional Representation

Table 2.2 summarises the status of the site vegetation types State-wide, in the Swan Coastal Plain Bioregion, the Perth Bioregion, the Shire of Chittering and within a 15km radius of the site.

Table 2.2 Status of Vegetation Types

<i>Vegetation Unit</i>	<i>Pre-European Extent (km²)</i>	<i>Current Extent (km²)</i>	<i>% Remaining</i>	<i>% In Secure Reserves</i>
Remnant Vegetation				
Shire of Chittering	1,217	393	32	5
15km Radius	706	365	52	3.6
Coonambidgee Complex (Heddle, 1980)				
Swan Coastal Plain (2013)	63	29	45.6	10.4
Shire of Chittering (2017)	11.5	2.1	18	
15km Radius	19	9	48	3.1
Reagan Complex (Heddle, 1980)				
Swan Coastal Plain (2013)	91	31	33.6	3.8
Shire of Chittering (2017)	20.2	10.4	51	
15km Radius	46	33	72	3.1
Pinjarra 4 (Beard, 1981)				
Statewide	10,543	3002	28.5	4.3
Swan Coastal Plain (2013)	159	32	20	2.6
Perth Subregion	131	20	15.4	1.85
15km Radius	56	11	19.3	6.7

The table shows that the vegetation types present in the application area are moderately to well represented both locally and regionally, but that their formal reservation status is generally poor.

2.4.8 Threatened and Priority Ecological Communities

Table 2.3 summarises the conservation status of the ecological communities that appear most likely to be present in the application area.

Table 2.3 Status of Ecological Communities

<i>Ecological Community</i>	<i>Status (Gibson et al., 1994)</i>		<i>State Listing</i>	<i>Commonwealth Listing</i>
	<i>Reservation</i>	<i>Conservation</i>		
SCP 20a	Unreserved	Endangered	Threatened	Endangered
SCP 28	Well reserved	Low risk	-	Endangered
SCP Banksia Yellow-Orange Sands	-	-	Priority 2	Endangered

All of the possible FCTs at the site are listed as part of the *Banksia Woodlands of the Swan Coastal Plain*, which is listed as Endangered under the Commonwealth EPBC Act 2000. The EPBC listing includes all woodlands on the Swan Coastal Plain in which one or more Banksia species are dominant or co-dominant. Under the EPBC Act, all actions which might affect the ecological community require referral if they meet the following criteria:

- The vegetation meets the description of Banksia woodland in terms of location, soils & landform, structure and composition.
- The vegetation is in at least Good condition (vegetation structure altered but retains basic vegetation structure or ability to regenerate to it; obvious signs of disturbance e.g. from partial clearing, dieback, logging, grazing; presence of very aggressive weeds).
- For vegetation in Good condition, the patch is at least 2ha in area.

The vegetation in the application area meets the description of Banksia woodland for the purposes of the EPBC listing. The vegetation condition (as described above) is marginally within the definition, although it would be expected to decline further with continued cattle grazing. The area of the application, at 1.8ha, is below the minimum threshold for referral under the EPBC Act. Therefore, it is concluded that the proposed clearing does not require referral to the Commonwealth.

2.5 Fauna

2.5.1 Species and Habitats

The disturbed vegetation in the application area offers poor to moderate habitat for disturbance-tolerant native species. The habitat can be broadly described as Banksia

open low woodland with sparse understorey and an open ground surface. There are no trees large enough to offer roosting or nesting habitat for black cockatoos, although the Banksias present would offer some feeding habitat in conjunction with the much larger areas of undisturbed vegetation to the north and east.

There is no dense undergrowth or ground cover to provide cover for small to medium mammals such as Quenda or Brush Wallaby, although these and other mobile species such as Chuditch may visit the application area from time to time. The open and largely bare ground surface would offer limited cover for reptiles.

Direct and indirect observations during the site survey in April 2018 included Kangaroos (scats and tracks), Splendid Fairy-Wren (seen), Magpie (heard) and Pied Butcherbird (heard). There was abundant evidence of cattle in the form of manure, tracks and bones. Cattle roamed freely through the application area until about six months before the survey.

2.5.2 Significant Fauna

Coffey (2015) searched all relevant fauna databases over an area including the application area as part of an assessment of Lot M291 Ippolo Rd, Chittering for the Perth-Darwin Highway project. The databases searched included:

- DBCA Naturemap (15km radius including the application area);
- DBCA Threatened Fauna Database (15km radius including the application area);
- EPBC Protected Matters Search Tool (10km radius including the application area);
- and
- Birds Australia Birddata database (1 degree/60nm square including the application area) .

The searches produced a list of three Threatened Fauna species, six Priority Fauna species and five otherwise significant species from the search area. These species are summarised, and their likelihood of occurrence in the application area assessed, below:

- Carnaby's Black Cockatoo *Calyptorhynchus latirostris* (S1, EN) – Feeds and breeds in eucalypt and Banksia woodland from the lower Murchison to the lower south-west. Numerous records of occurrence near the application area. Likely to occur in and around the application area, although the site contains no suitable nesting or roosting trees and limited food resources.
- Forest Red-tailed Black Cockatoo *Calyptorhynchus banksii naso* (S1, VU) - Feeds and breeds in eucalypt and Banksia woodland from Gingin to the lower south-west. May occur in and around the application area, although the site contains no suitable nesting or roosting trees and limited food resources. The nearest recorded sighting in recent times is from approximately 35km south of the application area (Coffey, 2015).

- Baudin's Black Cockatoo *Calyptorhynchus baudinii* (S1, VU) - Feeds and breeds mainly in tall, dense Marri, Jarrah and Karri forests from Gidgegannup to the south coast. Feeds also in Banksia woodland. Unlikely to be present as the application area is outside the species' current mapped distribution (DSEWPC, 2012).
- Barking Owl *Ninox connivens* (P2) - Prefers dense forest vegetation in the deep south-west. The closest recent record is an isolated record approximately 50km south of the application area (Coffey, 2015).
- Black-striped Snake *Neelaps calonotos* (P3) - Inhabits dense leaf litter in Banksia and eucalypt woodlands with sandy soil from Lancelin south to Mandurah. Has been previously recorded by DBCA approximately 5km south of the application area in Muchea (Coffey, 2015). Likely to be present around the application area, although the lack of dense leaf litter and ground cover makes its presence within the site unlikely.
- Bush Stone-curlew *Burhinus grallarius* (P4) - Although suitable habitat exists around the application area there have been limited recent records of this species on the Swan Coastal Plain and it is thought to be locally extinct due to predation from feral species. Unlikely to be present.
- Brush Bronzewing *Phaps elegans* (P4) - Inhabits dense shrubland and dense understorey in woodlands. Thought to be locally extinct on the Swan Coastal Plain. Unlikely to be present in the application area due to the absence of dense understorey, although it may be present in surrounding areas.
- Western Brush Wallaby *Macropus irma* (P4) - Inhabits open forests and woodlands, favouring seasonally wet flats and thickets (van Dyck and Strahan, 2008). Eucalypt and Banksia woodland provide habitat for this species and one individual was recorded in eucalypt woodland by Coffey (2015) 4km north of the application area. Likely to be present in the vicinity and may visit the application area, but would not be resident due to the absence of cover.
- Quenda *Isodon obesulus fusciventer* (P5) - Inhabits dense ground cover in forests, woodlands and heaths, preferring areas around wetlands and damplands. Has previously been recorded in the vicinity of the application area (Coffey, 2015). Likely to be present in the vicinity and may visit the application area, but would not be resident due to the absence of dense cover.
- Chuditch *Dasyurus geoffroii* (S3, VU) - Occurs in a wide range of habitats including woodlands, dry sclerophyll forests and riparian vegetation. All habitats in the application area provide foraging habitat but the absence of hollow logs (due to recent hot fire) means that den sites are absent. Likely to be present sporadically in the application area.

