RPS

APPENDIX 3

Natural Regeneration of Cleared Pine Plantations in Nowergup, Western Australia

MCKINLEY ROAD PROJECT AREA

NATURAL REGENERATION OF CLEARED PINE PLANTATIONS IN NOWERGUP, WESTERN AUSTRALIA

Prepared for: Rocla Quarry Products

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pgv ENVIRONMENTAL

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1 INTRODUCTION

1.1 Background

Rocla Quarry Products owns substantial areas of exploration licences for sand extraction within the Gnangara Pine Plantation in the localities of Nowergup and Yanchep. The resource to be extracted lies underneath already cleared pine plantations and existing plantations to be cleared by the Forest Products Commission (FPC) prior to extraction operations.

The project has a large time frame, possibly up to 50 years. The clearing of existing pine plantations will not necessarily be timed to occur immediately prior to resource extraction. Therefore, a significant time lapse could occur between clearing the pines and resource extraction during which time the land could naturally regenerate with native vegetation to an extent that it could affect the future approvals to mine the resource. The extent to which natural regeneration occurs in cleared plantations in the Gnangara Pine Plantation has not been studied.

The objective of this report was:

- to provide information on the patterns of natural regeneration after pine plantation clearing within the McKinley Road Project Area.

1.2 Location

The McKinley Project Area is located in the Gnangara Pine Plantation approximately 35km north of the Perth Central Business District (Figure 1). The sites surveyed in this report extend for a distance of approximately 7km north to south, generally between McKinley Road to the north and Wesco Road to the south. The Old Yanchep Road passes from south-east to north-west through the centre of the study area.

2 METHODS

The McKinley Road Project Area contains a mix of existing pine plantations of variable age and pine plantations cleared between 2006 and 2013 (Figure 2). In addition there are stands of native vegetation adjoining and within the Project Area that have remained uncleared.

Five blocks of cleared pine plantations were chosen for sampling. Using historic aerial photographs available on the LandGate website (https://www.landgate.wa.gov.au/bmvf/app/mapviewer/) the areas were identified as being cleared sometime in 2013, 2011, 2008, 2007 and 2006. The exact dates of clearing the plantations are not known, however this is not considered essential as the outcome of the report is to look at patterns of regeneration rather than a time-sequence of events on each site. The short time-frame of the work did not allow individual blocks to be monitored over a large number of years.

Historic aerial photographs were examined to ensure that the blocks surveyed were completely cleared of native vegetation and planted with dense pine seedlings. The age of each block at the time of clearing ranged was at least 37 years and generally over 40 (Table 1).

Table 1: Plantation Block Details

Block Number	Year Planted	Year Cleared	Age at Clearing (yr)(approx.)
1	Between 1965-74	2011	37-46
2a	Prior to 1963	2007	>44
2b	Between 1965-74	2007	33-42
3	Prior to 1963	2008	>45
4	Prior to 1963	2006	>43
5	Between 1965-74	2013	39-48

Within each block several 20m x 20m quadrats were chosen to sample the range of regeneration patterns occurring. A total of 15 survey quadrats were recorded. The location of each quadrat is shown in Figure 3.

The data recorded from each of the 20m x 20m quadrats included the following:

- GPS location
- Vegetation structure
- Percentage cover and height of all plant species (native and introduced)
- Soil type
- Photograph

Other observations within the cleared plantations and existing plantations were made where the information might be relevant to explaining the patterns of regeneration.

It was assumed that no artificial seeding of the blocks had occurred after the pines were cleared. The abundance of *Acacia pulchella* on some sites, especially Block 1 site could indicate that this site was seeded. However, as discussed in Section 4 any artificial seeding probably did not change the outcome as far as the environmental significance of the regeneration for future mining approvals.

3 RESULTS

Five cleared pine plantation blocks of varying age since clearing were surveyed. The age since clearing ranged from 1 – 8 years. The characteristics of each block are summarised below. The specific quadrat data are contained in Appendix 1 and a combined flora list is shown in Appendix 2.

3.1 Block 1 – Cleared 2011 (Age 3 years since clearing)

This block is located at the northern end of the project area and is extensive at around 350ha of pines cleared in 2011. Four quadrats were recorded in this area.

The pattern of regeneration within this large block was very uniform and predominantly consisted of low shrubs and herbs. *Acacia pulchella* was particularly dominant with cover percentages up to 60% in places and a height of 1m. Other common native species included *Xanthorrhoea preissii, Stirlingia latifolia, Jacksonia densiflora* and *Anigozanthos humilis.*

One stand of *Jacksonia sternbergiana* Tall Shrubland up to 2m high occurred within this block. The Shrubland contained several native shrub and herbaceous species as well as common weed species.

Very few trees occur in the cleared pine plantation with only occasional scattered Jarrah trees observed. Several young pine seedlings were observed in the area previously cleared but not in high numbers.

A total of 56 plant species was recorded in this block with a large proportion (15 species) in the wattle and pea family (Fabaceae)

3.2 Block 2 – Cleared 2007 (Age 7 years since clearing)

Block 2 is a large block of around 100ha in the centre of the study area that was cleared in 2007. The portion of this block east of the well-formed limestone track Lisbon Road was planted prior to 1963 and therefore has a minimum age of pine plantation of 44 years. The portion of this block west of Lisbon Road was planted between 1965 and 1974 and therefore has an age of 33-42 for the pine plantation when cleared.

The structure of the regeneration in this block is very different from the adjoining block 3 even though the age of regeneration is only one year apart. The dominant vegetation on the block is that of a woodland of Marri (*Corymbia calophylla*) trees over an open low understorey dominated by *Gastrolobium capitatum* and with other native species such as *Acacia pulchella, Xanthorrhoea preissii, Gompholobium tomentosum, Hibbertia hypericoides* and *Hardenbergia comptoniana* common. The Marri trees are tall, up to 8-12m high, but with relatively small trunk sizes making ageing of the trees difficult.

Aerial photography for the site from 1974 indicates that the pine plantation was densely planted in a grid pattern and does not show patches of native vegetation or individual trees remaining at the time of planting the pines (Plate 1). The height of the trees suggests the Marri trees were present in the pine plantation at the time of clearing the pines.

A variety of ages of Marri plants occurred on the block. In the vicinity of tall Marri trees was also found new seedlings and young saplings up to 3m high (Plate 2). The age structure of the Marri plants indicates regeneration following clearing of the Marri trees.

Plate 1: Pine plantations (showing as dark colours) in September 1974.

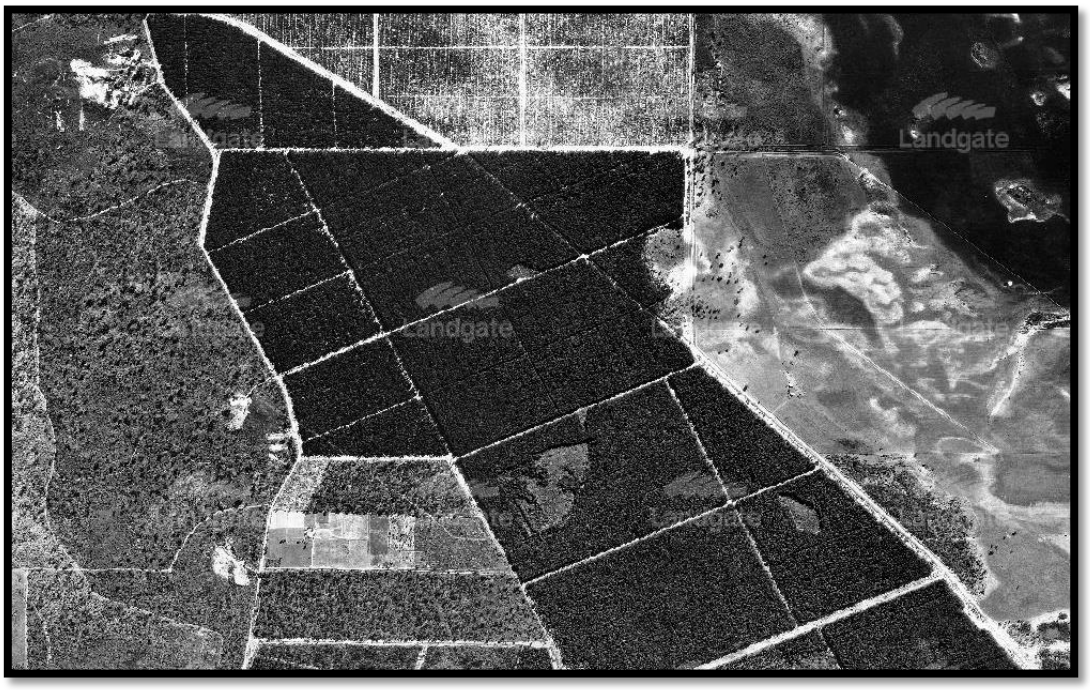


Plate 2: Mixed age Marri trees in a 7 year old site

A small stand of Tuart trees (*Eucalyptus gomphocephala*) up to 12m high occurred in one part of this block. Several pine seedlings 3-4m were regenerating among the Tuarts. The understorey was similar to that under the Marri woodland vegetation.

The regeneration in the areas of this block without Marri or Tuart trees was a Low Open Heath with *Gastrolobium capitatum* the dominant species and a mix of other natives, none of which were particularly abundant. Common weed species included Pigface, Ursinia, Lupins and Clover (*Trifolium* sp.).

The total number of species recorded in this block was 56 and, similar to other blocks, had a high proportion of wattle and pea species (39%).

3.3 Block 3 – Cleared 2008 (Age 6 years since clearing)

Block 3 is a small area of around 20ha located in the centre of the study area adjoining Old Yanchep Road and the unmade Tavira Road track. The block was planted prior to 1963 and cleared in 2008 giving an age of pine plantation of at least 45 years.

The structure of the regeneration was very uniform throughout the block with scattered small Jarrah trees up to 4m high over an open heath understorey dominated by sparse native shrubs such as *Stirlingia latifolia, Gastrolobium capitatum* and *Daviesia triflora* and abundant weed species including Lupins, Veldtgrass and Pigface (*Carpobrotus edulis*) (as represented by Quadrat 8).

A stand of *Jacksonia furcellata* Tall Shrubland up to 3m high occurred to the south of the firebreak running through the centre of the block. The understorey was similar in composition with native and weeds species as the scattered Jarrah regeneration.

A total of 43 plant species was recorded in this block with a high proportion (28%) of wattle and pea species.

3.4 Block 4 – Cleared 2006 (Age 8 years since clearing)

Block 4 was located towards the southern end of the study area east of Lisbon Road. The portion of the block cleared in 2006 within the study area is approximately 75ha.

The dominant vegetation type regenerating in this block is a Low Open Woodland of Marri 6-10m high over a weedy understorey with Lupins and Veldtgrass very common. Scattered shrubs of *Jacksonia sternbergiana, Xanthorrhoea preissii* and *Macrozamia fraseri* occur in the understorey.

Several large dense stands of *Jacksonia furcellata* up to 3m high mixed with *Acacia saligna* and *Acacia pulchella* occur on the block. The *Jacksonia* stands are very weedy with Lupins, Flatweed, Ursinia and Pigface common.

The total number of plant species in this block was 26 which potentially reflects the higher density of aggressive weeds such as Lupins and Veldtgrass in suppressing some of the native species.

3.5 Block 5 – Cleared 2013 (Age 1 year since clearing)

The youngest block cleared was located at the southern end of the project area straddling Wesco Road. Most of the area is very open as would be expected from a site cleared of pines only around 1 year previously. Quadrat 14 is indicative of the structure of most of the block with scattered native shrubs such as *Jacksonia furcellata* regrowing at low densities and a high density of herbaceous weed species covering the ground, particularly Clover (*Trifolium* sp.) and Flat Weed (*Hypochaeris glabra*).

In places scattered young Marri (*Corymbia calophylla*) trees occur up to 8m high over a mix of native and weedy understorey shrubs and herbs (See Quadrat 12 as an example). The height of the Marri trees and their thin stature indicates that the trees would have been present within the pine plantation at the time of clearing.

Small stands of Jarrah trees up to 6m high also occur on the lower eastern part of this block (Quadrat 15). The age of the Jarrah trees and the *Xanthorrhoea preissii* and Zamia Palm (*Macrozamia fraseri*) shrubs (1-1.2m) also indicates these species have been growing in the pine plantation for many years prior to clearing.

The native vegetation adjoining the eastern boundary of this cleared block contains Banksia woodland with scattered Sheoak (*Allocasuarina fraseriana*), Jarrah and Marri in very good condition.

No regenerating Banksia seedlings or mature trees were observed in Block 5. Several young pine seedlings were observed in the area previously cleared but not in high numbers.

A total of 37 species was recorded in this block (Appendix 2).

3.6 Plant Species Recorded

A list of the species recorded during the survey is included in Appendix 2. The list is not exhaustive as the survey was not done in the optimal spring survey period. However, the list gives an indication of the types of species present in areas regenerating after pine plantations have been cleared in the sandy soils of Nowergup.

A total of 92 plant species were recorded in the five blocks of which 75 were native and 17 introduced. The largest group represented, 21 species (22% of the total) was the Fabaceae which includes Wattles and Peas. The next most commonly represented groups were the Asteraceae (Daisy family – 10 species), and the Myrtaceae and Haemodoraceae with 8 species each.

Several native species were recorded in all five regeneration blocks surveyed and included *Macrozamia fraseri, Xanthorrhoea preissii, Acacia pulchella, Gompholobium tomentosum, Hardenbergia comptoniana* and *Stirlingia latifolia*. Weed species that occurred on all five blocks included *Gladiolus caryophyllaceus, Carpobrotus edulis, Ursinia anthemoides* and *Pelargonium capitatum.*

While *Banksia menziesii* is listed in the species list that was represented by only one plant. The regeneration sites are notable for the complete lack of *Banksia attenuata, B. menziesii* and Sheoak (*Allocasuarina fraseriana*).

A summary of the species recorded in each quadrat and block is provided in Table 2. In summary there was no relationship between the age of the regeneration and the number of plant species recorded.

Table 2: Quadrat Summary

Quadrat	Block	Age of Regeneration	Native species	Introduced species	Total species
1	1	3	11	9	20
2	1	3	12	11	23
3	1	3	16	9	25
4	1	3	15	8	23
5	2b	7	8	10	18
6	2b	7	21	9	29
7	2b	7	14	9	22
10	2a	7	15	6	21
8	3	6	13	6	19
9	3	6	10	9	19
11	4	8	13	7	20
13	4	8	8	5	13
12	5	1	13	8	21
14	5	1	6	8	14
15	5	1	9	7	16

One Priority 4 species, *Jacksonia sericea*, was recorded in low numbers in Block 2. *Jacksonia sericea* is a low spreading pea plant (Plate 3) that is often found in disturbed sandy sites.

Plate 3: *Jacksonia sericea* (P4) in Block 2

3.7 Significant Fauna Species

Evidence of foraging by Carnaby's Black Cockatoo (*Calyptorhynchus latirostris*) on Marri nuts was observed in Block 4 which had been cleared of pine trees around 7 years previously. Carnaby's Black Cockatoo is listed as Scheduled Fauna under the State *Wildlife Conservation Act 1950* and Endangered under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*. The northern Wanneroo area has been a hotspot for Carnaby's Cockatoo as a result of the species preference for foraging on pine cones.

Plate 4: Marri Nuts foraged by Carnaby's Black Cockatoo

3.8 Observations in Existing Pine Plantations

Several pine plantations ranging in age from relatively young to mature occur in the study area, particularly between Nisa Road and Old Yanchep Road. The composition of the pine plantations could provide useful information on the regeneration patterns observed in the five blocks of cleared pine plantation.

Young pine plantations are planted very densely and the presence of native species within the pine plantation is virtually non-existent due both to the clearing required prior to planting the pines and the shading effect of a dense, young pine plantation.

The mature areas of pine plantation, however, had a very open canopy of pines as the trees are thinned as the plantation ages. Several areas within mature areas of pine plantation were observed to contain young Marri and Jarrah trees as shown in Plate 5. The understorey also contained native species such as *Jacksonia* species, *Acacia pulchella* and *Xanthorrhoea preissii*.

Plate 5: Young Marri trees in a mature pine plantation

4 DISCUSSION AND CONCLUSIONS

There are many factors that could have an influence on the natural regeneration pattern of a cleared pine plantation including the following:

- Age since clearing
- Soil type
- Presence of native plant species within the pine plantation prior to clearing
- Proximity of the plantation to natural stands of vegetation
- Native seed store in the soil of the plantation
- Climate

To properly investigate all of these factors would take a comprehensive survey which is beyond the scope of this project.

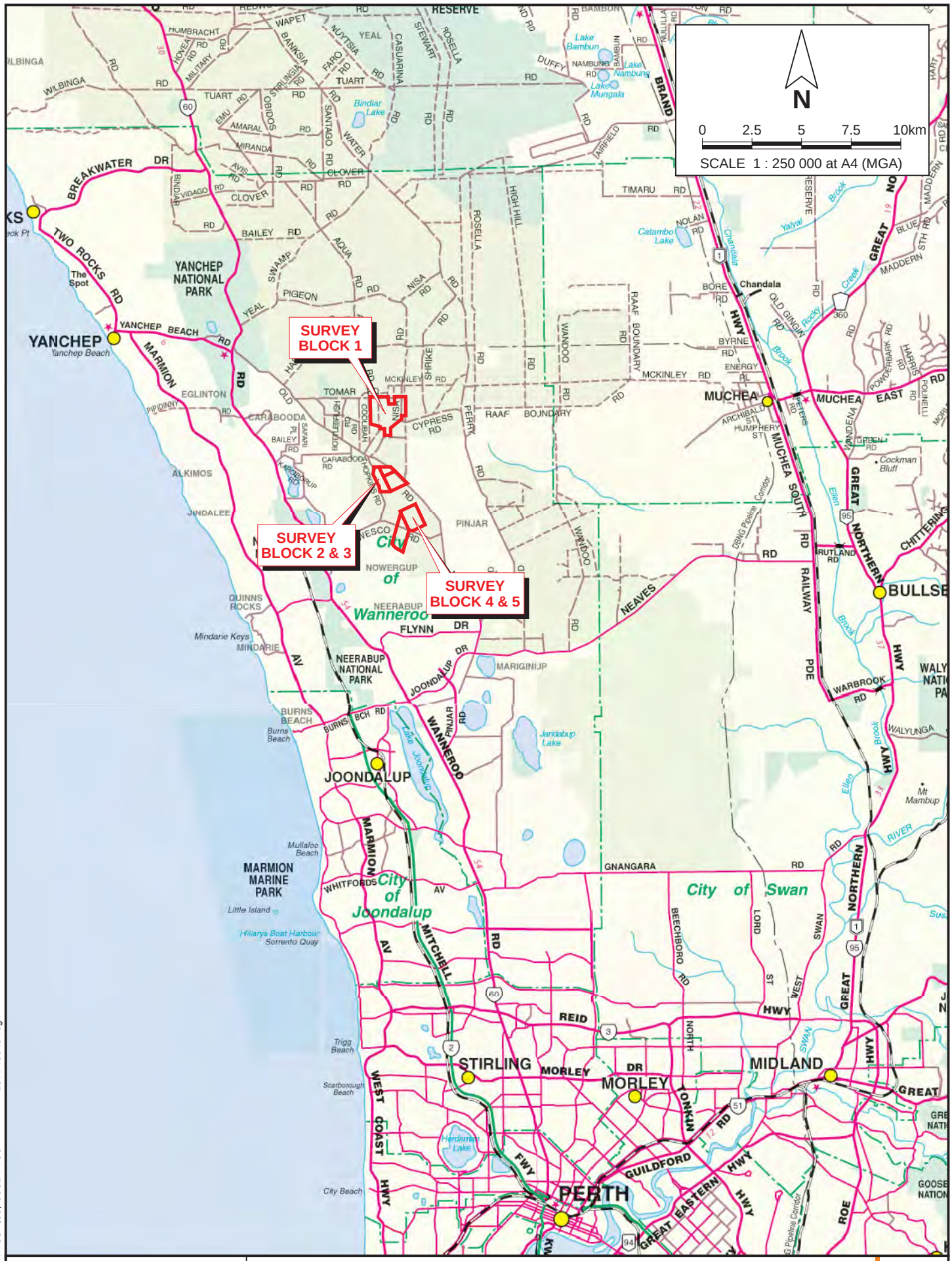
There are limitations in using the method applied in this report of assessing the vegetation on a cleared site and attempting to determine regeneration patterns in cleared pine plantations. In particular, the method does not enable knowledge of the conditions within the pine plantation prior to clearing such as the presence of native trees and shrubs.

Notwithstanding the limitations of the method used in this report, the following observations can be made.

- The structure of a naturally regenerating cleared pine plantation in the sandy soils of Nowergup, Wanneroo is only generally related to the age since clearing of the pines. In general large tracts of recently cleared pine plantations are mostly very open and sparsely vegetated with native and introduced species. Within only a few years after the clearing of a pine plantation those areas initially appearing open and sparsely vegetated become vegetated with denser and taller shrublands, with *Jacksonia* species (*J. furcellata* and *J. sternbergiana*) commonly dominant.
- However, recently cleared pine plantations can also contain scattered trees and woodlands up to 12m high immediately after clearing of the pines. In the study area the tree species predominantly were Marri trees but also included Jarrah and Tuart trees in places. The tall, thin appearance of the trees indicated that the woodlands 'emerging' immediately after a pine plantation had been cleared was the result of the trees already having become established within the pine plantation prior to clearing. Observation of young Marri and Jarrah trees within mature pine plantations in the survey area supports this theory.
- The natural vegetation within the Nowergup area on dry sandy soils is predominantly Banksia Woodland (*B. attenuata, B. menziesii*) with Sheoak, Jarrah and Marri also commonly associated. The understorey is typically a low mixed heath or shrubland. While a number of different regeneration patterns were recorded in the five blocks of varying age since clearing of the pines, no areas were observed that contained Banksia or Sheoak trees or seedlings. The results of this survey can confidently conclude that a cleared pine plantation will not naturally regenerate into a Banksia woodland.

- The composition of the regenerating vegetation is significantly different from naturally vegetated areas in the Nowergup area including greatly altered vegetation structure and reduced species richness. As a result, the possibility that the vegetation in a cleared pine plantation would naturally regenerate into a Threatened or Priority Ecological Community is considered to be negligible to non-existent.
- A total of 75 native plant species was recorded in the regeneration blocks surveyed in this study. Several more species are likely to be recorded in spring. However, while one small population of the Priority 4 plant species *Jacksonia sericea* was observed in an area cleared of pines 7 years previously it is considered highly unlikely that any Threatened (Declared Rare) Flora would regenerate within the cleared pine plantation.
- The areas of naturally regenerating cleared pine plantations in places contain abundant Marri and Jarrah regrowth. Some of the trees were young and will mature into tall trees while others are already semi-mature trees present due to their existence in the pine plantations prior to clearing. Young Marri seedlings and saplings were observed that have self-seeded around the pre-existing Marri trees since the pines were cleared.
- Evidence of foraging on Marri nuts by Carnaby's Black Cockatoos was observed. The large-scale harvesting of pines and replacement with native vegetation in the northern Wanneroo and Gnangara Pine planation area could result in an increased reliance of Carnaby's Cockatoos on natural foraging species. Banksia woodlands are the preferred natural foraging habitat for Carnaby's Cockatoos. However, as this study concludes that a cleared pine plantation will not naturally regenerate into a Banksia woodland, Carnaby's Cockatoos may turn to other native species to obtain their foraging needs in the region. The Marri and Jarrah woodlands that occur in regenerating cleared pine plantations could become important foraging habitat for the endangered species. In addition, three of the five blocks surveyed contained *Pinus pinaster* seedlings following clearing. While the density of pine seedlings was very low, the pines on maturity will provide further foraging value for Carnaby's Black Cockatoo in addition to the Marri and Jarrah trees in the area;
- This study concludes that there is some potential for the future mining approvals in some areas of cleared pine plantations to be affected by the immediate and increasing presence of foraging habitat (Marri and Jarrah woodlands) for the endangered Carnaby's Black Cockatoos in the regenerating areas.

FIGURES



pgv ENVIRONMENTAL	Rocla Quarry Products NATURAL REGENERATION OF CLEARED PINE PLANTATIONS MCKINLEY ROAD PROJECT AREA - NOWERGUP, WESTERN AUSTRALIA	Figure 1
Drawn: P. van der Moezel	Date: 16 Sep 2014	
Job: 10189 Rpt: 2014-160	Revision: A	**SITE LOCATION**

PINPOINT CARTOGRAPHICS (08) 9562 7136 2014-160-f01.dgn

PINPOINT CARTOGRAPHICS (08) 9562 7136 2014-160-f02.dgn

N

0 250 500 750 1000m

SCALE 1 : 22 500 at A3 (MGA)

Legend

- Regeneration Survey Block Boundary
- Cadastral Boundary
- Easement Boundary
- (2011) Year Cleared
- Quadrat Location

TOMAR ROAD
382 500mE
385 000mE
6 505 000mN
6 502 500mN
6 500 000mN
6 497 500mN
COOLIBAH ROAD
DELMA ROAD
AQUA ROAD
PORCUPINE ROAD
NISA ROAD
OLD YANCHEP ROAD
LISBON ROAD
HOPKINS ROAD
SERPA ROAD
WESCO ROAD
ORCHID ROAD

Block 1 (2011)
Block 2a (2007)
Block 2b (2007)
Block 3 (2008)
Block 4 (2006)
Block 5 (2013)

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15

CADASTRAL SOURCE: Landgate, September 2014.
AERIAL PHOTOGRAPH SOURCE: NearMap, flown August 2014.

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Rocla Quarry Products
NATURAL REGENERATION OF CLEARED PINE PLANTATIONS
MCKINLEY ROAD PROJECT AREA - NOWERGUP, WESTERN AUSTRALIA

Drawn: P. van der Moezel | Date: 18 Sep 2014
Job: 10189 Rpt: 2014-160 | Revision: A

REGENERATION SURVEY BLOCKS

Figure 2

APPENDIX 1

Quadrat Data

Quadrat 1

31°34'57.8" 115°46'38.2"

Vegetation: *Xanthorrhoea preissii* Open Low Shrubland over weeds
Soil Type: Orange-brown sand
Year of Clearing: 2011

PLOT (20 x 20m)

SPECIES	HEIGHT (m)	COVER (%)
Xanthorrhoea preissii	1	1
**Pinus pinaster*	Up to 1m	<1
**Gladiolus caryophyllaceus*	0.6	<1
Stirlingia latifolia	0.5	<1
Jacksonia densiflora	0.4	1
Haemodorum sp	0.4	<1
Petrophile linearis	0.4	<1
Kunzea glabrescens	0.3	<1
Anigozanthos humilis	0.2	<1
**Conyza bonariensis*	0.2	<1
Glischrocaryon aureum	0.2	<1
**Carpobrotus edulis*	0.1	25
**Ursinia anthemoides*	0.1	5
**Lupinus cosentinii*	0.1	1
Gastrolobium capitatum	0.1	<1
Scaevola repens	0.1	<1

SPECIES	HEIGHT (m)	COVER (%)
Podotheca angustifolia	0.1	<1
**Trifolium sp.*	<0.1	<1
**Hypochaeris radicata*	Flat	<1
**Hypochaeris glabra*	Flat	10
Other native species recorded nearby		
Acacia pulchella		
Conospermum stoechadis		
Philotheca spicata		
Bossiaea eriocarpa		
Hibbertia hypericoides		
Nuytsia floribunda		
Conostephium pendulum		
Daviesia triflora		
Jacksonia sternbergiana		
Eucalyptus marginata		
Anigozanthos manglesii		
Kennedia prostrata		
Hybanthus calycinus		

* introduced species

Quadrat 2

31°35'3.8" 115°46'5.6"

Vegetation: *Acacia pulchella/Xanthorrhoea preissii* Low Shrubland
Soil Type: Orange-brown sand
Year of Clearing: 2011

PLOT (20 x 20m)

SPECIES	HEIGHT (m)	COVER (%)
Acacia pulchella	1	20
Xanthorrhoea preissii	1	1
**Conyza bonariensis*	1.2	2
Stirlingia latifolia	0.5	<1
Hibbertia hypericoides	0.5	<1
Jacksonia densiflora	0.4	<1
Bossiaea eriocarpa	0.4	<1
**Pelargonium capitatum*	0.3	<1
Patersonia occidentalis	0.3	<1
Anigozanthos manglesii	0.2	1
**Ursinia anthemoides*	0.2	<1
**Sonchus oleraceus*	0.2	<1
Gompholobium tomentosum	0.2	<1
Podotheca angustifolia	0.1	5
Kennedia prostrata	0.1	2
**Gladiolus caryophyllaceus*	0.1	1

SPECIES	HEIGHT (m)	COVER (%)
**Trifolium campestre*	0.1	<1
Scaevola repens	0.1	<1
**Carpobrotus edulis*	0.1	<1
**Trifolium sp*	<0.1	4
**Hypochaeris glabra*	Flat	2
**Hypochaeris radicata*	Flat	<1
**Taraxacum officinale*	Flat	<1
Other native species recorded nearby		
Corynotheca micrantha		
Nuytsia floribunda		
Anigozanthos humilis		
Haemodorum spicatum		
Conostephium pendulum		
Eremaea pauciflora		
Petrophile linearis		
Banksia menziesii (4 plants 1.5m high)		
Gastrolobium reticulatum		
Conostephium pendulum		

* introduced species

Quadrat 3

31°34'59.2" 115°45'53.1"

Vegetation: *Acacia pulchella* Open Low Heath
Soil Type: Light orange-brown sand
Year of Clearing: 2011

PLOT (20 x 20m)

SPECIES	HEIGHT (m)	COVER (%)
Acacia pulchella	1	60
Hibbertia hypericoides	0.6	<1
Stirlingia latifolia	0.6	<1
Xanthorrhoea preissii	0.6	<1
Jacksonia densiflora	0.6	<1
Eremaea pauciflora	0.5	<1
Patersonia occidentalis	0.5	<1
Anigozanthos manglesii	0.4	5
Bossiaea eriocarpa	0.4	<1
**Conyza bonariensis*	0.3	2
Conostephium pendulum	0.2	<1
**Pelargonium capitatum*	0.2	<1
Tricoryne elatior	0.2	<1
Gompholobium tomentosum	0.2	<1
Podotheca angustifolia	0.1	2

SPECIES	HEIGHT (m)	COVER (%)
Kennedia prostrata	0.1	1
Scaevola repens	0.1	<1
**Gladiolus caryophyllaceus*	0.1	<1
**Ursinia anthemoides*	0.1	<1
Anigozanthos humilis	0.1	<1
**Sonchus oleraceus*	0.1	<1
**Crassula colorata*	<0.1	<1
**Trifolium campestre*	0.1	<1
**Hypochaeris glabra*	Flat	2
**Trifolium sp*	Flat	2
Other native species recorded nearby		
Hakea costata		
Sowerbaea laxiflora		
Hibbertia subvaginata		
Petrophile linearis		
Macrozamia fraseri		
Gastrolobium capitatum		
Hybanthus calycinus		
Acacia saligna		
Daviesia divaricata		
Acacia stenoptera		

* introduced species

Quadrat 4

31°35'17.6" 115°46'26.7"

Vegetation: *Jacksonia sternbergiana* Tall Shrubland
Soil Type: light orange-brown sand
Year of Clearing: 2011

PLOT (20 x 20m)

SPECIES	HEIGHT (m)	COVER (%)
Jacksonia sternbergiana	2	20
Xanthorrhoea preissii	1	<1
Macrozamia fraseri	0.8	<1
**Conyza bonariensis*	0.4	2
Helichrysum luteoalbum	0.4	<1
Stirlingia latifolia	0.4	<1
Gompholobium tomentosum	0.3	1
**Gladiolus caryophyllaceus*	0.3	<1
Gastrolobium capitatum	0.3	<1
Lomandra hermaphrodita	0.3	<1
Anigozanthos manglesii	0.2	2
**Ursinia anthemoides*	0.2	1
Sowerbaea laxiflora	0.2	<1
Tricoryne elatior	0.2	<1
**Carpobrotus edulis*	0.1	3

SPECIES	HEIGHT (m)	COVER (%)
Podotheca angustifolia	0.1	2
Kennedia prostrata	0.1	2
Scaevola repens	0.1	<1
Hybanthus calycinus	0.1	<1
**Trifolium sp*	Flat	3
**Hypochaeris glabra*	Flat	2
**Hypochaeris radicata*	Flat	<1
**Arctotheca calendula*	Flat	<1
Other native species recorded nearby		
Hardenbergia comptoniana		
Acacia pulchella		
Eucalyptus marginata		

* introduced species

Quadrat 5

31°37'8.4" 115°46'28.8"

Vegetation: *Eucalyptus gomphocephala* (Tuart) Low Woodland over *Gastrolobium capitatum* and weeds

Soil Type: Grey-brown sand

Year of Clearing: 2007

PLOT (20 x 20m)

SPECIES	HEIGHT (m)	COVER (%)
Eucalyptus gomphocephala	Up to 12m	10
**Pinus pinaster*	3-4	2
Olearia axillaris	1.1	1
Hibbertia hypericoides	0.5	<1
**Pelargonium capitatum*	0.4	2
Gompholobium tomentosum	0.4	<1
Gastrolobium capitatum	0.3	4
**Carpobrotus edulis*	0.3	4
Conostylis candicans	0.2	<1
**Ehrharta sp*	0.1	20
**Ursinia anthemoides*	0.1	10
**Lupinus cosentinii*	0.1	2
**Briza maxima*	0.1	2
**Trifolium campestre*	0.1	2
Kennedia prostrata	0.1	<1

