



**Western
Botanical**

Assessment of Conservation Significant Species,
Cooljarloo
February 2014

Tronox Management Pty Ltd
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Executive Summary

Tronox Management Pty. Ltd. (Tronox) has operated a mineral sands mine at Cooljarloo, approximately 170km north-northwest of Perth CBD in the northern sandplains region Western Australia (WA), since 1989. Exploration activities have taken place at Cooljarloo since 2005, which have included Tronox implementing a range of studies focussed on the flora and vegetation of their tenements.

In late 2013, Western Botanical (WB) was commissioned by Tronox to conduct targeted searches of conservation significant species including *Paracaleana dixonii* (Threatened Flora) and *Malleostemon* sp. Cooljarloo (B. Backhouse s.n. 16/11/88) (Priority 1) within the Tronox proposed Cooljarloo West Development Envelope; Department of Parks and Wildlife (DPAW) regionally managed lands; and Unallocated Crown Land (UCL) in the vicinity of the Cooljarloo minesite. In December 2013 Western Botanical conducted searches for these two species, however, failed to locate either species (Western Botanical Report WB819) but did record four other Myrtaceae species similar to the *Malleostemon*, including *Baeckea* sp. Perth Region (R.J. Cranfield 444) (P3).

Following discussions with Tronox, the scope of the project was modified to include targeted searches for *Malleostemon* sp. Cooljarloo and *Baeckea* sp. Perth Region. Western Botanical confirmed the populations of *Malleostemon* sp. Cooljarloo from existing records, with one from the south eastern corner of the Tronox Mining Lease (at the location of the type collection) and two from near Lake Guraga, approximately 20km south of Cooljarloo. However, the two historical records supplied by Tronox (including a record with 41,553 plants) were found to have been misidentified and were actually *Baeckea* sp. Perth Region (R.J. Cranfield 444). No new populations of *Malleostemon* sp. Cooljarloo were found within the Cooljarloo West Development Envelope.

The majority of existing records for *Baeckea* sp. Perth Region occur within two disjunct regions, Cooljarloo – Wongonderrah and Perth. Based on the field observations and correlation of species occurrence, habitat and aerial photograph imagery, the sum of known records within the Cooljarloo West Development Envelope and in the broader Cooljarloo – Wongonderrah region are regarded by Western Botanical as significantly under-representing the full distribution of *Baeckea* sp. Perth Region in this region.

A taxonomic review of *Baeckea* sp. Perth Region (R.J. Cranfield 444) conducted by Mr Malcolm Trudgen (of M.E. Trudgen and Associates) found that plants from the two disjunct regions varied in the number of ovules and morphology of anthers. As such it is likely that this species will be recommended to be recognised as two subspecies. Furthermore, there appears to be hybridisation in the Cooljarloo - Wongonderrah region between this species and *Malleostemon* sp. Cooljarloo (B. Backhouse s.n. 16/11/88) (pers. comm. Malcolm Trudgen).

If *Baeckea* sp. Perth Region is split into two subspecies, the northern populations in the Cooljarloo-Wongonderrah region will likely retain the current P3 ranking as they are extensive, and still in relatively undisturbed vegetation. However, the populations near Perth are at relatively high risk due to their proximity to the Perth metropolitan area and subsequent habitat loss from development leaving small remnants in less secure tenure. .

1. Introduction

1.1. Project Background

Tronox Management Pty. Ltd. (Tronox) has operated a mineral sands mine at Cooljarloo, Western Australia (WA), approximately 170 km north-northwest of Perth CBD since 1989. The mine is located within the *Mineral Sands (Cooljarloo) Mining and Processing State Agreement Act 1988* (lease M268SA) (Woodman Environmental Consulting (WEC), 2010). Exploration at Cooljarloo has occurred since 2005 and Tronox has implemented a range of studies into flora and vegetation of their Cooljarloo tenements.

In late 2013, Western Botanical was commissioned by Tronox to conduct targeted searches of conservation significant species including *Paracaleana dixonii* and *Malleostemon* sp. Cooljarloo (B. Backhouse s.n. 16/11/88) (P1). In December 2013 Western Botanical conducted searches for these two species within the Cooljarloo West Development Envelope and Department of Parks and Wildlife (DPaW) regionally managed lands (reserves). During these searches there was uncertainty in the identification of *Malleostemon* sp. Cooljarloo (B. Backhouse s.n. 16/11/88), as a closely related species (*Baeckea* sp. Perth Region (R.J. Cranfield 444)) was found to have very similar habitat preferences, growth habits and flowers. They differ significantly in their fruits as *Malleostemon* has indehiscent fruit with only one locule (unilocular) and *Baeckea* has dehiscent fruit with three locules (trilocular). These are reliable characters for differentiation of the two genera; however, mature fruit from both species was not available at the time of the survey, and determination was made on other features of specimens collected, following conclusion of the field work.

Following discussions with Tronox the scope of the survey was modified to include targeted searches for *Malleostemon* sp. Cooljarloo (B. Backhouse s.n. 16/11/88) and *Baeckea* sp. Perth Region (R.J. Cranfield 444) (as it also has conservation significance (P3)) and with the aim of clarifying the uncertainty in identification between the two species.

1.2. Conservation Significant Flora

1.2.1. *Malleostemon* sp. Cooljarloo (B. Backhouse s.n. 16/11/88)

Malleostemon sp. Cooljarloo (B. Backhouse s.n. 16/11/88) is a pink-flowered shrub to around 40cm, growing in low-lying areas and ephemeral winter-wet wetlands. It flowers in November. It is only known from five records at the Western Australian Herbarium (WA Herbarium) (2014), one of which is within the Tronox mining lease.

1.2.2. *Baeckea* sp. Perth Region (R.J. Cranfield 444)

Baeckea sp. Perth Region (R.J. Cranfield 444) is a pink flowered shrub to 2m, growing in ephemeral winter-wet wetlands. The majority of existing records for *Baeckea* sp. Perth Region occur within two disjunct regions, Cooljarloo – Wongonderrah and Perth. Prior to the

current work, it was speculated that the species may have taxonomic differences between the two regions due to the large distance (approximately 200km) and might require separation at subspecies level or similar. If this occurs, the Perth region populations will likely be seen as at higher risk because of its proximity to the Perth metropolitan area, with habitat loss from development, leaving small remnants in less secure tenure. The northern populations at Cooljarloo-Wongonderrah will likely retain the current P3 ranking as it is the larger, and is still in relatively undisturbed vegetation.

1.3. Physical Environment

1.3.1. Location

The Tronox Cooljarloo mine site is located approximately 170 km north of Perth, Western Australia, on the Brand Highway. Figure 1 shows the regional context of the Cooljarloo mine site.