- Western Carpet Python *Morelia spilota imbricata* (S4) - Inhabits eucalypt and Banksia woodlands, heathland, grassland and semi-arid areas from Northampton to the south coast and eastern goldfields. Likely to be present although the lack of dense ground cover and leaf litter reduces the habitat value of the application area.
- Peregrine Falcon *Falco peregrinus* (S4) - A wide-ranging species that prefers nesting in cliff faces. Likely to overfly the application area but would not be resident.
- Rainbow Bee-eater *Merops ornatus* (S3, MI) - A common and widespread migratory species that utilises a wide range of habitats, with a preference for nesting in open sandy ground. The application area provides ample sandy areas and it is likely to be present during breeding season (early summer), although the high incidence of cattle trampling would threaten the success of nesting.
- Fork-tailed Swift *Apus pacificus* (S3, MI) - A widespread and almost entirely aerial species. Likely to overfly the application area but would not be resident or dependent upon it.

Several of the species listed above are likely to visit the application area to feed, including the black cockatoos, Brush Wallaby, Quenda and Chuditch. Due to the sparseness of the vegetation, the degree of ongoing disturbance and the lack of cover, none are likely to be resident in or dependent upon the site.

2.5.3 Black Cockatoo Habitat Assessment

Feeding Habitat

The application area contains ten species recorded as food resource species for Carnaby's Cockatoo (Valentine & Stock 2008, Coffey 2015). Carnaby's Cockatoo is the cockatoo species considered most likely to be present in the area, and Banksia is a favoured food resource of Carnaby's cockatoo. Therefore, the density of Banksia on the site can be used as a proxy measure of the available black cockatoo food resource on the site.

The Banksia density over the site was estimated using a combination of counting living Banksias within informal 10x10m plots and use of high-resolution aerial photography to count all trees on the site with canopies wider than 3m and sufficiently tall to cast a significant shadow. This is believed to give an over-estimate of food resources, as most of the larger trees are actually *Eucalyptus todtiana*, a secondary food species for black cockatoos.

The count gave a total of 83 trees on the 1.8ha application area at a density of 46 trees per hectare. This is a low density compared with Banksia woodland in the Perth area, which is typically around 150-200 per hectare or higher (M. Bamford, unpub. data).

The potential food resource for Carnaby's Cockatoos can be estimated based on previous studies by Bamford (2009, 2004), Valentine & Stock (2008) and Cooper *et al.*

(2002) of typical *Banksia* cone production and the number of *Banksia* cones necessary to support one Carnaby's Cockatoo. The bases of this estimate are as follows:

- Bamford (2009) counted an average of 14 inflorescences (corresponding to annual cone production) per tree for *B. attenuata* and 12 for *B. menziesii*.
- Bamford & Bamford (2004) found an average inflorescence density per tree of 6.7 for *B. attenuata* and 6.5 for *B. menziesii*.
- Valentine & Stock (2008) found an average of 12 unopened cones per *B. attenuata* tree.
- Cooper *et al.* (2002) calculated that 11 *B. attenuata* cones can support one Carnaby's Cockatoo for one day.

Based on these findings, and assuming that all significant trees counted in the application area are *B. attenuata* and that the cone production is the average of previous counts for *B. attenuata* (i.e. 10.9 cones per year), it is estimated that the trees in the application area could support 0.23 Carnaby's Cockatoo for one year. Thus the application area contains less than one quarter of the food resources needed to support one Carnaby's Cockatoo.

Roosting Habitat

The application area contains no trees taller than five metres. It is considered that there is no usable roosting habitat for black cockatoos.

Nesting Habitat

The application area contains no trees with diameter at breast height (dbh) greater than 0.5m and no trees with significant hollows that would be usable by black cockatoos. It is concluded that there is no existing or potential (in the foreseeable future) nesting habitat for black cockatoos on the site.

3.0 PROJECT DESCRIPTION

3.1 Clearing and Topsoil Stripping

Clearing will be undertaken by bulldozer. The cleared vegetation will be windrowed adjacent to the pit for use in rehabilitation. Topsoil will be stripped with a scraper to a nominal depth of 150mm and stockpiled for use in rehabilitation.

3.2 Sand Extraction

The sand resource will be excavated using wheeled loaders and loaded directly onto B-double trucks for transport to the highway construction site. No stockpiling of sand will occur on site. The quarrying operation will be carried out by CPB Contractors.

A gravel haul roads capable of carrying B-double trucks has been constructed from Old Gingin Road to the pit. Old Gingin Road has been upgraded and sealed to a standard suitable for RAV Category 2 heavy vehicles. Up to 600 truck movements a day will be used to transport the sand.

The quarry will operate generally from Monday to Friday between the hours of 7am and 6pm, and on Saturdays from 7:30am to 5pm. The quarrying operation is expected to last for up to 12 months.

3.3 Rehabilitation

Rehabilitation will occur immediately following the end of sand extraction. The landform at the end of extraction will be a flat or gently sloping pit floor with a silty sand soil texture. The pit floor will be left smooth and even to prevent ponding of surface water and erosion. The rear and sides of the pit will be battered to a slope of less than 1:2.

Rehabilitation will comprise battering (if necessary) to a slope of less than 1:2, spreading of topsoil and vegetation debris. These rehabilitation activities will be completed within one month of the completion of quarrying.

Topsoil will be applied to the completed pit surface using a wheeled loader and spread using a grader. Contour ploughing will be carried out if and where necessary to minimise erosion and promote water infiltration and retention.

Stockpiled vegetation debris will be spread over the soil surface to provide a seed source. Some debris may be burned *in situ* to break seed dormancy and create ash beds for germination.

The application area will be fenced to permanently exclude cattle.

Regrowth of native vegetation in the rehabilitated area will be monitored visually once each year for two years after the completion of the initial rehabilitation works. Records of the monitoring, including photographs of the rehabilitated area, will be reported to the Shire of Chittering in the biannual reports required under Condition (xxiii)(g) of the Shire's approval of the extraction operation.

If at the end of two years the regrowth is not seen to be progressing satisfactorily, direct seeding with local native species (selected from the species list in Table 2.1) may be undertaken.

4.0 ASSESSMENT AGAINST THE CLEARING PRINCIPLES

- a) **Native vegetation should not be cleared if it comprises a high level of biological diversity.**

Summary: Proposal is not likely to be at variance to this principle.

The wording of this principle suggests that, to be regarded as having a “high level” of biological diversity then the diversity of the vegetation should be relatively high compared to other vegetation, either of the same type or of different types.

The Banksia woodlands of the eastern Swan Coastal Plain are generally regarded as having a high level of biodiversity in their undisturbed state. Gibson *et al.* (1994) noted that FCT 20a had the highest flora species richness of any of the Banksia woodlands, with an average of 67.4 species in a 100m² plot. FCT 28 had a lesser richness at 55.2 species per 100m² plot.

The vegetation surveys by Bennett (2011) and BES (2018) found a total of 54 native species on the 1.8ha application area. This is comparable to the numbers quoted by Gibson *et al.* (1994) for a 100m² plot, but is less than the number expected in this vegetation type for a 1.8ha site. By comparison, Coffey (2015) recorded 148 native taxa in a 986ha site in mostly Excellent to Pristine condition located 3km north of the application area.

In summary, the biological diversity of the application area is less than would be expected for vegetation of this type, probably due largely to the disturbed state of the vegetation.

- b) **Native vegetation should not be cleared if it comprises the whole or part of, or is necessary for the maintenance of, a significant habitat for fauna indigenous to Western Australia.**

Summary: Proposal is not likely to be at variance to this principle.

The application area provides low quality habitat for disturbance-tolerant fauna. The absence of a dense understorey and ground cover reduces its value for many fauna species, while the low number of trees and large shrubs means that it offers few roosting, nesting or feeding resources for birds.

- c) **Native vegetation should not be cleared if it includes, or is necessary for the continued existence of, rare flora.**

Summary: Proposal is not likely to be at variance to this principle.

The vegetation surveys by Bennett (2011) and BES (2018) found no Declared Rare Flora or Priority Flora species in the application area. Two Priority 3 Flora species, *Acacia drummondii* ssp. *affinis* and *Verticordia serrata* var. *linearis*, could occur at the site but were not found by either survey. It is concluded that the application area is unlikely to be significant as a habitat for rare flora.

- d) Native vegetation should not be cleared if it comprises the whole or a part of, or is necessary for the maintenance of, a threatened ecological community.**

Summary: Proposal is not likely to be at variance to this principle.