SPECIES	HEIGHT (m)	COVER (%)
Hardenbergia comptoniana	Climber	1
**Hypochaeris glabra*	Flat	1
**Hypochaeris radicata*	Flat	<1
Other native species recorded nearby		
Exocarpos sparteus		
Xanthorrhoea preissii		
Acacia pulchella		
Jacksonia sericea **P4**		
Desmocladus flexuosus		
Rhagodia baccata		
Corynotheca micrantha		

* introduced species

Quadrat 6

31°36'59.1" 115°46'15.5"

Vegetation: *Corymbia calophylla* (Marri) Low Woodland over *Gastrolobium capitatum* and weeds

Soil Type: Grey-brown sand

Year of Clearing: 2007

PLOT (20 x 20m)

SPECIES	HEIGHT (m)	COVER (%)
Corymbia calophylla	8-12	20
Kunzea glabrescens	2	<1
Acacia pulchella	1	<1
Xanthorrhoea preissii	0.6	<1
Macrozamia fraseri	0.6	<1
Gompholobium tomentosum	0.5	15
Stirlingia latifolia	0.5	<1
Mesomelaena pseudostygia	0.5	<1
Gastrolobium capitatum	0.4	10
Hibbertia hypericoides	0.4	1
**Ehrharta sp*	0.4	<1
Hovea trisperma	0.4	<1
Patersonia occidentalis	0.4	<1
**Gladiolus caryophyllaceus*	0.4	<1
**Pelargonium capitatum*	0.4	<1

SPECIES	HEIGHT (m)	COVER (%)
Haemodorum spicatum	0.3	<1
Sowerbaea laxiflora	0.3	<1
Lechenaultia floribunda	0.3	<1
Conostylis aculeata	0.3	<1
Opercularia vaginata	0.3	<1
Dampiera linearis	0.3	<1
**Lupinus cosentinii*	0.2	50
**Ursinia anthemoides*	0.2	1
**Briza maxima*	0.1	2
Scaevola repens	0.1	<1
Scaevola canescens	0.1	<1
Hardenbergia comptoniana	Climber	<1
**Trifolium sp*	Flat	5
**Hypochaeris glabra*	Flat	1
Other native species recorded nearby		
Eucalyptus marginata		
Daviesia divaricata		
Desmocladus flexuosus		
Acacia saligna		

* introduced species

Quadrat 7

31°36'54.8" 115°46'14.3"

Vegetation: *Gastrolobium capitatum* mixed Open Low Heath
Soil Type: Grey-brown sand
Year of Clearing: 2007

PLOT (20 x 20m)

SPECIES	HEIGHT (m)	COVER (%)
Daviesia divaricata	2	2
Jacksonia furcellata	2	2
Hakea lissocarpha	1.2	1
Acacia pulchella	1	1
Bossiaea eriocarpa	0.5	<1
Gastrolobium capitatum	0.4	20
Patersonia occidentalis	0.4	<1
Stirlingia latifolia	0.4	<1
Calytrix flavescens	0.4	<1
**Gladiolus caryophyllaceus*	0.4	<1
Conostylis aculeata	0.3	2
**Pelargonium capitatum*	0.3	<1
Conostephium pendulum	0.3	<1
Desmocladus flexuosus	0.2	1
**Briza maxima*	0.2	1
Haemodorum paniculatum	0.2	<1

SPECIES	HEIGHT (m)	COVER (%)
**Ehrharta sp*	0.2	<1
**Carpobrotus edulis*	0.1	15
Scaevola repens	0.1	5
**Ursinia anthemoides*	0.1	5
**Lupinus cosentinii*	0.1	2
**Trifolium sp*	0.1	2
Other native species recorded nearby		
Adenanthos cygnorum		
Dampiera linearis		
Haemodorum spicatum		
Macrozamia fraseri		
Scaevola canescens		
Kennedia prostrata		
Acacia huegelii		

* introduced species

Quadrat 8

31°36'40.0" 115°46'6.0"

Vegetation: Scattered *Eucalyptus marginata* (Jarrah) over *Stirlingia latifolia/Gastrolobium capitatum* Open Low Heath and weeds

Soil Type: Grey-brown sand

Year of Clearing: 2008

PLOT (20 x 20m)

SPECIES	HEIGHT (m)	COVER (%)
Eucalyptus marginata	3.5	1
Stirlingia latifolia	1	5
Xanthorrhoea preissii	1	1
Gastrolobium capitatum	0.5	5
Daviesia triflora	0.5	2
Lyginia barbata	0.5	<1
Gompholobium tomentosum	0.5	1
Bossiaea eriocarpa	0.4	<1
**Ehrharta sp*	0.3	5
Conostylis juncea	0.3	<1
Acacia stenoptera	0.3	<1
Conostephium pendulum	0.3	<1
**Lupinus cosentinii*	0.2	25
**Gladiolus caryophyllaceus*	0.2	1
Schoenus curvifolius	0.2	<1

SPECIES	**HEIGHT (m)**	**COVER (%)**
**Carpobrotus edulis*	0.1	20
Scaevola repens	0.1	1
**Trifolium sp*	0.1	1
**Hypochaeris glabra*	Flat	<1
Other native species recorded nearby		
Acacia saligna		
Lechenaultia floribunda		
Philotheca spicata		
Lomandra sp1		
Dianella revoluta var. *divaricata*		
Lomandra sp2		
Patersonia occidentalis		

* introduced species

Quadrat 9

31°36'45.2" 115°46'8.8"

Vegetation: *Jacksonia furcellata* Tall Shrubland over
Soil Type: Grey-brown sand
Year of Clearing: 2008

PLOT (20 x 20m)

SPECIES	HEIGHT (m)	COVER (%)
Jacksonia furcellata	3	25
Xanthorrhoea preissii	1	2
Acacia pulchella	1	<1
Eremaea pauciflora	0.6	1
Stirlingia latifolia	0.4	2
**Ehrharta sp*	0.4	1
Macrozamia fraseri	0.4	<1
Gastrolobium capitatum	0.4	<1
**Gladiolus caryophyllaceus*	0.4	<1
Bossiaea eriocarpa	0.4	<1
**Lupinus cosentinii*	0.3	25
**Pelargonium capitatum*	0.3	4
Calytrix flavescens	0.3	<1
Dampiera linearis	0.3	<1
**Briza maxima*	0.2	2
**Ursinia anthemoides*	0.2	1

SPECIES	HEIGHT (m)	COVER (%)
**Carpobrotus edulis*	0.1	5
**Trifolium campestre*	0.1	5
**Hypochaeris glabra*	Flat	1
Other native species recorded nearby		
Haemodorum spicatum		
Hypolaena exsulca		
Patersonia occidentalis		
Haemodorum paniculatum		
Olearia axillaris		
Desmocladus flexuosus		
Acacia huegelii		
Leucopogon parviflorus		

* introduced species

Quadrat 10

31°36'53.3" 115°45'59.9"

Vegetation: *Corymbia calophylla* (Marri) Woodland over *Gastrolobium capitatum/Hibbertia hypericoides/Xanthorrhoea preissii* Open Low Heath

Soil Type: Brown-grey sand

Year of Clearing: 2007

PLOT (20 x 20m)

SPECIES	HEIGHT (m)	COVER (%)
Corymbia calophylla	12	15
Acacia saligna	2	1
Acacia pulchella	1	<1
Xanthorrhoea preissii	0.8	1
Hibbertia hypericoides	0.5	2
Daviesia triflora	0.5	1
Hypolaena exsulca	0.5	<1
Lyginia barbata	0.5	<1
Gastrolobium capitatum	0.4	5
Gompholobium tomentosum	0.4	1
**Gladiolus caryophyllaceus*	0.4	<1
Sowerbaea laxiflora	0.4	<1
Conostylis aculeata	0.3	1
Stirlingia latifolia	0.3	<1

SPECIES	HEIGHT (m)	COVER (%)
Scaevola canescens	0.2	<1
**Lupinus cosentinii*	0.1	40
**Ehrharta sp.*	0.1	10
**Trifolium sp.*	0.1	5
**Carpobrotus edulis*	0.1	2
**Ursinia anthemoides*	0.1	1
Hardenbergia comptoniana	Climber	<1
Other native species recorded nearby		
Daviesia decurrens		
Conostephium pendulum		

* introduced species

Quadrat 11

31°37'56.4" 115°46'46.1"

Vegetation: *Acacia saligna/Jacksonia furcellata* Tall Shrubland over Lupins and other weeds

Soil Type: Grey-brown sand

Year of Clearing: 2006

PLOT (20 x 20m)

SPECIES	HEIGHT (m)	COVER (%)
Acacia saligna	3	10
Jacksonia furcellata	3	5
Acacia pulchella	1	5
Macrozamia fraseri	0.5	<1
Hypocalymma robustum	0.5	<1
Stirlingia latifolia	0.5	<1
Gastrolobium capitatum	0.4	3
Gompholobium tomentosum	0.4	1
Lyginia barbata	0.4	<1
Petrophile linearis	0.4	<1
Patersonia occidentalis	0.4	<1
**Pelargonium capitatum*	0.3	2
Acacia huegelii	0.3	<1
**Lupinus cosentinii*	0.2	40
**Gladiolus caryophyllaceus*	0.2	1

SPECIES	HEIGHT (m)	COVER (%)
**Ursinia anthemoides*	0.1	5
**Carpobrotus edulis*	0.1	4
**Ehrharta sp.*	0.1	2
Scaevola repens	0.1	<1
**Hypochaeris glabra*	Flat	20

* introduced species

Quadrat 12

31°38'0.8" 115°46'40.0"

Vegetation: *Corymbia calophylla* (Marri) Low Open Woodland over *Xanthorrhoea preissii/Stirlingia latifolia* Low Shrubland

Soil Type: Grey-brown sand

Year of Clearing: 2013

PLOT (20 x 20m)

SPECIES	HEIGHT (m)	COVER (%)
Corymbia calophylla	8	5
Xanthorrhoea preissii	1	5
Macrozamia fraseri	0.6	<1
Stirlingia latifolia	0.5	5
Hibbertia hypericoides	0.5	<1
Bossiaea eriocarpa	0.4	<1
Petrophile linearis	0.3	<1
**Ursinia anthemoides*	0.2	10
**Gladiolus caryophyllaceus*	0.2	<1
Kunzea glabrescens	0.2	<1
**Pelargonium capitatum*	0.2	<1
Lyginia barbata	0.2	<1
Acacia huegelii	0.2	<1
Philotheca spicata	0.2	<1
**Lupinus cosentinii*	0.2	<1

SPECIES	HEIGHT (m)	COVER (%)
**Trifolium sp*	0.1	10
Gompholobium tomentosum	0.1	1
**Pinus pinaster*	0.1	<1
**Carpobrotus edulis*	0.1	<1
Hardenbergia comptoniana	Climber	<1
**Hypochaeris glabra*	Flat	10
Other native species recorded nearby		
Acacia pulchella		
Hibbertia subvaginata		
Eucalyptus marginata		
Nuytsia floribunda		

* introduced species

Quadrat 13

31°38'14.8" 115°46'54.9"

Vegetation: *Corymbia calophylla* (Marri) Low Open Woodland over *Gastrolobium capitatum,* Lupins and *Pelargonium capitatum* Low Shrubland

Soil Type: Grey-brown sand

Year of Clearing: 2006

PLOT (20 x 20m)

SPECIES	HEIGHT (m)	COVER (%)
Corymbia calophylla	6-10	5
Jacksonia sternbergiana	2.2	2
Macrozamia fraseri	1	<1
Xanthorrhoea preissii	1	<1
Gastrolobium capitatum	0.5	10
**Pelargonium capitatum*	0.4	5
Gompholobium tomentosum	0.4	<1
**Lupinus cosentinii*	0.3	70
**Ehrharta sp.*	0.3	20
Conostylis aculeata	0.3	2
**Carpobrotus edulis*	0.1	2
Hardenbergia comptoniana	Climber	2
**Hypochaeris glabra*	Flat	1
Other native species recorded nearby		

SPECIES	HEIGHT (m)	COVER (%)
Scaevola repens		
Corynotheca micrantha		
Hypocalymma robustum		
Acacia pulchella		

* introduced species

Quadrat 14

31°38'26.6" 115°46'49.1"

Vegetation: *Jacksonia furcellata* Open Shrubland and weeds
Soil Type: Grey-brown sand
Year of Clearing: 2013

PLOT (20 x 20m)

SPECIES	HEIGHT (m)	COVER (%)
Jacksonia furcellata	1.5	2
Xanthorrhoea preissii	1	<1
Acacia pulchella	0.5	<1
**Gladiolus caryophyllaceus*	0.3	<1
Gompholobium tomentosum	0.3	<1
**Pinus pinaster*	0.2	<1
**Ursinia anthemoides*	0.1	2
**Carpobrotus edulis*	0.1	1
Podotheca angustifolia	0.1	<1
**Sonchus oleraceus*	0.1	<1
Kennedia prostrata	0.1	<1
**Trifolium sp*	<0.1	80
**Hypochaeris glabra*	Flat	5
**Arctotheca calendula*	Flat	<1

SPECIES	HEIGHT (m)	COVER (%)
Other native species recorded nearby		
Stirlingia latifolia		
Jacksonia sternbergiana		

* introduced species

Quadrat 15

31°37'54.9" 115°47'14.5"

Vegetation: *Eucalyptus marginata* Low Open Woodland over *Xanthorrhoea preissii* Low Open Shrubland and weeds

Soil Type: Grey-brown sand

Year of Clearing: 2013

PLOT (20 x 20m)

SPECIES	HEIGHT (m)	COVER (%)
Eucalyptus marginata	6	10
Jacksonia sternbergiana	1.2	2
Macrozamia fraseri	1.1	<1
Xanthorrhoea preissii	1	5
Kunzea glabrescens	0.6	<1
**Gladiolus caryophyllaceus*	0.5	<1
**Euphorbia terracina*	0.4	2
Petrophile linearis	0.4	<1
Stirlingia latifolia	0.3	<1
Gompholobium tomentosum	0.3	<1
**Ehrharta sp.*	0.2	4
**Ursinia anthemoides*	0.1	2
Kennedia prostrata	0.1	<1
**Trifolium campestre*	<0.1	80
**Hypochaeris glabra*	Flat	10

SPECIES	HEIGHT (m)	COVER (%)
**Arctotheca calendula*	Flat	<1
Other native species recorded nearby		
Nuytsia floribunda		
Leucopogon parviflorus		
Scholtzia involucrata		
Daviesia decurrens		

* introduced species

APPENDIX 2

Species List

Age since clearing (years)	1	3	6	7	8
GYMNOSPERMS					
CYCADACEAE					
Macrozamia fraseri	1	1	1	1	1
PINACEAE					
**Pinus pinaster*	1	1		1	
MONOCOTYLEDONS					
ANARTHRIACEAE					
Lyginia barbata	1		1	1	1
ASPARAGACEAE					
Lomandra hermaphrodita		1			
Lomandra sp1			1		
Lomandra sp2			1		
Sowerbaea laxiflora		1		1	
CYPERACEAE					
Mesomelaena pseudostygia				1	
Schoenus curvifolius			1		
HAEMODORACEAE					
Anigozanthos humilis		1			
Anigozanthos manglesii		1			
Conostylis aculeata				1	1
Conostylis candicans				1	
Conostylis juncea			1		
Haemodorum paniculatum			1	1	
Haemodorum spicatum		1	1	1	
Haemodorum sp.		1			
HEMEROCALLIDACEAE					
Corynotheca micrantha		1		1	1
Dianella revoluta var. divaricata			1		
Tricoryne elatior		1			
IRIDACEAE					
**Gladiolus caryophyllaceus*	1	1	1	1	1
Patersonia occidentalis		1	1	1	1
POACEAE					
**Briza maxima*			1	1	
**Ehrharta sp.*	1		1	1	1
RESTIONACEAE					
Desmocladus flexuosus			1	1	
Hypolaena exsulca			1	1	
XANTHORRHOEACEAE					
Xanthorrhoea preissii	1	1	1	1	1
DICOTYLEDONS					
AIZOACEAE					
**Carpobrotus edulis*	1	1	1	1	1
ASTERACEAE					
**Arctotheca calendula*	1	1			
**Conyza bonariensis*		1			
Helichrysum luteoalbum		1			
**Hypochaeris glabra*	1	1	1	1	1
**Hypochaeris radicata*		1		1	
Olearia axillaris			1	1	
Podotheca angustifolia	1	1			
**Sonchus oleraceus*	1	1			
**Taraxacum officinale*		1			
**Ursinia anthemoides*	1	1	1	1	1
CHENOPODIACEAE					
Crassula colorata		1			
CHENOPODIACEAE					
Rhagodia baccata				1	
DILLENIACEAE					
Hibbertia hypericoides	1	1		1	
Hibbertia subvaginata	1	1			

Age since clearing (years)	1	3	6	7	8
ERICACEAE					
Conostephium pendulum		1	1	1	
Leucopogon parviflorus	1		1		
EUPHORBIACEAE					
**Euphorbia terracina*	1				
FABACEAE					
Acacia huegelii	1		1	1	1
Acacia pulchella	1	1	1	1	1
Acacia saligna		1	1	1	1
Acacia stenoptera		1	1		
Bossiaea eriocarpa	1	1	1	1	
Daviesia decurrens	1			1	
Daviesia divaricata		1		1	
Daviesia triflora		1	1	1	
Gastrolobium capitatum		1	1	1	1
Gastrolobium reticulatum		1			
Gompholobium tomentosum	1	1	1	1	1
Hardenbergia comptoniana	1	1		1	1
Hovea trisperma				1	
Jacksonia densiflora		1			
Jacksonia furcellata	1		1	1	1
Jacksonia sericea **P4**				1	
Jacksonia sternbergiana	1	1			1
Kennedia prostrata	1	1		1	
**Lupinus cosentinii*	1		1	1	1
**Trifolium campestre*	1	1	1	1	
**Trifolium sp.*	1	1	1	1	
GERANIACEAE					
**Pelargonium capitatum*	1	1	1	1	1
GOODENIACEAE					
Dampiera linearis			1	1	
Lechenaultia floribunda			1	1	
Scaevola canescens				1	
Scaevola repens		1	1	1	1
HALORAGACEAE					
Glischrocaryon aureum		1			
LORANTHACEAE					
Nuytsia floribunda	1	1			
MYRTACEAE					
Calytrix flavescens			1	1	
Corymbia calophylla	1			1	1
Eremaea pauciflora		1	1		
Eucalyptus gomphocephala				1	
Eucalyptus marginata	1	1	1		
Hypocalymma robustum					1
Kunzea glabrescens	1	1		1	
Scholtzia involucrata	1				
PROTEACEAE					
Adenanthos cygnorum				1	
Banksia menziesii		1			
Conospermum stoechadis		1			
Hakea lissocarpha				1	
Hakea ruscifolia		1			
Petrophile linearis	1	1			1
Stirlingia latifolia	1	1	1	1	1
RUBIACEAE					
Opercularia vaginata				1	
RUTACEAE					
Philotheca spicata	1	1	1		
SANTALACEAE					
Exocarpos sparteus				1	
VIOLACEAE					
Hybanthus calycinus		1			
Total Number Species	**23**	**30**	**23**	**32**	**15**

RPS

APPENDIX 4

Aboriginal Heritage Search Results

Search Criteria

1 sites in a search box. The box is formed by these diagonally opposed corner points:

MGA Zone 50	
Northing	Easting
6513704	372349
6524612	381840

Disclaimer

Aboriginal sites exist that are not recorded on the Register of Aboriginal Sites, and some registered sites may no longer exist. Consultation with Aboriginal communities is on-going to identify additional sites. The AHA protects all Aboriginal sites in Western Australia whether or not they are registered.

Copyright

Legend

Restriction

N	No restriction
M	Male access only
F	Female access

Access

C	Closed
O	Open
V	Vulnerable

Coordinate Accuracy

Accuracy is shown as a code in brackets following the site coordinates.

[Reliable]	The spatial information recorded in the site file is deemed to be reliable, due to methods of capture.
[Unreliable]	The spatial information recorded in the site file is deemed to be unreliable due to errors of spatial data capture and/or quality of spatial information reported.

Status

L - Lodged		ACMC Decision Made
Information lodged, awaiting assessment	→	R - Registered Site I - Insufficient information S - Stored Data

Spatial Accuracy

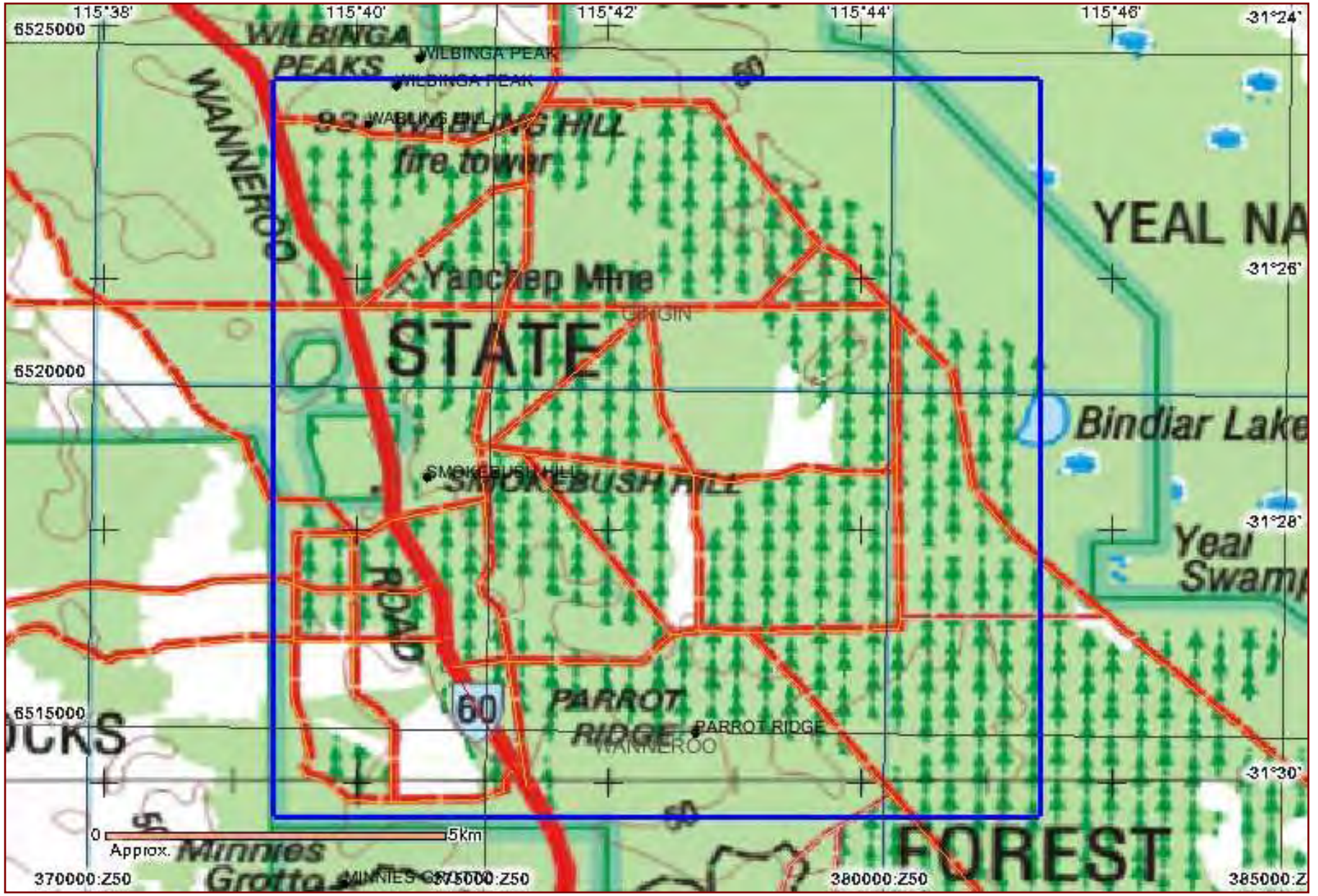
Index coordinates are indicative locations and may not necessarily represent the centre of sites, especially for sites with an access code “closed” or “vulnerable”. Map coordinates (Lat/Long) and (Easting/Northing) are based on the GDA 94 datum. The Easting / Northing map grid can be across one or more zones. The zone is indicated for each Easting on the map, i.e. '5000000:Z50' means Easting=5000000, Zone=50.

Sites Shown on Maps

Site boundaries may not appear on maps at low zoom levels

List of Registered Aboriginal Sites with Map

No results



Legend

Selected Heritage Sites

Registered Sites

Town

Map Area

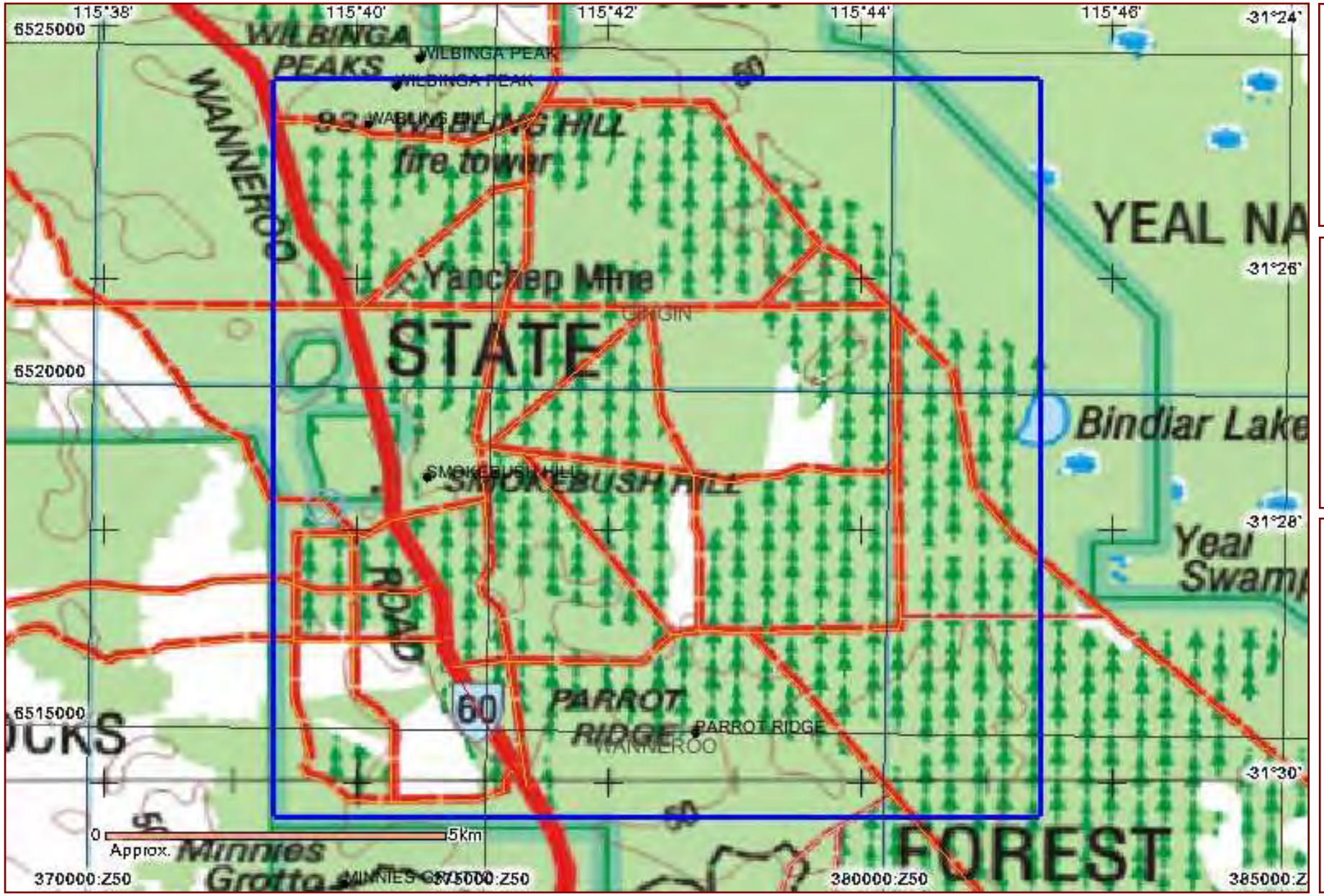
Search Area

List of 1 Other Heritage Places with Map

Site ID	Status	Access	Restriction	Site Name	Site Type	Additional Info	Informants	Coordinates	Site No.
3574	I	O	N	Smokebush Waterhole.	Artefacts / Scatter	Camp, Water Source	*Registered Informant names available from DIA.	372939mE 6518249mN Zone 50 [Reliable]	S02379

Aboriginal Heritage Inquiry System

Aboriginal Sites Database



Legend

Selected Heritage Sites

Other Heritage Places

Town

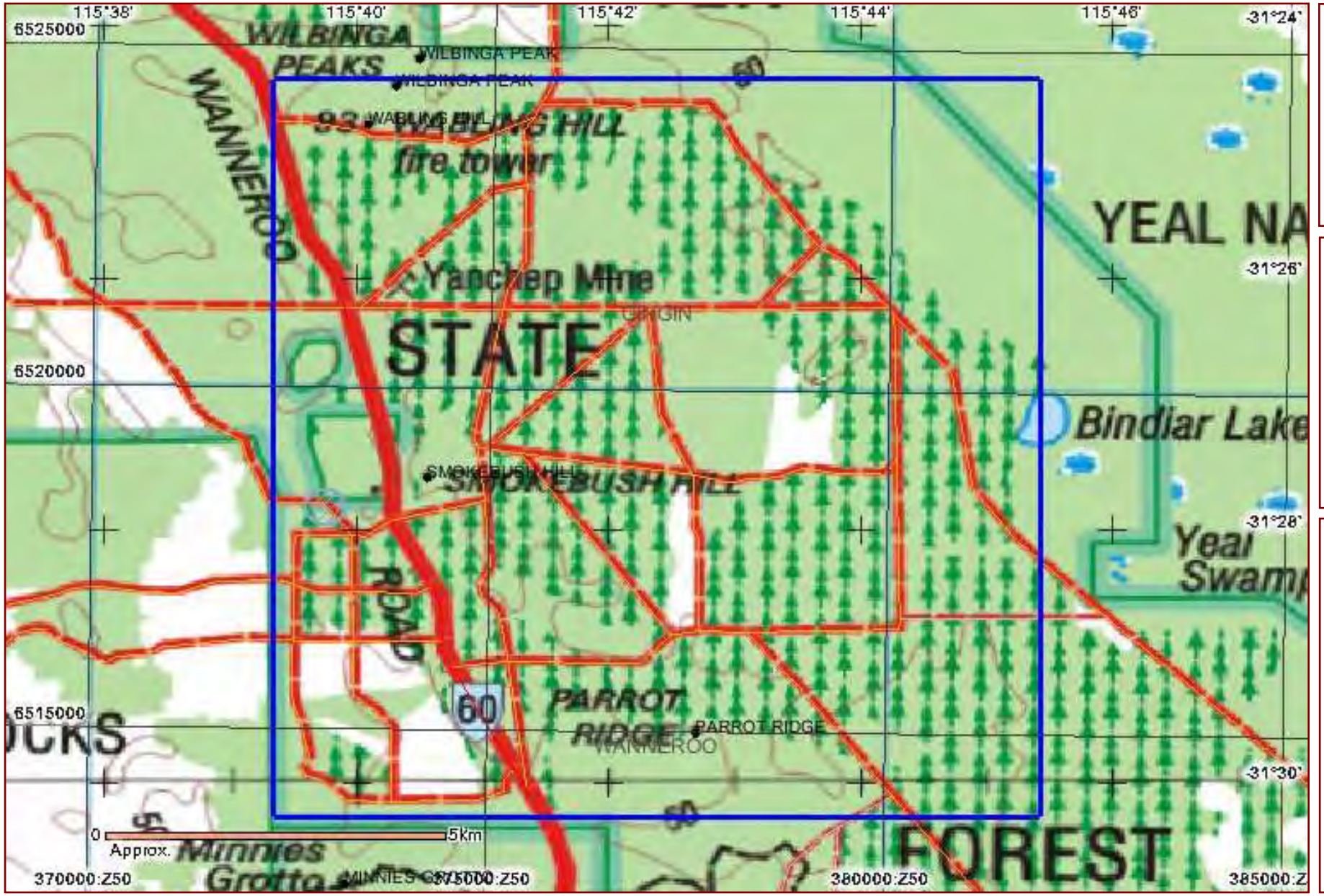
Map Area

Search Area

Map Showing Registered Aboriginal Sites and Other Heritage Places

Aboriginal Heritage Inquiry System

Aboriginal Sites Database



Legend

Selected Heritage Sites

- Registered Sites
- Other Heritage Places
- Town
- Map Area
- Search Area

Aboriginal Heritage Inquiry System

Aboriginal Sites Database

Search Criteria

0 sites in a search box. The box is formed by these diagonally opposed corner points:

MGA Zone 50	
Northing	Easting
6509460	381294
6517467	389526

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Access

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Coordinate Accuracy

Accuracy is shown as a code in brackets following the site coordinates.

[Reliable]	The spatial information recorded in the site file is deemed to be reliable, due to methods of capture.
[Unreliable]	The spatial information recorded in the site file is deemed to be unreliable due to errors of spatial data capture and/or quality of spatial information reported.