1.3.2. Climate

The Cooljarloo area has a warm semi-arid to Mediterranean climate with 400-500 mm of rainfall annually (Mitchell *et al.*, 2002).

1.3.3. Biogeographic Region

Cooljarloo is situated in the Swan Coastal Plain (SWA1) subregion of the Swan Coastal Plain Interim Bioregion Regionalisation for Australia (IBRA) bioregion, as described in Mitchell *et al.* (2002). While Cooljarloo is within the Swan Coastal Plain SWA1 subregion, it should be noted that the Study Area is close to the western border of the Dandaragan Plateau SWA2 subregion and may, therefore, share some of its characteristics.

The Swan Coastal Plain SWA1 subregion is characterised by low lying coastal plains mainly covered with woodlands (Mitchell *et al.*, 2002). It is dominated by *Banksia* or Tuart on sandy soils, *Casuarina obesa* on outwash plains, and paperbark in swampy areas. In the east the plain rises to duri-crustsed Mesozoic sediments dominated by *Jarrah* woodland (Mitchell *et al.* 2002).

The nearby Dandaragan SWA2 subregion is characterised by *Banksia* low woodland, Jarrah-Marri woodland, Marri woodland, and by scrub-heaths on laterite pavement and on gravelly sandplains (Mitchell *et al.* 2002).

1.4. Beard Pre-European Vegetation

J. S. Beard (1976) mapped the pre-European disturbance vegetation types for Western Australia at 1:250,000 for selected areas. As described by Beard, the survey area comprises part of the Bassendean Vegetation System. Figure 1 shows the Bassendean Vegetation System at Cooljarloo and surrounding areas.

The Bassendean system stretches intermittently for the entire length of the Swan Coastal Plain, with a general cover of *Banksia* low woodland over a dense understorey of sclerophyllous shrubs.

1.5. Previous surveys

Malleostemon sp. Cooljarloo (B. Backhouse s.n. 16/11/88) has been previously located at five locations, with specimens lodged at the WA Herbarium (2014). The type specimen was taken from the southern end of the Tronox Cooljarloo mining lease, with all other records outside of the Cooljarloo mining tenements.

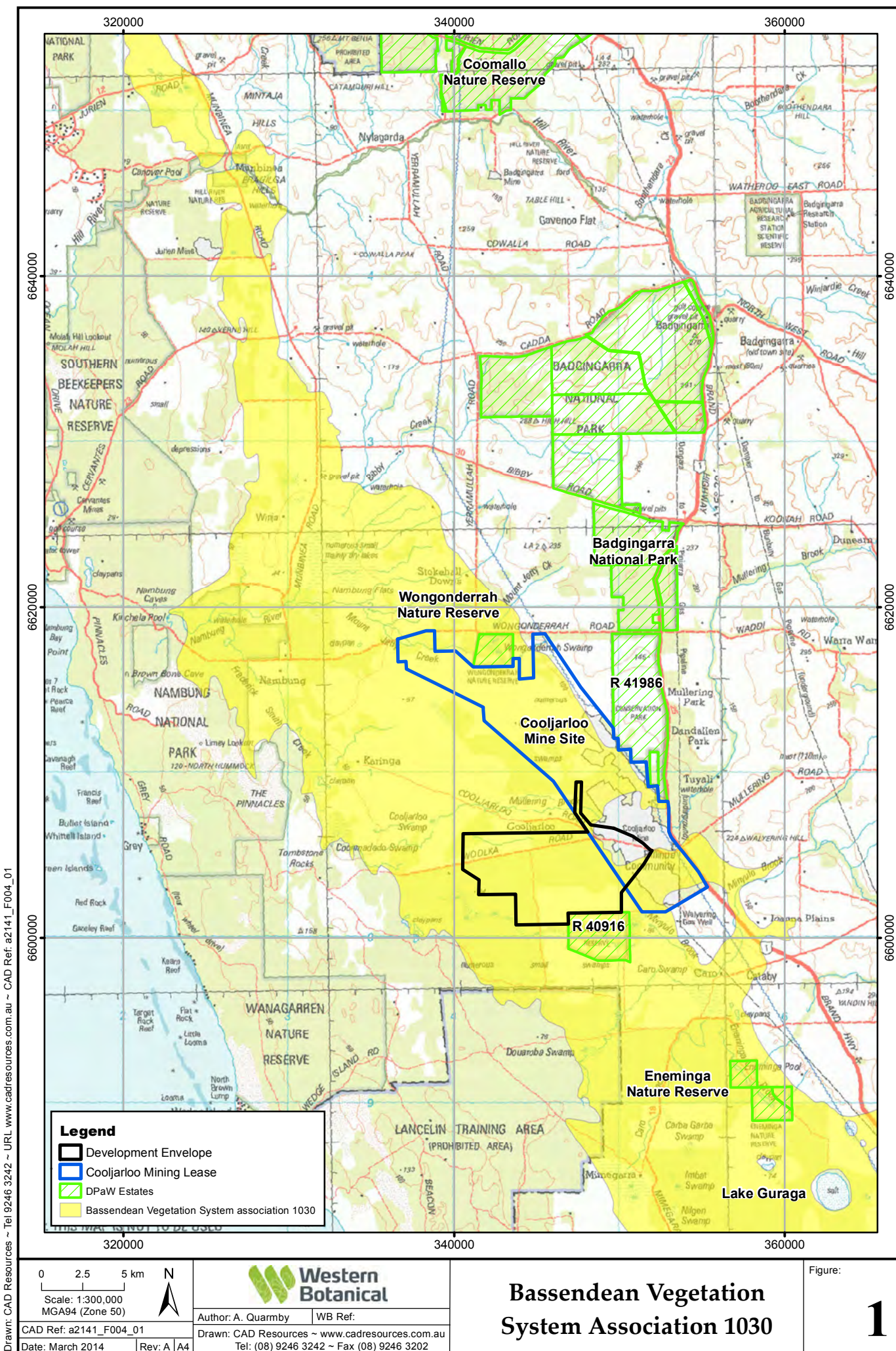
There were two unconfirmed records of *Malleostemon* sp. Cooljarloo (B. Backhouse s.n. 16/11/88) within the Cooljarloo West Development Envelope, however, these records have not been verified by specialists at the Western Australian Herbarium.

Baeckea sp. Perth Region (R.J. Cranfield 444) has been recorded from numerous records within the Cooljarloo West Development Envelope and surrounding areas. These have been recorded mainly by consultants contracted by Tronox and include Woodman Environmental Consulting (WEC), Mattiske Consulting (Mattiske) and Nick Evelegh.