The condition of the vegetation and the relatively low number of species recorded meant that it was not possible to assign the vegetation to any floristic community, either by comparison with the descriptions in Gibson *et al.* (1994) or by statistical analysis. Of the Floristic Community Types considered most likely to be present, FCT 21a is listed as Threatened under Western Australian legislation, and FCT: Banksia Yellow-Orange Sands is listed as Priority 2.

All Banksia woodlands on the Swan Coastal Plan are listed as Threatened Ecological Communities under the Commonwealth EPBC Act 2000, but the application area is below the minimum size for referral under the EPBC Act.

- e) Native vegetation should not be cleared if it is significant as a remnant of native vegetation in an area that has been extensively cleared.**

Summary: Proposal is not likely to be at variance to this principle.

Table 2.2 shows that the vegetation types present in the application area are generally well represented in the Swan Bioregion, the Shire of Chittering and within a 15km radius of the site. Although the percentage of formal reservation in most cases is low, the table shows that there is ample scope for further reservation.

- f) Native vegetation should not be cleared if it is growing in, or in association with, an environment associated with a watercourse or wetland.**

Summary: Proposal is not likely to be at variance to this principle.

The application area is located on elevated dry land. The nearest mapped wetland is located 160m to the west, and consists of cleared grazing paddocks on palusplain. The nearest mapped wetland of any significance is a small Conservation Category sumpland located 1.9km south-west of the application area.

- g) Native vegetation should not be cleared if the clearing of the vegetation is likely to cause appreciable land degradation.**

Summary: Proposal is not likely to be at variance to this principle.

Land degradation may be taken to mean erosion, salinisation or other events that reduce the land's capability to support biological production.

The proposed sand extraction operation will begin with clearing vegetation and stripping topsoil to a depth (nominally) of 150mm. The vegetation debris and topsoil will be windrowed for use in rehabilitation. The windrows will be watered as necessary to minimise dust generation and erosion. The underlying sands are coarser with low organic content and are much less susceptible to erosion. Dust and erosion management measures for the existing extraction operation are set out in the Dust Management Plan (BES, 2017), which was approved by the Shire of Chittering in December 2017.

Once the sand extraction has been completed the pit will be recontoured and the stockpiled topsoil and vegetation debris will be respread over the ground surface. Given the short period of stockpiling, the debris and topsoil are expected to contain a considerable store of viable seeds. Some vegetation debris may be burned *in situ* to break seed dormancy and create ash beds for germination. Further details of proposed rehabilitation were given in Section 3.3.

The application area is situated on elevated sandy soils with no significant risk of salinisation.

- h) Native vegetation should not be cleared if the clearing of the vegetation is likely to have an impact on the environmental values of any adjacent or nearby conservation area.**

Summary: Proposal is not likely to be at variance to this principle.

There are no conservation areas adjacent to or near the application area. The closest DBCA-managed lands are the Barracca Nature Reserve, located 3.4km east of the application area, and the Chandala Nature Reserve, located 3.5km to the north-west. The proposed sand extraction will have no effect on either of these reserves.

- i) Native vegetation should not be cleared if the clearing of the vegetation is likely to cause deterioration in the quality of surface or underground water.**

Summary: Proposal is not likely to be at variance to this principle.

The proposed sand extraction operation will maintain a minimum 0.5m clearance between the pit floor and the maximum groundwater level (as calculated from on-site

bores and DWER reference bores). The operation will not involve the use of any chemicals, fertilisers or other potentially contaminating materials.

Refuelling of machinery on site will take place in a bunded enclosure with a floor composed of concrete or compacted clay. This refuelling facility will be located within the existing extraction operation, outside of the application area.

Fuel will primarily be transported to the site in a mobile tank mounted on a trailer or vehicle. If fuel is stored on site it will be held in a properly constructed tank within a sealed bunded enclosure, in accordance with the *Storage and Handling of Dangerous Goods Code of Practice 2010*. No other environmentally hazardous materials (e.g. pesticides or oils) will be stored on site.

Machinery used on the site will be properly maintained to prevent leakage of oils, fuel and hydraulic fluid. In the unlikely event of a spill or significant leak, the spilled fluid and any spill-affected soil will be cleaned up and placed in a sealed container or removed from the site within 24 hours.

These and other groundwater protection measures for the existing extraction operation are set out in the Water Management Plan (BES, 2017), which was approved by the Shire of Chittering in December 2017.

- j) Native vegetation should not be cleared if clearing the vegetation is likely to cause, or exacerbate, the incidence or intensity of flooding.**

Summary: Proposal is not likely to be at variance to this principle.

The application area is situated on elevated ground which is not at risk of flooding.