Status

L - Lodged		ACMC Decision Made
Information lodged, awaiting assessment	→	R - Registered Site I - Insufficient information S - Stored Data

Spatial Accuracy

Index coordinates are indicative locations and may not necessarily represent the centre of sites, especially for sites with an access code “closed” or “vulnerable”. Map coordinates (Lat/Long) and (Easting/Northing) are based on the GDA 94 datum. The Easting / Northing map grid can be across one or more zones. The zone is indicated for each Easting on the map, i.e. '5000000:Z50' means Easting=5000000, Zone=50.

Sites Shown on Maps

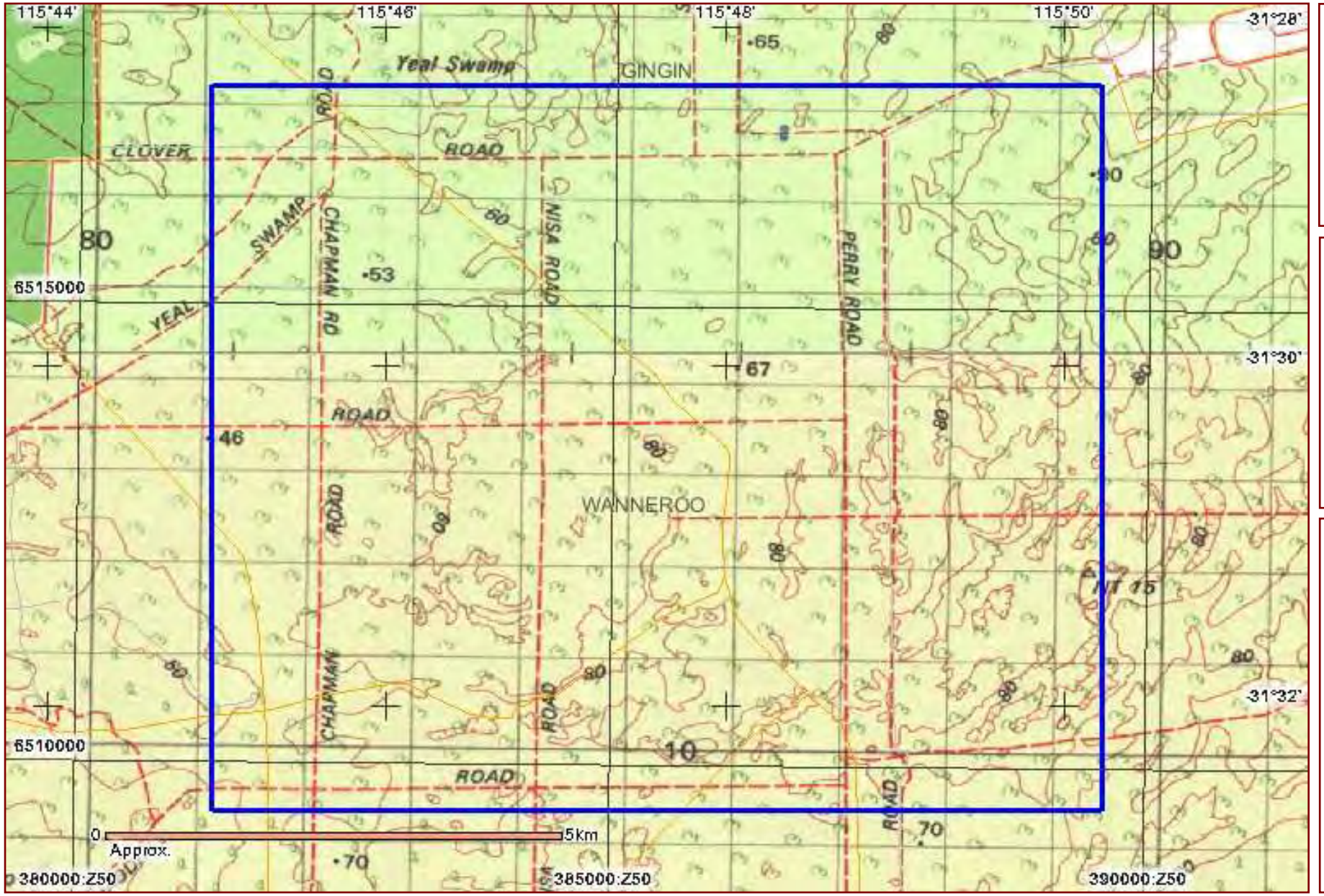
Site boundaries may not appear on maps at low zoom levels

List of Registered Aboriginal Sites with Map

No results

Aboriginal Heritage Inquiry System

Aboriginal Sites Database



Legend

Selected Heritage Sites

Registered Sites

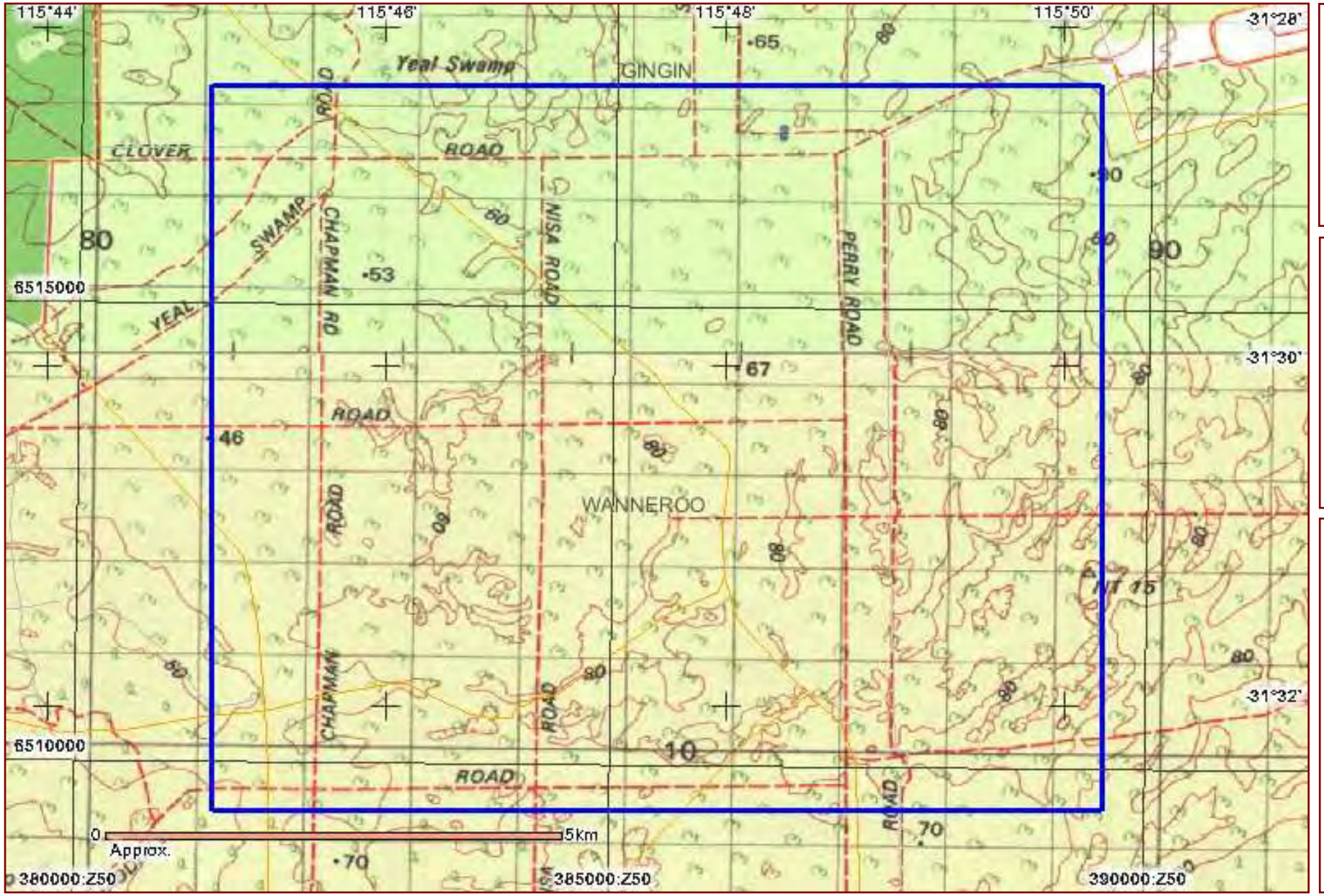
Town

Map Area

Search Area

List of Other Heritage Places with Map

No results



Legend

Selected Heritage Sites

Other Heritage Places

Town

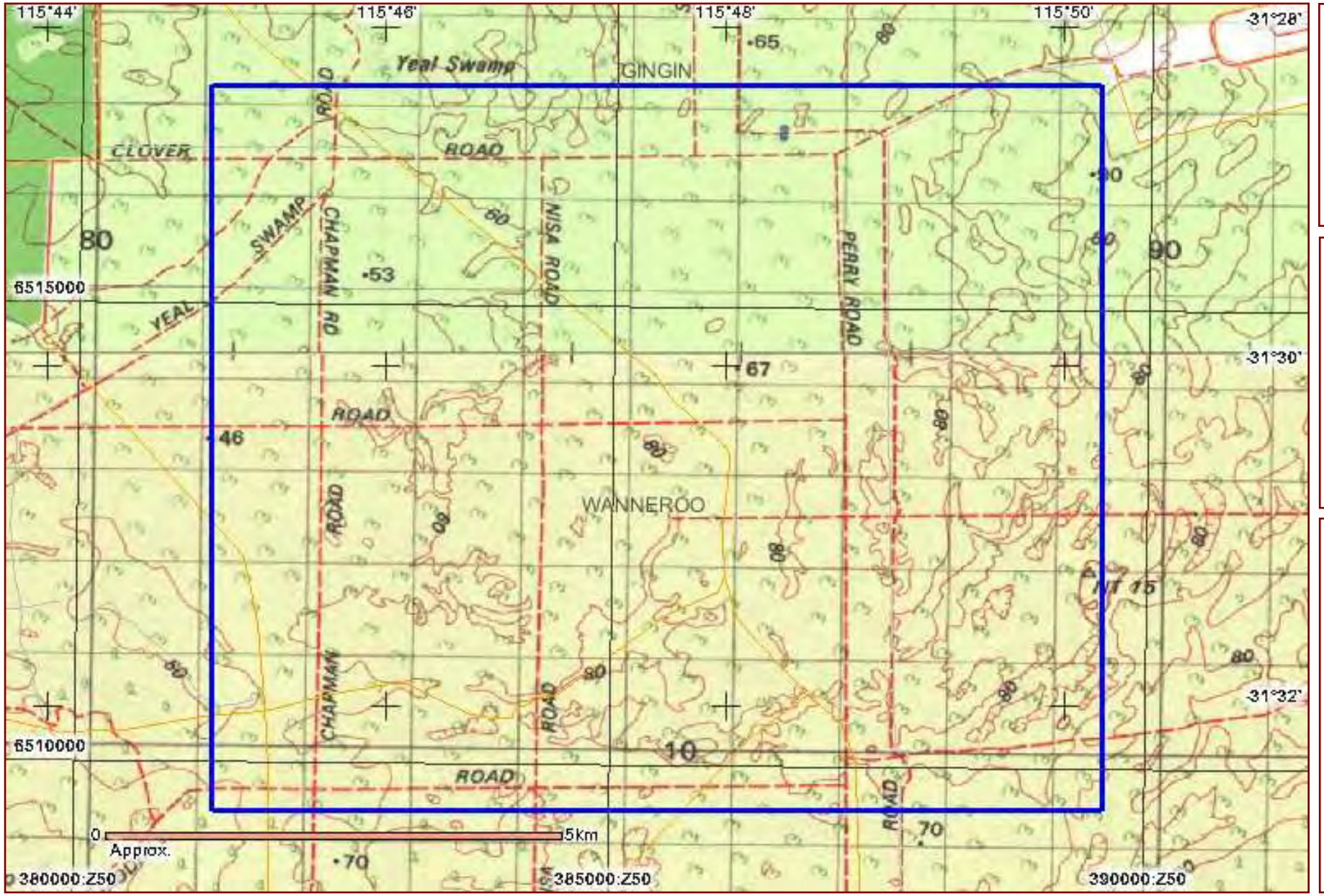
Map Area

Search Area

Map Showing Registered Aboriginal Sites and Other Heritage Places

Aboriginal Heritage Inquiry System

Aboriginal Sites Database



Legend

Selected Heritage Sites

- Registered Sites
- Other Heritage Places
- Town
- Map Area
- Search Area

Search Criteria

0 sites in a search box. The box is formed by these diagonally opposed corner points:

MGA Zone 50	
Northing	Easting
6483427	391990
6486704	393737

Disclaimer

Aboriginal sites exist that are not recorded on the Register of Aboriginal Sites, and some registered sites may no longer exist. Consultation with Aboriginal communities is on-going to identify additional sites. The AHA protects all Aboriginal sites in Western Australia whether or not they are registered.

Copyright

Legend

Restriction

N	No restriction
M	Male access only
F	Female access

Access

C	Closed
O	Open
V	Vulnerable

Coordinate Accuracy

Accuracy is shown as a code in brackets following the site coordinates.

[Reliable]	The spatial information recorded in the site file is deemed to be reliable, due to methods of capture.
[Unreliable]	The spatial information recorded in the site file is deemed to be unreliable due to errors of spatial data capture and/or quality of spatial information reported.

Status

L - Lodged		ACMC Decision Made
Information lodged, awaiting assessment	→	R - Registered Site I - Insufficient information S - Stored Data

Spatial Accuracy

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Sites Shown on Maps

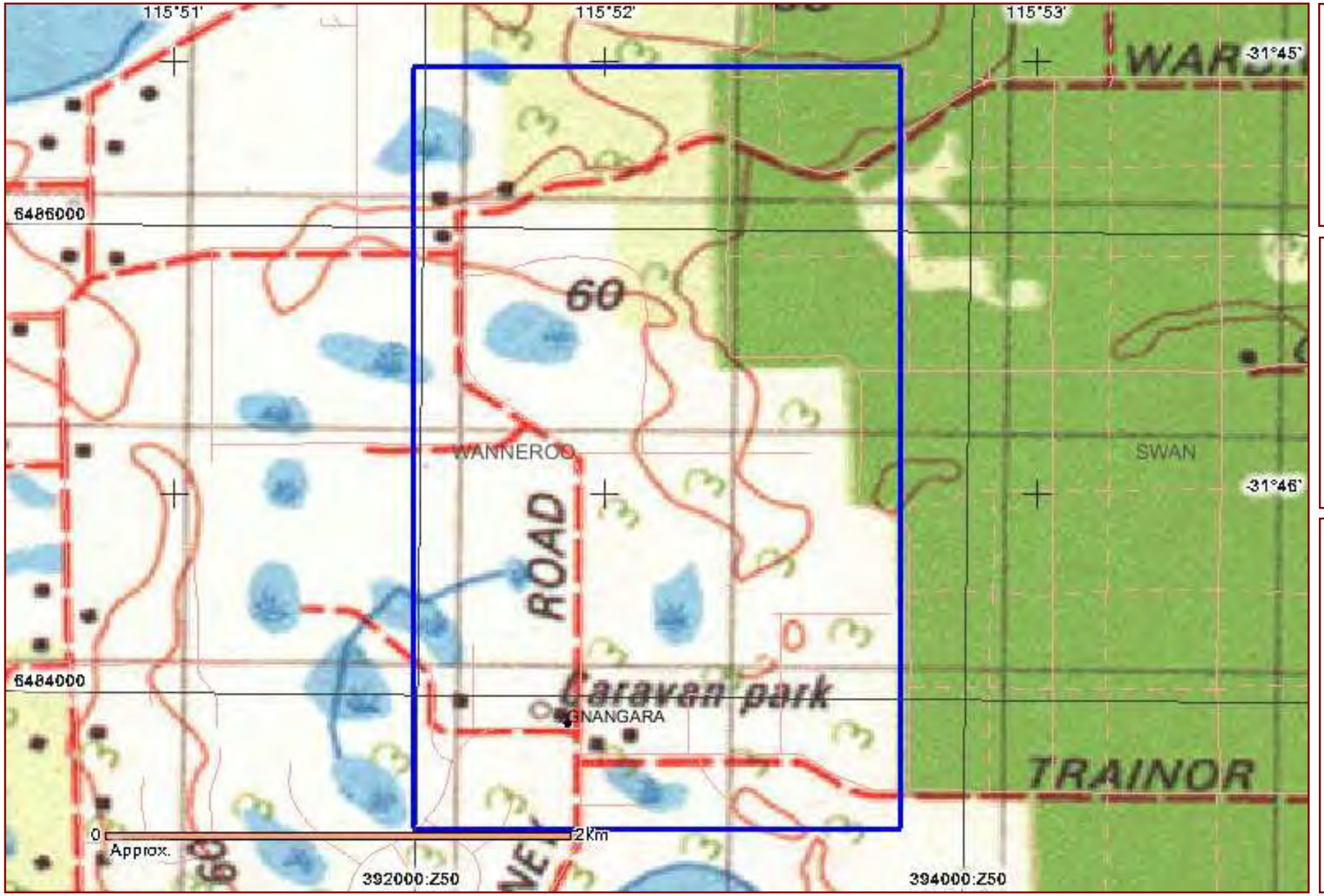
Site boundaries may not appear on maps at low zoom levels

List of Registered Aboriginal Sites with Map

No results

Aboriginal Heritage Inquiry System

Aboriginal Sites Database



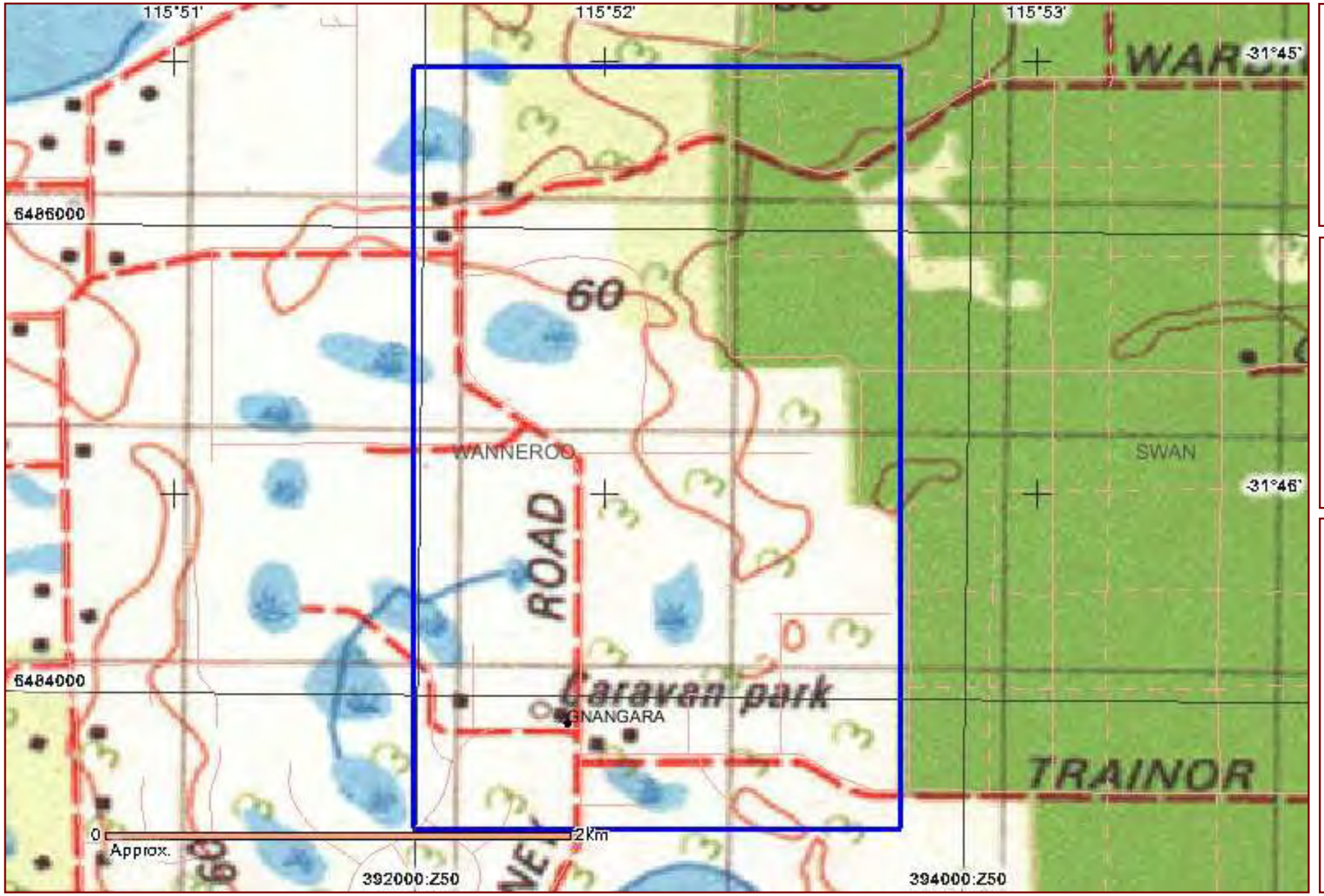
Legend

Selected Heritage Sites

- Registered Sites
- Town
- Map Area
- Search Area

List of Other Heritage Places with Map

No results



Legend

Selected Heritage Sites

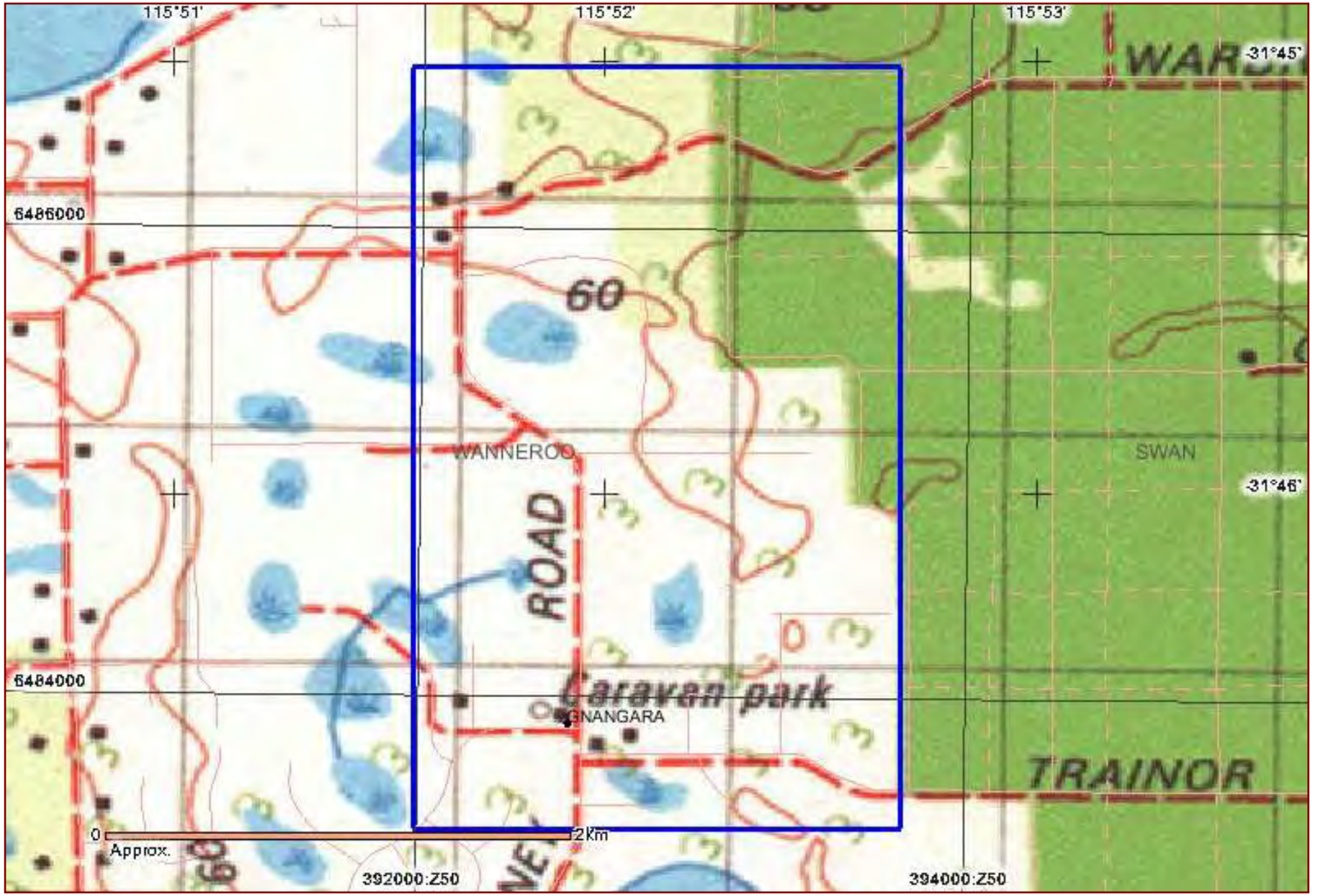
Other Heritage Places

Town

Map Area

Search Area

Map Showing Registered Aboriginal Sites and Other Heritage Places



Legend

Selected Heritage Sites

- Registered Sites
- Other Heritage Places
- Town
- Map Area
- Search Area

From: Carolyn Fennelle [mailto:Carolyn.Fennelle@noongar.org.au]
Sent: Thursday, 18 August 2016 1:32 PM
To: Newton, Vern (Rivervale) AUS
Subject: RE: Consultation Rocla / Hanson Gnangara Pine Plantation Projects

Dear Vern,

Thank you, for your email.

The South West Aboriginal land and Sea Council (SWALSC) confirms that Rocla Pty Limited (now Hanson) has consulted with the SWALSC relation to their suite of tenements in the Gnangara Pine Plantation (State Forest 65) area. The SWALSC act on behalf of the Whadjuk People (WAD242/2011) and Yued (WAD6192/1998).

Consultation is ongoing in relation to the implementation of the Native Title Agreement, heritage related matters and in terms of the stage of approval process for the Exploration Licences.

Consultation has been ongoing since 2008.

Kind regards,

Carolyn Fennelle | Legal Officer
South West Aboriginal Land & Sea Council
p: (08) 9358 7400 | f: (08) 9358 7499
carolyn.fennelle@noongar.org.au | www.noongar.org.au
1490 Albany Hwy CANNINGTON | PO Box 585 CANNINGTON WA 6987

From: Newton, Vern (Rivervale) AUS [mailto:vern.newton@hanson.com.au]
Sent: Tuesday, 16 August 2016 3:50 PM

RPS

APPENDIX 5

Report of An Aboriginal Heritage Survey of E70/3279 Near Two Rocks

REPORT OF AN ABORIGINAL HERITAGE SURVEY OF E70/3279 NEAR TWO ROCKS IN PERTH, WESTERN AUSTRALIA

A report prepared for the South West Aboriginal Land and Sea Council (SWALSC) on behalf of Rocla Quarry Products (WA)

Anthropological Report prepared by:

Roina Williams
Consulting Anthropologist
121A Rokeby Rd
SUBIACO WA 6008
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Archaeological Report prepared by:

Kellie Cue & Bradie Baldisseri
Deep Woods Surveys (WA) Pty Ltd
PO Box 1625
ALBANY WA 6331
paul.greenfeld@bigpond.com

Report submitted September 2011 to:

Rocla Quarry Products
Mr Vern Newton
130 Fauntleroy Ave
REDLCIFFE WA 6104

South West Aboriginal Land & Sea Council
Future Acts Officer
Mr Sean O'Hara
1490 Albany Highway
CANNINGTON WA 6107

The Registrar
Department of Indigenous Affairs
PO Box 7770
Cloisters Square
PERTH WA 6000

79 Naturaliste Terrace
Dunsborough WA 6281
Email:- bradnlee@westnet.com.au
Phone:- 97553716

HERITAGE SURVEY

ACKNOWLEDGEMENTS

The authors would like to thank the following organisations and individuals who helped with the organisation and management of the heritage survey.

- Mr Brad Goode - Brad Goode & Associates Pty Ltd (Anthropologist)
- Mr Vern Newton – Rocla Quarry Products (Proponent representative)
- Yued (WC97/71), (WAD6192/98) Native Title Claim group representatives

Ethnographic survey informants:

- Ms Edith Warrell
- Ms May McGuire
- Ms Rhonda Flowers
- Ms Evelyn Dawson
- Ms Delores Flowers
- Mr Gus Ryder

DISCLAIMER

All of the information contained in this report is believed to be correct and accurate at the time it was recorded. The author does not take responsibility or accept any liability for errors or omissions contained in the report based upon information supplied by others.

*Note: In terms of its assessment under section 5 of the Western Australian Aboriginal Heritage Act (1972), this report should be read in conjunction with the archaeological report by Deep Woods Surveys (WA) Pty Ltd (Cue, K and Baldassari, B 2011).

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GLOSSARY OF TERMS

The Proponent – Rocla Quarries
The Consultant – Roina Williams on behalf of Brad Goode & Associates Pty Ltd
AHA - Western Australian Aboriginal Heritage Act (1972)
DIA - Department of Indigenous Affairs
ACMC - Aboriginal Cultural Material Committee
SWALSC - South West Aboriginal Land and Sea Council

EXECUTIVE SUMMARY

This report presents the findings of an Aboriginal heritage survey performed in compliance with the *Aboriginal Heritage Act 1972*, undertaken by Ms Roina Williams (consultant anthropologist) and representatives of the Yued native title claim group (WC97/71) as selected by their legal representatives South West Land and Sea Council under the *Native Title Act 1993.*

The survey took place north of in the Gnangara Pine Plantation along Wanneroo Road/Indian Ocean Drive, approximately 12km northeast of the town of Yanchep, 10km east of the town of Two Rocks, and 57km northwest of Perth, Western Australia.

Rocla Quarry Products is proposing to drill approximately 900 holes located on existing tracks and firebreaks, within lease E70/3279. The exploration is an endeavour by Rocla to locate suitable building sand products with a view to quarrying these in the near future.

A search of the Aboriginal Sites Register, located at the Department of Indigenous Affairs (DIA), Heritage and Culture Division (Perth), identified two previously recorded and/or registered sites within the boundaries, or within the immediate vicinity, of the lease E70/3279.

These are the recommendations that Yued Representatives have agreed to in order for the proposed drilling program, as described by the co-ordinates provided (see Appendices), can proceed:

It is recommended that Rocla give due consideration to the Yued representatives request for monitoring during the drilling process.

No known sites will be impacted by the current drilling program.

Human remains - If skeletal materials that may be human, or materials that may be a human grave are uncovered during the approved work program, Rocla and its contractors **must stop work immediately** and the materials and the area **must be left undisturbed**. The Western Australian Police **must be informed immediately** and Yued native title claimants informed through their representative, SWALSC.

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REPORT

Report of an Aboriginal Heritage Survey of Tenement E70/3279, Western Australia

ISSUE

Rocla Quarry Products WA (Rocla) is proposing to conduct geotechnical exploratory across the current Gnangara Pine Plantation within mining tenement E70/3279 located near Two Rocks, north of Perth Western Australia. Rocla wishes to determine whether any sites of significance to Aboriginal people will be impacted upon by this proposed work and are thereby fulfilling their obligations under the Aboriginal Heritage Act (1972).

REPORT OBJECTIVES

To report on archival research in order to determine if any previously recorded Aboriginal Heritage sites will be impacted upon by the above project proposal.

To report on consultations held with representatives of the Yued (WC97/71) Native Title Claim group in order to determine if any new Aboriginal Heritage sites will be affected by this proposal.

BACKGROUND

On the 7th July 2011 Mr Sean O'Hara, from the South West Aboriginal Land and Sea Council ('SWALSC'), acting on behalf of Rocla, invited Brad Goode & Associates Pty Ltd to submit a budget estimate for a Work Area Clearance Aboriginal Heritage Survey of an Exploration Drilling Program within mining tenement E70/3279.

Rocla is the major supplier of processed sand products for building requirements in Metropolitan Perth. With this project they are specifically hoping to find areas of yellow sands to supply Perth's building demand for the next few decades. The area proposed for drilling is wholly within the Gnangara Pine plantation. The survey area is currently being deforested and harvested by the Department of Environment and Conservation, in order to improve underground water reserves within the Gnangara Mound. Rocla do not intend to drill any areas of existing native vegetation and will use existing fire tracks and roads. The approximately 907 target drill holes will be 200m apart, 50mm in diametre and range to a depth of 30m. The area being targeted is approximately 7x7 km. Once quarrying begins, the life of the mine(s) is expected to be approximately 30 years. Rocla also has an interest in the restoration of the Gnangara Pine plantation to native Banksia Woodland and the restoration of wetlands and has other research projects occurring to this end, in the Kings Park National Forest. Rocla will require water bores for dust suppression and will apply to the Department of Water for licenses.

The Work Area Clearance Aboriginal Heritage Survey consisted of an archaeological inspection, conducted by Kellie Cue and Bradie Baldassari (Consultant Archaeologists acting for Deep Woods Surveys) and an ethnographic survey and consultation, conducted from the 18th-19th August 2011 by Ms Roina Williams (Anthropologist), assisted by Ms Nicole Azzalini and representatives of the Yued Native Title Claim group. The results of the ethnographic survey are detailed in the following report.