In December 2013 Western Botanical searched for *Paracaleana dixonii* and *Malleostemon* sp. Cooljarloo (B. Backhouse s.n. 16/11/88) within the Cooljarloo West Development Envelope and nearby conservation reserves, however, failed to locate either species (Western Botanical 2014). However, Western Botanical recorded new populations of *Baeckea* sp. Perth Region (R.J. Cranfield 444) (P3) from within the Development Envelopment.

1.6. Current Survey

The scope of the current survey included searches for *Malleostemon* sp. Cooljarloo (B. Backhouse s.n. 16/11/88) and *Baeckea* sp. Perth Region (R.J. Cranfield 444) within the Tronox proposed Cooljarloo West Development Envelope, (DPaW) regionally managed lands, and unallocated crown land (UCL) in the vicinity of the Cooljarloo minesite. It also included re-visiting selected existing records of *Baeckea* sp. Perth Region (R.J. Cranfield 444) from the Perth region to enable collection of specimens for taxonomic review.



2. Methods

2.1. Desktop Survey

Details of existing records lodged at the WA Herbarium of the target species were searched using the FloraBase database (WA Herbarium, 2014). Strategen Environmental Consultants (Strategen), on behalf of Tronox, also provided Western Botanical with additional records of both species from their flora and vegetation surveys in the Cooljarloo region.

2.2. Field Survey

Field surveys were conducted at Cooljarloo from the 3rd to 6th February 2014. The existing Perth records of *Baeckea* sp. Perth Region (R.J. Cranfield 444) were also visited on the 13th and 19th of February 2014 to gain fresh material for taxonomic reviews.

2.3. Flora Specimen Identification

Flowering and fruiting specimens of *Malleostemon* sp. Cooljarloo (B. Backhouse s.n. 16/11/88) and *Baeckea* sp. Perth Region (R.J. Cranfield 444) were delivered to Mr. Malcolm Trudgen (of M.E. Trudgen and Associates) for verification and taxonomic review.

2.4. Personnel Involved

Geoff Cockerton SOPP Licence No. SL010714

Alice Quarmby SOPP Licence No. SL010717

Malcolm Trudgen (M.E. Trudgen and Associates)

3. Results

3.1. Desktop Survey

3.1.1. *Malleostemon* sp. Cooljarloo (B. Backhouse s.n. 16/11/88)

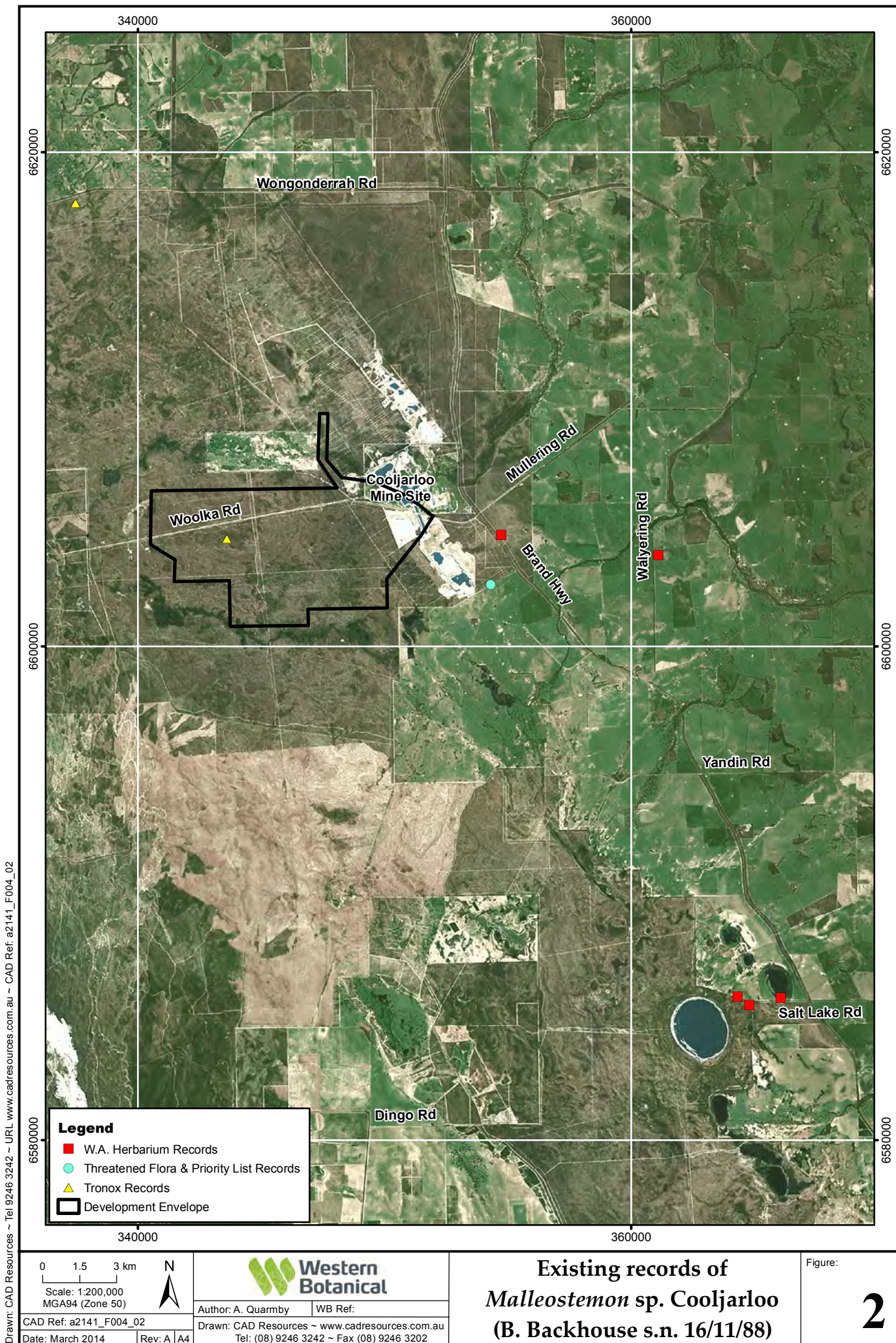
The existing records of *Malleostemon* sp. Cooljarloo (B. Backhouse s.n. 16/11/88) are provided in Table 1 and Figure 2. Five of these records were from specimens lodged at the WA Herbarium (2014). It should be noted these records were collected prior to hand held GPS devices, with coordinates provided estimated by the WA Herbarium. As such the coordinates provided may not reflect the actual locations.