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Figures

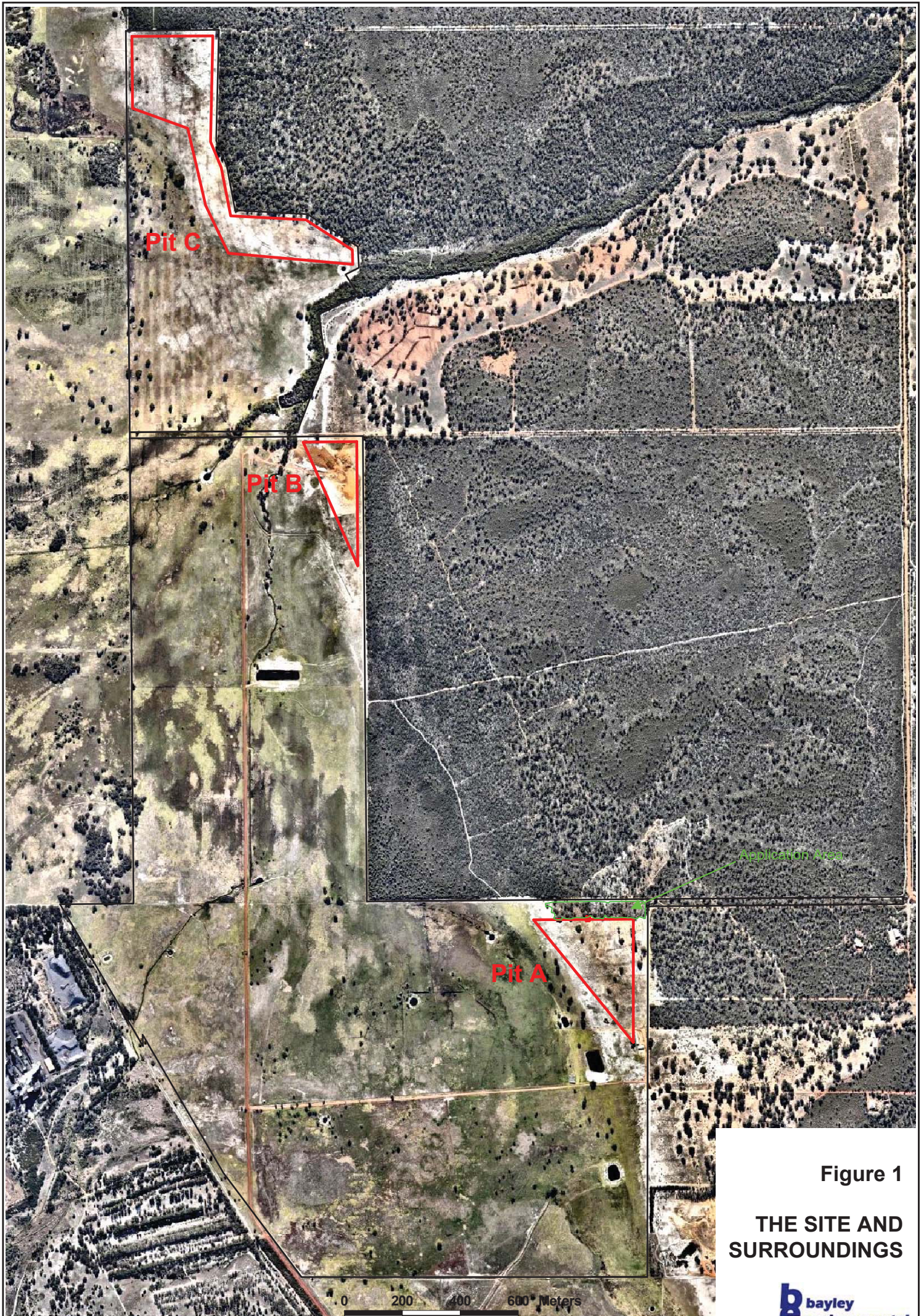
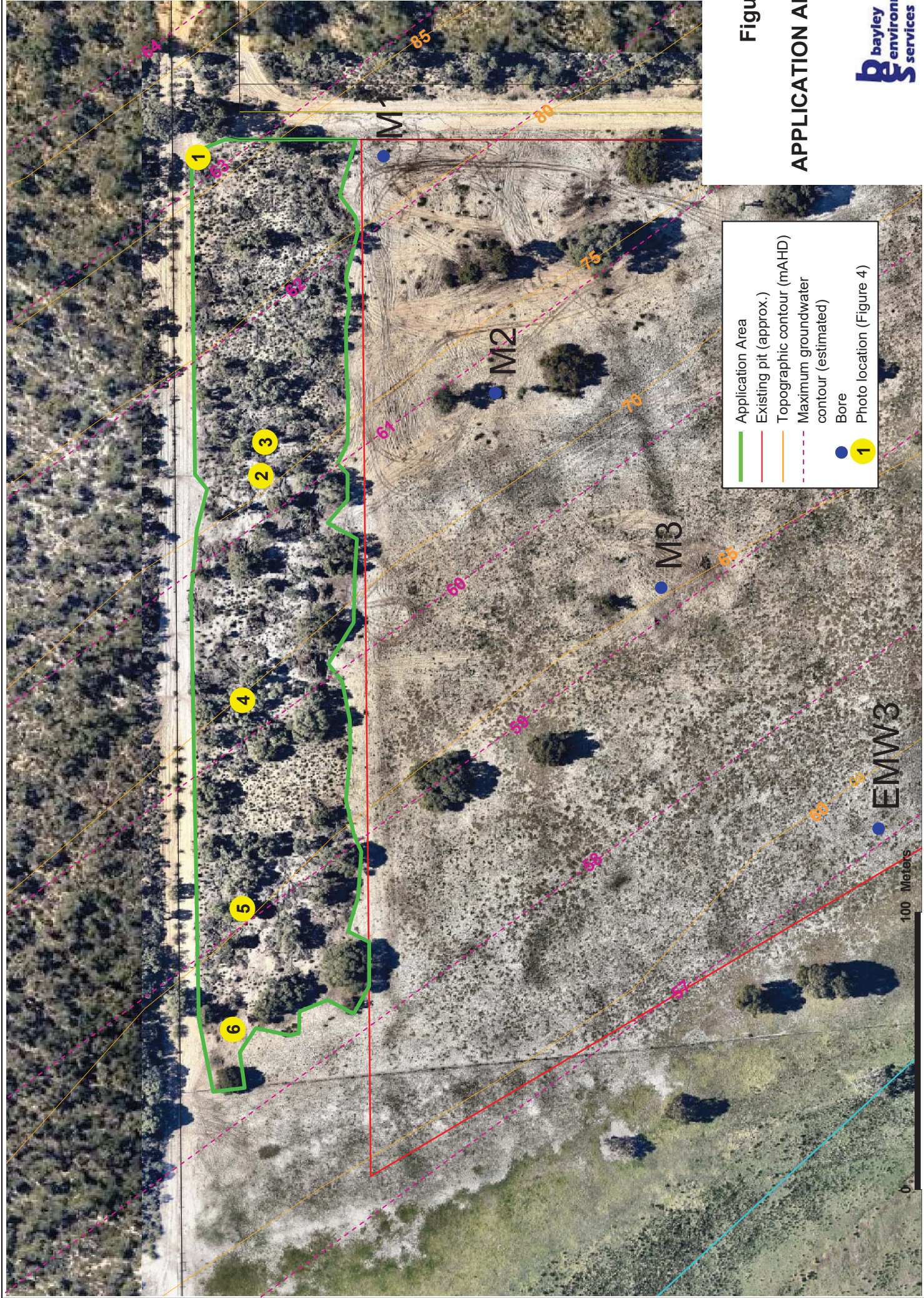


Figure 1
THE SITE AND
SURROUNDINGS



	Application Area
	Existing pit (approx.)
	Topographic contour (mAHD)
	Maximum groundwater contour (estimated)
	Bore
	Photo location (Figure 4)

Figure 2

APPLICATION AREA

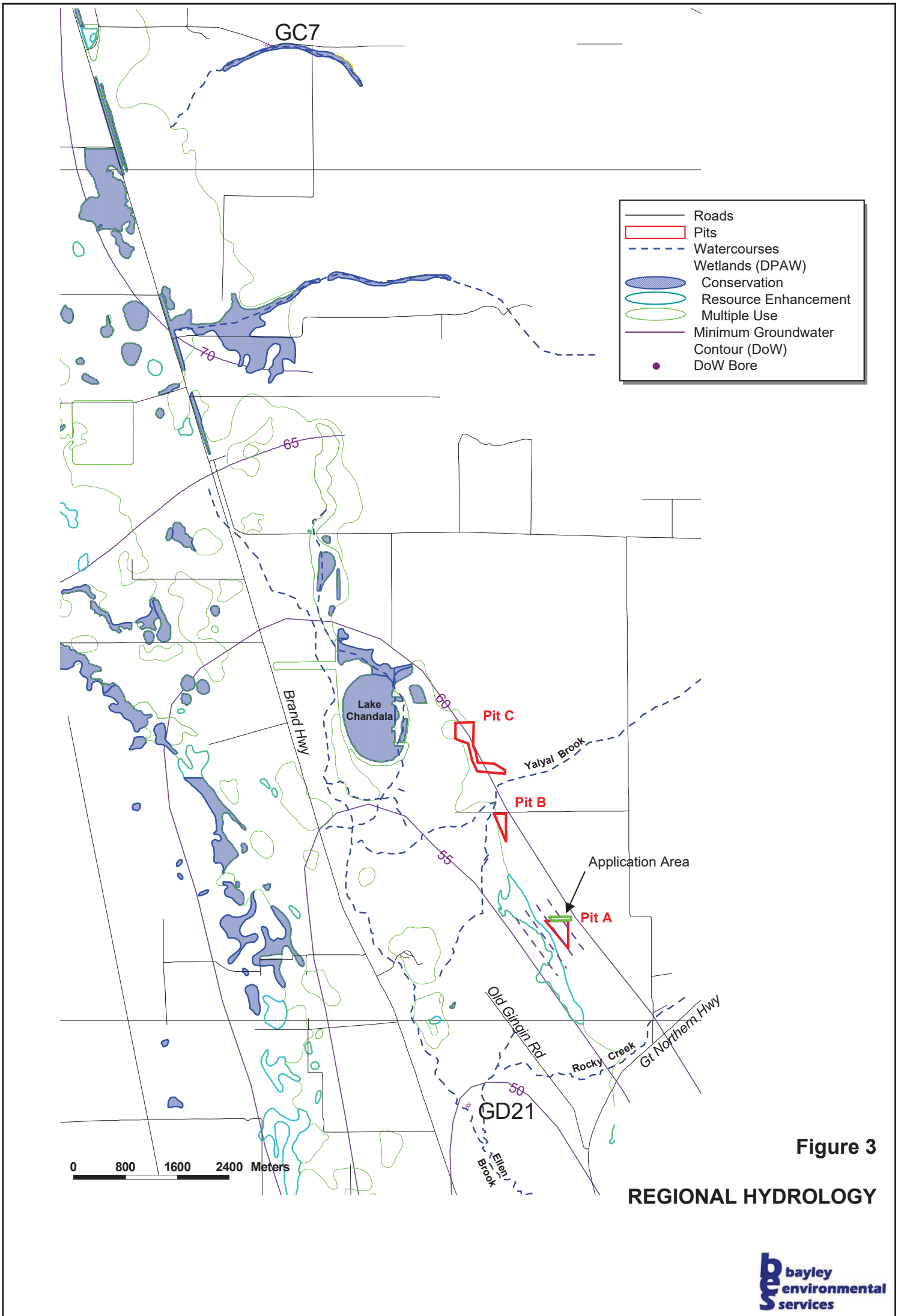


Figure 3

REGIONAL HYDROLOGY



Figure 4a

VEGETATION PHOTOGRAPHS



5



6

Figure 4b

VEGETATION PHOTOGRAPHS

Appendix A

Letter from CPB Contractors

12 April 2018

File ref: W01021-CPB-NCC-0025

To whom it may concern,

**Contract No. 183/15: Northlink WA Northern Section, Perth Darwin National Highway Project
(Maralla Road to Muchea)**

Subject: Lot 52 Old Gingin Road – Vegetation Clearing

Statement

CPB Contractors has been awarded the design and construction of the northern section of NorthLink WA – Ellenbrook to Muchea. Northlink WA (Project). Northlink WA is a joint State and Federally funded project that will deliver a national highway with four lanes taking the majority of heavy traffic away from Great Northern Highway.