LOCATION

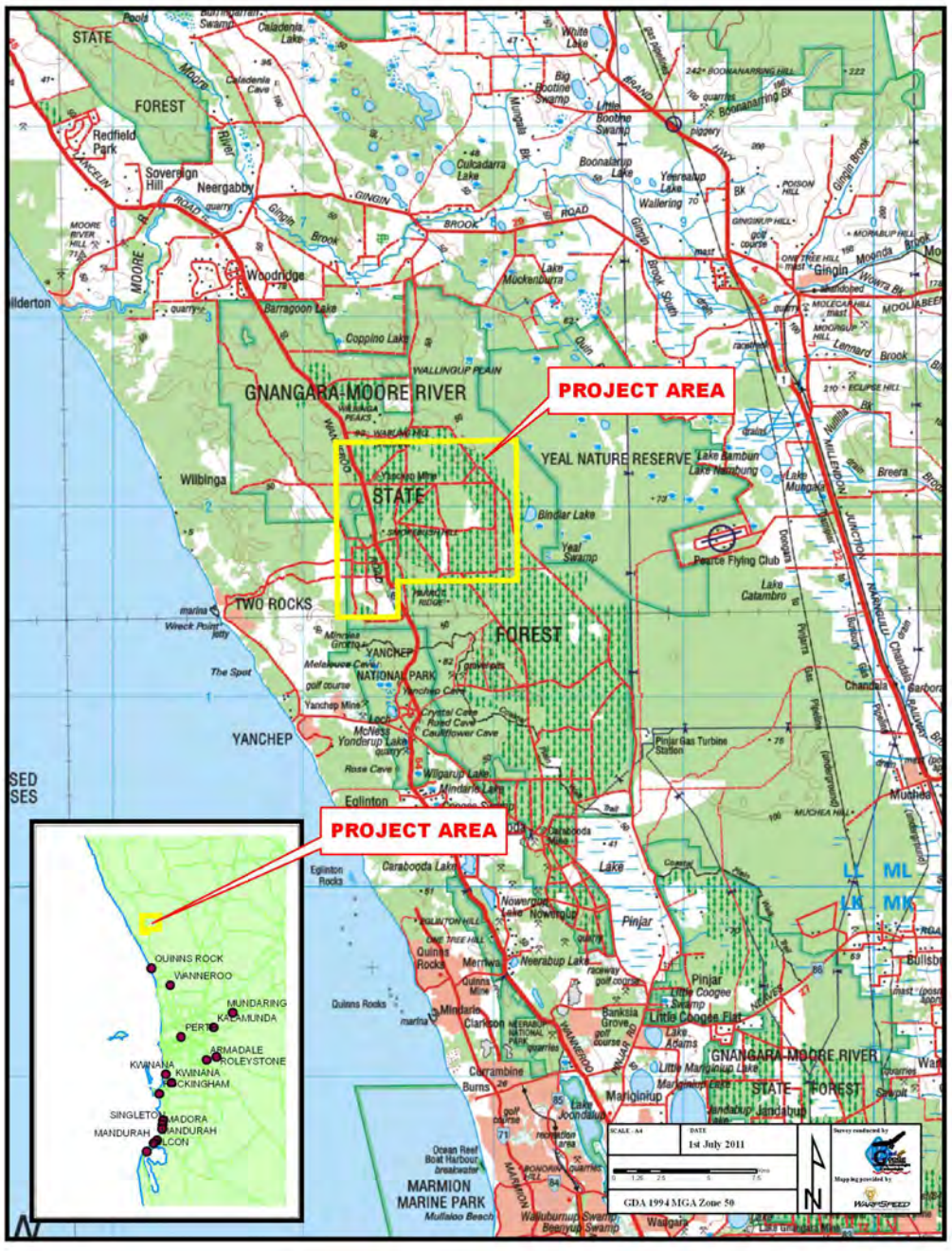

Figure 1: Location of the survey area.

Figure 2: GPS tracking of ethnographic survey.

ETHNOGRAPHIC & HISTORICAL BACKGROUND

Prior to European colonisations, thirteen socio-dialectal groups with shared traditions and a common language occupied what is now known as the Perth southwest region. Today, this group is known collectively as the *Noongar* people. Pre-European settlement, the 13 *Noongar* language groups originally occupied country from Jurien Bay in the north, to Esperance in the southeast (Berndt 1979, Tindale 1974, Tilbrook 1983).

Since the *Native Title Act 1993*, the *Noongar* people have been engaged in the mapping and representation of their lands, boundaries and traditions, in order to conform to Commonwealth legislative requirements. The Yued Native Title Claim (WC 97/71) today traces country from the Moore River (O'Connor 1992) bounded by the coast, Wanneroo and Toodyay (in the south), Goomalling and Dalwallinu (in the east), and Coorow (in the north).

Prior to colonisation and the imposition of British Rule of Law, *Noongar* cosmologies and cosmogonies framed a 'law' that provided the basis for social order. This was encapsulated in oral traditions and ceremonies passed down since time immemorial, collectively described today as 'the Dreaming complex'. The Dreaming stories, songs and dances traced the creative movements of ancestral beings from the beginning of time, during what *Noongars* call the *nyitting* (cold time). During this time, the ancestral beings created the world and all within it, including aspects of the natural world that defined law, social, moral and territorial rights for all inhabitants. In a sense, ancestors and the living, created a 'moral community' whereby identification with ancestral beings allowed the channeling of their power for use by those vested with the rights to do so (Keen 2004, p.212). In this way, all generations continue to be linked to the Dreaming and to the eternal spiritual beings (Berndt 1979). These consubstantial links created a connection between body, spirit, name, shadow, ancestral track and totem, with damage to one being irrevocably linked to damage to the other (Keen 2004, p.211).

The *Noongar* also held beliefs in a central creator spirit, the *Waugal* (after Moore 1842, Berndt 1979; *woggal* after Bates 1938 & 1985), who created and is still present in all sources of water in the southwest. The Yued people continue to have a close spiritual and historical association with the natural water features of Gingin Brook, Moondah Brook, Lennards Creek, and surrounding areas (Port-Louis 2008). For the Yued, another important Dreaming mythology centres upon the *Waitch* (Emu) Dreaming which details the coming into being of the emu from an ancient serpent (described as a 'crocodile' but more likely a salt-water *waugal*) that was bitten and injured by a shark and retreated to land, taking refuge in a cave (Emu Cave – DIA Site 17597). As it lay dying, other animals took pity and healed it by giving it feathers, a beak and legs; from this point on the 'crocodile' was transformed into the emu (Smeeton 2009). This story of spiritual survival and metamorphosis into a living being is still important to the Yued people, as is Emu Cave, the site where this metamorphosis was said to have occurred.

Noongars moved seasonally in local family groups in order to exploit and manage resources. This movement was usually along a series of well-known tracks or paths (*bidi*) aligned with corridors of easiest movement, and lines identified in Dreaming songs. Waterways provided food resources, birthing places and camping grounds, which in turn gave people a birthright over and spiritual connection with these sites. The density of food resources in the *Noongar's* domain and the potentially large size of family groups would likely have made their range comparatively small (Keen 2004, p.104). This in turn would have enabled even stronger connections to spirit, place and kin.

ARCHIVAL RESEARCH

Archival research involved an examination of the DIA Sites Register, a review of any relevant site files and a review of any unpublished ethnographic reports that relate to the tenement.

SITES REGISTER SEARCH

The DIA Aboriginal Sites Register categorises places reported to be of importance and significance to Aboriginal people into two separate categories.

The first category contains sites classified as **'Registered',** which have been assessed by the ACMC as meeting the definition of section 5 of the AHA and are fully protected under the AHA. Disturbance to land that contains such sites requires a section 18 application for ministerial consent should proponents wish to use the land that contain these sites.

'Other Heritage Places' is the second category which includes reported sites both 'Lodged' and awaiting ACMC assessment, and 'Information Assessed' by the ACMC, however awaiting a final decision on the places status. Also there are places where the ACMC have determined there is 'Insufficient' information for these places to be fully 'Registered' under the AHA, however that there is enough information to warrant their temporary protection. Within the category of 'Other Heritage Places' are sites that are awaiting assessment or are lodged are protected by the provisions of the AHA, until assessed and their final status determined. Other heritage places that have been assessed and fail to meet the definition of section 5 of the AHA are classified as 'Stored Data'. Places in this category that have been assessed as 'Stored Data' are not sites under the AHA as they have failed to meet the definition of section 5.

In relation to this survey a search of the DIA Aboriginal Sites Register was conducted for this project in August 2011, in order to determine if there were any previously recorded Aboriginal heritage sites that would be affected by the project proposal (see Appendix 1: Sites Register Search).

Table 1: Summary of Aboriginal heritage sites within or adjacent to project area.

Site ID	Name	Status	Access	Restriction	Location (GDA94 Zone 50)* East	Location (GDA94 Zone 50)* North	Site Type
Registered Aboriginal Site							
3574	Smoke-bush Waterhole	I	O	N	372939	6518249	Camp, water source
Other Heritage Places							
17597	Emu Cave	R	O	N	371098	6516058	Myth, cave

***** Please note: Coordinates are indicative locations that represent the centre of sites as shown on maps produced by the DIA – they may not necessarily represent the true centre of all sites.

LEGEND

R – Registered Site, **I** - Insufficient Information, **S** - Stored Data, L - Lodged awaiting assessment, **IA** - Information Assessed, **O** – Access Open, **C** - Closed Access, **N** – File Not Restricted.

REVIEW OF RELEVANT SITE FILES

Site ID 3574 – 'Smoke-bush Waterhole'

The Smoke-bush Waterhole was recorded by Pat Vinnicombe in 1987 with the aid of Aboriginal informants, Corrie and Violet Bodney. It is described as pool surrounded by bulrushes with associated campsite and artefact scatter. It was considered to have been a transit camping ground for the 'old people' when walking through from Gingin to Yanchep.

Site ID 17597 – 'Emu Cave'

Recorded in 2000 by Lily Bhavna Kauler and Ken Macintyre with the main informant named as Ken Colbung. The site is described as a cave on the southeast corner of a knoll behind a Grass tree and a Tuart tree. It is related to the Emu *Waitch* or Dreaming and is part of a songline which tracks out to the Indian Ocean. This site is mapped as outside of the survey area.

REVIEW OF RELEVANT ETHNOGRAPHIC REPORTS

Macintyre, K and Dobson, B 1991, *Yanchep Structure Plan: Report on a Survey for Aboriginal Sites*, Unpublished Report accessed at the Department for Indigenous Affairs

This survey identifies significant sites in the Yanchep-Two Rocks area, associated with fresh water campsites near the lakes and swamplands. It also links these wetlands and nearby limestone caves to the mythological journeys of the *Waugal* Dreaming serpent and other important creation beings. Important cultural procedures such as employing fire to enable safe entry into some of these caves are also outlined.

Relevance: Of some importance for this report is the information on the site called Emu Cave, which is related to the story of the Emu *Waitch ("Wedj")* Dreaming mythology and songline. While not within the survey area, this site is located nearby and may be threatened by inevitable building development in the area.

McDonald, E 2005, *Study of Groundwater-related Aboriginal Cultural Values on the Gnangara Mound,* Unpublished report accessed at the Department for Indigenous Affairs, August 2011.

This ethno-historical study seeks to record the views of Noongar people toward wetlands and waterways, including groundwater systems, particularly in relation to the Gnangara Mound, the source of potable water for Metropolitan Perth. McDonald (2005) employs wide-ranging references to establish both the traditional anthropological and current contemporary perspectives of Noongar Aboriginal people in an area where increasing consumer demand and development are taking a visible toll on groundwater features. McDonald (2005) stresses the inter-connectivity of the water systems on a physical and spiritual level for local Indigenous people. This included underground water flows that were known to the Indigenous groups through ancestral stories related to the journey of the creation being, the *Waugal* during the *Nyitting* ('Cold Time' or Dreaming). Local watercourses were also sources of food supply and were connected by pads, '*…like watery stepping stones over an arid landscape…'* (McDonald 2005, p.20). Many major road alignments today follow these pads (McDonald 2005, p.21).

As McDonald (2005) points out,

> 'Nyungar perspectives on water (*gabbi/kapi)* are premised on a dichotomy between fresh *(gabbi dijkap)* and salt water (sea water – *mampakut*; and brackish – *gabbi-karning*). Both fresh and salt water were created in the Dreaming by the ancestral spirits' (McDonald 2005, p.25).

The saltpans and brackish water are thought to be the urine of the *Waugal* and the limestone areas its excreta. Large stones are believed to be the eggs of the *Waugal,* who also created the caves. In this way, the *Waugal* operated on both the visible surfaces of the ground, in the sky as a rainbow and on the unseen surfaces, deep within the bowels of the earth. Other totemic animals are also responsible for particular water and cave sites, with the 'Shark, Sea Waugal and Emu Dreaming story' and 'The Turtle' dreaming track referred to (McDonald 2005, p.52) as having influence over the Yanchep/Two Rocks area and out to the Indian Ocean. McDonald references Rose (2004) in stating that control over access to water was key to Aboriginal survival and control over all associated information was, as it is now, a primary form of defence.

Interestingly, an understanding of geomorphology is encapsulated by the Noongar words for the three zones of the Swan River Coastal Plain: *Booyeembara, Gandoo and Warget*. These areas are characterised by changes in bands of soil that correspond with different vegetation types. The area that corresponds with the yellow sands is the *Gandoo* is the type of sand that Rocla is drilling for. However, the natural cues for finding these sands without drilling have long since been eradicated and replaced with an introduced mono species – the pine forest.

Relevance: The Gnangara Mound will be directly impacted by the de-forestation currently taking place by the Department of Environment and Conservation (DEC), of the existing pine forest, which in turn will have an impact on lakes and swamps in the area. While this de-forestation was not directly related to the Rocla survey, it will eventually enable the quarrying of the sands in the area by Rocla and ultimately clear the way for the suburban building developments that are planned for the area. The impact on Aboriginal cultural values for the area and surrounds will also likely increase as a result of this development. Given the attitude of guardianship by Noongar people over water sources and sites associated with their Dreaming narratives, together with their more generalised concern for the disturbance of the *Waugal,* the sites outlined in this McDonald (2005) report and in the report below, may become increasingly significant (McDonald 2005, p.41) and, in my opinion, sensitive.

McDonald, E 2005, *Study of Groundwater-related Aboriginal Cultural Values on the Gnangara Mound, Volume 2 Inventory of Sites*, Restricted report for Department of Environment, accessed at the Department for Indigenous Affairs, August 2011

Relevance: This report presents an inventory of sites and should be read in conjunction with the ethno-historical report referred to above.

Machin, B 2001, *Aboriginal Heritage issues and cable crossings: upper Canning River downstream from Nicholson Road traffic bridge adjacent downstream from Canning Bridge and Narrows bridge utilising internal bridge structure Swan River adjacent upstream to Causeway*, Report prepared for Powerwise Australia Pty Ltd, Unpublished report accessed at the Department for Indigenous Affairs, August 2011

This survey was conducted with Swan River Noongar people over major waterways in the metropolitan region. The section on Cultural and Historical Background gives a useful insight into traditional practice. The way in which women secured their children's hereditary birthright and totemic association to a place, through choosing to limit their movements in the last stages of pregnancy, is noted by Bishop Salvado (Machin 2001, p.24). Women would generally select waterholes or rivers, not just to use the water during birthing but also to give their child (and by proxy themselves) some control and representation over place-specific narratives. Machin (2001) believes this suggests a merging of socio-economic and religious spheres to what he describes as 'empirical ends' (Machin 2001, p.24). Self-identity does not stop with the edges of the skin but instead becomes an incorporation of human, plants and animals, and place.

> 'Country or Boodjarra' encompasses the earth itself, the dreaming sites in the area, the water, the areas beneath and above the earth, the localised plant resources, the animals whose dreaming sites are there and the people associated with the area' (Colbung and Kauler in Machin 2001).

Relevance: Site-specific information and the exclusive ways that stories are transmitted are relevant for this report in that there was a predominantly female survey team. While none of the women had given birth in the area, birth practices (prior to enforced hospitalisation) were discussed. The way in which identity is constructed in relation to sites, in particular birth sites helps to contextualise some of the discussions that took place with these women.

OUTCOMES OF ARCHIVAL RESEARCH

Only one of the sites is mapped as being inside the survey area: Site ID 3574 Smokebush waterhole. The drilling will avoid this site completely so as to have no impact upon it. No further action is required by Rocla (other than continued avoidance) in regard to this site in order to remain compliant with the *Aboriginal Heritage Act (1972).*

Figure 3: Native flowering bush (Diplolaena D. Veltonina).

IDENTIFICATION OF SPOKESPEOPLE

THE RIGHT TO SPEAK ON HERITAGE ISSUES

Various authors have discussed the contemporary problem of who in the Aboriginal Community has the authority to speak on heritage issues within an area. O'Connor et al. (1989:51) suggest that when this question is posed to people in Aboriginal Australia, answers are usually framed by such terms as 'the traditional owners', i.e., those people who are defined by place of birth i.e. descent. Myers presents a broader and more contemporary view of 'ownership' based upon descent and association:

> An estate, commonly a sacred site, has a number of individuals who may identify with it and control it. They constitute a group solely in relationship to this estate. Identification refers to a whole set of relationships a person can claim or assert between himself or herself and a place. Because of this multiplicity of claims, land holding groups take essentially the form of bilateral, descending kindred. Membership as a recognised owner is widely extended (cited in Machin 1993:22).

Myers then goes on to further clarify the current perception of 'ownership' when he states:

> ....such rights exist only when they are accepted by others. The movement of the political process follows a graduated series of links or claims of increasing substantiality, from mere identification and residual interest in a place to actual control of its sacred association. The possession of such rights as recognised by others, called 'holding' (kanyininpa) a country, is the product of negotiation (Ibid.).

While the notion of descent is clearly an important criterion within Myers analysis, it must be seen in terms of the contemporary Nyungar situation. Nyungar tradition in the south west has been seriously eroded since colonisation, lines of descent have been broken and previously forbidden and mixed marriages have interconnected many Nyungar groups who would not have traditionally had a close association (Ibid.). Consequently, in contemporary times the criteria of historical 'association' seems to be important in regards to the 'right to speak' on heritage issues within an area:

> Traditional subsistence no longer sufficed to support Aboriginals so they combined this with menial work on farms and over time new relationships to land developed. As a consequence, the more recent history associated with their involvement with European agriculture and labour patterns is often more relevant than the pre-contact mode of attachment to an old way of life and the roots of the identity as original owners of the land. Biographical associations are often tied to post-settlement labour patterns and identification. These can predominate. This is part of a dynamic process of ethnicity, identity and tradition (Machin 1995:11).

O'Connor, et al. (1989) identified several criteria for determining contemporary community spokes people. A spokesperson must have a long-term association with an area, usually as a young person, and had extensive contact with a member or members of the 'pivotal generation of the culture transmitters'; those people whom, as children themselves, had contact with people who could pass on their traditional knowledge. A spokesperson must also demonstrate knowledge of the region's natural resources, its hunting, fishing and camping grounds, its local water sources, and the flora. This is important because a person without this knowledge is unlikely to be seen by their fellow Nyungars as truly being from that country, despite having been born or lived in that area. In some cases, people from outside a specific region have established themselves by political activism. They are accepted by their fellow Nyungar because they may have participated in mainstream white pursuits, such as advanced education, or legal and political careers, that have empowered them within the broader community. As such, these people are a valuable resource to the local Aboriginal Community. The people consulted in this survey fulfil at least one of these criteria.

NATIVE TITLE CLAIMS OVER THE SURVEY AREA

Currently lodged with the Register of Native Title Claims and the Schedule of Applications, held by the Commonwealth Native Title Tribunal, there is one registered Native Title application – the Yued (WC97/71) (WAD6192/98). The Schedule of Applications includes registered applications, unregistered applications and applications still undergoing the registration test.

Figure 4: (from left to right) Rhonda Flowers, Edith Warrell, Evelyn Dawson, Roina Williams, Delores Flowers, Gus Ryder, May McGuire.

SELECTION OF SPOKESPEOPLE FOR THIS SURVEY

The selection of spokespeople for the Rocla heritage survey was based on advice given from the South West Aboriginal Land and Sea Council who represent members of the Yued Native Title Claim with regards to heritage issues in the region. As a result of this pre-consultation process, the following Aboriginal people were selected to participate in the survey:

Ms Delores Flowers is a Yued Working Party member and senior claimant. Delores was born at Mogumber mission in 1941 to parents William Warrell (born in Moora) and Dorothy Flowers. Her grandparents on her father's side are Olivia Delores Nettles and old William Warrell. Her maternal grandparents are George Ronan and Alice Harris. Delores says she 'loved her years at school' and has fond memories of a kind teacher, who would always give them lovely food to eat. Delores association with the area being surveyed is to do with her uncle Albert Warrell, who one day got up and left Bassendean ('went on walkabout') and never returned. Delores believes he may have died somewhere in the Gnangara area.

Ms Rhonda Flowers is Delores daughter and is a Yued Working Party member. She was born at Mogumber Mission and her father's name was Donald Hector Flowers. Donald was born in Albany. Rhonda fondly remembers her school years at Mogumber Mission then later at St Brigid's in West Perth**.**

Ms May McGuire was born at New Norcia mission in 1943 to Alfred Robert Stack (of Guildford) and Matilda Ryder (of Bolgart). Her paternal grandparents are Robert Neville and May Nippy (from Mandurah). Robert Neville's mother was Mary Taylor. On her mother's side

her grandfather was Savara Ryder and grandmother, Rose Moody. Ms McGuire states that she is a member of the Stolen Generation and was taken from her parents to be schooled at New Norcia, later being a domestic help, a hospital domestic and, later with a college degree under her belt she became a health worker. Nowadays May is a proud mother and grandmother. Her connection to the area being surveyed was her memory of it being a travelling through area, from Moore River to Perth. Her apical ancestor is a woman from the Guildford area known as Konan.

Ms Edith Warrell was born in Geraldton in 1957. Her paternal grandparents are Billy Warrell (born in Dandaragan) and Olive Neville, while on her mother's side her grandparents are Edward Ronan and Alice Robinson of Meekatharra and Geraldton respectively. Edith went to school in Moora. Her cultural association with the area is that her father was a stockman and worked in the Moora area. Edith is a Yued working party member and currently lives in Moora.

Ms Evelyn Dawson participated in this survey; however no biographic details were given during the consultation process.

Mr Gus Ryder participated in this survey; however no biographic details were given during the consultation process.

COMMUNITY CONSULTATION

AIMS

- To establish contact with Aboriginal people who retain traditional or current knowledge pertaining to the region.
- To determine if there are any sites of significance, as defined by section 5 of the AHA, within the project area.
- To record any ethnographic information provided about identified sites.
- To generate consensual recommendations from the Aboriginal community representatives in regards to any section 18 requests and to record management strategies for identified ethnographic and archaeological sites.

METHOD

To arrange the survey the selected informants were contacted by phone to attend an onsite meeting. During this meeting the informants were briefed as to the details of the project drawing on project plans and maps showing previously recorded Aboriginal heritage sites overlaid upon a large-scale aerial map. The initial consultation meeting was conducted on site just off Vidago Road. The Survey Team was then guided through a portion of the impact area by Vern Newton, after which Vern left, and the team continued to methodically traverse the area in vehicles, stopping at intervals for further discussion.

Ethnographic information was recorded in a notebook and photographs of the survey process were taken. GPS coordinates of any cultural features were recorded in the field and transferred to ArcGIS V9 where final maps were produced. The results of the survey process are outlined below.

Figure 5: (from left to right) Lisa Moody, Vern Newton, Evelyn Dawson, Rhonda Flowers, Edith Warrell, Nicole Azzalini, May McGuire, Gus Ryder, Delores Flowers.

COMMUNITY CONSULTATION PROCESS

On the 19th and 20th of August 2011 the consultant; Ms Roina Williams (Anthropologist) assisted by Ms Nicole Azzalini (Field Assistant) met with representatives from Rocla and representatives of the Yued Native Claimant group. Vern Newton of Rocla introduced himself and gave a brief outline of the project. He explained the process by which the area was State Forest, 'vested' in DEC, which currently had control of the land and was looking to harvest the pines, replant and restore native plants and wildlife to the over 12,000 ha of pine plantation.

Vern discussed the process by which Rocla would access existing forestry and fire tracks using an agricultural tractor towing a drill rig. The drill bit was only 50m mm diameter and it would then drill at 200m intervals to approximately 30 m depth. There were restrictions as to how deep they could drill because of the water table. He also explained that the 'life of mine' for each quarry was expected to be approximately 30 years. After mining was finished Rocla was required by law to repatriate the area and restore it to something akin to the original Banksia woodlands and wetlands that existed prior to the pine plantation. To arrive at this current drilling stage had taken approximately four years of planning and the further approval process to mining stage was expected to take another four years.

The Aboriginal consultants were encouraged to ask questions and put forward any concerns. They voiced the concern that when the pine plantation was first planted, there was no consultation with Aboriginal people because there was no legislation at the time that enforced companies or government to do so. Therefore, the amount of ground disturbance and possible disturbance to Aboriginal cultural heritage materials that occurred at the time of planting and that was continuing with the harvesting of the pines has not been mitigated. The ground is currently still being to disturbed by DEC's deforestation, to a depth of approximately 3m, without any Aboriginal monitors present. The consultants also wished to know what was happening with all the wood that was being harvested and with the leftover scraps of wood left behind. Vern suggested speaking to Owen Donovan of DEC regarding this.

Vern further explained what was involved in wetlands restoration and that 80% of the species to be regenerated required good topsoil. Unfortunately much of the soil had been leached of nutrients by the pines. Also, large quantities of seed would be required for a regeneration of this size and the seed required a particular type of smoke to regenerate. It was my opinion that this effort would require substantial Indigenous knowledge and was likely to create jobs for interested Aboriginal parties and/or contractors. Vern Newton explained that water bores would be required for dust suppression and that these would require extraction licenses from the Department of Water.

Figure 6: Pictured on left: Gus Ryder shows paperbark, used for drawing. Pictured on right: Edith Warrell throws sand over her shoulder to ward off spirits.

The Survey Team then proceeded to traverse the pine plantation, accessing all available tracks. We stopped for lunch at the Smoke-bush Waterhole and camp DIA Site ID 3574. Observance of particular plants by Survey Team participants indicated we were close to water. Delores Flowers

in particular was keen to see the swamp area and recounted the traditional method for catching turtles (*yakarn*). It was stated that when you clap your hands, the turtle will poke its head up, you then place a line in the water and when he tugs, you pull on the line and the hook goes into its jaw. It was stated to the anthropologist that the Warrell family were 'turtle eaters'. The Paperbark was used for drawing on and the gum from the Redgum trees had medicinal value. Blackbutt trees were also noted. The area towards the swamp became too thick with reeds so the group turned back. Vern Newton stated that the drilling would completely avoid this area. The group would like a 100 m buffer on the site. As the group left the area, they threw sand over their shoulders. This was a ritual to prevent the old people's spirits from following them home.

COMMUNITY CONSULTATION OUTCOMES

Waterholes and wetlands (swamps) generally are considered highly significant to the Aboriginal people consulted. It was stated that the old people would have utilised these sites and camped there because they represented a source of food and water. In addition women would have given birth in these places when necessary. Certain rites and rituals were observed when leaving and entering these spaces. These areas are required to remain protected.

Even though the survey area has been previously heavily disturbed without prior consultation and the subsequent likelihood of finding cultural material remains may be low, the Survey Team felt strongly that monitoring of the drilling process should still occur. This is because the belief prevails that there may still be burials in the area along with the fact that there have been no previous mitigative actions taken.

The Yued representatives would like to see two monitors on rotation over the period of drilling. Should exploration proceed to quarrying, further consultation is required with the Yued native title claimants regarding jobs and Aboriginal tenders for contract work.

The Survey Team of Yued representatives are otherwise happy with the consultation process and for the work program to proceed, as proposed.

Figure 7: (from left to right) Delores Flowers, May McGuire, Edith Warrell.

RECOMMENDATIONS

It is recommended that Rocla give due consideration to the Yued representatives request for monitoring during the drilling process.

Human remains - If human remains, skeletal materials that may be human, or materials that may be a human grave are uncovered during the approved work program, Rocla and its contractors must stop work immediately and the materials and the area must be left undisturbed. The Western Australian Police must be informed immediately and Yued native title claimants informed through their representative, SWALSC.

No known sites will be impacted by the current drilling program.

It is recommended that all existing tracks and fire breaks be utilised and for the work program to remain bounded by the co-ordinates provided.

If these recommendations are complied with then Rocla may proceed with the drilling program, as planned.

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REPORT ON THE ARCHAEOLOGICAL HERITAGE SURVEY OF THE ROCLA PTY LTD PROPOSED EXPLORATION PROGRAM WITHIN LEASE E70/3279, NORTH-EAST OF YANCHEP, WESTERN AUSTRALIA.

Prepared by
Kellie Cue (BSc. Hons.)
Bradie Baldisseri (BA Hons.)

On behalf of
Yued Native Title Claim Group (WC 97/71)

August 2011

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DISCLAIMER

The author is not accountable for omissions and inconsistencies resulting from information which may come to light in the future but was not available at the time of this research.

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- Deep Woods Surveys – Paul Greenfeld (Director and Principle Archaeologist), Kellie Cue (Senior Archaeological Consultant), and Bradie Baldisseri (Archaeological Assistant).
- Brad Goode (Consulting Anthropologist)
- Rocla Pty Limited – Vern Newton (Resource and Development Manager).
- Yued Native Title Claim Group – Colin Hedland, and Brendan Moore.

EXECUTIVE SUMMARY

This report provides details on the Archaeological Heritage Survey of the Rocla Pty Ltd proposed exploration program within lease E70/3279, which was undertaken by Miss Kellie Cue and Miss Bradie Baldisseri, and representatives of the Yued Native Title Claim Group (WC 97/71) between August 17th & 20th, 2011.

The proposed exploration program consists of approximately 708 drill holes located over existing access tracks and fire-breaks, bounded by exploration lease E70/3279. The lease is located with the north-west of the Gnangara Pine Plantation along Wanneroo Road/Indian Ocean Drive, approximately 12km north-east of the town of Yanchep, 10km east of the town of Two Rocks, and 57km north-west of Perth, Western Australia.

The exploration leases are held by Rocla Pty Limited (Rocla), who proposes to undertake an exploration drilling program across the 708 drill holes, using a light vehicle-mounted rig, drilling to an average depth of approximately 30m. It is understood that Rocla intend to drill with the aim of identifying any suitable building sand products, with the possibility of quarrying the product in the future under an upgraded mining lease.

A search of the Aboriginal Sites Register, located at the Department of Indigenous Affairs (DIA), Heritage and Culture Division (Perth), identified two previously recorded and/or registered sites within the boundaries, or within the immediate vicinity, of the lease E70/3279.

As Rocla is undertaking a Site Avoidance program, none of the registered sites will be impacted upon in any way. However, **it is recommended that Rocla notify all employees and contractors of the location and significance of Smokebush Waterhole and Emu Cave, and avoid them entirely during all future works**.

A random sampling of the planned drill holes saw 115 drill holes specifically surveyed via pedestrian transects along accessible tracks within E70/3279, resulting in 16.24% coverage of the proposed drilling locations (Table 4).

In conjunction with the pedestrian transects, vehicular traverses were made along all accessible tracks – soft fire-breaks and some tracks being used by pine loggers were inaccessible. 81.1km of vehicle traverses were undertaken throughout the entire survey area.

Based on the availability and accessibility of tracks, and aiming to achieve the highest percentage of drill hole clearance possible via a random sampling, the pedestrian transects were mapped allowing for sampling across all areas of the lease, along differing easting's and northing's, and throughout the differing vegetative states within the lease.

During the course of the Archaeological Survey, **no sites**, as defined by Section 5(a) of the *Aboriginal Heritage Act 1972*, were identified and recorded.

Due to the limitations of the survey type it is recommended that drilling works should be confined to all existing access tracks and defined drill locations, further impact upon the broader landscape should be avoided.

Should the drilling program change and further areas need to be explored then further archaeological inspections should take place. Alternatively the proponent may also choose to employ an archaeologist and Yued members to monitor further works to mitigate the potential to encounter cultural material.

During the course of the archaeological survey the Yued assistants requested that during the drilling that all construction vehicles must not deviate into unsurveyed bushland/plantation.

Should the above concerns and recommendations be taken into account, the Yued members of the archaeological survey team supported Rocla Pty Limited proceeding, under the *Aboriginal Heritage Act 1972-80*, with the proposed drilling program within lease E70/3279, according to the co-ordinates provided in this report.

INTRODUCTION

This report provides details on the Archaeological Heritage Survey of the Rocla Pty Ltd proposed exploration program within lease E70/3279, which was undertaken by Miss Kellie Cue and Miss Bradie Baldisseri, and representatives of the Yued Native Title Claim Group (WC 97/71) between August 17th-20th, 2011.

The proposed exploration program consists of approximately 708 drill holes located over existing access tracks and fire-breaks, bounded by exploration lease E70/3279 (Figure 1 and 2, and Table 1). The lease is located with the north-west of the Gnangara Pine Plantation along Wanneroo Road/Indian Ocean Drive, approximately 12km north-east of the town of Yanchep, 10km east of the town of Two Rocks, and 57km north-west of Perth, Western Australia.