The latter four records in Table 1 were provided by Strategen, on behalf of Tronox; however, the Project and Mattiske records have not been verified (?*Malleostemon* sp. Cooljarloo (B. Backhouse s.n. 16/11/88) and *Malleostemon* sp. ?Cooljarloo (B. Backhouse s.n. 16/11/88) respectively).

Two of the records in Table 1 were from the southern end of the Tronox Cooljarloo mining lease ((B. & B. Backhouse s.n.; PERTH 02794349) and the Threatened and Priority List (DPaW) record). The Mattiske record (?*Malleostemon* sp. Cooljarloo (B. Backhouse s.n. 16/11/88), with 41,553 plants, was located within the Cooljarloo West Development Envelope. All other records were located outside of the Tronox tenements.

Table 1 Existing records of *Malleostemon* sp. Cooljarloo (B. Backhouse s.n. 16/11/88) (GDA 94)

Collector & WA Herbarium Specimen I.D.	Zone	Easting	Northing
B. & B. Backhouse s.n. PERTH 02794349 (type specimen)	50J	Coordinates omitted due to confidentiality	
Keighery, B.J., 1990/14 PERTH 01298305	50J		
Griffin, E.A., 7967 PERTH 03255166	50J		
Hort, F. & Hort, J., 2423 PERTH 06983189	50J		
Hort, F. & Hort, J., 2424 PERTH 06983197	50J		
Threatened and Priority Flora List (DPaW)	50J		
Project	50J		
Woodman Environmental Consulting (WEC)	50J		
Mattiske	50J		



Existing records of
Malleostemon sp. Cooljarloo
(B. Backhouse s.n. 16/11/88)

Figure:

2

3.1.2. *Baeckea* sp. Perth Region (R.J. Cranfield 444)

Seventeen records (specimens) of *Baeckea* sp. Perth Region (R.J. Cranfield 444) have been lodged at the WA Herbarium. Six of these records were from locations north of Perth, with three in the Cooljarloo region (Table 1 & Figure 3). The rest of the records were from the Perth region; however, eight of these were from the same location (Table 2 and Figure 4) and most, if not all of these records were made without the use of a hand held GPS (coordinates estimated by the WA Herbarium).

Strategen, acting for Tronox, also supplied Western Botanical with 68 additional records of *Baeckea* sp. Perth Region (R.J. Cranfield 444) from the Cooljarloo region (within the Cooljarloo West Development Envelope and surrounding areas). Thirty-two percent of these records (22 records) were within the Cooljarloo West Development Envelope (Figure 3 and Appendix 1).

During December 2013 Western Botanical recorded a further 107 waypoints representing populations of *Baeckea* sp. Perth Region (R.J. Cranfield 444) within the Cooljarloo West Development Envelope. These records are presented in Figure 3 and Appendix 2.

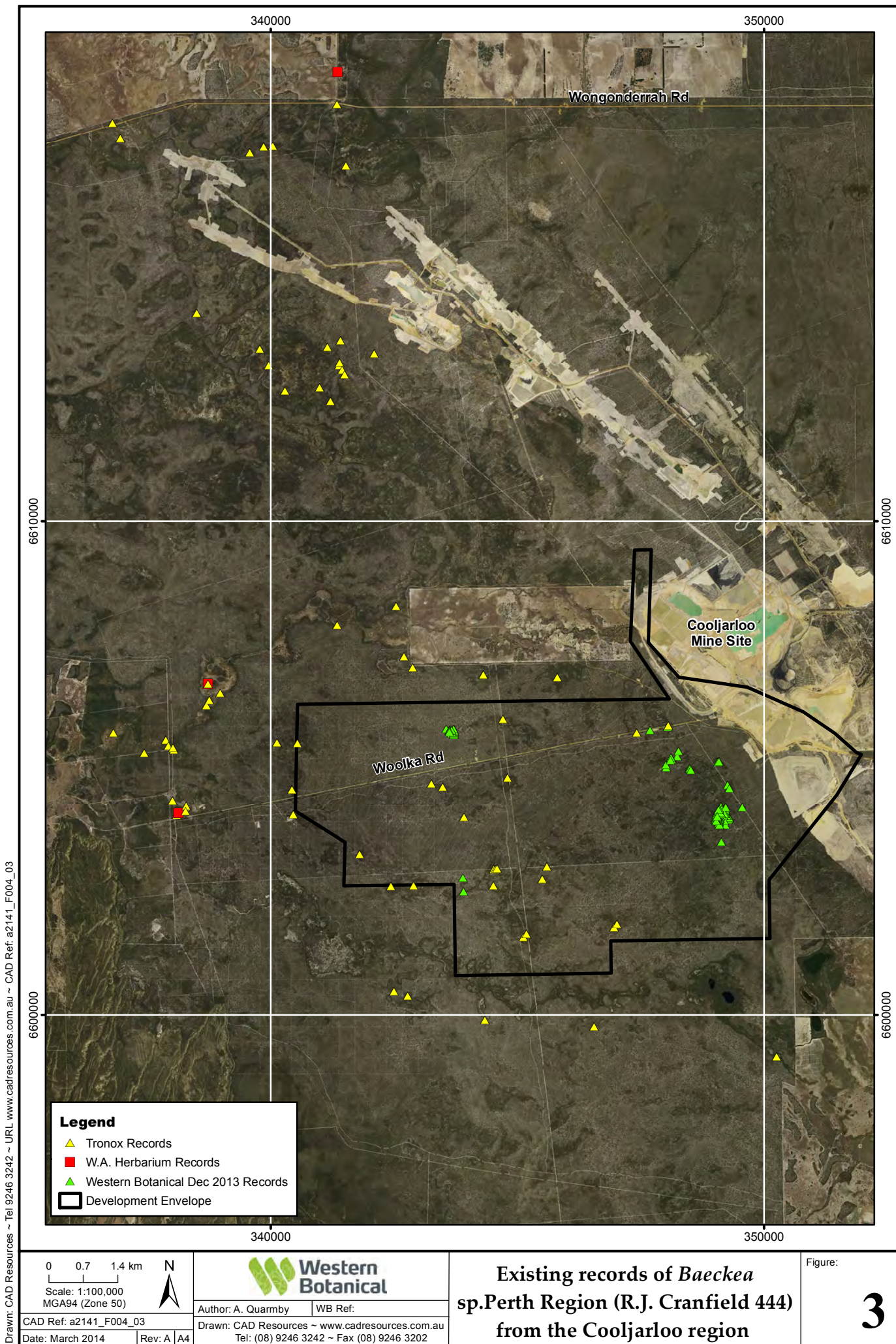
Based on field observations and correlation of species occurrence, habitat and aerial photograph imagery, the sum of known records within the Cooljarloo West Development Envelope and in the broader Cooljarloo – Wongonderrah region are regarded by Western Botanical as significantly under-representing the full distribution of *Baeckea* sp. Perth Region in this area.