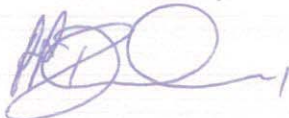
To construct the Project CPB requires the importation of over 3 million cubic metres of general fill (sand) materials. The importation of general fill materials is a critical element to the success of the Project.

CPB confirms it is in a commercial arrangement with the Owner of Lot 52 Old Gingin Rd for supply of sand material to the Project via the extraction of the material from their land (at Pit A, Pit B & Pit C), operating under Excavation License dated 5th December 2017.

The Owner has advised CPB that the vegetation thicket located near the northern boundary of Pit A may be cleared by the Owner. CPB states that it supports in principle, the clearing of this vegetation subject to satisfaction of all statutory approvals, as it will allow CPB to access additional sand.

CPB support relates to the requirement for sand to construct the Project and the fact that additional progressive investigations indicate groundwater levels are higher than originally determined. To ensure the pit floor level complies with the Excavation License the original floor levels calculated from original investigations have to be lifted. This has reduced the available quantities of sand for use on the Project.

Yours faithfully,



Stephen Nicolay
Project Manager

North Link WA Stage 3
CPB Contractors Pty Limited
E Stephen.Nicolay@cpbcon.com.au
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Appendix B

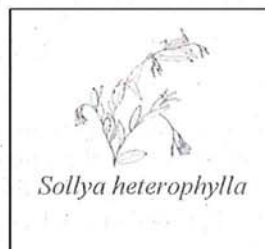
Bennett (2011) Botanical Report

Lot 52 Old Gingin Road, Chittering



Prepared for:
Statewest Surveying and Planning
69 Great Northern Highway
MIDLAND

Prepared by:
Bennett Environmental Consulting Pty Ltd



PO Box 341
KALAMUNDA 6926

November 2011

STATEMENT OF LIMITATIONS

Scope of Services

This report ("the report") has been prepared in accordance with the scope of services set out in the contract, or as otherwise agreed, between the Client and Eleanor Bennett ("the Author"). In some circumstances a range of factors such as time, budget, access and/or site disturbance constraints may have limited the scope of services.

Reliance on Data

In preparing the report, the Author has relied upon data, surveys, analyses, designs, plans and other information provided by the Client and other individuals and organisations, most of which are referred to in the report ("the data"). Except as otherwise stated in the report, the Author has not verified the accuracy or completeness of the data. To the extent that the statements, opinions, facts, information, conclusions and/or recommendations in the report ("conclusions") are based in whole or part on the data, those conclusions are contingent upon the accuracy and completeness of the data. The Author will not be liable in relation to incorrect conclusions should any data, information or condition be incorrect or have been concealed, withheld, misrepresented or otherwise not fully disclosed to the Author.

Environmental Conclusions

In accordance with the scope of services, the Author has relied upon the data and has conducted environmental field monitoring and/or testing in the preparation of the report. The nature and extent of monitoring and/or testing conducted is described in the report.

The conclusions are based upon field data and the environmental monitoring and/or testing carried out over a limited period of time and are therefore merely indicative of the environmental condition of the site at the time of preparing the report. Also it should be recognised that site conditions, can change with time.

Within the limitations imposed by the scope of services, the field assessment and preparation of this report have been undertaken and performed in a professional manner, in accordance with generally accepted practices and using a degree of skill and care ordinarily exercised by reputable environmental consultants under similar circumstances. No other warranty, expressed or implied, is made.

Report for Benefit of Client

The report has been prepared for the benefit of the Client and no other party. The Author assumes no responsibility and will not be liable to any other person or organisation for or in relation to any matter dealt with or conclusions expressed in the report, or for any loss or damage suffered by any other person or organisation arising from matters dealt with or conclusions expressed in the report (including without limitation matters arising from any negligent act or omission of the Author or for any loss or damage suffered by any other party relying upon the matters dealt with or conclusions expressed in the report). Other parties should not rely upon the report or the accuracy or completeness of any conclusions and should make their own enquiries and obtain independent advice in relation to such matters.

Other Limitations

The Author will not be liable to update or revise the report to take into account any events or emergent circumstances or facts occurring or becoming apparent after the date of the report. The scope of services did not include any assessment of the title to or ownership of the properties, buildings and structures referred to in the report nor the application or interpretation of laws in the jurisdiction in which those properties, buildings and structures are located.

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1. INTRODUCTION

1.1 Background

Bennett Environmental Consulting Pty Ltd was commissioned by Statewest Surveying and Planning to undertake a botanical survey of Lot 2 Old Gingin Road, Chittering. The site is between the Great Northern Highway and Brand Highway and is used to graze cattle. It is proposed to utilise three small areas of the property for sand extraction. From the aerial photograph provided the site appeared to be completely cleared but was surrounded on the eastern and northern side by privately owned remnant bushland, by TiWest extraction plant and farmland on the western side, and by farmland to the south.



Diagram 1. Location of site (outlined in red) and the three areas intended for sand extraction (outlined in blue)

1.2 Scope of Works

The requirements for this project were to:

- i. Undertake a Level 1 vegetation survey (Environmental Protection Authority, 2004); and to
- ii. Search for and record all significant species at the site.

2. BACKGROUND INFORMATION

2.1 Geology and Landform

The survey area is included in the Yanga unit which is a poorly drained area characterised by a pattern of flat sandy benches with intervening swamps (Churchward and McArthur, 1980).

2.2 Vegetation

The Interim Biogeographical Regionalisation for Australia (IBRA) (Thackway and Cresswell, 1995) recognizes 85 bioregions. The IBRA is used as the common unit to compare biological and biophysical attributes. Bioregions represent a landscape-based approach to classifying the land surface and each region is defined by a set of major environmental influences, which shape the occurrence of flora and fauna and their interaction with the physical environment. The site occurs in the Swan Coastal Plain, which has been subdivided into the northern section and the southern section. The study area is located in the southern section, abbreviated SWA2 (Mitchell, Williams and Desmond, 2002).

Beard (1981) mapped the site as a mosaic consisting of a Medium Open Woodland of Jarrah (*Eucalyptus marginata*) and Marri (*Corymbia calophylla*), with Low Woodland of *Banksia* species / Medium sparse Woodland of Jarrah and Marri (abbreviated e2,3Mi bLi/e2,3Mp). Shepherd *et al.* (2002) have determined the pre-European and current extent of the vegetation associations described by Beard. In addition they have assessed the percentage of each vegetation association remaining, the amount in IUCN reserves and the percentage in other reserves. The pre-European area of e2,3Mi bLi/e2,3Mp is estimated to be 46,7481ha, the current extent 26,423 which represents 56.5% remaining vegetated of which 30% is included in conservation.

Hedde *et al.* (1980) described the vegetation complexes of the Darling System at a scale of 1:250 000. There was found to be a distinct pattern of plant distribution linked to landforms, soils and climate. The most obvious trend was associated with increasing aridity from west to east on the Darling Plateau. The vegetation changes observed were a decrease in height and percentage cover of the tallest stratum and a distinct change in floristics. The site occurs in the Yanga Complex which is described as predominantly a Closed Scrub of *Melaleuca* species on flats subjected to inundation. On the dried sites (the higher ground) the vegetation reflects that of the Coonambidgee Complex. The Coonambidgee Complex is described as ranging from a Low Open Forest and Low Woodland of *Eucalyptus todtiana*, *Banksia attenuata*, *Banksia menziesii* and *Banksia ilicifolia* to an Open Woodland of *Corymbia calophylla* and *Banksia* species.

Bush Forever (Government of Western Australia, 2000) states that 1% of the original area of the Yanga and 9.4% of the Coonambidgee Complex remain vegetated within the Swan Coastal Plain.