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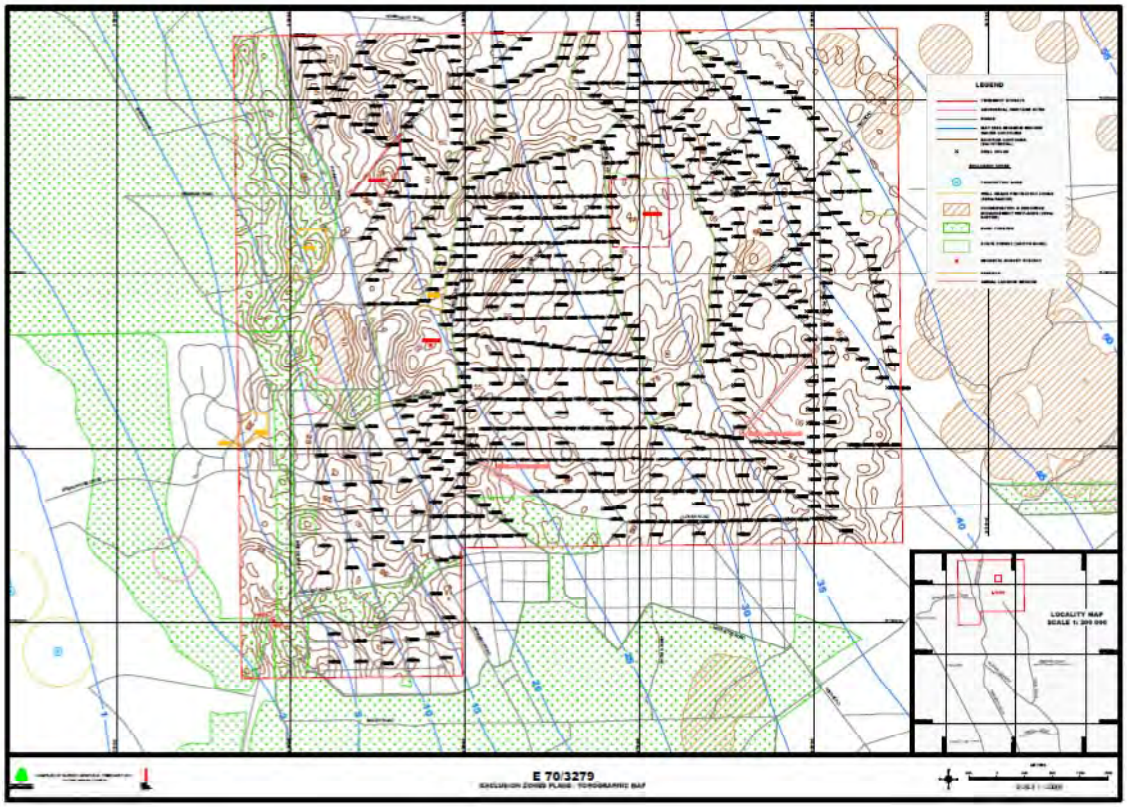

Figure 1: Rocla exploration survey area and drill hole locations within E70/3279, August 2011 (topographic image)..

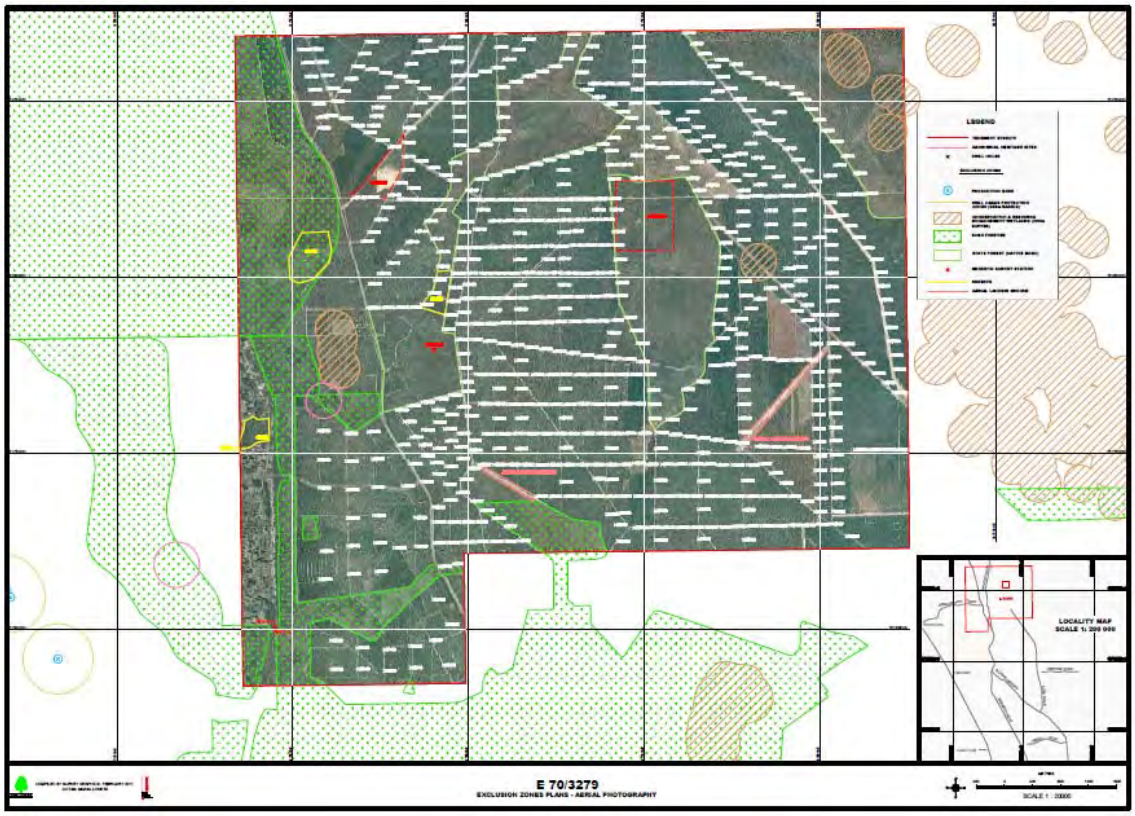

Figure 2: Rocla exploration survey area and drill hole locations within E70/3279, August 2011 (satellite image).

METHODOLOGY

SURVEY METHODOLOGY

The Archaeological Survey of Rocla's proposed drilling area within lease E70/3279 was carried out by two teams, each comprised of one archaeologist and one Yued assistant, who undertook a series of pedestrian transects along either side of the tracks within the lease along which drilling will be carried out, providing a random sample of the drill program throughout the survey area. A vehicle inspection of all driveable tracks within the lease which will contain drilling was also carried out.

Any Aboriginal Sites identified were recorded to a standard consistent with a Site Avoidance survey, as set out in the *Draft Guidelines for Aboriginal Heritage Assessment in Western Australia* (DAS 1993: 22; DIA 2005). In this type of survey, the boundaries of any sites located within the survey area are broadly defined (co-ordinates, photographs, brief site description), to enable the proposed development to proceed within alternative parts of the overall survey area.

The datum used for all coordinates during this Survey was GDA 94 Zone 50.

SITE TYPES

On the basis of previous archaeological studies in the region, a number of different types of Indigenous archaeological sites may be encountered. Definitions of these sites are as follows (Hiscock and Mitchell 1993; Burke and Smith 2004; Department of Aboriginal Sites n.d.).

Artefact scatter refers to locations where a range of activities has occurred such as the manufacture and maintenance of tools and the processing of foods. These sites will often contain a wider range of lithic materials than quarries and reduction scatters. For the purposes of this assessment an artefact scatter was defined as any concentration consisting of the following.

- More than five artefacts.
- A minimum average artefact density of 0.05 artefacts per m^2
- An average artefact density of more than five times the average density of isolated artefacts (Hughes and Quartermaine 1992).

Shell scatter and midden refers to the occasional (scatter) or frequent long term use (midden) of economically sized edible shell species.

Gnamma hole/water source refers to a natural or artificial rock cavity which holds water after rain or is linked to the water table.

Quarry refers to a location from which stone used to manufacture flaked or ground stone artefacts has been extracted.

Reduction area refers to a cluster of stone artefacts which represent the remains of the flaking of a core. Artefacts within a reduction area can usually be conjoined back together.
Rock art refers to art placed on a rock surface. Such art may be created by additive (such as painting or drawing) or subtractive (such as abrading or engraving) processes.

Rock shelter refers to an overhang, cave or cliff face that contains evidence of human occupation in the form of stone artefacts, charcoal, faunal material or rock art.

Where the evidence for human occupation is solely in the form of stone artefacts, the definition for a site is the same as for open scatters. Rock shelters with insufficient stone artefacts to warrant classification as a site, but displaying the potential for subsurface cultural material, will be recorded as potential sites.

Modified tree is one which has its trunk and limbs modified by the removal of bark and/or wood. Aboriginal people removed wood/bark for material items such as shields and baskets or to access native honey inside hollows in the tree.

Structure is a term used by DIA that refers to groupings or piles of rocks or tree branches, relating to economic (eg. habitation) or ceremonial practices. Cairns may mark water sources, rock shelters may be walled to make small animal habitats and tall stones or lines of stones may indicate ritual grounds. Tree trunks trimmed of branches have been identified in rock shelters and are interpreted as ladders.

SITE SCALE DEFINITIONS

The definitions for scales of site size and artefact density used in the report are as follows (Table 2 and 3):

Site Size (m²)	Classification (Size)
<99 m²	Small
100 – 999 m²	Small-Medium
1000-9,999 m²	Medium-Large
10,000-99,999 m²	Large
>100,000 m²	Very Large

Table 1: Classification of site size.

Artefact Density (per m²)	Classification (Density)
<0.15/m²	Low
0.15-1/m²	Medium
1-10/m²	High
>10/m²	Very High

Table 2: Classification of artefact density within a site.

ENVIRONMENT

SURVEY AREA

The Rocla survey area (E70/3279) was comprised entirely of active and degraded pine plantation. The area was flat, though heavily vegetated, country. No significant rock outcroppings were identified; the only lithic materials identified was limestone and sandstone imported when establishing tracks within the plantation, all of which was non-artefactual.

The vegetation was very dense throughout the majority of the survey area, aside from several areas that have been cleared of pines and left to degrade. The vegetation comprised almost entirely of farmed pine, with some areas of remnant native vegetation present (acacias, grasses, etc). Visibility within the plantation was very poor due to heavy ground cover and the density of the vegetation (10%). However, along the tracks and firebreaks where drilling will be carried out, visibility was good (90%).

There are many tracks located throughout the lease, including firebreaks, fence-line tracks, and power line corridors. However, not all of these tracks are in a good enough condition to drive on.
As the lease is located over part of the Gnangara Pine Plantation, there is a high degree of associated disturbance, most obviously in the form of the planting of foreign, farmed tree species, as well as the associated tracks and fences. There is also a substantial amount of discarded refuse present throughout the survey area.

SWAN COASTAL PLAIN

Climate

The Swan Coastal Plain lies within the dry Mediterranean climatic region, characterised by cold, wet winters, and hot, dry summers (Beard 1981). The seasons within this region are fairly evenly divided, with five-to-six months of dry weather every year.

The average yearly rainfall in the survey area and its surrounds is 625 mm (Beard 1981, MacIntyre 2005), although this can be highly variable depending on other environmental factors. The temperatures range from 3° on average in early winter (June), to 26° on average in late summer (February) (Beard 1979).

Vegetation

Beard (1981) typified the Swan Coastal Plain as being a part of the Southwest Botanical Province, with the survey area and its coastal surrounds sub-classified in the Drummond Botanical Sub-district of the Darling Botanical District.

The Drummond Botanical Subdistrict is characterised by an understory of Banksia low woodland amongst Tuart (*Eucalyptus gomphocephala*), Jarrah (*E. Marginate*) and Marri (*E. Calophylla*) woodlands on leached sands, and Melaleuca and associated species on poorly drained soils. Banksia species noted include *Banksia attenuate, B. menziesii*, and *B. ilicifolia* (Beard 1981 and MacIntyre 2005). Numerous shrub species, including *Acacia*, *Hakea* and *Grevillea*, are also typically present within the Drummond Subdistrict.

Geology and Landforms

The Swan Coastal Plain, within with the Rocla survey area lies, is located within the Perth Region, one of numerous physiographic zones ascribed by Beard (1981) dividing the southwest of Western Australia. The Swan Coastal Plain is bounded to the west by the coast, and to the east by the Darling Fault.

The Swan Coastal Plain is divided into a series of geomorphic units or shorelines and associated dune deposits, each defined by changes in the Western Australian coastline during the Glacial and Interglacial periods of the Pleistocene (Bolland 1998). The Quindalup Dunes are located immediately along the present day coast line and are the youngest of the three dune systems, having formed during the Holocene (Beard 1979, Bolland 1998). The Spearwood Dunes formed approximately 40,000 years ago and are the intermediate dune system, located between approximately 2-5 km from the present coast line. The Bassendean Dunes, dated at 800,000 years old, are the oldest dune system within the Swan Coastal Plain and are located between approximately 5-10km from the coast. Climatic and environmental stability over the past 5,000 years has set the coastline at its present level.

The survey area is located on the furthest inland, and therefore oldest, dune system, the Bassendean Dunes, which lies at a lower relief in comparison to progressively younger dune systems closer to the present day coastline. The Bassendean Dune System is characterised as follows (Beard 1981, Bolland 1998):

- parallel association to the coast;
- low vegetated hills of white quartz sands;
- interdunal swamps and lakes;
- no organised drainage (aside from in the vicinity of rivers);
- leached soils;
- low fertility and high acidity.

ARCHAEOLOGICAL AND CULTURAL BACKGROUND

ARCHAEOLOGICAL BACKGROUND

The earliest archaeological evidence of the occupation of the South-West of Western Australia is located at Upper Swan (25km north-west of Perth), a stratified, open air site containing chert artefacts, fossils and evidence of camping, dated at 38,000 BP (Pearce and Barbetti 1981). Other south-west sites have also been dated to the Pleistocene, namely at Devils Lair (33,000 BP) and on the Helena River (dated up to 29,000 BP).

Archaeological research carried out along the Swan Coastal Plain, and throughout the South-West in general, ultimately aims to support and develop upon this established sequence of occupation.

Hallam (1986) suggests four phases of occupation for the Swan Coastal Plain:

- **Early (> 5,000 BP)** – sites centred around the coast; artefacts include steep scrapers on flakes and scrapers made from an Eocene fossiliferous chert.
- **Middle (5,000 – 500 BP)** – occupation of areas near permanent water; artefacts made of quartz and green chert, and included backed blades, adzes, scrapers and flakes.
- **Late (< 500 BP)** – concentration of sites on the Coastal Plain. Bipolar cores were introduced, and a majority of assemblages comprised of quartz flakes, chips and debitage.
- **Final (post European contact and settlement)** – utilise introduced materials (glass, pottery and clay pipes) for the manufacture of artefacts.

The vast majority of recorded sites in the Swan Coastal Plain are found on intact or deflated Holocene Dunes around rivers, lakes and swamps, and represent a general background scatter reflecting single activity, or ephemeral, use (Hallam 1986, MacIntyre 2005). These sites are predominately comprised of quartz artefacts, with a lesser representation of fossiliferous chert.

There is an underrepresentation of inland areas in the archaeological record of the Swan Coastal Plain, with the majority of research being undertaken along the coast. This may be due to the fact that a lot of land away from the coast within the Swan Coastal Plain has been cleared and converted to pine plantations. That being said, sites have been recorded within pine plantations (McDonald 2005), although they are very disturbed and are ultimately unable to contribute to the larger archaeological record.

Over the past two decades, numerous heritage surveys have been undertaken both within the vicinity of the present survey area (Yanchep/Two Rocks), and within the Swan Coastal Plain in general (eg. McDonald 2005, MacIntyre 2005, Port-Louis 2008, Quartermaine 1991, etc).

Sites types that have been identified and recorded along the Swan Coastal Plain include:

- Artefact scatters
- Modified/Scar Trees
- Healing Pits
- Lakes, Wetlands, and Swamps
- Rivers, Brooks, and Creeks
- Wells
- Caves
- Camping
- Hunting
- Ceremonial Areas
- Waugal sites

ETHNOGRAPHIC BACKGROUND

Yued (or Jued) country is defined as the area described by the Yued Native Title Claim (WC 97/71), centred around Moore River (O'Connor 1992) – bounded by the coast, Wanneroo and Toodyay (in the south), Goomalling and Dalwallinu (in the east), and Coorow (in the north).

During the late 1800s and up until as late as the 1940s, Indigenous groups throughout Australia were displaced from their traditional lands by White settlers and their introduced English land laws, which most often led to Indigenous people being pushed into the country of neighbouring groups. This resulted in inter-mixing of Indigenous groups and a subsequent loss of knowledge as information passed out of living memory, exacerbated by marriage between Indigenous people and White settlers. From this point on, cultural information was passed on matrilineally (as ones mother is always a certainty), where information had previously been passed on through patrilineal descent (MacIntyre 1991, and Port-Louis 2008).

The first documented colonisation of Yued country was in 1830, when a Mr Edward Barrett-Lennard lodged an application for ownership of an area of traditional Yued land (Port-Louis 2008). From that point forward, Yued people were displaced, culminating in 1916 with the establishment of the Moore River Mission at Mogumber, where Indigenous people from Moora and surrounding districts were centralised (O'Connor 1992).

Despite this displacement, many Yued continue to maintain a strong collective identity, shaped largely by Noongar life as it existed prior to European contact (Port-Louis 2008). Family was, and still is, the focal point of social organisation, warfare and protection (MacIntyre 1991), with six families connected throughout Yued country - Warrell, Yates, Jackamarra, Ryder, Hedland and Anderson.

* * * *

Indigenous people throughout Australia are very closely connected with ground water in all of its forms. This is certainly the case amongst Noongar people, and the Yued people in particular. Ground water sources are of primary importance to Noongar people, as there are sacred spiritual values centred on the Wargle/Noongar Rainbow Serpent from the Dreaming - many believe the Wargles life force is present in flowing water. The Wargle made the rivers, swamps and waterholes, and there are still certain spots known to be Wargle resting places where certain laws have to be abided by and respected (Port-Louis 2008).

In addition to everyday subsistence and ceremonial gathering, the wetlands of the Perth region were also a focus of trade for Indigenous people, eg. Bates (1985) recorded that Perth Aboriginals had an ochre patch near Lake Monger or Herdsman Lake, which was a principle article of trade; Perth ochre travelled north while Murchison ochre came south and elsewhere (McDonald 2005).

The Yued people have a close historical association with the natural water features of Gingin Brook, Moondah Brook, Lennards Creek, and surrounding areas (Port-Louis 2008), with intense activity being noted around these places (eg. camping, birthing, burials, hunting, etc). As such, the main recommendation to come from survey reports and consultation with the Yued people, and Noongar groups in general, has been for all parties involved to not alter water sources in any way, and particularly not to alter natural water flow.

As well as the Wargle Dreaming, another important Dreaming story within Yued country centres around the Waitch. The Waitch (Emu) Dreaming details the coming into being of the emu, from the form of a crocodile – a crocodile was bitten and injured by a shark, it came onto land and took refuge in a cave (Emu Cave – DIA Site 17597); as it lay dying, other animals took pity on it, healing it and giving it feathers, a beak and legs to replace what the shark had bitten off; the crocodile then transformed into an emu (Smeeton 2009). This story of survival is still important to the Yued people, as is Emu Cave, which continues to be used to teach young people about Yued history and culture.

ARCHIVAL RESEARCH

A search of the Aboriginal Sites Register, located at the Department of Indigenous Affairs (DIA), Heritage and Culture Division (Perth), identified two previously recorded and/or registered sites within the boundaries, or within the immediate vicinity, of the lease E70/3279 (Table 4).

As Rocla is undertaking a Site Avoidance program, none of the registered sites will be impacted upon in any way. However, **it is recommended that Rocla notify all employees and contractors of the location and significance of Smokebush Waterhole and Emu Cave, and avoid them entirely during all future works**.

SITE ID	SITE NAME	STATUS	ACCESS	RESTRICTION	SITE TYPE	CO-ORDINATES
3574	Smokebush Waterhole	Insufficient Information	Open	None	Artefact scatter; Camp; Water source	372939mE; 6518249mN
17597	Emu Cave	Registered Site	Open	None	Mythological; Natural Feature; Cave	371098mE; 6516058mN

Table 3: Registered sites within the immediate vicinity of E70/3279.

PREDICTION OF SITE LOCATION

Archaeological sites along the Swan Coastal Plain are unlikely to be located in low lying, poorly drained, or seasonally inundated areas, or more than 350m away from a fresh water source (Strawbridge 1988). Elevated dunes or sandy ridges situated in close proximity to existing or former fresh water sources were used for camping, as they were better drained and more comfortable.

Previously recorded sites that have been found to coincide with natural water resources tend to be larger sites that have been used repeatedly over time.

Most archaeological sites that have been recorded are former camping areas, indicated by scatters of stone artefacts, and occasionally associated with remnants of camp fires, mollusc shells, and animal bones (Mulvaney and Kamminga 1999).

The distribution of recorded archaeological sites partly reflects traditional seasonal movement patterns; in summer/autumn, large groups gathered by the coast/wetlands to exploit water-based resources; in winter/spring, coastal groups dispersed, instead exploiting fauna in forests and bushland (McDonald 2005). Camping and occupation of Yued country was defined by available food and water sources (Port-Louis 2008), hence shell scatters/middens would be expected in large quantities along the coast (Quindalup Dunes), whilst camping sites dominated by faunal remains are expected inland (Spearwood and Bassendean Dunes).

SITE SIGNIFICANCE

If any sites are located, an assessment is made of its significance. The significance of an archaeological site is determined by its ability to address regional and site-specific research questions and by its representativeness (Bowdler 1984). Significance is a mutable quality, changing as more sites are recorded, research questions are answered or new research directions arise.

Broad research questions that sites in the South-West may address include:

1) The antiquity of colonisation of the South-West of Western Australia.

The ability for sites to contribute to the known sequence of colonisation of Western Australia, in particular the South-West, would greatly advance our knowledge and understanding of past occupation. Despite several sites having been identified and recorded in the South West that have provided materials which can be dated, in particular at Upper Swan (38,000 BP) and Devils Lair (33,000 BP), little is known of the settlement and patterns of early human activity in the area (Lilley 1993). Adding to and developing this established chronology will serve to enhance what is currently known of the origins of settlement in the South-West.

2) Social and technological changes that may have occurred in the mid-Holocene.

Over the last decade there has been a lot of research undertaken in the South-West, suggesting possible cultural and environmental changes within Indigenous groups around the present Perth metropolitan area following the stability of the coast-lines to current levels at approximately 5,000 BP (eg. Quartermaine 1991). Ongoing research has the ability to pose and answer questions with regards to these changes in exploitation of lithic and subsistence resources that influenced social change in early Indigenous groups. It can also aid in our understanding of how and why Indigenous people interacted amongst themselves and within their surroundings.

3) Specific patterns of occupation in regional zones.

All sites can in some way contribute to the known footprint of Indigenous groups as they moved through the country. At the most basic level, archaeological sites are able to be mapped to show their location relative to primary water and lithic resources, as well as Dreaming tracks and significant localities relative to the culture of a specific group. In so doing, we are able to extend our understanding of the patterns and influences of occupation in certain regions.

4) Dating of industrial sequences in the region.

The overwhelming majority of the sites identified and recorded in the South-West contain early-stage tool workings with high degrees of cortex present amongst artefactual debris and debitage. The identification of sites containing flakes and tools further along in the manufacture process, or large advanced grinding sites will be able to address the timing of changes in tool and technological industries in the region, a knowledge that is currently lacking.

RESULTS

ARCHAEOLOGICAL SURVEY

A random sampling of the planned drill holes saw 115 drill holes specifically surveyed via pedestrian transects along accessible tracks within E70/3279, resulting in 16.24% coverage of the proposed drilling locations (Table 4).

In conjunction with the pedestrian transects, vehicular traverses were made along all accessible tracks – soft fire-breaks and some tracks being used by pine loggers were inaccessible. 81.1km of vehicle traverses were undertaken throughout the entire survey area.

Based on the availability and accessibility of tracks, and aiming to achieve the highest percentage of drill hole clearance possible via a random sampling, the pedestrian transects were mapped allowing for sampling across all areas of the lease, along differing eastings and northings, and throughout the differing vegetative states within the lease.

During the course of the Archaeological Survey, **no sites**, as defined by Section 5(a) of the *Aboriginal Heritage Act 1972*, were identified and recorded.

DRILL HOLE	EASTING	NORTHING	DRILL HOLE	EASTING	NORTHING	DRILL HOLE	EASTING	NORTHING
SB 212	372866.10	6522127.11	**SB 422**	375804.70	6521106.88	**SB 706**	373296.61	6515784.25
SB 213	372967.04	6522300.49	**SB 423**	376004.69	6521108.93	**SB 726**	374843.50	6516941.32
SB 214	373072.50	6522507.34	**SB 428**	377004.64	6521119.16	**SB 727**	375043.52	6516824.76
SB 215	373159.97	6522649.80	**SB 430**	376281.38	6520957.82	**SB 728**	375190.58	6516692.57
SB 216	373257.23	6522826.00	**SB 454**	376702.97	6520822.13	**SB 748**	376962.06	6516886.35
SB 217	373358.41	6523003.79	**SB 457**	376467.71	6520657.54	**SB 766**	377136.15	6516649.59
SB 218	373451.16	6523178.76	**SB 471**	376245.04	6520441.16	**SB 769**	377360.43	6516444.36
SB 219	373550.73	6523353.81	**SB 478**	376059.38	6520262.57	**SB 770**	377560.39	6516448.11
SB 263	375389.86	6523273.83	**SB 497**	375663.44	6519890.02	**SB 771**	377760.90	6516446.71
SB 264	375383.48	6523473.73	**SB 506**	375500.29	6519710.97	**SB 772**	377960.49	6516448.37
SB 268	375419.33	6522710.25	**SB 517**	375305.09	6519532.96	**SB 773**	378160.61	6516449.48
SB 276	375415.40	6522474.24	**SB 526**	375037.91	6519344.36	**SB 774**	378361.78	6516451.59
SB 277	375421.78	6522274.34	**SB 537**	377227.50	6519428.06	**SB 775**	378560.46	6516456.07
SB 278	375428.16	6522074.44	**SB 538**	377313.53	6519247.51	**SB 787**	380159.94	6516496.86
SB 330	378547.04	6522851.92	**SB 539**	377399.56	6519066.96	**SB 800**	380129.11	6518669.65
SB 331	378663.94	6522691.22	**SB 555**	374827.66	6519113.30	**SB 801**	380134.43	6518469.72
SB 351	379859.99	6521360.69	**SB 557**	374853.90	6518915.03	**SB 802**	380139.74	6518269.79
SB 352	379829.70	6521172.08	**SB 558**	374880.15	6518716.75	**SB 803**	380145.06	6518069.86
SB 353	379626.86	6521160.34	**SB 573**	377498.51	6518623.51	**SB 804**	380150.38	6517869.93
SB 354	379736.37	6521517.90	**SB 574**	377559.57	6518399.79	**SB 805**	380151.44	6517679.74
SB 355	379612.74	6521675.11	**SB 579**	374906.39	6518518.48	**SB 806**	380156.93	6517476.18
SB 356	379489.11	6521832.33	**SB 580**	374926.25	6518383.88	**SB 807**	380166.17	6517266.26
SB 357	379332.84	6521955.24	**SB 602**	377569.12	6518200.02	**SB 808**	380171.64	6517070.21
SB 360	378785.75	6522534.24	**SB 604**	377577.72	6517997.43	**SB 809**	380177.70	6516867.05
SB 361	378916.64	6522376.24	**SB 609**	374970.55	6518033.81	**SB 810**	380181.75	6516677.35
SB 362	379040.48	6522222.22	**SB 626**	377672.42	6517798.57	**SB 822**	380123.79	6518869.58
SB 369	379426.61	6521165.47	**SB 627**	377866.68	6517766.97	**SB 823**	380118.48	6519069.51
SB 370	379222.68	6521151.24	**SB 628**	378069.56	6517743.96	**SB 824**	380113.16	6519269.44
SB 371	379022.21	6521158.84	**SB 629**	378267.36	6517716.21	**SB 825**	380094.47	6519468.24
SB 372	378827.00	6521148.37	**SB 630**	378454.17	6517693.01	**SB 826**	380101.70	6519665.63
SB 376	378519.16	6521150.58	**SB 631**	378650.95	6517667.63	**SB 827**	380095.24	6519864.74
SB 414	374004.80	6521112.59	**SB 632**	378817.54	6517644.59	**SB 828**	380091.23	6520065.55
SB 415	374204.79	6521110.42	**SB 643**	375016.30	6517688.20	**SB 829**	380087.32	6520263.89
SB 416	374404.78	6521108.25	**SB 644**	375028.83	6517545.67	**SB 830**	380082.07	6520465.84
SB 417	374604.77	6521106.08	**SB 656**	375003.70	6517287.71			
SB 418	375004.74	6521101.74	**SB 684**	376788.42	6517141.06			
SB 419	375204.73	6521099.57	**SB 698**	373272.68	6516984.02			
SB 420	375404.72	6521102.78	**SB 700**	373280.66	6516584.09			
SB 421	375601.51	6521104.44	**SB 703**	373288.63	6516184.17			

Table 4: Proposed drill holes surveyed by random pedestrian transects along accessible tracks within E70/3279.

RECOMMENDATIONS AND CONCLUSIONS

RECOMMENDATIONS

During the course of the Archaeological Survey, no sites, as defined by Section 5(a) of the *Aboriginal Heritage Act 1972*, were identified and recorded.

It is recommended that Rocla notify all employees and contractors of the location and significance on the existing Smokebush Waterhole and Emu Cave sites in the west of E70/3279, and avoid them entirely during all future works.

Due to the limitations of the survey type **it is recommended** that drilling works should be confined to all existing access tracks and defined drill locations, further impact upon the broader landscape should be avoided.

Should the drilling program change and further areas need to be explored then further archaeological inspections should take place. Alternatively the proponent may also choose to employ an archaeologist and Yued members to monitor further works to mitigate the potential to encounter cultural material.

During the course of the archaeological survey the Yued assistants requested that during the drilling that all construction vehicles must not deviate into unsurveyed bushland/plantation.

CONCLUSIONS

Should the above concerns and recommendations be taken into account, the Yued members of the archaeological survey team supported Rocla Pty Limited proceeding, under the *Aboriginal Heritage Act 1972-80*, with the proposed drilling program within lease E70/3279, according to the co-ordinates provided in this report.

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APPENDIX 1: SITES REGISTER SEARCH

Search Criteria

2 sites in a search polygon. The polygon is formed by these points (in order):

MGA Zone 50	
Northing	Easting
6524100	370900
6524100	381800
6514200	381800
6514200	370900

Disclaimer

Aboriginal sites exist that are not recorded on the Register of Aboriginal Sites, and some registered sites may no longer exist. Consultation with Aboriginal communities is on-going to identify additional sites. The AHA protects all Aboriginal sites in Western Australia whether or not they are registered.

Copyright

Legend

Restriction

N	No restriction
M	Male access only
F	Female access

Access

C	Closed
O	Open
V	Vulnerable

Coordinate Accuracy

Accuracy is shown as a code in brackets following the site coordinates.

[Reliable]	The spatial information recorded in the site file is deemed to be reliable, due to methods of capture.
[Unreliable]	The spatial information recorded in the site file is deemed to be unreliable due to errors of spatial data capture and/or quality of spatial information reported.

Status

L - Lodged	→	IA - Information Assessed	→	ACMC Decision Made
Information lodged, awaiting assessment		Information Awaiting ACMC Decision Assessment Only		R - Registered Site I - Insufficient information S - Stored Data

*Explanation of Assessment

Sites lodged with the Department are assessed under the direction of the Registrar of Aboriginal Sites. These are not the final assessment.

Final assessment and decisions will be determined by the Aboriginal Cultural Material Committee (ACMC).