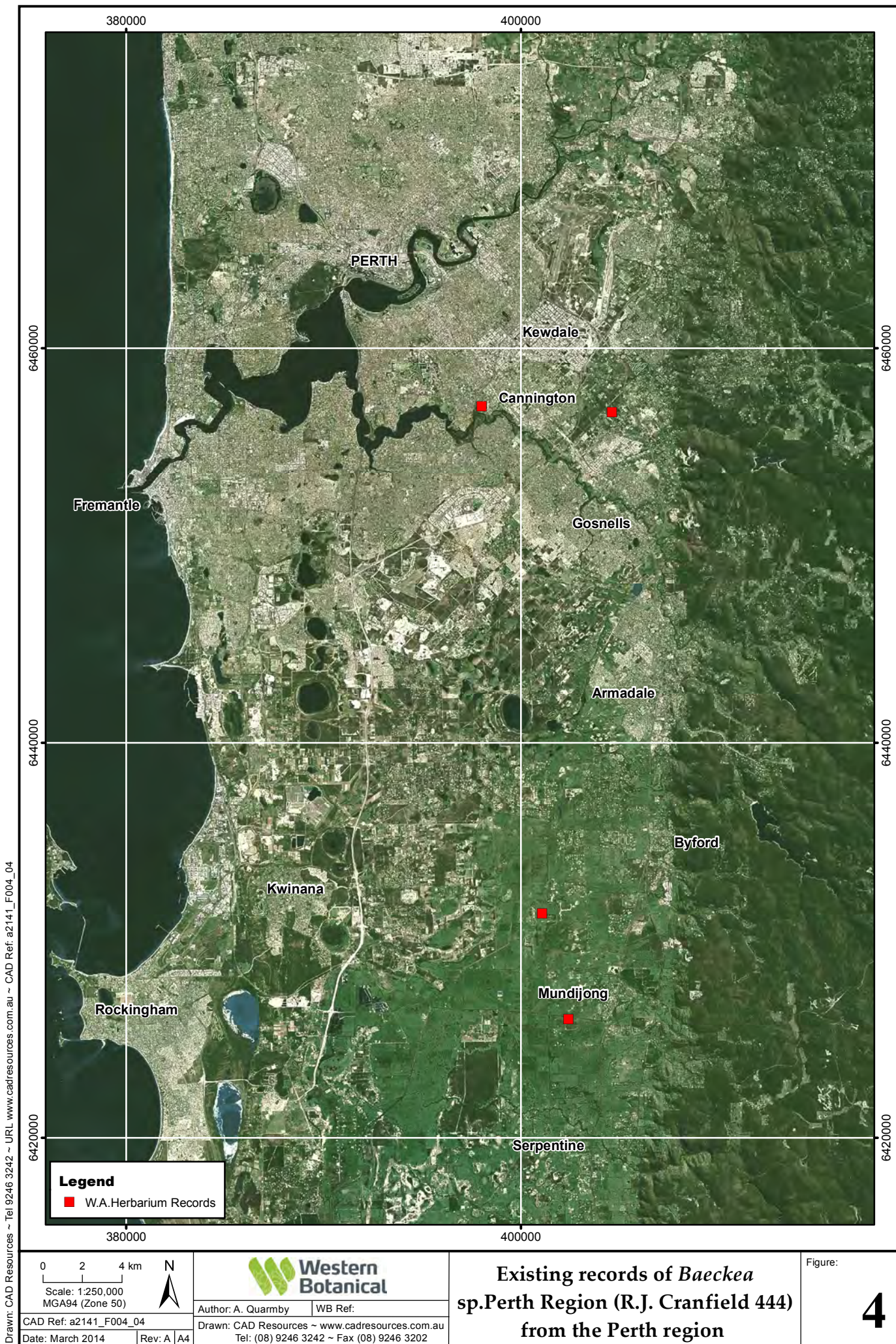
Table 1 Existing records of *Baeckea* sp. Perth Region (R.J. Cranfield 444) from the Cooljarloo area north of Perth (GDA 94)

Collector & WA Herbarium Specimen Number	Zone	Easting	Northing	Coll. Year	Region
Coultas, D.; Rodda, K. Coll No: M 118 - 3; PERTH 07812140	50J	Coordinates omitted due to confidentiality		2006	Cataby
Hislop, M.; Hort, F. Coll No: MH 3403; PERTH 07302541	50J			2005	Badgingarra
Keighery G.J. & Keighery B.J.; Coll No: 433; PERTH 07096372	50J			2004	Badgingarra
Demarz, H. Coll No: 2121; PERTH 03377954	50J			1970	Lancelin
Pritzel, D. Coll No: s.n. PERTH 03378373	50J			1901	Mogumber
Griffin, E.A. Coll No: 5502 PERTH 03378446	AMG 50JLM959226 (Lake Dalaroo 1:50,000 sheet)			1988	Moora

Table 2 Existing records of *Baeckea* sp. Perth Region (R.J. Cranfield 444) from the Perth region (GDA 94)

Collector & WA Herbarium Specimen I.D.	Zone	Easting	Northing	Year Coll.	Location:
Keighery, G.J. Coll No: 12705 PERTH 04099672	50H			1992	Mundijong road, 4 km W of Mundijong State: WA
Cranfield, R.J. Coll No: 1679 PERTH 03377962	50H			1981	Abernethy Road, Oakford State: WA
Cranfield, R.J. Coll No: 444 PERTH 03378454	50H			1978	Brentwood Road, Kenwick State: WA
Speck, N.H. Coll No: s.n. PERTH 03377946	50H			1948	Cannington State: WA
Speck, N.H. Coll No: UWA 827 PERTH 03378411	50H			1948	Cannington Swamp State: WA
Morrison, A. Coll No: s.n. PERTH 03378357	50H			1903	Cannington, Lower Canning River State: WA
Morrison, A. Coll No: s.n. PERTH 03378438	50H			1902	Cannington, Lower Canning River State: WA
Morrison, A. Coll No: s.n. PERTH 03378365	50H			1901	Cannington, Canning Range State: WA
Morrison, A. Coll No: s.n. PERTH 03377938	50H			1900	Cannington State: WA
Morrison, A. Coll No: s.n. PERTH 03378403	50H			1900	Cannington, Canning Range State: WA
Morrison, A. Coll No: s.n. PERTH 03378381	50H			1899	Cannington, Lower Canning River State: WA





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3.2. Field Surveys

3.2.1. *Malleostemon* sp. Cooljarloo (B. Backhouse s.n. 16/11/88)

Attempts were made to visit each of the *Malleostemon* sp. Cooljarloo (B. Backhouse s.n. 16/11/88) records provided in Table 1 .