3. METHODS

Transects were walked through the remnant bushland listing the vegetation units in the area and the dominant taxa. Most of the site was assessed at a Level 1 vegetation survey but where an area was of a reasonable size and included good vegetation a quadrat was assessed.

3.1 Vegetation

The vegetation at the site is described using the vegetation classification of Muir (1977) as set out in Table 1.

Table 1. Vegetation Classification (from Muir, 1977)

LIFE FORM / HEIGHT CLASS	Canopy Cover			
	DENSE 70% - 100%	MID DENSE 30% - 70%	SPARSE 10% - 30%	VERY SPARSE 2% - 10%
Trees > 30 m	Dense Tall Forest	Tall Forest	Tall Woodland	Open Tall Woodland
Trees 15 – 30 m	Dense Forest	Forest	Woodland	Open Woodland
Trees 5 – 15 m	Dense Low Forest A	Low Forest A	Low Woodland A	Open Low Woodland A
Trees < 5 m	Dense Low Forest B	Low Forest B	Low Woodland B	Open Low Woodland B
Mallee (tree form)	Dense Tree Mallee	Tree Mallee	Open Tree Mallee	Very Open Tree Mallee
Mallee (shrub form)	Dense Shrub Mallee	Shrub Mallee	Open Shrub Mallee	Very Open Shrub Mallee
Shrubs > 2 m	Dense Thicket	Thicket	Scrub	Open Scrub
Shrubs 1.5 – 2 m	Dense Heath A	Heath A	Low Scrub A	Open Low Scrub A
Shrubs 1 - 1.5 m	Dense Heath B	Heath B	Low Scrub B	Open Low Scrub B
Shrubs 0.5 – 1 m	Dense Low Heath C	Low Heath C	Dwarf Scrub C	Open Dwarf Scrub C
Shrubs 0 - 0.5 m	Dense Low Heath D	Low Heath D	Dwarf Scrub D	Open Dwarf Scrub D
Mat plants	Dense Mat Plants	Mat Plants	Open Mat Plants	Very Open Mat Plants
Hummock grass	Dense Hummock Grass	Mid-Dense Hummock Grass	Hummock Grass	Open Hummock Grass
Bunch grass > 0.5 m	Dense Tall Grass	Tall Grass	Open Tall Grass	Very Open Tall Grass
Bunch grass < 0.5 m	Dense Low Grass	Low Grass	Open Low Grass	Very Open Low Grass
Herbaceous spp.	Dense Herbs	Herbs	Open Herbs	Very Open Herbs
Sedges > 0.5 m	Dense Tall sedges	Tall Sedges	Open Tall Sedges	Very Open Tall Sedges
Sedges < 0.5 m	Dense Low Sedges	Low Sedges	Open Low Sedges	Very Open Low Sedges
Ferns	Dense Ferns	Ferns	Open Ferns	Very Open Ferns
Mosses, liverworts	Dense Mosses	Mosses	Open Mosses	Very Open Mosses

3.2 Vegetation Condition

Bushland has been historically subject to ongoing degradation and is especially susceptible to disturbances arising as a result of indirect impacts from surrounding developments and human activity. Degradation is caused by a wide range of factors, including isolation, edge effects, weed invasion, plant diseases, changes in fire frequency, landscape fragmentation, increased predation on native fauna by feral animals, decrease in species richness and general modification of ecological function. These issues can affect the biodiversity rating and ecological viability of areas of remnant vegetation and should be assessed in line with conservation values. The vegetation condition was rated according to the vegetation condition scale used in Keighery (1994), see Table 2.

Table 2. Explanation of Vegetation Condition Rating (Keighery, 1994)

Rating	Description	Explanation
1	Pristine	Pristine or nearly so, no obvious signs of disturbance.
2	Excellent	Vegetation structure intact, disturbance affecting individual species and weeds are non-aggressive species.
3	Very Good	Vegetation structure altered, obvious signs of disturbance.
4	Good	Vegetation structure significantly altered by very obvious signs of multiple disturbances. Retains basic vegetation structure or ability to regenerate it.
5	Degraded	Basic vegetation structure severely impacted by disturbance. Scope for regeneration but not to a state approaching good condition without intensive management.
6	Completely Degraded	The structure of the vegetation is no longer intact and the area is completely or almost completely without native species.

4. RESULTS

Field work was undertaken on 18th November 2011. Each of the three areas identified for sand extraction were assessed in detail and the vegetation of the remainder of the site recorded. A level 1 assessment was undertaken for all except GG10 where a quadrat was utilised. The site is utilised to graze cattle and no areas of remnant bushland are fenced off from them. In addition rabbits and kangaroos also graze the areas adjacent to the large area of remnant bushland on other properties to the east.

An * indicates the plant is a weed, a plant in bold indicates it was a dominant species at the site.

4.1 Vegetation

Site GG01 – Northern area proposed for sand extraction

GPS: 402496E; 6514380N

Heath A of *Jacksonia furcellata* over Open Herbs dominated by *Podotheca gnaphalioides* and *Cartonema philydroides* over Open Tall Grass of *Austrostipa flavescens* over Very Open Low Grass of *Pentaschistis airoides* in grey sand.

Vegetation condition - good to degraded.

RECORDED SPECIES

Shrubs: *Acacia huegelii*, *Acacia saligna*, ***Jacksonia furcellata***, **Solanum nigrum*

Herbs: **Arctotheca calendula*, *Calandrinia linifolia*, *Cartonema philydroides*, *Crassula colorata*, *Dianella revoluta* subsp. *divaricata*, **Erodium botrys*, **Hypochaeris glabra*, **Lachnagrostis aemula*, **Lotus subbiflorus*, **Ornithopus sativus*, **Orobanche australis*, ***Podotheca gnaphalioides***, *Trachymene pilosa*, **Trifolium angustifolium*, **Trifolium campestre*, **Ursinia anthemoides*, **Wahlenbergia capensis*, *Wahlenbergia multicaulis*, **Zantedeschia aethiopica*

Grasses: ***Austrostipa flavescens***, **Bromus diandrus*, **Cynodon dactylon*, **Ehrharta longiflora*, **Lolium multiflorum*, **Pennisetum clandestinum*, ***Pentaschistis airoides***, **Vulpia bromoides*

Sedges: **Isolepis marginata*



This area was cleared previously and has now partly regrown.

Site GG02 – Northern area proposed for sand extraction

GPS: 402496E; 6514380N

Open Scrub of *Kunzea glabrescens* over Very Open Tall Sedges

Vegetation condition – degraded

This was a small area within GG01

RECORDED SPECIES

Shrubs: *Kunzea glabrescens*

Herbs: *Cartonema philydroides*, *Lemna disperma*

Sedges: **Cyperus congestus*, **Isolepis prolifera*, **Juncus pallidus*



Site GG03 – To the west of where it is proposed to extract sand

GPS: 402288E; 6514163N also GG03A: 402421E; 6513926N

Open Low Woodland A of *Eucalyptus marginata* subsp. *thalassica* over Open Low Scrub B of *Jacksonia furcellata* over Low Grass of **Vulpia bromoides* over Herbs of **Hypochaeris glabra* in damp sandy loam

Vegetation condition – Degraded to completely degraded

RECORDED SPECIES

Trees: *Corymbia calophylla*, *Eucalyptus marginata* subsp. *thalassica*

Shrubs: *Acacia saligna*, *Astartea scoparia*, *Jacksonia furcellata*, *Jacksonia sternbergiana*, *Kunzea glabrescens*, *Xanthorrhoea preissii*

Herbs: *Dianella revoluta* subsp. *divaricata*, **Disa bracteata*, **Homeria flaccida*, **Hypochaeris glabra*, *Lobelia alata*, **Lotus angustissimus*, **Orobancha minor*, **Trifolium subterraneum*

Grasses: **Avena barbata*, **Briza minor*, **Holcus lanatus*, **Paspalum urvillei*, **Pennisetum clandestinum*, **Vulpia bromoides*

Sedges: **Cyperus congestus*, *Desmocladius flexuosus*, *Juncus pallidus*

Ferns: *Pteridium esculentum*



Site GG04 - In lower area to the west of where it is proposed to extract sand

GPS 402306W; 6514084N

Open Low Woodland A of *Eucalyptus rudis* subsp. *rudis* and occasional *Corymbia calophylla* over weeds in wet grey silty loam