Spatial Accuracy

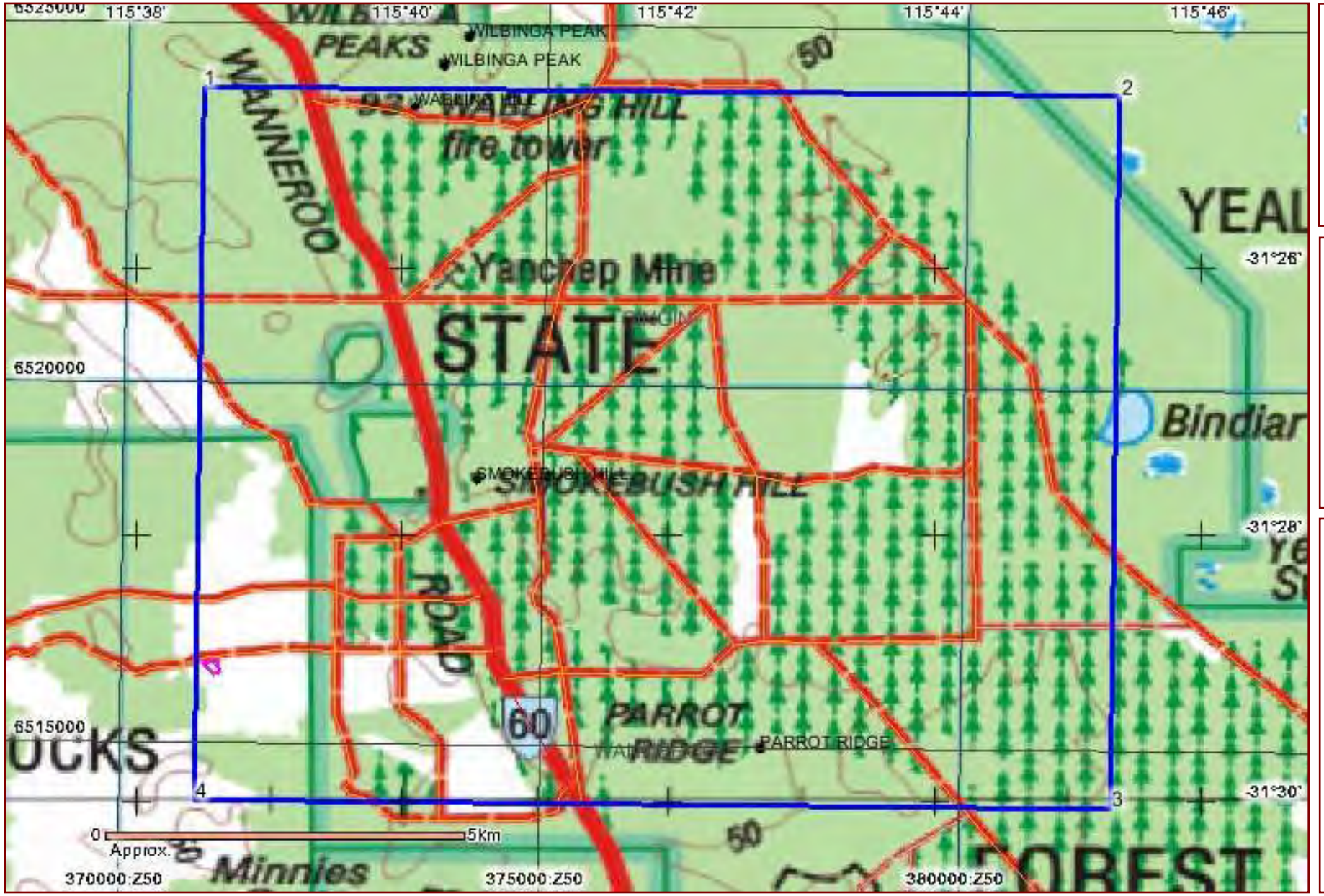
Index coordinates are indicative locations and may not necessarily represent the centre of sites, especially for sites with an access code “closed” or “vulnerable”. Map coordinates (Lat/Long) and (Easting/Northing) are based on the GDA 94 datum. The Easting / Northing map grid can be across one or more zones. The zone is indicated for each Easting on the map, i.e. '5000000:Z50' means Easting=5000000, Zone=50.

Sites Shown on Maps

Site boundaries may not appear on maps at low zoom levels

List of 1 Registered Aboriginal Sites with Map

Site ID	Status	Access	Restriction	Site Name	Site Type	Additional Info	Informants	Coordinates	Site No.
17597	R	O	N	Emu Cave	Mythological	Natural Feature, [Other: Cave]	*Registered Informant names available from DIA.	371098mE 6516058mN Zone 50 [Reliable]	



Legend

Selected Heritage Sites

Registered Sites

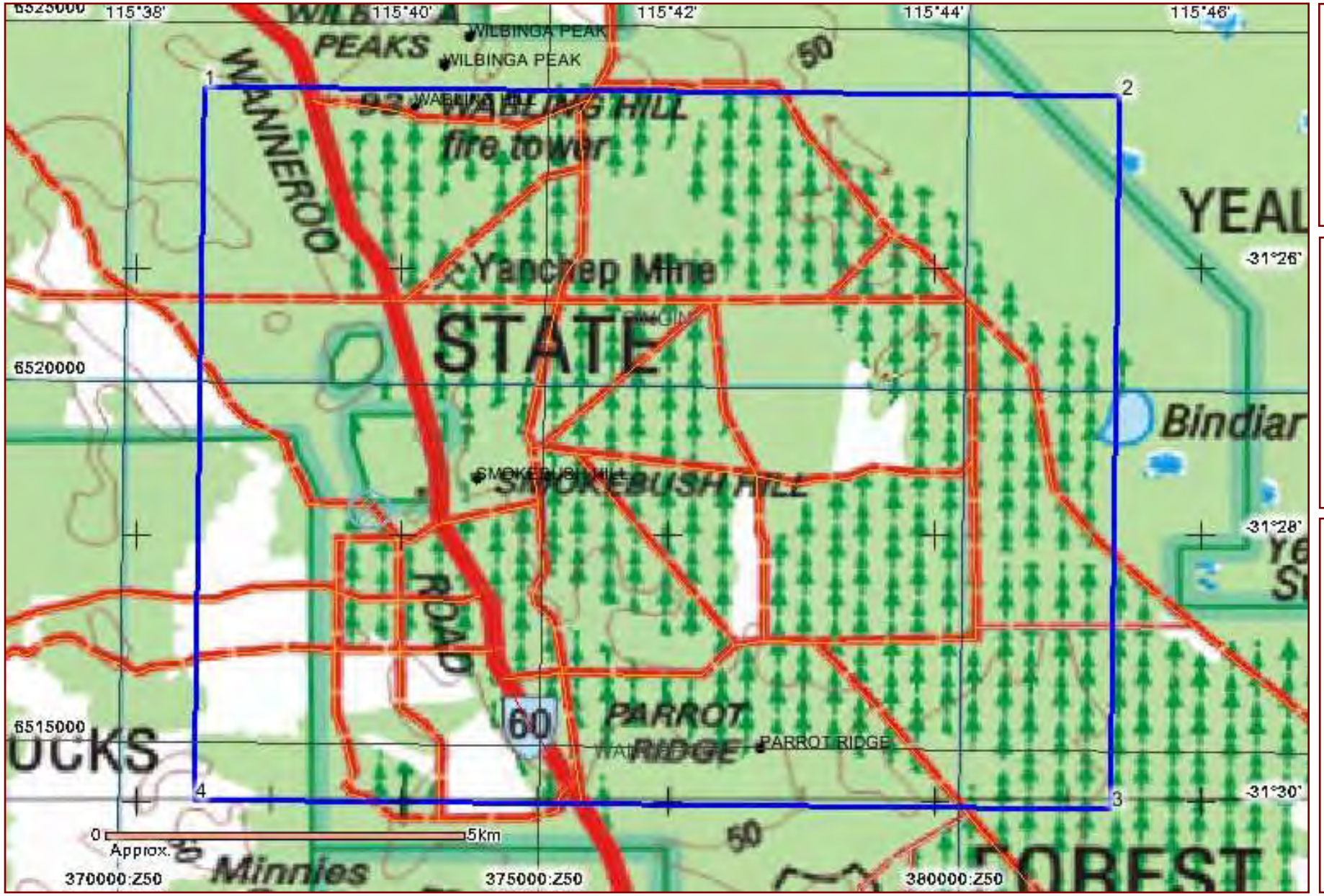
Town

Map Area

Search Area

List of 1 Other Heritage Places with Map

Site ID	Status	Access	Restriction	Site Name	Site Type	Additional Info	Informants	Coordinates	Site No.
3574	I	O	N	Smokebush Waterhole.	Artefacts / Scatter	Camp, Water Source	*Registered Informant names available from DIA.	372939mE 6518249mN Zone 50 [Reliable]	S02379



Legend

Selected Heritage Sites

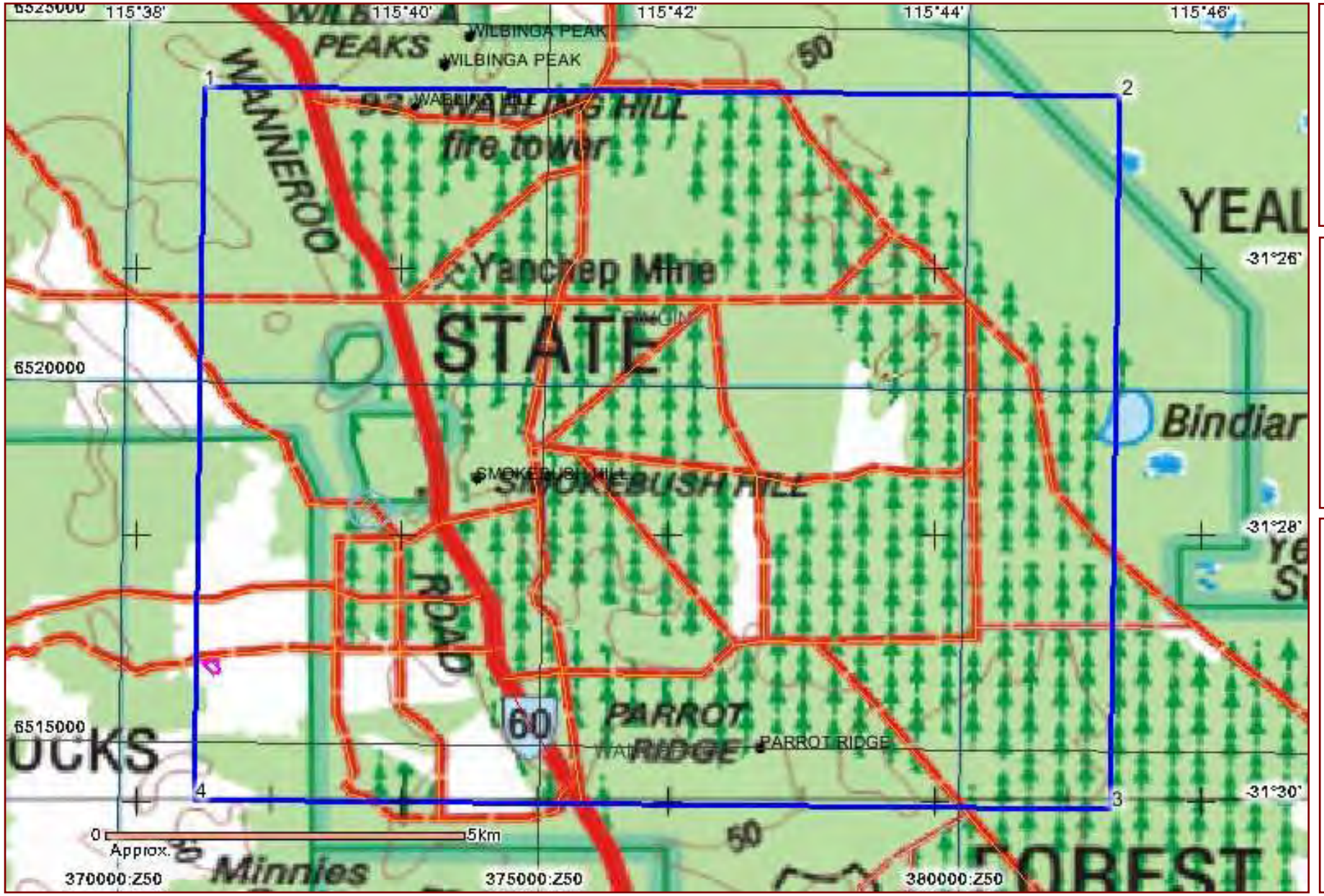
Other Heritage Places

Town

Map Area

Search Area

Map Showing Registered Aboriginal Sites and Other Heritage Places



Legend

Selected Heritage Sites

- Registered Sites
- Other Heritage Places
- Town
- Map Area
- Search Area

APPENDIX 2: LETTER OF ADVICE

Brad Goode & Associates Pty Ltd
Consulting Anthropologist
Heritage Assessments

79 Naturaliste Terrace
DUNSBOROUGH WA 6281
(08) 9755 3716
bradnlee@westnet.com.au
ACN: 134 732 040
ABN: 41 134 732 040

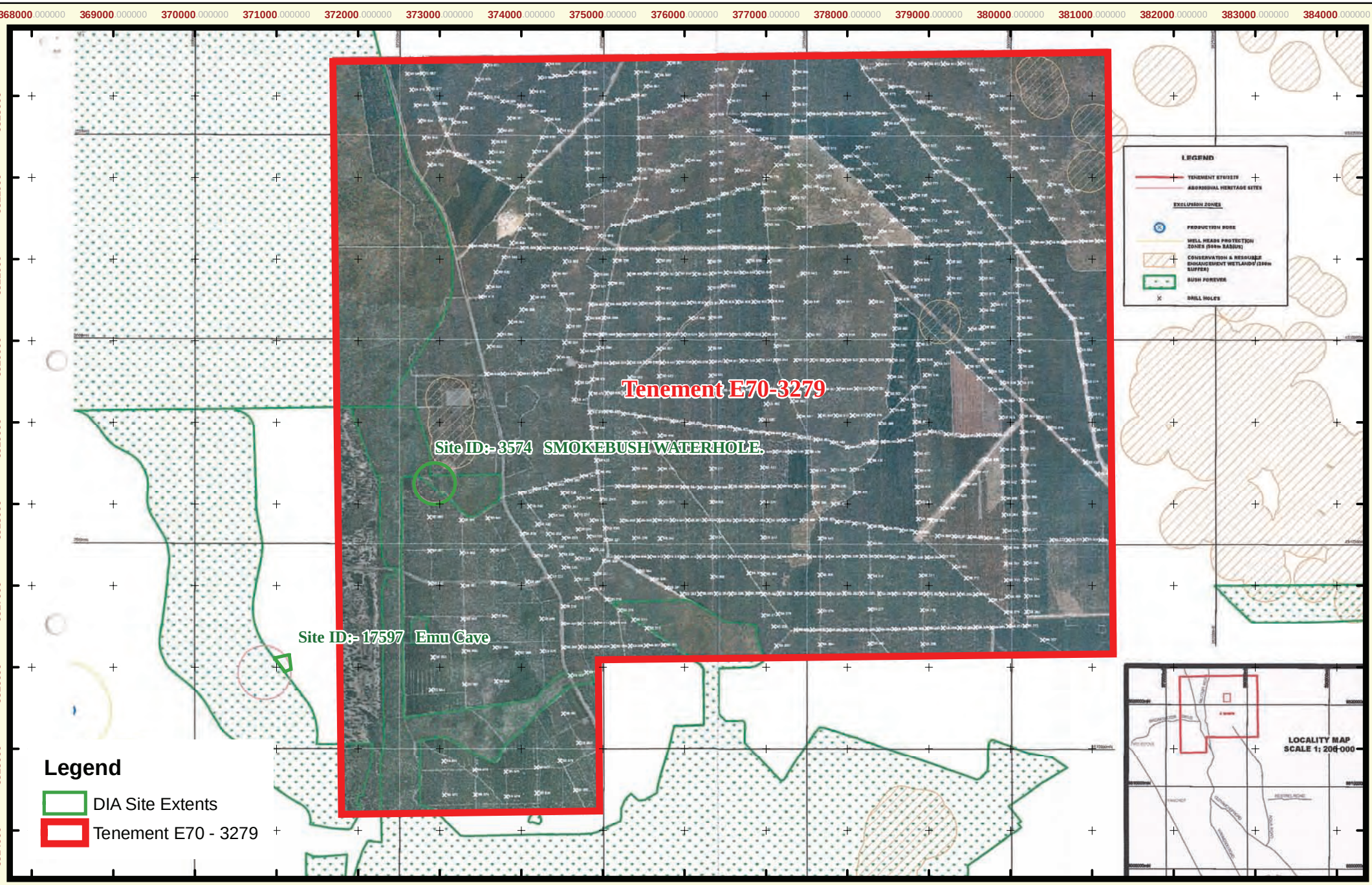
19th August 2011

We the undersigned Yued people of the Noongar native title claimant group have been consulted by Roina Williams on behalf of Brad Goode and Associates in regard to heritage clearances for survey areas in tenement E70/3279. We would like to make the following recommendations in relation to the Western Australian Aboriginal Heritage Act (1972).

Recommendations:
1. It is recommended that Rocla give consideration to monitoring during drilling
2. If human remains are found Rocla + contractors must stop work immediately + contact SWALSC
3. all existing firebreaks and tracks to be utilised, no Native bush to be damaged.
4. no known sites will be impacted during this drilling programme
5. If these recommendations are adhered to Rocla may proceed with its work program.

Name	Date	Signature
Rhonda Flowers	19.8.2011	R Flowers.
Delores Flowers	19.8.2011	Delores Flowers
Edith Worrell	19.8.2011	Edith Worrell
Evelyn Dawson	19.8.2011	Evelyn Dawson
Jas Ryder	19.8.2011	
May McGuire	19.8.2011	M McGuire.

APPENDIX 3: MAPS OF THE PROJECT AREA IN RELATION TO ABORIGINAL HERITAGE SITES



Rocla Quarry Products - TWO ROCKS
in relation to DIA Site Extents

DATE	SCALE - at A4
29th Sept 2011	1:60,000

0 200 400 800 1,200 1,600 2,000 2,400
Meters

N

GDA 1994 MGA Zone 50

Survey conducted by
BRAD GOODE & ASS - 79 Naturaliste Terrace, DUNSBOROUGH WA 6281
Mapping provided by
WARPSPEED GIS - P.O. BOX 147, VASSE WA 6280

Rocla Quarry Products - TWO ROCKS
in relation to DIA Site ID 17597 Emu Cave

DATE
12th Oct 2011

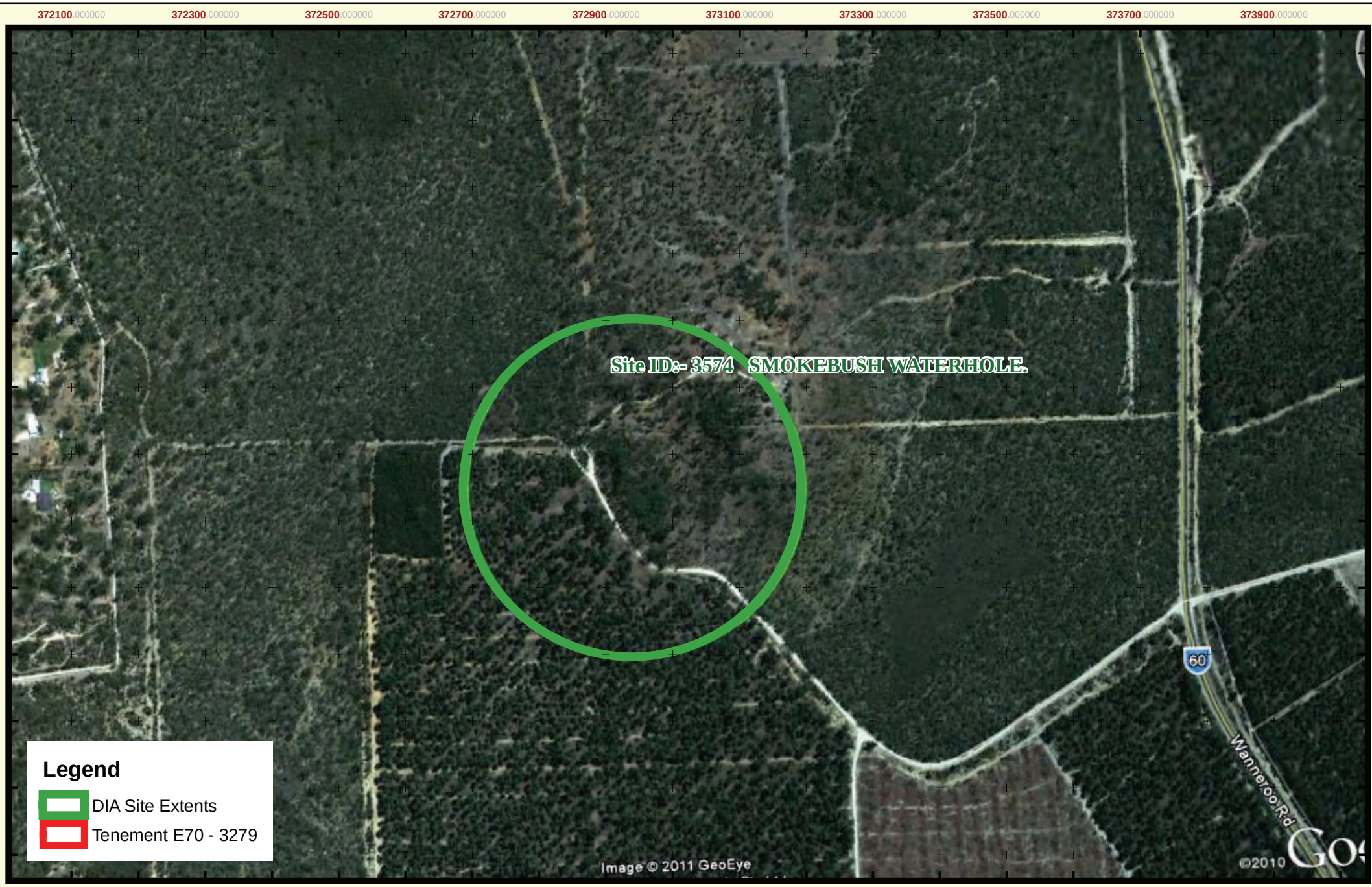
SCALE - at A4
1:5,736

0 20 40 80 120 160 200 240
Meters

N

GDA 1994 MGA Zone 50

Survey conducted by
BRAD GOODE & ASS - 79 Naturaliste Terrace, DUNSBOROUGH WA 6281
Mapping provided by
WARPSPEED GIS - P.O. BOX 147, VASSE WA 6280



Rocla Quarry Products - TWO ROCKS
in relation to DIA Site ID 3574 Smokebush Waterhole

DATE
12th Oct 2011

SCALE - at A4
1:7,340

0 25 50 100 150 200 250 300
Meters

N

GDA 1994 MGA Zone 50

Survey conducted by
BRAD GOODE & ASS - 79 Naturaliste Terrace, DUNSBOROUGH WA 6281
Mapping provided by
WARPSPEED GIS - P.O. BOX 147, VASSE WA 6280

APPENDIX 4: GPS CO-ORDINATES OF PROPOSED DRILL HOLES

Horizontal Datum:	MGA GDA94 Zone 50			
Drill hole No	**Easting GDA94**	**Northing GDA94**	**Elevation**	**RL Accuracy**
SB 200	6523437.22	372533.03	60.4	+/- 1m
SB 201	6523432.92	372693.95	71.8	+/- 1m
SB 202	6523242.07	372584.19	62.8	+/- 1m
SB 203	6523247.80	372769.66	58.0	+/- 1m
SB 204	6523051.36	372638.43	61.9	+/- 1m
SB 205	6523062.69	372845.37	54.3	+/- 1m
SB 206	6522857.68	372688.75	52.8	+/- 1m
SB 207	6522877.57	372921.08	50.0	+/- 1m
SB 208	6522667.73	372741.83	45.9	+/- 1m
SB 209	6522692.45	372996.79	55.3	+/- 1m
SB 210	6522465.57	372795.25	40.9	+/- 1m
SB 211	6522275.15	372848.95	39.5	+/- 1m
SB 212	6522127.11	372866.10	42.0	+/- 1m
SB 213	6522300.49	372967.04	42.6	+/- 1m
SB 214	6522507.34	373072.50	51.2	+/- 1m
SB 215	6522649.80	373159.97	53.4	+/- 1m
SB 216	6522826.00	373257.23	57.7	+/- 1m
SB 217	6523003.79	373358.41	56.4	+/- 1m
SB 218	6523178.76	373451.16	53.9	+/- 1m
SB 219	6523353.81	373550.73	49.9	+/- 1m
SB 220	6522957.30	373553.92	52.1	+/- 1m
SB 221	6522911.38	373753.39	54.8	+/- 1m
SB 222	6522262.43	373185.28	53.7	+/- 1m
SB 223	6522160.20	373357.18	60.1	+/- 1m
SB 224	6522057.98	373529.08	53.9	+/- 1m
SB 225	6522161.49	373580.34	55.2	+/- 1m
SB 226	6522293.28	373618.71	56.5	+/- 1m
SB 227	6522418.74	373644.36	60.2	+/- 1m
SB 228	6522554.72	373727.88	70.4	+/- 1m
SB 229	6522701.37	373838.48	60.9	+/- 1m
SB 230	6522858.33	373963.27	61.8	+/- 1m
SB 231	6523033.13	374114.29	70.5	+/- 1m
SB 232	6523201.51	374214.46	67.5	+/- 1m
SB 233	6523371.54	374305.57	64.7	+/- 1m
SB 234	6523221.99	374399.51	62.2	+/- 1m
SB 235	6523263.70	374593.86	58.2	+/- 1m
SB 236	6522785.54	374123.76	61.8	+/- 1m
SB 237	6522688.24	374298.49	59.1	+/- 1m
SB 238	6522559.19	374452.94	57.3	+/- 1m
SB 239	6522479.20	374241.50	56.6	+/- 1m
SB 240	6522302.50	374147.43	56.8	+/- 1m
SB 241	6522126.19	374084.31	60.5	+/- 1m
SB 242	6521955.75	373700.98	57.1	+/- 1m
SB 243	6521853.52	373872.88	56.6	+/- 1m
SB 244	6521919.14	374079.16	57.1	+/- 1m
SB 245	6521719.15	374078.20	56.6	+/- 1m
SB 246	6521659.64	374258.16	58.1	+/- 1m
SB 247	6521559.28	374431.16	60.9	+/- 1m
SB 248	6521458.92	374604.16	67.8	+/- 1m
SB 249	6521383.68	374724.73	67.5	+/- 1m
SB 250	6521630.11	374742.00	54.4	+/- 1m
SB 251	6521882.35	374805.65	56.3	+/- 1m
SB 252	6522082.25	374799.26	56.5	+/- 1m
SB 253	6522282.14	374792.86	53.8	+/- 1m
SB 254	6522482.04	374786.47	49.4	+/- 1m
SB 255	6522681.94	374780.08	50.2	+/- 1m
SB 256	6522865.29	374774.67	50.1	+/- 1m
SB 257	6523065.19	374768.28	53.8	+/- 1m
SB 258	6523265.09	374761.88	56.2	+/- 1m
SB 259	6523425.17	374746.60	56.1	+/- 1m

Horizontal Datum:	MGA GDA94 Zone 50			
Drill hole No	**Easting GDA94**	**Northing GDA94**	**Elevation**	**RL Accuracy**
SB 260	6522876.72	374965.06	60.8	+/- 1m
SB 261	6522929.90	375157.86	56.0	+/- 1m
SB 262	6522983.08	375350.66	56.0	+/- 1m
SB 263	6523273.83	375389.86	54.5	+/- 1m
SB 264	6523473.73	375383.48	56.8	+/- 1m
SB 265	6523099.29	375506.11	54.4	+/- 1m
SB 266	6523237.75	375641.24	56.2	+/- 1m
SB 267	6523386.43	375784.59	58.5	+/- 1m
SB 268	6522710.25	375419.33	58.6	+/- 1m
SB 269	6522783.49	375601.74	58.6	+/- 1m
SB 270	6522862.36	375791.97	59.9	+/- 1m
SB 271	6522930.38	375977.44	62.9	+/- 1m
SB 272	6523002.49	376159.98	63.5	+/- 1m
SB 273	6523107.99	376315.12	64.6	+/- 1m
SB 274	6523299.75	376374.41	64.7	+/- 1m
SB 275	6523460.78	376429.53	66.4	+/- 1m
SB 276	6522474.24	375415.40	64.2	+/- 1m
SB 277	6522274.34	375421.78	66.0	+/- 1m
SB 278	6522074.44	375428.16	75.1	+/- 1m
SB 279	6521963.02	375361.42	83.0	+/- 1m
SB 280	6521886.90	375171.66	74.5	+/- 1m
SB 281	6521807.07	374988.29	62.1	+/- 1m
SB 282	6521395.76	375114.18	71.4	+/- 1m
SB 283	6521449.94	375308.20	74.8	+/- 1m
SB 284	6521504.39	375499.15	78.9	+/- 1m
SB 285	6521558.71	375691.63	75.6	+/- 1m
SB 286	6521610.37	375884.65	60.1	+/- 1m
SB 287	6521667.35	376076.60	56.9	+/- 1m
SB 288	6521721.67	376269.08	57.1	+/- 1m
SB 289	6521775.99	376461.56	64.1	+/- 1m
SB 290	6521830.31	376654.04	69.4	+/- 1m
SB 291	6521893.07	376844.05	72.3	+/- 1m
SB 292	6521982.93	376989.38	75.6	+/- 1m
SB 293	6522132.90	377121.82	75.2	+/- 1m
SB 294	6522270.51	377247.30	70.8	+/- 1m
SB 295	6522357.46	377120.38	69.7	+/- 1m
SB 296	6522460.94	376950.08	65.1	+/- 1m
SB 297	6522566.18	376780.00	63.8	+/- 1m
SB 298	6522671.42	376609.93	69.9	+/- 1m
SB 299	6522917.38	376540.09	69.1	+/- 1m
SB 300	6523108.16	376600.09	74.6	+/- 1m
SB 301	6523286.08	376688.98	77.6	+/- 1m
SB 302	6523471.37	376758.17	76.2	+/- 1m
SB 303	6522753.21	376720.37	65.2	+/- 1m
SB 304	6522752.96	376918.88	62.1	+/- 1m
SB 305	6522752.92	377118.88	58.1	+/- 1m
SB 306	6523475.11	377350.19	58.3	+/- 1m
SB 307	6523275.12	377348.67	57.5	+/- 1m
SB 308	6523075.12	377347.15	55.8	+/- 1m
SB 309	6522875.13	377345.62	56.8	+/- 1m
SB 310	6522676.08	377331.43	57.8	+/- 1m
SB 311	6522478.55	377303.21	64.2	+/- 1m
SB 312	6522126.81	377407.21	77.4	+/- 1m
SB 313	6521988.98	377632.50	66.4	+/- 1m
SB 314	6522484.14	377546.47	62.6	+/- 1m
SB 315	6522345.49	377690.61	60.9	+/- 1m
SB 316	6522110.33	377791.47	56.8	+/- 1m
SB 317	6522244.31	377971.87	47.9	+/- 1m
SB 318	6522356.10	378111.48	46.1	+/- 1m
SB 319	6522524.02	378312.24	51.9	+/- 1m
SB 320	6522644.19	378468.74	48.9	+/- 1m
SB 321	6522760.58	377518.27	58.6	+/- 1m
SB 322	6522758.61	377718.48	60.9	+/- 1m
SB 323	6522763.94	377917.92	58.7	+/- 1m

Horizontal Datum:	MGA GDA94 Zone 50			
Drill hole No	**Easting GDA94**	**Northing GDA94**	**Elevation**	**RL Accuracy**
SB 324	6522766.46	378115.40	54.6	+/- 1m
SB 325	6522763.82	378320.13	57.6	+/- 1m
SB 326	6523484.67	378056.93	50.6	+/- 1m
SB 327	6523322.01	378172.95	49.9	+/- 1m
SB 328	6523178.14	378281.23	51.6	+/- 1m
SB 329	6523005.95	378415.42	49.5	+/- 1m
SB 330	6522851.92	378547.04	49.5	+/- 1m
SB 331	6522691.22	378663.94	51.2	+/- 1m
SB 332	6523095.94	378525.41	50.0	+/- 1m
SB 333	6523027.87	378732.53	50.8	+/- 1m
SB 334	6522904.78	378867.68	50.5	+/- 1m
SB 335	6522833.10	379054.54	50.4	+/- 1m
SB 336	6522751.88	379244.36	50.9	+/- 1m
SB 337	6522704.72	379469.18	52.7	+/- 1m
SB 338	6522608.55	379586.36	53.7	+/- 1m
SB 339	6522528.00	379696.14	54.2	+/- 1m
SB 340	6522396.16	379800.66	54.8	+/- 1m
SB 341	6522240.81	379918.57	53.0	+/- 1m
SB 342	6522087.45	380031.51	53.0	+/- 1m
SB 343	6521934.82	380155.78	54.1	+/- 1m
SB 344	6521724.70	380318.98	57.0	+/- 1m
SB 345	6521482.30	380487.33	56.8	+/- 1m
SB 346	6521191.44	380649.80	55.7	+/- 1m
SB 347	6521185.84	380454.11	57.5	+/- 1m
SB 348	6521182.00	380254.60	53.4	+/- 1m
SB 349	6521596.19	380203.74	55.9	+/- 1m
SB 350	6521447.21	380066.47	55.3	+/- 1m
SB 351	6521360.69	379859.99	56.3	+/- 1m
SB 352	6521172.08	379829.70	64.2	+/- 1m
SB 353	6521160.34	379626.86	60.4	+/- 1m
SB 354	6521517.90	379736.37	53.9	+/- 1m
SB 355	6521675.11	379612.74	56.5	+/- 1m
SB 356	6521832.33	379489.11	52.1	+/- 1m
SB 357	6521955.24	379332.84	53.0	+/- 1m
SB 358	6522349.31	379345.53	50.6	+/- 1m
SB 359	6522194.26	379204.44	51.3	+/- 1m
SB 360	6522534.24	378785.75	52.7	+/- 1m
SB 361	6522376.24	378916.64	54.0	+/- 1m
SB 362	6522222.22	379040.48	51.2	+/- 1m
SB 363	6522051.20	379071.93	50.1	+/- 1m
SB 364	6521903.62	378939.70	49.3	+/- 1m
SB 365	6521701.85	379042.10	49.9	+/- 1m
SB 366	6521565.44	379188.21	52.0	+/- 1m
SB 367	6521432.86	379336.64	52.8	+/- 1m
SB 368	6521301.18	379484.69	59.0	+/- 1m
SB 369	6521165.47	379426.61	57.1	+/- 1m
SB 370	6521151.24	379222.68	56.8	+/- 1m
SB 371	6521158.84	379022.21	56.7	+/- 1m
SB 372	6521148.37	378827.00	53.5	+/- 1m
SB 373	6521238.96	378840.98	50.7	+/- 1m
SB 374	6521318.94	379071.22	53.2	+/- 1m
SB 375	6521459.41	378923.74	47.0	+/- 1m
SB 376	6521150.58	378519.16	50.8	+/- 1m
SB 377	6521063.16	378294.18	58.0	+/- 1m
SB 378	6521240.44	378203.97	61.2	+/- 1m
SB 379	6521315.86	378396.98	54.0	+/- 1m
SB 380	6521374.96	378699.60	55.2	+/- 1m
SB 381	6521462.80	378532.66	53.2	+/- 1m
SB 382	6521613.22	378667.10	47.9	+/- 1m
SB 383	6521597.70	378777.15	46.2	+/- 1m
SB 384	6521759.14	378803.32	47.1	+/- 1m
SB 385	6521729.78	378633.95	45.5	+/- 1m
SB 386	6521652.25	378411.32	49.2	+/- 1m
SB 387	6521409.35	378118.14	62.2	+/- 1m