The location of the type specimen of *Malleostemon* sp. Cooljarloo (B. Backhouse s.n. 16/11/88) was reconfirmed, with approximately 45 plants recorded over 450m in an east – west direction, parallel with the track running approximately 30m north of the boundary fence (Plate 1, Plate 2, Figure 5). . It should be noted that WA Herbarium coordinates for the record were found to be inaccurate and that the correct coordinates for this site corresponded with the Threatened and Priority Flora List record (DPaW) (provided by Strategen)

The vegetation associated with this site was considered to be a heath of *Actinostrobilus pyramidalis* 0.5 to 2m high, *Calothamnus hirsutus* 0.5m, *Verticordia densiflora* 0.6m, *Darwinia pinifolia* 0.2m, *Hypocalymma angustifolium* 0.5m, *Schoenus* sp. 10cm, Cyperaceae (0.7m), ?*Pityrodia* sp. (1m), *Banksia telmatiaea* (1m), *Jacksonia sternbergiana* (2m), *Beaufortia squarrosa* (1.2m), *Verticordia lindleyi subsp. lindleyi* P4 (0.8m) and *Petrophile seminuda* (Western Swamps Form) (0.6m).

The coordinates provided for the Keighery (1990/14) record were visited and no *Malleostemon* sp. Cooljarloo plants were observed at this location. On examination of the record description, however, it is more likely that this record is from the same location as the type specimen.



Plate 1 *Malleostemon* sp. Cooljarloo (B. Backhouse s.n. 16/11/88) population at the B. Backhouse s.n. 16/11/88 collection site (southern end of the Tronox Mining Lease).



Plate 2 *Malleostemon* sp. Cooljarloo (B. Backhouse s.n. 16/11/88) plant habit B. Backhouse s.n. 16/11/88 collection site (Tronox Mining Lease).

The population at the Griffin (7967) record was re-confirmed; however, the coordinates provided were inaccurate. This population has an estimated 10,000 plants over an area of approximately two hectares spanning three land different land tenures including a road reserve, Reserve R31223 (west of road) and private land owned by Superior Lawns (east of road). On the east of the track (Superior Lawns private land) the vegetation was characterised as a heath of *Verticordia densiflora* 0.8m, *Banksia telmatiaea* 0.6m, *Hakea varia* 1.5m, *Callitris* sp. 0.4m, with *Malleostemon* sp. Cooljarloo (B. Backhouse s.n. 16/11/88) 0.5m considered as co-dominant. Within the R31223 reserve *Malleostemon* sp. Cooljarloo (B. Backhouse s.n. 16/11/88) was considered as the dominant shrub with occasional *Melaleuca raphiophylla* 2-5m, *Callitris pyramidalis* 2m (unburnt), and *Calothamnus brevifolius* P2 0.5m. The Projected Foliar Cover (PFC) of taller shrubs (*Callitris* & *Melaleuca*) was 25%, with the PFC of *Malleostemon* sp. Cooljarloo (B. Backhouse s.n. 16/11/88) was approximately 20% (Plate 3).



Plate 3 *Malleostemon* sp. Cooljarloo (B. Backhouse s.n. 16/11/88) population at the Griffin 7967 location

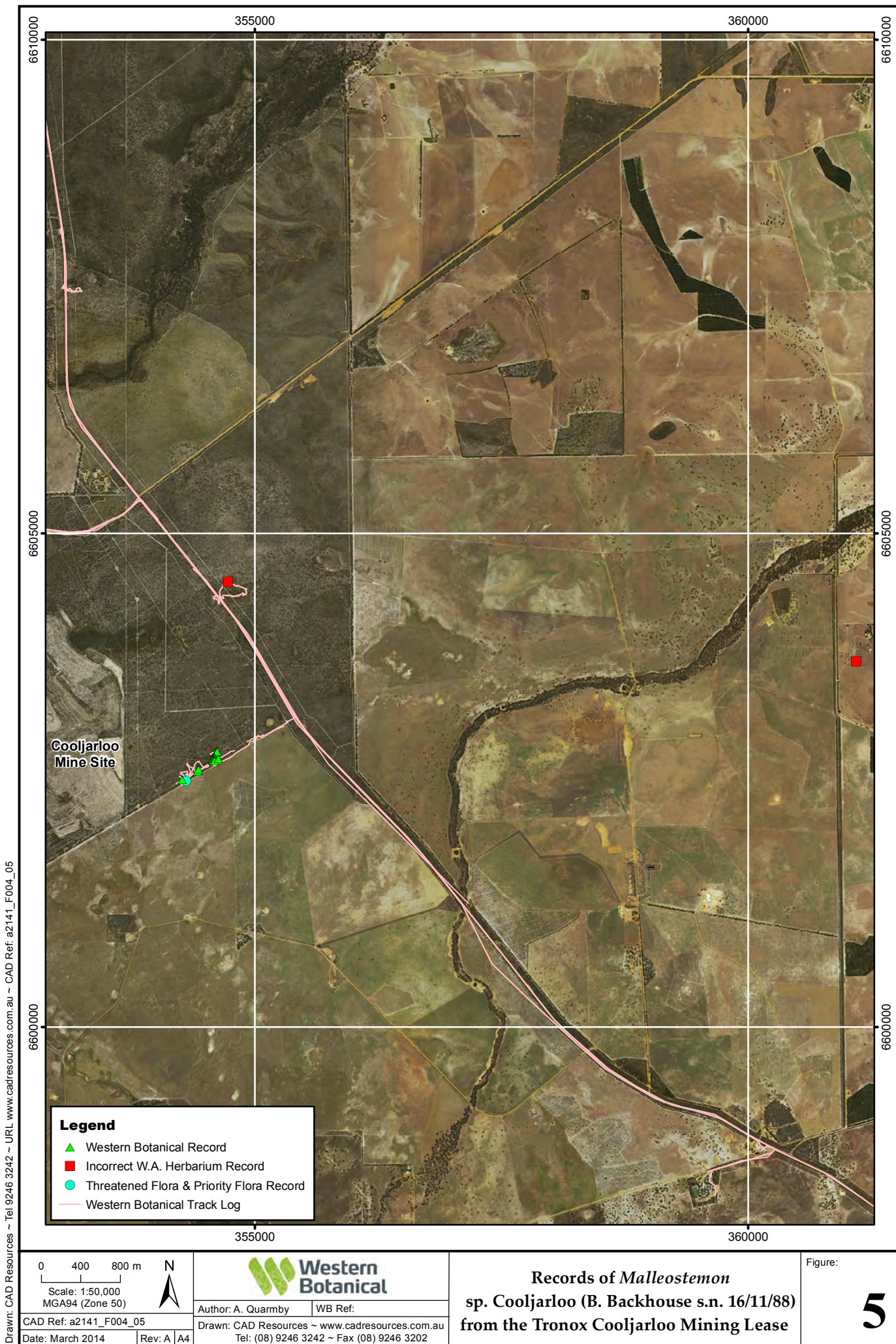
The population at the Hort & Hort (2423) record was re-confirmed; however, the coordinates were also found to be incorrect. The population is estimated to have 300 plants in an area of approximately 100m x 50m. It was in the lowest part of the landscape, within an ephemeral wetland, along Salt Lake Road (Figure 6, Plate 4). The vegetation community associated with this population was considered to be a post fire regenerating Heath (PFC 20-30%). This was characterised by *Actinostrobilus pyramidalis* 0.5m, *Verticordia densiflora* 0.7m, *Malleostemon* sp. Cooljarloo 0.5m, PFC 20 to 30% with occasional emergent *Acacia saligna* 2.5m, *Melaleuca raphiophylla* 3.5m, PFC < 1%. *Acacia saligna*, *Calothamnus quadrifidus*, *Conostylis juncea*, Asteraceae sp. (weed), *Calothamnus hirsutus*, *Pityrodia* sp., *Baeckea* sp. (shrub to 1.5m h x 3m w), *Calytrix* sp., *Drosera gigantea*, *Cassytha* sp., *Schoenus* sp. (10 cm), *Actinostrobilus pyramidalis* 2m, *Verticordia densiflora* 0.8m, *Darwinia pinifolia* (0.4m), Cyperaceae (0.7m), *Hypocalymma angustifolium* (0.7m), and *Petrophile seminuda* (Western Swamps Form) 0.7m.