Vegetation condition- Degraded

RECORDED SPECIES

Trees: *Corymbia calophylla*, *Eucalyptus rudis* subsp. *rudis*

Shrubs: *Aotus gracillima*, *Astartea scoparia*, *Taxandria linearifolia*, *Xanthorrhoea brunonis*

Herbs: *Calandrinia corrigioloides*, **Hypochaeris glabra*, *Lobelia alata*, **Lotus angustissimus*, **Trifolium subterraneum*

Grasses: **Briza minor*, **Cynodon dactylon*, **Holcus lanatus*, **Paspalum urvillei*, **Pennisetum clandestinum*, **Polypogon monspeliensis*

Sedges: *Isolepis cyperoides*, **Juncus microcephalus*, *Juncus pallidus*



Site GG05 – Open area still within the proposed northern sand extraction area

GPS: Not recorded

Very Open Tall Grass of **Ehrharta calycina* over Dense Low Grass of mixed species including **Pentastichis airoides* and **Vulpia bromoides* over Open Herbs of *Podotheca gnaphalioides* in grey/yellow sand

Vegetation condition - Completely degraded

RECORDED SPECIES

Shrubs: *Acacia huegelii*, *Xanthorrhoea preissii*

Herbs: **Arctotheca calendula*, *Calandrinia linifolia*, *Conostylis aculeata*, *Lomandra caespitosa*, **Lotus angustissimus*, **Lupinus cosentinii*, **Ornithopus sativus*, **Panicum capillare*, **Podotheca gnaphalioides*, *Ptilotus polystachyus*, **Trifolium arvense*, **Ursinia anthemoides*, **Wahlenbergia capensis*,

Grasses: **Ehrharta calycina*, **Paspalum urvillei*, **Pentastichis airoides*, **Vulpia bromoides*



Site S06 – Middle area and southern area proposed for sand extraction

GPS: 402898E; 6513786N (middle area) and GG06A: 2103014E; 6513095N (southern area)

Open Low Woodland A of *Eucalyptus marginata* subsp. *thalassica* over Open Dwarf Scrub C of *Xanthorrhoea preissii* over Open Low Grass of *Vulpia bromoides* over Open Herbs of *Podotheca gnaphalioides* in yellow sand

Vegetation condition – few areas good mostly degraded

RECORDED SPECIES

Trees: *Eucalyptus marginata* subsp. *thalassica*

Shrubs: *Acacia huegelii*, *Acacia pulchella*, *Bossiaea eriocarpa*, *Daviesia divaricata*, *Daviesia incrassata*, *Gompholobium tomentosum*, *Hibbertia hypericoides*, *Jacksonia furcellata*, *Kunzea glabrescens*, *Macrozamia riedlei*, *Pelargonium capitatum*, *Xanthorrhoea preissii*

Herbs: **Arctotheca calendula*, **Citrullus lanatus*, *Conostylis aculeata*, *Crassula colorata*, **Erodium botrys*, *Gladiolus caryophyllaceus*, *Kennedia prostrata*, *Lomandra caespitosa*, *Lomandra hermaphrodita*, **Lysimachia arvensis*, **Orobanche minor*, *Podotheca gnaphalioides*, *Ptilotus polystachyus*, **Ornithopus sativus*, **Wahlenbergia capensis*, **Zantedeschia aethiopica*

Grasses: **Avena barbata*, **Bromus diandrus*, **Ehrharta longiflora*, **Pentstemonis airoides*, **Vulpia bromoides*

Sedges: **Isolepis marginatus*



At the most southern end of where it is proposed to extract sand there were many plants of *Daviesia divaricata* (See Map)

Site GG07 – Line of relatively dense Marri

GPS: 402580E; 6513207N also 402727E; 6513078N (near GG08)

Open Low Woodland A of *Corymbia calophylla* over Low Grass of **Pennisetum clandestinum* and **Lolium rigidum* over Dense Herbs of **Lotus angustissimus* in damp grey sand

Vegetation condition – completely degraded

RECORDED SPECIES

Trees: *Corymbia calophylla*, *Eucalyptus marginata* subsp. *thalassica*

Shrubs: *Jacksonia furcellata*

Herbs: **Hypochaeris glabra*, **Lotus angustissimus*, **Orobancha minor*, **Rumex crispus*

Grasses: **Bromus hordeaceus*, **Lolium rigidum*, **Pennisetum clandestinum*

Sedges: *Juncus pallidus*



Site GG8 – Along narrow creek line

GPS: 402789E; 6513081N

Low Woodland A of *Eucalyptus rudis* subsp. *rudis* and *Melaleuca preissiana* over Open Tall Grass of **Paspalidium distichum* in sand

Vegetation condition - degraded

RECORDED SPECIES

Trees: *Eucalyptus rudis* subsp. *rudis*, *Melaleuca preissiana*, *Melaleuca raphiophylla*

Shrubs: *Kunzea glabrescens*

Herbs: **Hypochaeris glabra*, *Lobelia alata*, **Lotus angustissimus*, **Zantedeschia aethiopicum*

Grasses: **Cynodon dactylon*, **Paspalum distichum*

Sedges: **Isolepis proliferata*, *Juncus pallidus*



Site GG09 – Damp area with lying water

GPS: 402663E; 6511559N

Open Tall Sedges of **Typha orientalis* over Open Herbs dominated by *Cotula coronopifolia* over Low sedges dominated by **Isolepis prolifera* and **Cyperus congestus* in dam sandy loam

Vegetation condition – degraded to completely degraded.

RECORDED SPECIES

Herbs: **Cotula coronopifolia*, *Lemna disperma*, **Lotus angustissimus*, **Lythrum hyssopifolia*,
**Polygonum aciculare*, **Rumex crispus*

Grasses: **Holcus lanatus*, **Pennisetum clandestinum*

Sedges: **Cyperus congestus*, **Isolepis prolifera*, **Typha orientalis*



Site GG10 adjacent to southern area proposed for sand extraction

GPS 404000E; 6511365N

Low Woodland A of *Eucalyptus todtiana*, *Banksia attenuata* and *Nuytsia floribunda* over Heath B of *Xanthorrhoea preissii* over Dwarf Scrub C of mixed taxa in yellow sand

Vegetation condition – Good

SPECIES	HEIGHT	% COVER
<i>Acacia pulchella</i>	30	<1
<i>Banksia attenuata</i>	800	5
<i>Bossiaea eriocarpa</i>	50	1
<i>Calothamnus quadrifidus</i>	60	5
<i>Conostephium preissii</i>	35	1
<i>Conostylis aculeata</i> subsp. <i>aculeata</i>	25	<1
<i>Desmocladius flexuosa</i>	25	5
<i>Eremaea pauciflora</i>	50	<1
<i>Eucalyptus todtiana</i>	1000	20
* <i>Gladiolus caryophyllaceus</i>	70	<1
<i>Gompholobium knightianum</i>	35	<1
<i>Gompholobium marginatum</i>	5	<1
<i>Haemodorum laxus</i>	50	<1
<i>Hibbertia huegelii</i>	60	25
* <i>Hypochaeris glabra</i>	50	2
<i>Jacksonia floribunda</i>	70	1
<i>Lagenophora huegelii</i>	5	<1
<i>Lepidosperma angustifolium</i>	50	<1
* <i>Lolium temulentum</i>	70	<1
<i>Lyginia barbata</i>	60	<1
<i>Mesomelaena pseudostygia</i>	50	3
<i>Nuytsia floribunda</i>	1200	2
<i>Scaevola canescens</i>	5	<1
* <i>Ursinia anthemoides</i>	60	1
<i>Xanthorrhoea brunonis</i>	80	5
<i>Xanthorrhoea preissii</i>	150	30
* <i>Aira cupaniana</i>	Opportunistic	
<i>Allocasuarina humilis</i>	Opportunistic	
<i>Anigozanthos humilis</i>	Opportunistic	
* <i>Briza maxima</i>	Opportunistic	
<i>Calandrinia pink</i>	Opportunistic	
<i>Cassutha racemosa</i>	Opportunistic	
<i>Conostylis setigera</i>	Opportunistic	
<i>Corymbia calophylla</i>	Opportunistic	
<i>Daviesia divaricata</i>	Opportunistic	
* <i>Ehrharta calycina</i>	Opportunistic	
<i>Gastrolobium capitatum</i>	Opportunistic	
<i>Hakea ruscifolia</i>	Opportunistic	
<i>Jacksonia sternbergiana</i>	Opportunistic	
<i>Lepidobolus preissianus</i>	Opportunistic	
<i>Podotrochea angustifolia</i>	Opportunistic	
<i>Stirlingia latifolia</i>	Opportunistic	
<i>Stylidium amoenum</i>	Opportunistic	
<i>Synaphea spinulosa</i>	Opportunistic	
<i>Trachymene pilosa</i>	Opportunistic	
* <i>Wahlenbergia capensis</i>	Opportunistic	