Horizontal Datum:	MGA GDA94 Zone 50			
Drill hole No	**Easting GDA94**	**Northing GDA94**	**Elevation**	**RL Accuracy**
SB 388	6521554.15	377966.92	61.5	+/- 1m
SB 389	6521705.51	377828.13	58.1	+/- 1m
SB 390	6521842.20	377686.02	63.4	+/- 1m
SB 391	6521644.59	378180.01	59.7	+/- 1m
SB 392	6521798.65	378278.77	58.4	+/- 1m
SB 393	6521866.73	378488.19	45.4	+/- 1m
SB 394	6522003.68	378342.43	51.8	+/- 1m
SB 395	6521938.54	378130.30	59.3	+/- 1m
SB 396	6522073.87	377987.06	53.8	+/- 1m
SB 397	6522140.63	378196.68	53.6	+/- 1m
SB 398	6521867.01	377474.02	78.1	+/- 1m
SB 399	6521736.91	377322.11	77.8	+/- 1m
SB 400	6521800.34	376955.39	71.3	+/- 1m
SB 401	6521601.32	376975.45	68.3	+/- 1m
SB 402	6521606.82	377170.21	77.4	+/- 1m
SB 403	6521409.26	377328.37	81.9	+/- 1m
SB 404	6521402.71	376997.06	70.0	+/- 1m
SB 405	6521321.61	376277.94	54.5	+/- 1m
SB 406	6521527.36	376271.93	56.0	+/- 1m
SB 407	6521240.70	374975.19	68.5	+/- 1m
SB 408	6521522.85	374062.96	57.8	+/- 1m
SB 409	6521347.51	373966.74	68.6	+/- 1m
SB 410	6521274.55	374149.04	56.1	+/- 1m
SB 411	6521172.18	373870.51	59.6	+/- 1m
SB 412	6521140.53	373555.37	52.4	+/- 1m
SB 413	6521132.91	373369.67	49.4	+/- 1m
SB 414	6521112.59	374004.80	60.1	+/- 1m
SB 415	6521110.42	374204.79	56.8	+/- 1m
SB 416	6521108.25	374404.78	60.7	+/- 1m
SB 417	6521106.08	374604.77	67.9	+/- 1m
SB 418	6521101.74	375004.74	63.3	+/- 1m
SB 419	6521099.57	375204.73	69.7	+/- 1m
SB 420	6521102.78	375404.72	81.6	+/- 1m
SB 421	6521104.44	375601.51	73.4	+/- 1m
SB 422	6521106.88	375804.70	69.3	+/- 1m
SB 423	6521108.93	376004.69	61.2	+/- 1m
SB 424	6521110.97	376204.68	53.5	+/- 1m
SB 425	6521113.02	376404.67	55.5	+/- 1m
SB 426	6521115.07	376604.66	60.0	+/- 1m
SB 427	6521117.11	376804.65	61.8	+/- 1m
SB 428	6521119.16	377004.64	69.7	+/- 1m
SB 429	6520964.19	377029.86	67.7	+/- 1m
SB 430	6520962.61	376780.33	65.2	+/- 1m
SB 431	6520957.82	376281.38	55.4	+/- 1m
SB 432	6520961.24	375655.83	64.8	+/- 1m
SB 433	6520962.83	375133.22	61.7	+/- 1m
SB 434	6520953.17	374524.04	59.1	+/- 1m
SB 435	6520996.85	373774.29	54.3	+/- 1m
SB 436	6520821.52	373678.07	46.8	+/- 1m
SB 437	6520646.19	373581.85	44.4	+/- 1m
SB 438	6520514.99	373489.80	41.9	+/- 1m
SB 439	6519910.88	373591.04	42.2	+/- 1m
SB 440	6520059.78	373724.57	41.2	+/- 1m
SB 441	6520208.68	373858.09	43.0	+/- 1m
SB 442	6520357.58	373991.62	42.7	+/- 1m
SB 443	6520506.48	374125.14	51.2	+/- 1m
SB 444	6520655.38	374258.67	51.2	+/- 1m
SB 445	6520804.28	374392.20	55.3	+/- 1m
SB 446	6520795.39	374900.27	59.8	+/- 1m
SB 447	6520802.78	375300.48	62.3	+/- 1m
SB 448	6520806.17	375500.24	62.7	+/- 1m
SB 449	6520806.33	375704.10	63.3	+/- 1m
SB 450	6520812.34	375897.13	66.9	+/- 1m
SB 451	6520806.39	376099.53	64.3	+/- 1m

Horizontal Datum:	MGA GDA94 Zone 50			
Drill hole No	**Easting GDA94**	**Northing GDA94**	**Elevation**	**RL Accuracy**
SB 452	6520816.88	376298.69	57.4	+/- 1m
SB 453	6520820.67	376502.25	58.1	+/- 1m
SB 454	6520822.13	376702.97	63.8	+/- 1m
SB 455	6520825.00	376901.16	66.5	+/- 1m
SB 456	6520652.91	377059.55	66.5	+/- 1m
SB 457	6520657.54	376467.71	59.9	+/- 1m
SB 458	6520640.79	376286.54	60.2	+/- 1m
SB 459	6520632.24	375657.70	63.5	+/- 1m
SB 460	6520686.63	375080.96	61.8	+/- 1m
SB 461	6520649.60	374865.23	58.5	+/- 1m
SB 462	6520546.63	374476.82	53.7	+/- 1m
SB 463	6520363.01	374566.35	51.0	+/- 1m
SB 464	6520423.57	374843.20	57.3	+/- 1m
SB 465	6520427.19	375043.79	58.7	+/- 1m
SB 466	6520431.93	375243.51	57.7	+/- 1m
SB 467	6520435.30	375447.94	56.7	+/- 1m
SB 468	6520440.01	375650.10	64.0	+/- 1m
SB 469	6520438.50	375841.89	67.5	+/- 1m
SB 470	6520448.30	376039.33	61.3	+/- 1m
SB 471	6520441.16	376245.04	63.8	+/- 1m
SB 472	6520455.51	376444.53	61.4	+/- 1m
SB 473	6520458.71	376642.39	62.3	+/- 1m
SB 474	6520460.78	376846.08	63.1	+/- 1m
SB 475	6520463.74	377042.76	62.2	+/- 1m
SB 476	6520255.65	377083.65	60.3	+/- 1m
SB 477	6520267.52	376291.34	62.2	+/- 1m
SB 478	6520262.57	376059.38	58.0	+/- 1m
SB 479	6520253.51	375660.31	69.3	+/- 1m
SB 480	6520259.52	375000.15	58.5	+/- 1m
SB 481	6520254.81	374800.91	51.9	+/- 1m
SB 482	6520157.19	374561.54	48.7	+/- 1m
SB 483	6520057.41	374768.76	55.6	+/- 1m
SB 484	6520062.81	374967.64	53.7	+/- 1m
SB 485	6520061.78	375173.02	58.9	+/- 1m
SB 486	6520061.95	375373.02	67.9	+/- 1m
SB 487	6520062.12	375573.02	59.3	+/- 1m
SB 488	6520067.70	375770.20	51.9	+/- 1m
SB 489	6520063.72	375969.28	54.9	+/- 1m
SB 490	6520065.65	376174.51	58.3	+/- 1m
SB 491	6520062.78	376373.02	63.3	+/- 1m
SB 492	6520060.32	376572.87	63.7	+/- 1m
SB 493	6520065.21	376769.19	55.9	+/- 1m
SB 494	6520066.13	376973.23	58.7	+/- 1m
SB 495	6519926.80	377112.33	60.8	+/- 1m
SB 496	6519895.91	376287.73	59.8	+/- 1m
SB 497	6519890.02	375663.44	49.5	+/- 1m
SB 498	6519900.57	374932.23	49.9	+/- 1m
SB 499	6519860.01	374736.60	55.9	+/- 1m
SB 500	6519961.62	374520.21	55.3	+/- 1m
SB 501	6519781.10	374446.56	55.8	+/- 1m
SB 502	6519662.85	374712.19	48.4	+/- 1m
SB 503	6519700.44	374900.39	50.6	+/- 1m
SB 504	6519704.25	375101.80	63.6	+/- 1m
SB 505	6519707.46	375300.33	62.1	+/- 1m
SB 506	6519710.97	375500.29	49.5	+/- 1m
SB 507	6519711.88	375700.42	50.1	+/- 1m
SB 508	6519717.99	375900.23	55.4	+/- 1m
SB 509	6519719.51	376099.71	57.9	+/- 1m
SB 510	6519725.01	376300.17	60.7	+/- 1m
SB 511	6519728.51	376500.14	65.1	+/- 1m
SB 512	6519732.02	376700.11	61.2	+/- 1m
SB 513	6519737.44	376899.99	61.8	+/- 1m
SB 514	6519742.65	377099.53	64.6	+/- 1m
SB 515	6519558.43	376294.49	64.5	+/- 1m

Horizontal Datum:	MGA GDA94 Zone 50			
Drill hole No	**Easting GDA94**	**Northing GDA94**	**Elevation**	**RL Accuracy**
SB 516	6519549.97	375669.14	52.1	+/- 1m
SB 517	6519532.96	375305.09	54.1	+/- 1m
SB 518	6519507.55	374857.87	50.6	+/- 1m
SB 519	6519465.22	374672.29	55.1	+/- 1m
SB 520	6519618.58	374330.24	50.0	+/- 1m
SB 521	6519576.81	374164.35	52.1	+/- 1m
SB 522	6519574.31	373964.37	49.8	+/- 1m
SB 523	6519571.81	373764.38	47.3	+/- 1m
SB 524	6519569.31	373564.40	40.5	+/- 1m
SB 525	6519338.79	374837.61	50.5	+/- 1m
SB 526	6519344.36	375037.91	54.7	+/- 1m
SB 527	6519344.25	375236.23	53.4	+/- 1m
SB 528	6519351.01	375435.28	53.8	+/- 1m
SB 529	6519354.38	375643.52	54.2	+/- 1m
SB 530	6519360.52	375840.50	55.0	+/- 1m
SB 531	6519365.02	376037.03	60.0	+/- 1m
SB 532	6519370.55	376227.48	63.0	+/- 1m
SB 533	6519375.26	376437.86	63.3	+/- 1m
SB 534	6519382.44	376647.94	62.4	+/- 1m
SB 535	6519384.71	376825.87	62.2	+/- 1m
SB 536	6519391.18	377038.69	61.9	+/- 1m
SB 537	6519428.06	377227.50	67.1	+/- 1m
SB 538	6519247.51	377313.53	69.8	+/- 1m
SB 539	6519066.96	377399.56	81.3	+/- 1m
SB 540	6519215.24	376992.60	61.0	+/- 1m
SB 541	6519024.11	376930.50	60.4	+/- 1m
SB 542	6518804.48	377408.05	74.9	+/- 1m
SB 543	6518840.00	377213.71	76.2	+/- 1m
SB 544	6518852.05	377011.76	66.0	+/- 1m
SB 545	6518871.23	376812.88	60.0	+/- 1m
SB 546	6518899.15	376614.84	57.4	+/- 1m
SB 547	6518927.06	376416.80	58.0	+/- 1m
SB 548	6518950.88	376218.22	62.1	+/- 1m
SB 549	6518982.89	376020.72	58.3	+/- 1m
SB 550	6519010.81	375822.67	56.2	+/- 1m
SB 551	6519038.72	375624.63	53.5	+/- 1m
SB 552	6519066.64	375426.59	58.1	+/- 1m
SB 553	6519094.55	375228.55	65.9	+/- 1m
SB 554	6519122.47	375030.50	56.5	+/- 1m
SB 555	6519113.30	374827.66	54.6	+/- 1m
SB 556	6519267.82	374640.13	61.3	+/- 1m
SB 557	6518915.03	374853.90	63.9	+/- 1m
SB 558	6518716.75	374880.15	61.5	+/- 1m
SB 559	6518855.73	375362.73	68.2	+/- 1m
SB 560	6518819.47	375676.84	52.5	+/- 1m
SB 561	6518626.60	375100.66	59.5	+/- 1m
SB 562	6518626.43	375300.66	61.7	+/- 1m
SB 563	6518626.26	375500.66	61.9	+/- 1m
SB 564	6518619.86	375684.39	55.3	+/- 1m
SB 565	6518619.04	375905.07	53.6	+/- 1m
SB 566	6518617.31	376114.08	61.1	+/- 1m
SB 567	6518625.57	376300.66	62.0	+/- 1m
SB 568	6518617.25	376505.81	55.0	+/- 1m
SB 569	6518618.11	376702.69	59.5	+/- 1m
SB 570	6518621.37	376902.17	66.6	+/- 1m
SB 571	6518624.88	377100.66	69.0	+/- 1m
SB 572	6518621.66	377292.21	69.5	+/- 1m
SB 573	6518623.51	377498.51	71.9	+/- 1m
SB 574	6518399.79	377559.57	72.4	+/- 1m
SB 575	6518437.15	376952.04	65.2	+/- 1m
SB 576	6518421.82	376303.71	57.3	+/- 1m
SB 577	6518419.47	375678.20	53.3	+/- 1m
SB 578	6518424.55	375361.55	53.7	+/- 1m
SB 579	6518518.48	374906.39	57.6	+/- 1m

Horizontal Datum:	MGA GDA94 Zone 50			
Drill hole No	**Easting GDA94**	**Northing GDA94**	**Elevation**	**RL Accuracy**
SB 580	6518383.88	374926.25	57.6	+/- 1m
SB 581	6518331.60	374733.20	52.4	+/- 1m
SB 582	6518279.33	374540.16	42.8	+/- 1m
SB 583	6518227.05	374347.11	38.6	+/- 1m
SB 584	6518174.77	374154.06	42.3	+/- 1m
SB 585	6518116.24	373978.14	41.6	+/- 1m
SB 586	6517950.88	374089.40	48.4	+/- 1m
SB 587	6518114.47	374497.84	47.1	+/- 1m
SB 588	6518050.30	374689.45	50.7	+/- 1m
SB 589	6518157.11	374858.55	51.6	+/- 1m
SB 590	6518207.07	375158.89	53.7	+/- 1m
SB 591	6518207.02	375358.89	59.5	+/- 1m
SB 592	6518200.08	375562.77	51.4	+/- 1m
SB 593	6518200.84	375760.97	50.8	+/- 1m
SB 594	6518198.40	375958.83	54.7	+/- 1m
SB 595	6518196.51	376156.67	54.1	+/- 1m
SB 596	6518194.62	376357.44	52.9	+/- 1m
SB 597	6518207.25	376561.65	55.6	+/- 1m
SB 598	6518202.86	376758.81	59.8	+/- 1m
SB 599	6518204.24	376959.49	63.8	+/- 1m
SB 600	6518206.57	377158.89	65.5	+/- 1m
SB 601	6518207.41	377357.94	66.5	+/- 1m
SB 602	6518200.02	377569.12	71.7	+/- 1m
SB 603	6517981.12	377824.02	74.4	+/- 1m
SB 604	6517997.43	377577.72	69.4	+/- 1m
SB 605	6517999.24	376948.67	59.2	+/- 1m
SB 606	6518004.09	376306.95	53.1	+/- 1m
SB 607	6518001.74	375683.85	50.8	+/- 1m
SB 608	6518000.19	375360.56	50.8	+/- 1m
SB 609	6518033.81	374970.55	58.2	+/- 1m
SB 610	6517943.50	374520.36	48.4	+/- 1m
SB 611	6517836.69	374351.27	48.6	+/- 1m
SB 612	6517847.91	374660.41	43.5	+/- 1m
SB 613	6517782.74	374854.54	51.4	+/- 1m
SB 614	6517778.33	375210.79	56.5	+/- 1m
SB 615	6517780.17	375417.47	54.2	+/- 1m
SB 616	6517782.70	375617.33	50.2	+/- 1m
SB 617	6517781.74	375819.48	50.6	+/- 1m
SB 618	6517781.87	376017.47	55.5	+/- 1m
SB 619	6517782.81	376214.49	57.4	+/- 1m
SB 620	6517782.33	376406.94	55.3	+/- 1m
SB 621	6517784.13	376621.49	57.3	+/- 1m
SB 622	6517783.71	376820.85	57.9	+/- 1m
SB 623	6517784.54	377019.83	59.3	+/- 1m
SB 624	6517785.92	377214.98	61.0	+/- 1m
SB 625	6517786.16	377431.03	66.9	+/- 1m
SB 626	6517798.57	377672.42	68.8	+/- 1m
SB 627	6517766.97	377866.68	61.0	+/- 1m
SB 628	6517743.96	378069.56	64.1	+/- 1m
SB 629	6517716.21	378267.36	66.7	+/- 1m
SB 630	6517693.01	378454.17	70.5	+/- 1m
SB 631	6517667.63	378650.95	72.8	+/- 1m
SB 632	6517644.59	378817.54	82.4	+/- 1m
SB 633	6517600.07	379092.14	84.6	+/- 1m
SB 634	6517592.83	379292.01	75.8	+/- 1m
SB 635	6517585.59	379491.88	69.1	+/- 1m
SB 636	6517578.36	379691.75	64.2	+/- 1m
SB 637	6517508.87	378264.95	62.0	+/- 1m
SB 638	6517568.17	377656.34	66.9	+/- 1m
SB 639	6517577.15	376958.05	58.9	+/- 1m
SB 640	6517580.96	376310.33	61.5	+/- 1m
SB 641	6517566.54	375679.30	48.0	+/- 1m
SB 642	6517569.58	375360.95	54.7	+/- 1m
SB 643	6517688.20	375016.30	51.6	+/- 1m

Horizontal Datum:	MGA GDA94 Zone 50			
Drill hole No	**Easting GDA94**	**Northing GDA94**	**Elevation**	**RL Accuracy**
SB 644	6517545.67	375028.83	52.2	+/- 1m
SB 645	6517590.45	374817.43	47.9	+/- 1m
SB 646	6517676.71	374684.97	44.9	+/- 1m
SB 647	6517731.07	374185.70	41.9	+/- 1m
SB 648	6517621.84	374006.81	39.3	+/- 1m
SB 649	6517621.04	374316.54	45.2	+/- 1m
SB 650	6517570.67	374515.39	42.8	+/- 1m
SB 651	6517465.22	374349.60	46.5	+/- 1m
SB 652	6517352.40	374173.10	45.4	+/- 1m
SB 653	6517366.23	374474.89	43.8	+/- 1m
SB 654	6517316.38	374678.97	46.6	+/- 1m
SB 655	6517424.46	374850.12	48.5	+/- 1m
SB 656	6517287.71	375003.70	45.5	+/- 1m
SB 657	6517342.29	375152.13	50.3	+/- 1m
SB 658	6517342.17	375352.13	51.5	+/- 1m
SB 659	6517342.04	375552.13	45.5	+/- 1m
SB 660	6517341.92	375752.13	46.2	+/- 1m
SB 661	6517337.74	375952.55	48.4	+/- 1m
SB 662	6517340.22	376152.25	53.0	+/- 1m
SB 663	6517340.80	376347.53	62.1	+/- 1m
SB 664	6517341.42	376552.13	61.0	+/- 1m
SB 665	6517341.30	376752.13	56.5	+/- 1m
SB 666	6517340.93	376954.35	56.1	+/- 1m
SB 667	6517343.21	377158.25	62.0	+/- 1m
SB 668	6517362.43	377350.63	72.0	+/- 1m
SB 669	6517343.71	377531.39	72.8	+/- 1m
SB 670	6517345.77	377752.10	62.4	+/- 1m
SB 671	6517346.48	377951.99	60.7	+/- 1m
SB 672	6517348.55	378156.91	57.6	+/- 1m
SB 673	6517346.58	378350.05	61.1	+/- 1m
SB 674	6517339.10	378539.56	65.7	+/- 1m
SB 675	6517337.29	378753.60	75.5	+/- 1m
SB 676	6517338.79	378967.03	82.8	+/- 1m
SB 677	6517350.82	379142.12	89.0	+/- 1m
SB 678	6517217.53	379295.90	91.4	+/- 1m
SB 679	6517081.45	379444.34	81.2	+/- 1m
SB 680	6517114.30	378893.78	80.1	+/- 1m
SB 681	6517106.11	378269.51	59.9	+/- 1m
SB 682	6517119.76	377652.95	56.9	+/- 1m
SB 683	6517128.52	376960.29	55.9	+/- 1m
SB 684	6517141.06	376788.42	52.9	+/- 1m
SB 685	6517094.98	376315.18	53.4	+/- 1m
SB 686	6517130.77	374894.07	47.7	+/- 1m
SB 687	6517062.41	374663.71	42.7	+/- 1m
SB 688	6517209.34	374510.03	44.7	+/- 1m
SB 689	6517099.88	374336.68	42.9	+/- 1m
SB 690	6517035.60	374062.91	45.74	+/- 0.25m
SB 691	6517806.75	373578.69	40.06	+/- 0.25m
SB 692	6517783.86	373256.73	34.12	+/- 0.25m
SB 693	6517821.54	372866.49	25.26	+/- 0.25m
SB 694	6517411.64	372870.08	31.47	+/- 0.25m
SB 695	6517390.03	373263.93	26.19	+/- 0.25m
SB 696	6517419.35	373637.40	41.84	+/- 0.25m
SB 697	6517020.77	373642.02	29.87	+/- 0.25m
SB 698	6516984.02	373272.68	18.85	+/- 0.25m
SB 699	6517011.66	372874.67	22.72	+/- 0.25m
SB 700	6516584.09	373280.66	34.20	+/- 0.25m
SB 701	6516619.61	373656.14	28.88	+/- 0.25m
SB 702	6516227.35	373669.22	38.08	+/- 0.25m
SB 703	6516184.17	373288.63	48.24	+/- 0.25m
SB 704	6516110.65	372909.19	42.37	+/- 0.25m
SB 705	6515711.74	372889.56	34.74	+/- 0.25m
SB 706	6515784.25	373296.61	49.39	+/- 0.25m
SB 707	6515820.59	373681.28	47.21	+/- 0.25m

Horizontal Datum:	MGA GDA94 Zone 50			
Drill hole No	**Easting GDA94**	**Northing GDA94**	**Elevation**	**RL Accuracy**
SB 708	6516160.36	373942.42	32.87	+/- 0.25m
SB 709	6516180.20	374247.85	35.86	+/- 0.25m
SB 710	6516228.67	374506.11	36.8	+/- 1m
SB 711	6516233.77	374710.35	37.2	+/- 1m
SB 712	6516238.75	374910.29	39.5	+/- 1m
SB 713	6516243.74	375110.23	43.5	+/- 1m
SB 714	6516248.72	375310.17	38.0	+/- 1m
SB 715	6516253.70	375510.10	41.5	+/- 1m
SB 716	6516258.53	375712.70	43.8	+/- 1m
SB 717	6516462.31	375517.66	43.6	+/- 1m
SB 718	6516577.44	375354.12	51.5	+/- 1m
SB 719	6516529.08	375103.20	38.3	+/- 1m
SB 720	6516529.33	374903.05	37.4	+/- 1m
SB 721	6516524.52	374703.10	37.3	+/- 1m
SB 722	6516524.31	374502.53	43.0	+/- 1m
SB 723	6516588.75	374237.18	29.02	+/- 0.25m
SB 724	6516735.60	374500.45	41.8	+/- 1m
SB 725	6516838.46	374671.98	47.3	+/- 1m
SB 726	6516941.32	374843.50	52.0	+/- 1m
SB 727	6516824.76	375043.52	43.4	+/- 1m
SB 728	6516692.57	375190.58	44.0	+/- 1m
SB 729	6515928.29	374785.90	37.6	+/- 1m
SB 730	6515892.26	374589.17	41.4	+/- 1m
SB 731	6515424.53	374502.76	39.44	+/- 0.25m
SB 732	6515072.01	374691.79	40.98	+/- 0.25m
SB 733	6514843.71	374458.53	49.44	+/- 0.25m
SB 734	6514762.03	374170.87	54.53	+/- 0.25m
SB 735	6514711.75	373799.99	41.70	+/- 0.25m
SB 736	6514735.72	373417.33	41.07	+/- 0.25m
SB 737	6514838.60	373042.80	31.38	+/- 0.25m
SB 738	6514432.81	373048.30	47.95	+/- 0.25m
SB 739	6514435.85	373426.01	37.95	+/- 0.25m
SB 740	6514411.93	373805.23	51.88	+/- 0.25m
SB 741	6514454.10	374177.68	60.70	+/- 0.25m
SB 742	6514490.79	374646.81	54.99	+/- 0.25m
SB 743	6516886.96	375955.35	48.2	+/- 1m
SB 744	6516888.22	376155.89	48.7	+/- 1m
SB 745	6516891.30	376362.89	46.8	+/- 1m
SB 746	6516891.75	376558.96	47.2	+/- 1m
SB 747	6516893.20	376766.66	51.7	+/- 1m
SB 748	6516886.35	376962.06	55.2	+/- 1m
SB 749	6516894.58	377152.03	60.4	+/- 1m
SB 750	6516895.55	377365.91	57.9	+/- 1m
SB 751	6516895.34	377563.73	54.1	+/- 1m
SB 752	6516892.40	377763.91	54.2	+/- 1m
SB 753	6516897.12	377957.97	59.3	+/- 1m
SB 754	6516896.83	378156.68	56.6	+/- 1m
SB 755	6516894.37	378377.19	57.2	+/- 1m
SB 756	6516893.50	378562.53	65.1	+/- 1m
SB 757	6516893.23	378760.27	69.9	+/- 1m
SB 758	6516891.41	378954.92	79.2	+/- 1m
SB 759	6516890.96	379146.12	89.5	+/- 1m
SB 760	6516890.30	379351.98	80.2	+/- 1m
SB 761	6516889.64	379562.05	71.1	+/- 1m
SB 762	6516819.60	379744.73	70.5	+/- 1m
SB 763	6516697.82	378905.60	74.6	+/- 1m
SB 764	6516705.91	378270.75	56.6	+/- 1m
SB 765	6516682.54	377657.25	51.3	+/- 1m
SB 766	6516649.59	377136.15	54.2	+/- 1m
SB 767	6516632.12	376964.00	52.1	+/- 1m
SB 768	6516483.07	377087.29	51.9	+/- 1m
SB 769	6516444.36	377360.43	52.1	+/- 1m
SB 770	6516448.11	377560.39	48.3	+/- 1m
SB 771	6516446.71	377760.90	51.6	+/- 1m

Horizontal Datum:	MGA GDA94 Zone 50			
Drill hole No	**Easting GDA94**	**Northing GDA94**	**Elevation**	**RL Accuracy**
SB 772	6516448.37	377960.49	55.5	+/- 1m
SB 773	6516449.48	378160.61	55.8	+/- 1m
SB 774	6516451.59	378361.78	55.2	+/- 1m
SB 775	6516456.07	378560.46	57.7	+/- 1m
SB 776	6516460.67	378762.50	64.8	+/- 1m
SB 777	6516465.18	378960.88	76.1	+/- 1m
SB 778	6516468.55	379160.68	74.9	+/- 1m
SB 779	6516472.41	379360.41	67.5	+/- 1m
SB 780	6516478.22	379560.79	70.8	+/- 1m
SB 781	6516478.51	379757.58	68.2	+/- 1m
SB 782	6516254.40	377121.63	53.1	+/- 1m
SB 783	6516269.44	377658.45	50.8	+/- 1m
SB 784	6516279.67	378271.94	54.2	+/- 1m
SB 785	6516274.94	378910.68	73.2	+/- 1m
SB 786	6516324.80	380380.51	59.6	+/- 1m
SB 787	6516496.86	380159.94	62.5	+/- 1m
SB 788	6516493.11	379959.97	66.7	+/- 1m
SB 789	6516672.07	379929.36	67.9	+/- 1m
SB 790	6516862.36	379943.50	73.1	+/- 1m
SB 791	6517060.99	379932.42	77.1	+/- 1m
SB 792	6517258.67	379929.00	74.4	+/- 1m
SB 793	6517457.50	379924.20	65.1	+/- 1m
SB 794	6517663.51	379916.05	59.9	+/- 1m
SB 795	6517852.51	379908.61	60.2	+/- 1m
SB 796	6518053.14	379903.02	50.5	+/- 1m
SB 797	6518256.87	379897.10	56.5	+/- 1m
SB 798	6518456.85	379892.98	60.0	+/- 1m
SB 799	6518656.72	379885.92	55.4	+/- 1m
SB 800	6518669.65	380129.11	58.3	+/- 1m
SB 801	6518469.72	380134.43	58.7	+/- 1m
SB 802	6518269.79	380139.74	57.9	+/- 1m
SB 803	6518069.86	380145.06	60.1	+/- 1m
SB 804	6517869.93	380150.38	57.7	+/- 1m
SB 805	6517679.74	380151.44	62.0	+/- 1m
SB 806	6517476.18	380156.93	65.6	+/- 1m
SB 807	6517266.26	380166.17	67.9	+/- 1m
SB 808	6517070.21	380171.64	74.5	+/- 1m
SB 809	6516867.05	380177.70	75.4	+/- 1m
SB 810	6516677.35	380181.75	73.4	+/- 1m
SB 811	6517552.52	380491.84	63.3	+/- 1m
SB 812	6517551.50	380689.51	64.4	+/- 1m
SB 813	6517557.27	380893.46	58.8	+/- 1m
SB 814	6517551.00	381091.38	52.1	+/- 1m
SB 815	6518356.83	381209.81	57.6	+/- 1m
SB 816	6518366.48	381048.41	56.5	+/- 1m
SB 817	6518504.34	380903.51	52.5	+/- 1m
SB 818	6518642.20	380758.62	52.6	+/- 1m
SB 819	6518780.06	380613.73	57.6	+/- 1m
SB 820	6518917.92	380468.83	54.8	+/- 1m
SB 821	6519055.78	380323.94	56.6	+/- 1m
SB 822	6518869.58	380123.79	58.3	+/- 1m
SB 823	6519069.51	380118.48	56.7	+/- 1m
SB 824	6519269.44	380113.16	57.1	+/- 1m
SB 825	6519468.24	380094.47	49.1	+/- 1m
SB 826	6519665.63	380101.70	47.5	+/- 1m
SB 827	6519864.74	380095.24	51.9	+/- 1m
SB 828	6520065.55	380091.23	56.8	+/- 1m
SB 829	6520263.89	380087.32	53.9	+/- 1m
SB 830	6520465.84	380082.07	54.4	+/- 1m
SB 831	6520668.94	380075.94	59.9	+/- 1m
SB 832	6520868.87	380070.62	59.1	+/- 1m
SB 833	6521068.80	380065.31	61.6	+/- 1m
SB 834	6520889.05	380230.88	57.1	+/- 1m
SB 835	6520731.83	380354.51	58.3	+/- 1m

Horizontal Datum:	MGA GDA94 Zone 50			
Drill hole No	**Easting GDA94**	**Northing GDA94**	**Elevation**	**RL Accuracy**
SB 836	6520574.62	380478.14	56.1	+/- 1m
SB 837	6520417.41	380601.77	54.7	+/- 1m
SB 838	6520260.20	380725.40	54.3	+/- 1m
SB 839	6520076.27	380789.91	56.0	+/- 1m
SB 840	6519879.59	380826.19	58.8	+/- 1m
SB 841	6519682.91	380862.47	56.2	+/- 1m
SB 842	6519486.22	380898.74	55.1	+/- 1m
SB 843	6519289.54	380935.02	54.4	+/- 1m
SB 844	6519094.12	380966.06	56.5	+/- 1m
SB 845	6518896.18	381007.58	53.3	+/- 1m
SB 846	6518699.50	381043.86	54.8	+/- 1m
SB 847	6519056.56	379874.75	61.4	+/- 1m
SB 848	6519256.48	379869.16	57.0	+/- 1m
SB 849	6519469.37	379889.26	53.0	+/- 1m
SB 850	6519388.56	379746.42	55.0	+/- 1m
SB 851	6519527.30	379602.36	56.4	+/- 1m
SB 852	6519666.03	379458.30	57.3	+/- 1m
SB 853	6519607.23	379744.36	55.5	+/- 1m
SB 854	6519752.28	379646.15	60.6	+/- 1m
SB 855	6519956.47	379651.01	56.9	+/- 1m
SB 856	6520154.20	379647.09	54.3	+/- 1m
SB 857	6520354.68	379641.02	50.5	+/- 1m
SB 858	6520554.66	379637.75	51.7	+/- 1m
SB 859	6520754.63	379634.48	51.0	+/- 1m
SB 860	6520954.60	379631.21	52.8	+/- 1m
SB 861	6520423.52	379777.36	50.6	+/- 1m
SB 862	6520567.47	379916.43	54.5	+/- 1m
SB 863	6520951.28	379226.57	54.1	+/- 1m
SB 864	6520940.07	378830.61	59.6	+/- 1m
SB 865	6520884.89	378384.83	60.6	+/- 1m
SB 866	6520706.61	378475.49	60.8	+/- 1m
SB 867	6520733.13	378833.13	61.8	+/- 1m
SB 868	6520751.32	379230.46	52.4	+/- 1m
SB 869	6520567.48	379235.81	48.8	+/- 1m
SB 870	6520536.41	378838.46	62.6	+/- 1m
SB 871	6520646.73	378664.02	62.0	+/- 1m
SB 872	6520489.57	378585.86	60.4	+/- 1m
SB 873	6520289.94	378587.21	61.7	+/- 1m
SB 874	6520133.96	378570.44	62.2	+/- 1m
SB 875	6519935.11	378549.06	61.6	+/- 1m
SB 876	6519736.26	378527.68	62.5	+/- 1m
SB 877	6519537.40	378506.31	65.4	+/- 1m
SB 878	6519338.61	378481.83	69.2	+/- 1m
SB 879	6518976.08	378390.95	74.2	+/- 1m
SB 880	6519140.26	378536.94	65.0	+/- 1m
SB 881	6519269.71	378663.09	60.3	+/- 1m
SB 882	6519412.95	378802.67	55.1	+/- 1m
SB 883	6519561.39	378943.08	54.9	+/- 1m
SB 884	6519696.25	379072.71	56.8	+/- 1m
SB 885	6519846.02	379220.27	54.4	+/- 1m
SB 886	6519882.95	379454.57	49.1	+/- 1m
SB 887	6520131.24	379495.89	52.5	+/- 1m
SB 888	6519944.27	378858.65	52.7	+/- 1m
SB 889	6519743.71	378868.78	53.8	+/- 1m
SB 890	6519198.41	378806.72	58.6	+/- 1m
SB 891	6518998.65	378814.02	58.5	+/- 1m
SB 892	6518749.95	378431.51	66.9	+/- 1m
SB 893	6518760.85	378629.49	60.8	+/- 1m
SB 894	6518838.47	378813.82	57.4	+/- 1m
SB 895	6518875.51	379002.93	57.9	+/- 1m
SB 896	6518842.98	379200.27	58.9	+/- 1m
SB 897	6518821.72	379398.25	54.0	+/- 1m
SB 898	6518830.55	379599.12	48.4	+/- 1m
SB 899	6518831.56	379799.11	55.9	+/- 1m

Horizontal Datum:	MGA GDA94 Zone 50			
Drill hole No	**Easting GDA94**	**Northing GDA94**	**Elevation**	**RL Accuracy**
SB 900	6518601.90	378829.95	60.4	+/- 1m
SB 901	6518402.05	378837.59	63.4	+/- 1m
SB 902	6518202.19	378845.22	67.4	+/- 1m
SB 903	6518002.34	378852.86	77.8	+/- 1m
SB 904	6517802.49	378860.49	83.0	+/- 1m
SB 905	6518520.54	378262.03	71.4	+/- 1m
SB 906	6518411.23	378048.17	72.1	+/- 1m
SB 907	6518127.44	378076.34	70.5	+/- 1m

APPENDIX 6

Banksia Seed Farm

Banksia Seed Farm

1.0 INTRODUCTION

Rocla proposes to construct Western Australia's first production seed farm for Banksia species required for the company's restoration work on the Perth Swan Coastal Plain. The farms will be located as part of Rocla's new operations within this environmental assessment and will underpin bio-diverse restoration works Rocla is undertaking and at future sand operations in the Gnangara Pine Plantation.