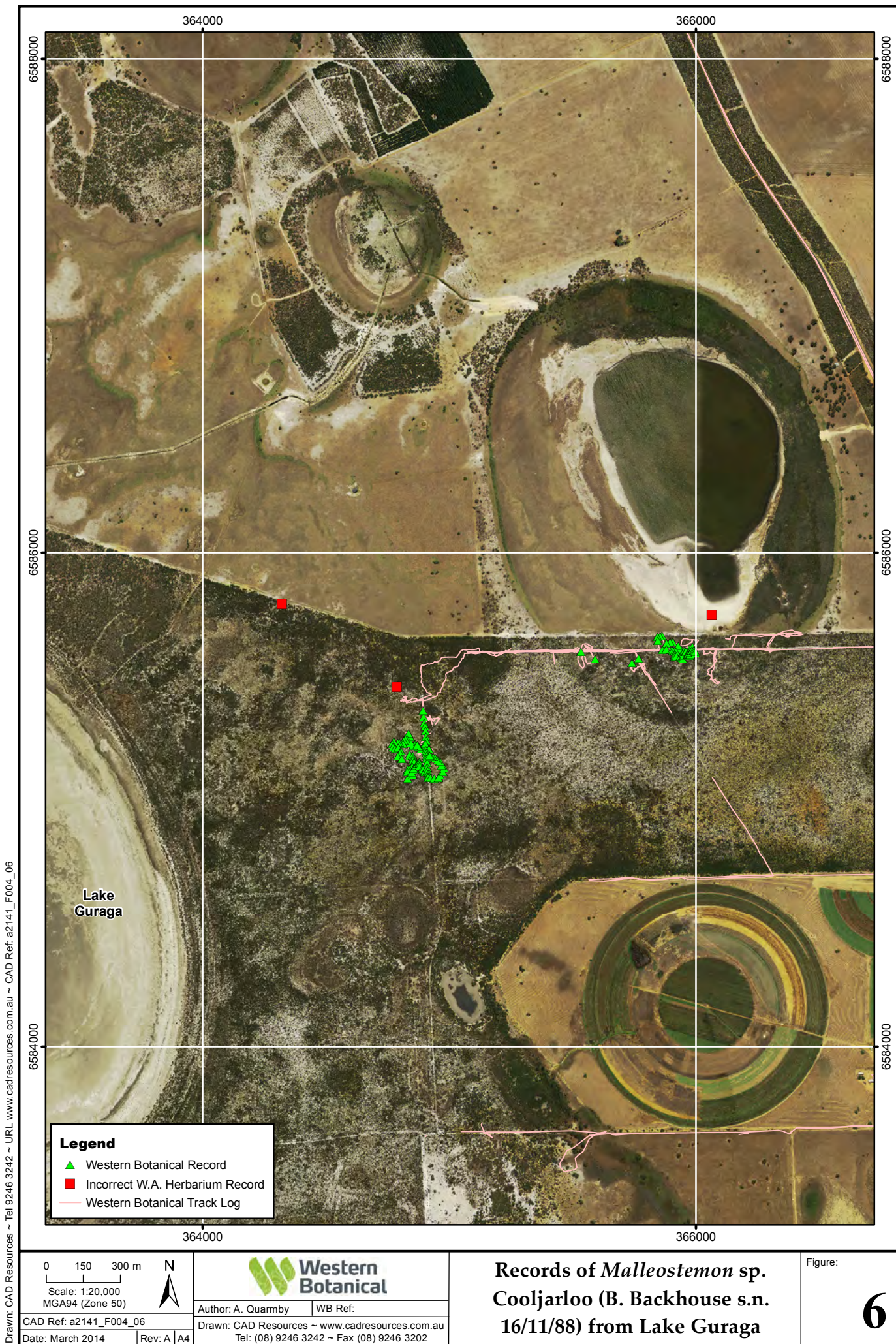


Plate 4 *Malleostemon* sp. Cooljarloo (B. Backhouse s.n. 16/11/88) population at the Hort & Hort 2423 location

The Hort & Hort (2424) record was not reconfirmed by Western Botanical. It should be noted that the record could not be reached by vehicle as Salt Lake Road has become severely overgrown with *Acacia saligna* approximately 2km west of Brand Highway.

All of the records provided by Strategen, on behalf of Tronox, were revisited. With the exception of the Threatened and Priority Flora List record (DPaW) (see above), *Baeckea* sp. Perth Region (R.J. Cranfield 444) was abundant at each location and there was no sign of *Malleostemon* sp. Cooljarloo (B. Backhouse s.n. 16/11/88). This included the unconfirmed Mattiske record of 41,553 plants within the Cooljarloo West Development Envelope.