Cattle walk through this bushland and graze. Kangaroos also come into this area from adjacent bushland



Several *Banksia attenuata* deaths were observed. This could be due to the long hot summer of 2010-2011 and the dry winter of 2010. Deaths of *Banksia* species are not uncommon due to the earlier hot and dry summers

Site GG11 – Within southern area proposed for sand extraction

GPS: 404000E; 6511365N

Open Woodland of *Corymbia calophylla* over Dwarf Scrub C of *Xanthorrhoea preissii* and *Xanthorrhoea brunonis* over Tall Grass of **Ehrharta longiflora* on brown/yellow sand

Vegetation condition - Degraded

RECORDED SPECIES

Trees: *Corymbia calophylla*, *Eucalyptus todtiana*

Shrubs: *Bossiaea eriocarpa*, *Hibbertia hypericoides*, **Solanum nigrum*, *Xanthorrhoea brunonis*, *Xanthorrhoea preissii*

Herbs: **Zantedeschia aethiopica*

Grasses: **Ehrharta calycina*, **Ehrharta longiflora*



This was only a very small area on the eastern side beside the adjacent vegetated property

Site GG12 – Below sites GG10 and GG11 but still within the area proposed for sand extraction

GPS: 403907E; 6511343E

Open Herbs of **Hypochaeris glabra* over Low Grass of **Aira cupaniana* and **Vulpia bromoides* with scattered trees of *Eucalyptus todtiana*, *Nuytsia floribunda* and *Banksia attenuata*

Vegetation condition – completely degraded

RECORDED SPECIES

Trees: *Banksia attenuata*, *Eucalyptus todtiana*, *Nuytsia floribunda*

Shrubs: *Acacia saligna*, *Daviesia incrassata*, *Xanthorrhoea preissii*

Herbs: **Arctotheca calendula*, *Eremaea pauciflora*, **Erodium botrys*, *Hibbertia hypericoides*, **Hypochaeris glabra*, *Jacksonia furcellata*, **Lupinus cosentinii*, *Ptilotus humilis* subsp. *humilis*, *Ptilotus polystachyus*, **Trifolium arvense*, **Wahlenbergia capensis*

Grasses: **Aira cupaniana*, **Pennisetum clandestinum*, **Vulpia bromoides*



Site GG13 – Lower lying areas

GPS: 403707E; 6510862N

Pasture with emergent *Melaleuca preissiana* and *Eucalyptus rudis* subsp. *rudis* in damp loam

Vegetation condition – completely degraded

RECORDED SPECIES

Trees: *Eucalyptus rudis* subsp. *rudis*, *Melaleuca preissiana*

Herbs: **Cotula coronopifolia*, **Homeria flaccida*, **Hypochaeris glabra*, *Lobelia alata*, **Rumex crispus*

Grasses: **Briza minor*, **Holcus lanatus*, **Hordeum leporinum*, **Lolium rigidum*, **Polypogon monspeliensis*

Sedges: *Juncus pallidus*



4.2 Significant Flora

None of the species recorded during the survey are listed as threatened or priority flora.

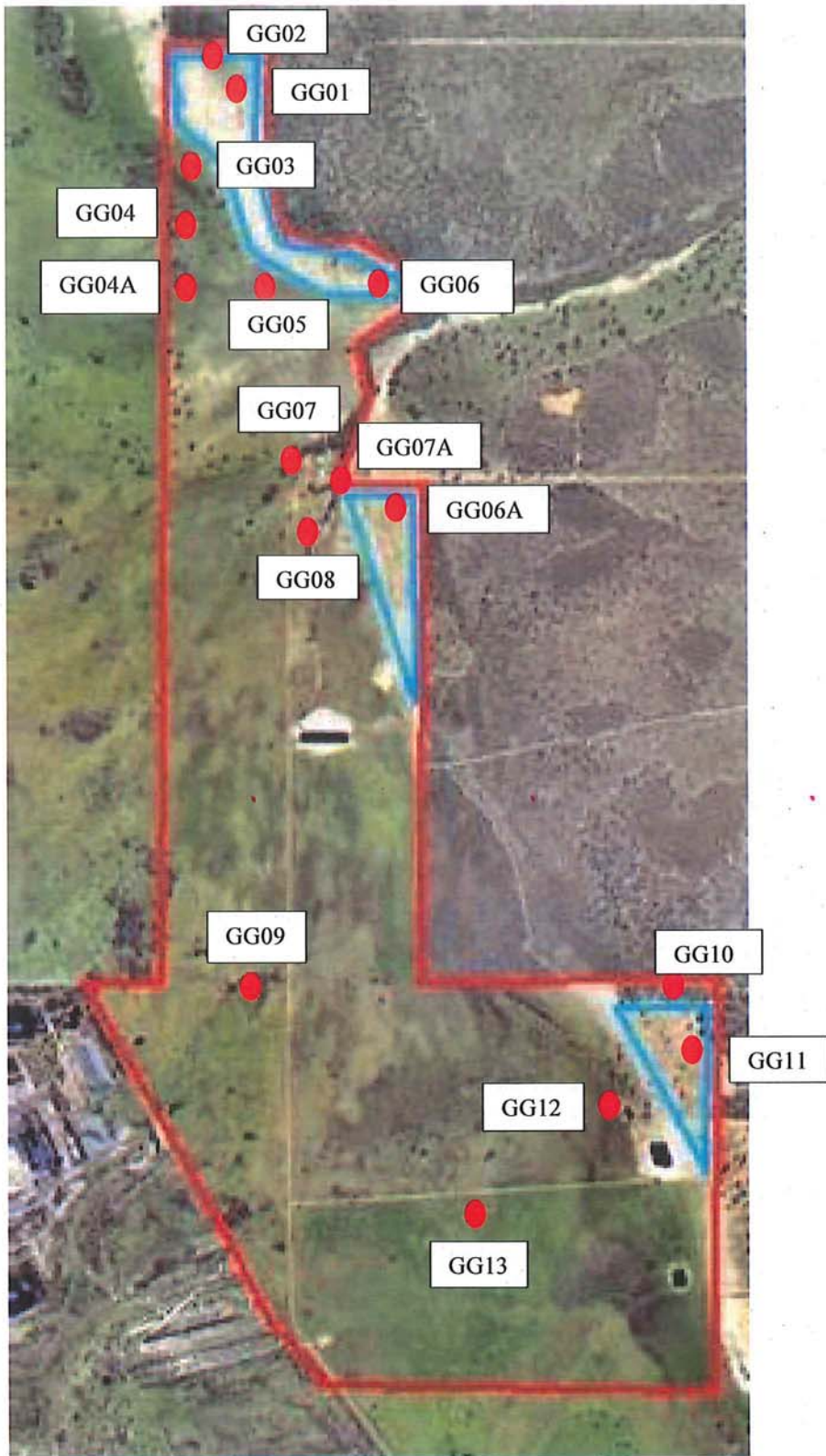


Diagram 2. Map indicating the approximate locations of all sites

5. DISCUSSION

The three areas planned for sand extraction have minimal to no native vegetation present. The most northern of the proposed sand extraction areas had some vegetation which appeared to have regrown after clearing. The *Jacksonia furcellata* shrubs were dense in some areas, but this is a common species which readily germinates after disturbance. The most southern area had remnant vegetation in good condition along the northern edge but this is not to be included in the proposed sand extraction. Only the open, degraded areas are to be included. The middle section had a few native plants present, but again the area was degraded.

The three areas selected for sand extraction are degraded. They included no significant flora and any remnants, including that at site GG10, are too small to be considered for conservation.

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