The seed farms will leverage the $6 million that Rocla has expended in Banksia woodland restoration research in the past 20 years.

Considering the reduction of Banksia species, as a result of land clearing, seed will become short in supply. Where Banksia seed was once purchased by the kilogram, now seed is often sold per seed with costs up to $3 per seed making large scale restoration expensive and problematic. Banksia woodlands are progressively removed through urban development and climate change limits seed production. Combined with this, the removal of 20,000 hectares (ha) of the Gnangara Pine Plantation will have negative impact on the foraging and feeding capacity of Carnaby's Black Cockatoo.

Rocla's intention to develop seed farms will secure Banksia seed for long-term future use in the Gnangara Pine Plantation for restoration and post-mining works, and will be the first of its type in Australia to address native seed supply through the use of innovative native seed farming. Importantly, the farm will underpin seed security for restoration of Banksia species important to sustaining Carnaby's Black Cockatoo.

Preliminary cost calculations estimate the establishment of a 100 ha farm to be approximately $4 million, with ongoing management to cost approximately $1.5 million per year, with a total cost in the first five years of operation of $11.5 million.

2.0 BANKSIA – ORIGINS, DISTRIBUTION AND BIOLOGY

2.1 Origin

Banksias have evolved over the last 40 to 50 million years. There are about 76 species in Australia and nearby islands.

In 1770 Joseph Banks and Daniel Solander collected, classified and named the first Banksia on the east coast of Australia at Botany Bay. Approximately 21 years later the first Banksias from Western Australia were collected near Albany.

2.2 Distribution

The widest range of Banksia species (58) occurs in the south-west of Western Australia but there are 14 species restricted to the east coast and Tasmania. A few grow in the tropics of northern Australia, northern islands and parts of Papua New Guinea.

Banksias are mainly restricted to coastal areas with reasonable rain. However, there are several species which grow with little rain and are drought tolerant in desert areas. *Banksia elderiana* grows in the Great Victoria Desert as well as between Narembeen, Lake King and Peak Charles.

2.3 Biology

This evergreen woody perennial can be a large tree or a small prostrate shrub. New vegetative growth has a wide range of forms and colours compared to that of mature leaves.

The *Banksia* genus is part of the Protea-ceae family which includes *Grevillea, Adenanthos, Persoonia* and also the South African *Protea*.

Banksias have a specialised proteoid root system in the wild. The root system is highly branched and has large numbers of root hairs. The large surface area of the roots improves the efficiency of nutrient absorption in infertile soils. Under more fertile conditions the roots may lose their proteoid nature.

The flower and fruit (nut) are of interest. The inflorescence has a woody axis running up the centre and there are often thousands of individual flowers spiraling over the spike.

Banksia seeds develop from the remnant bracts and the woody follicles (seed valves) produced by the fertilised ovary. Only a few of the thousands of flowers produce seed.

2.4 Banksia Seed Requirements

Three years ago Rocla began investigating the viability of a Banksia seed production farm to facilitate our restoration at mine sites as native seed became more difficult to source in the future.

There has been a rapid reduction in Banksia woodland surrounding the Perth Metropolitan Region as urban development continues to clear bushland. Due to this the availability of Banksia seed harvested in Western Australia is declining.

Requirements for bushland restoration and requirements for creating foraging habitat for Carnaby's Black Cockatoo (a commonwealth protected species) are becoming a legislative and regulatory requirement on all urban development and mining projects within the Perth Metropolitan Region.

Additionally, there are significant environmental issues confronting the community in Perth along the Swan Coastal Plain, including the requirement to revegetate 12,000 ha of pine plantation back to Banksia woodland and providing foraging habitat for Carnaby's Black Cockatoo. This restoration project requires 120 tonne of Banksia seed at a cost of $60 – $80 million. The 12,000 ha of Pines are being removed to protect the Gnangara Water Mound, which has been severely affected by draw from human consumption and the pine plantations. By removing the pines it is anticipated that the water table will rise due to increased infiltration from future rainfall.

Unfortunately, due to the reasons outlined above, there is currently not enough seed on the Swan Coastal Plain to complete this project. The State Government Agency – Department of Environment and Conservation are currently considering ways to address this problem which could cost at least $500 million to fully restore the Gnangara Pine Plantation to native Banksia woodland.

In the past 3 years the cost of Banksia seed used for rehabilitation has increased by over 100% and it is anticipated this trend will continue into the future as supply cannot meet demand because of the reductions in available Banksia woodland for seed collection.

2.5 Rocla's Current Expertise in Banksia Woodland Restoration

Rocla has been committed to sustainable development and restoration of Banksia woodlands; Rocla along with Botanic Gardens and Parks Authority (BGPA) were recognised for the development of rehabilitation techniques for the successful restoration of the biodiverse Banksia woodland at Rocla's sand quarries.

This recognition resulted in Rocla and BGPA being awarded the states most prestigious environmental award "The Golden Gecko" in 2008.

Rocla has invested many years of work in this project and the main benefit is the marked improvements in the survival rates of species. Rocla are continuing to find different techniques to gain a greater variety of species survival.

The 20 year long research program has resulted in techniques for increasing germination and seedling establishment including smoke application, seed coatings and best practice for topsoil management.

With little knowledge at the onset of the project on how to restore Banksia woodland, which is an iconic plant community to the Perth area, Rocla and BGPA began investigating how the Banksia woodland ecosystem operates, together with restoration principles.

The first year returned very little success in terms of returning plants to site, with only one or two species represented in post-restoration sites out of a potential 150-200 species that typically occur in a Banksia woodland.

Rocla began a research program to look at the topsoil seed bank; the topsoil is an important source of returning plants to a post-mine restoration site.

At the time, there was little understanding about the Banksia woodland seed bank, so that was the first step in the research program. Rocla had to gain an understanding as to what was in that seed bank and how the seeds were distributed through the seed bank to gain benchmark data on species return.

The research program also investigated if there were seeds in the topsoil seed bank, then what sort of restoration principles were needed to improve seedling recruitment and, ultimately, plant survival.

Within Rocla's first restoration site, there were two species represented out of a potential 150-200 species and plant numbers were quite low with about one plant per five square metres. Now, restoration activities are returning more than 100 species to sites.

Rocla is now using these findings when planning mining operations in order to improve rehabilitation success and the seed farm is an important requirement for the future.

3.0 BANKSIA SPECIES AND VARIETIES

The two key species required for seed, and those that are likely to be in short supply for Rocla's restoration projects in the near future, are *Banksia attenuata* and *Banksia menziesii*. These are key foraging species for Carnaby's Black Cockatoo. Other species will also be required and will be planted for seed as required.

3.1 *Banksia menziesii* (Firewood Banksia)

B.menziesii originates from areas between the Murchison River and Pinjarra. It prefers deep sands and can grown into a tree up to 10 m tall.

There is of range of colours available, from yellow to red, and flowers are 10-12 cm long by 7-8 cm wide. This species has a lignotuber.

3.2 *Banksia attenuata* (Candle Banksia)

B.attenuata is found from Fitzgerald River to Kalbarri in Western Australia. It has mainly been bush-picked, with only a few cultivated plants. It grows from 2 to 10 m in height.

The slender cylindrical flowers are an intense sulphur yellow and are 5 to 26 cm in length and up to 5cm in diameter.

4.0 BANKSIA ESTABLISHMENT

Banksias grow well in deep, well-drained, slightly acidic sand, sometimes overlying limestone or gravel lenses. Highly alkaline soils are best avoided for most species. Site selection for successful Banksia seed production is therefore important.

The following criteria need to be addressed before considering a Banksia farm.

4.1 Identifying suitable soil types

Banksias will grow on a variety of soil types from sands to sands over clay.

Sandy soils from deep white-grey sands to the yellow sands found in the Gnangara Pine Plantations are suitable. Land that becomes waterlogged in winter is not suitable and therefore will not be considered.

4.2 Site Security

As the farm will be part of the sand extraction operations, security of the site will be part of the operational footprint.

4.3 Weed identification and control strategies

The weed burden in harvested pine plantation locations is significant, and will need to be brought under control prior to planting.

Therefore weed control must start well before planting, especially for broad-leaf weed infestations. The same applies to sorrel, capeweed and oxalis. Flat weeds such as wild turnip and doublegee cannot be controlled in a single year. However, their effect on new plantings can be greatly reduced.

Weed control options available once the crop is established are:

- Careful applications of knockdown herbicides, targeted only at the weeds;
- Hand weeding around the plants or in-row mulching.

4.4 Planting densities and planting design

No research has been conducted to determine the optimum planting design for Banksia species. It is anticipated that single rows will be planted, with species in each section of the farm grouped together.

Determining factors will be:

- Species size at maturity;
- Irrigation or non irrigation production;
- Mechanical harvesting;
- Topography; and
- Vehicle access.

4.5 Plant bed preparation

Preparation of the plant bed will be required.

The following points need to occur:

- Cultivation of the plant beds;
- Non cultivation of inter rows;
- Ripping;
- Mounding;
- Mulching; and
- Windbreaks.

5.0 PRUNING BANKSIA

Pruning will be a management practice used for cultural improvement and productivity.

6.0 IRRIGATION OF BANKSIA

Many Banksia species in the wild are able to utilise surface soil moisture and groundwater at depth. They utilise surface water when it rains and they also develop extensive tap roots that can extract water from up to 7 m to survive summer dry spells.

On the deep Bassendean sands located within the Gnangara Pine Plantation, where Rocla's future mining and seed farms will operate, Banksias will require irrigation, particularly if there has not been adequate rain to affect recharge of the water aquifer.

Although Banksias can tolerate low levels of water supply of prolonged drying periods, this will compromise the seed production. Therefore, Rocla will utilise existing approved water licences or apply to the Department of Water for additional licences to enable irrigation of the farm to occur.

7.0 FERTILISERS FOR BANKSIA PRODUCTION

Although there is limited information on the fertiliser requirements, Banksias appear to respond well to balanced fertilisers applied at moderate rates from research completed by Rocla and BGPA. Having a suitable fertiliser program could be critical to producing plentiful seed production.

8.0 DISEASES

Banksias are subject to a number of diseases including Phytophthora or Dieback. Many of these diseases can be controlled through good management practices and use of pesticides.

To minimise the risk of introducing or spreading diseases, disease free plants will be secured and quarantine measures implemented. These include fencing the site and using foot and vehicle wash down areas. In addition, soil movement will be prevented from surrounding areas into the site.

The use of lime to a depth of 10 cm on roadways is also thought to be an effective control, as many organisms cannot survive in the raised pH environment. Rocla intends to use best practice to minimise risk to the seed farm.

Plants showing early disease symptoms will be treated with appropriate fungicides.

9.0 GNANGARA WATER MOUND

Most of Rocla's proposed sand extraction operations are located on the Gnangara Water Mound, which supplies critical water to the city of Perth. The majority of the mound is comprised of Priority 1 or Priority 2 water resource areas.

Rocla has identified four suitable locations, one within each of the Mining Tenements (M70/1306, E70/3275, E70/3275 and E70/3279) where the seed farms will be located (refer to Attachments 1-5). These identified locations are not within the Priority water source areas and as a result should not affect the integrity of the mound.

10.0 SITE LOCATIONS

The intention is to create a seed farm approximately 100 ha in size across the four sand extraction operations (M70/1306, E70/3275, E70/3275 and E70/3279). Each will be in close proximity to sand extraction operations for security purposes and to minimise overhead costs. The intention is for these farms to be located off the Gnangara Water Mound.

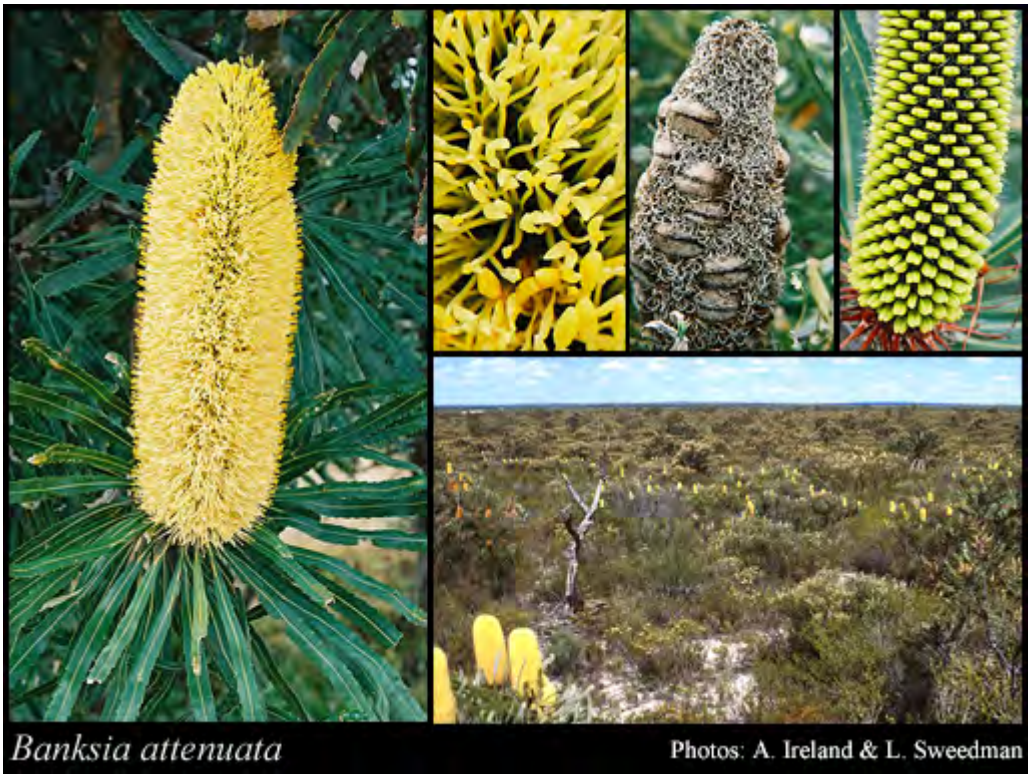
11.0 PHOTOS

11.1 Banksia Woodland


Banksia woodland plant communities are among the most biodiverse woodland types in Australia.

The woodlands have developed on deeply weathered and leached sands that form the basis of major sand extraction for silica products and building sands.

11.2 *Banksia attenuata*



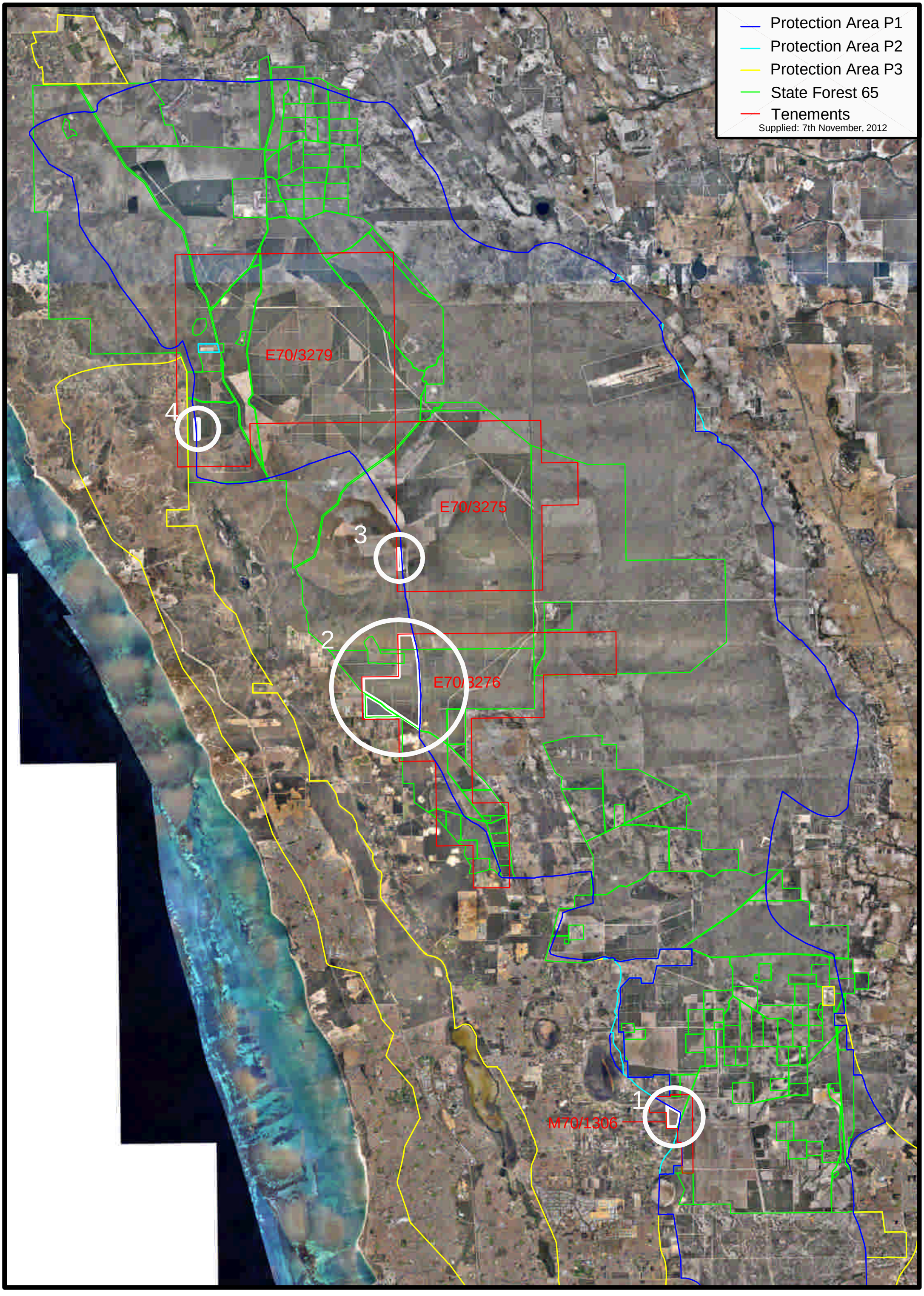
(Photo source: Florabase, 2012)

11.3 *Banksia menziesii*

(Photo source: Florabase, 2012)

12.0 REFERENCES

The Banksia Production Manual, Department of Agriculture and Food, Bulletin No. 4710, ISSN:1833-7236 April 2007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Tenements
Supplied: 7th November, 2012
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E70/3275
E70/3276
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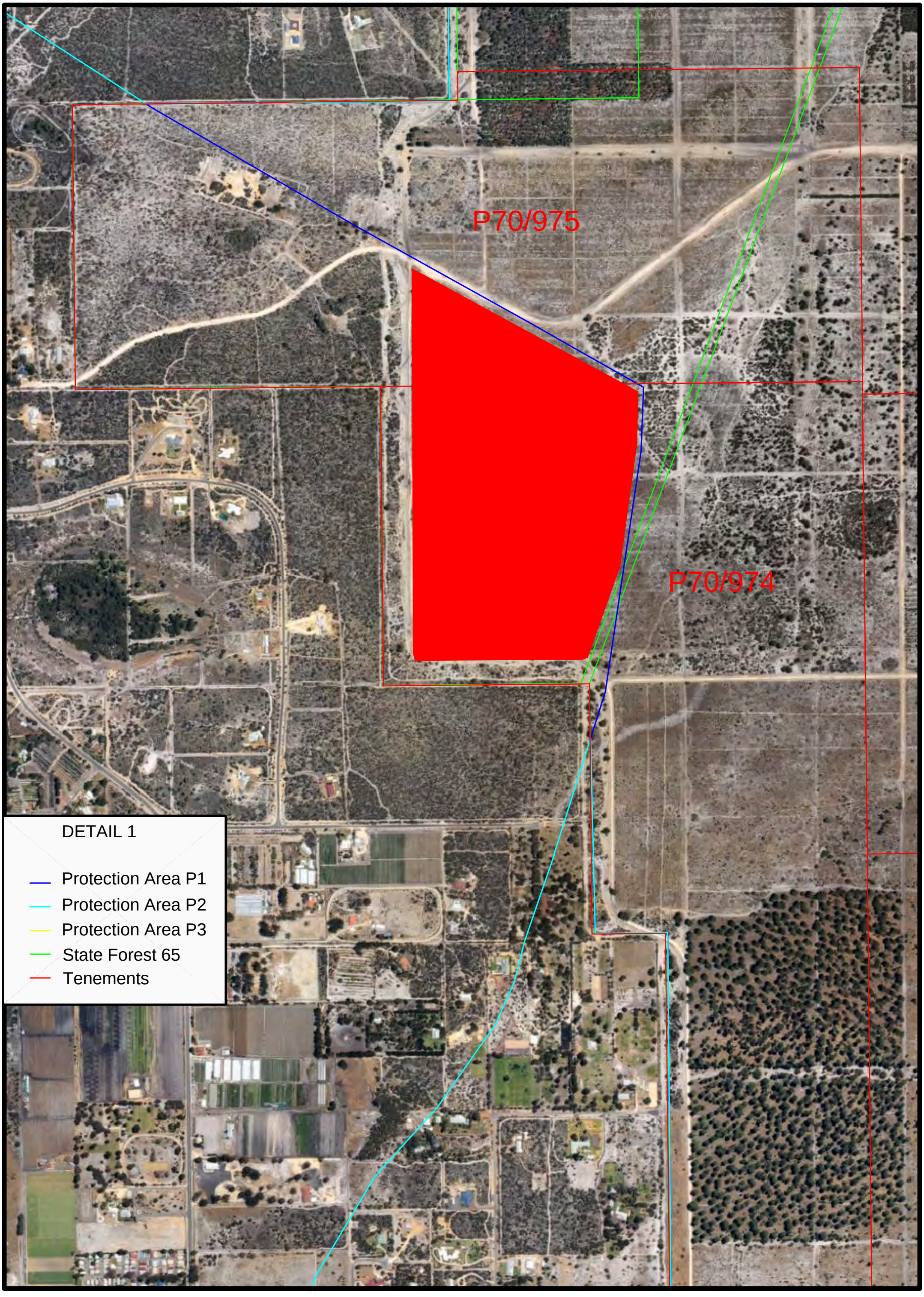
1
2
3
4


P70/975
P70/974
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Protection Area P1
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Protection Area P3
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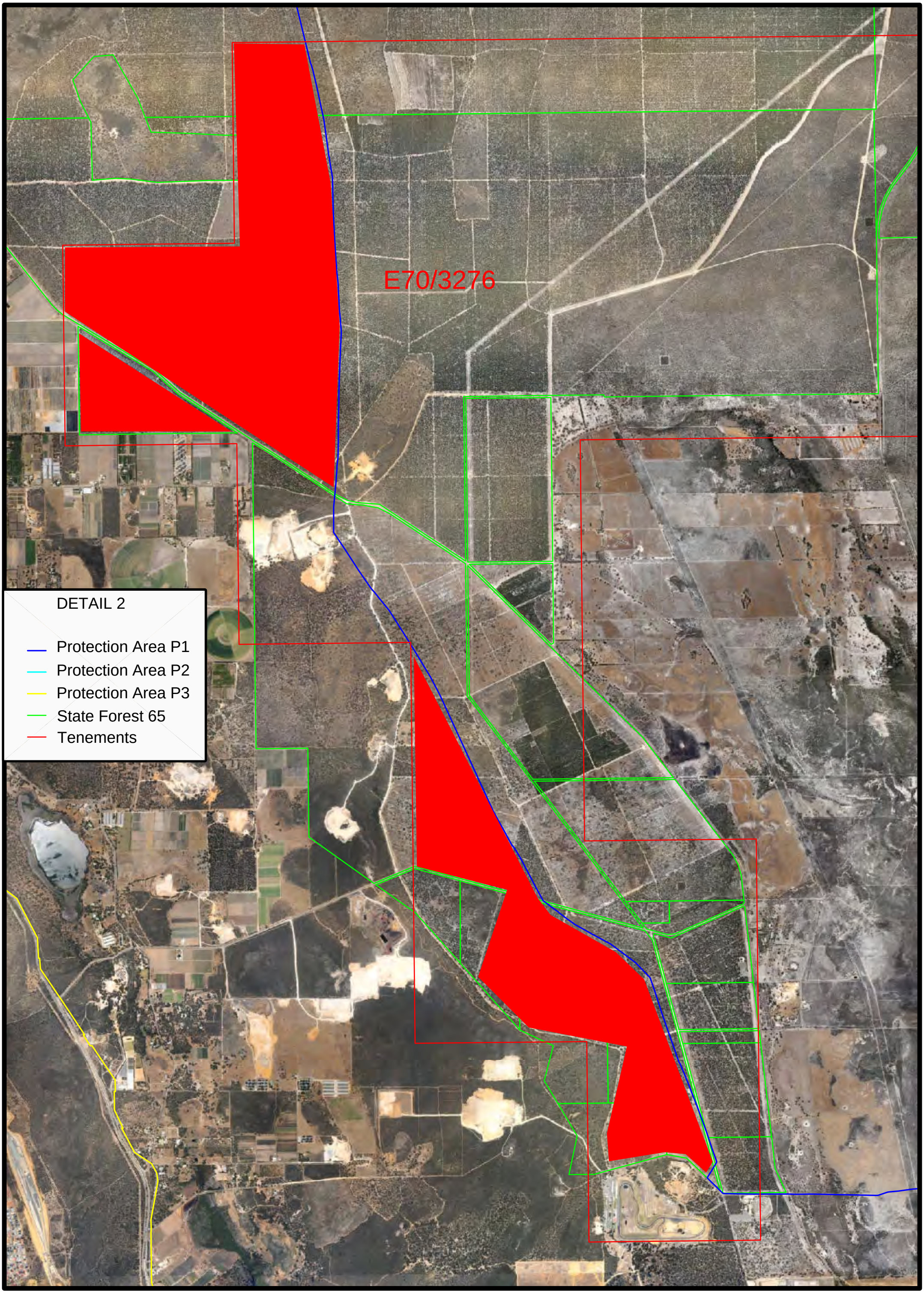
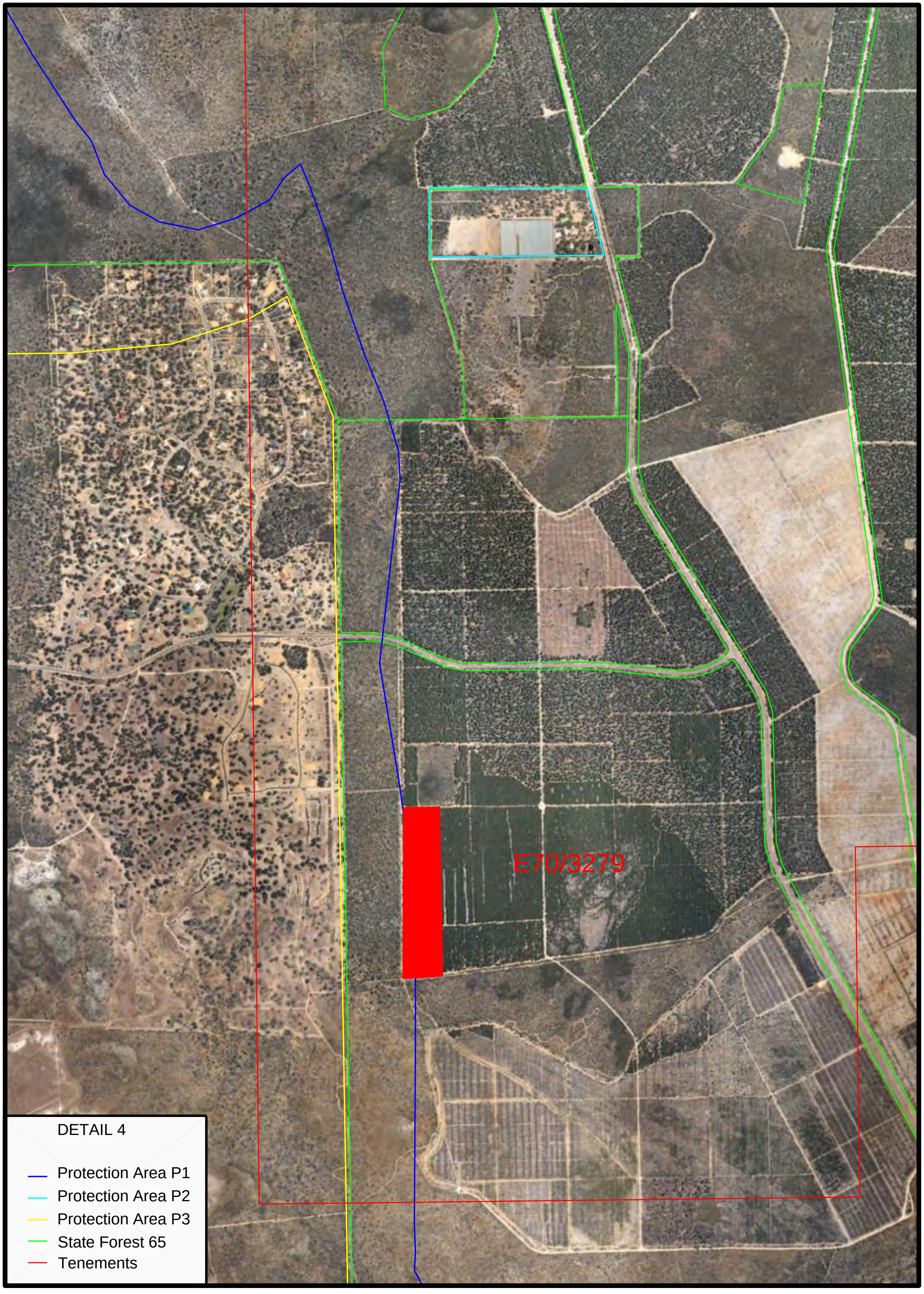
Tenements


E70/3276
DETAIL 2
Protection Area P1
Protection Area P2
Protection Area P3
State Forest 65
Tenements


E70/3275
DETAIL 3
Protection Area P1
Protection Area P2
Protection Area P3
State Forest 65
Tenements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Tenements