3.2.2. *Baeckea* sp. Perth Region (R.J. Cranfield 444)

Populations in the Cooljarloo area

In February 2014 Western Botanical revisited the three sites of *Baeckea* sp. Perth Region (R.J. Cranfield 444) from the Cooljarloo area that had been lodged at the WA Herbarium.

A large population was found approximately 450m south of the Coultas & Rodda M118-3 coordinates, in a low lying ephemeral wetland and associated drainage channel (Plate 5). *Baeckea* sp. Perth Region was locally common to co-dominant and associated with a *Banksia telmatiaea* thicket 1.5m PCF 85% with emergent *Acacia saligna* 3m, *Viminaria juncea* 3m, *Hakea obliqua* subsp. *parvifolia* 2m, PCF 5-10%. *Melaleuca viminea* 2m, *Cassytha* sp, *Verticordia densiflora* 1m, *Hakea varia* 2m, *Lepidosperma* sp. 0.6m, *Melaleuca lateritia* 1.1m and *Thysanotus ?spiniger* 0.4m.



Plate 5 *Baeckea* sp. Perth Region (R.J. Cranfield 444) population 450m south of the Coultas & Rodda (M118-3) coordinates

The Hislop and Hort (MH 3403) population was located and was found to be a large and healthy population on the road verge and extending into a *Banksia telmatiaea* heath on the margin of an ephemeral wetland within the Yerramullah Nature Reserve (Plate 6). Plants on the road verge were found to be larger and more vigorous in the roadside drain than the plants within the undisturbed vegetation (Plate 7). The population was found to extend into Wongonderrah Nature Reserve (NR) to the south and the adjacent UCL. The associated vegetation was characterised by *Banksia telmatiaea* 1m, *Beaufortia squarrosa* 1.4m, *Acacia pulchella* 1m, *Jacksonia hakeoides*, *Kingia australis* 0.5m, emergent *Adenanthos cygnorum* 1.5 to 2m, *Petrophile seminuda* Western Swamps Form 1m, *Isopogon panduratus* subsp. *palustris* P2 1.5m, *Patersonia occidentalis* 0.5m, *Verticordia densiflora* 0.7m, *Regelia ciliata* 1m, *Hypocalymma angustifolium* 0.6m, *Kunzea recurva* 1m, *Andersonia gracilis* 0.4m (DRF), *Cyperaceae* spp, and *Restionaceae* spp, PFC 70 to 80%.



Plate 6 Site of Hislop and Hort (MH 3403) record of *Baeckea* sp. Perth Region (R.J. Cranfield 444) (Yerramullah N.R)



Plate 7 Healthy, flowering plants at the site of Hislop and Hort (MH 3403) record of *Baeckea* sp. Perth Region (R.J. Cranfield 444)

No *Baeckea* sp. Perth Region (R.J. Cranfield 444) plants were found at the Keighery & Keighery (433) coordinates; however, a population was found approximately 250m to the east of this location (Plate 8). The *Baeckea* sp. Perth Region (R.J. Cranfield 444) was considered as the co-dominant species in a low shrubland with *Banksia telmatiaea* 0.7m, *Calothamnus hirsutus* 0.3m, *Melaleuca brevifolia* 1m, *Grevillea* sp. 0.4m, PCF 60-70%.

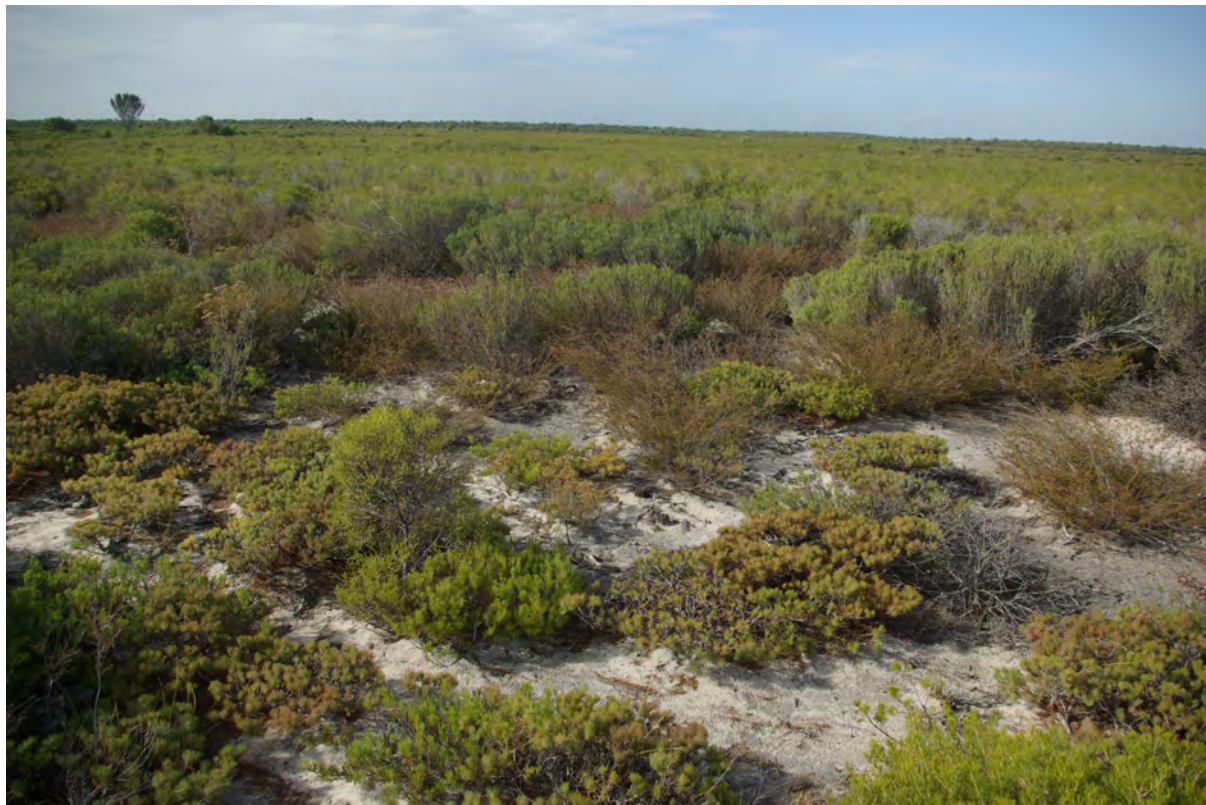
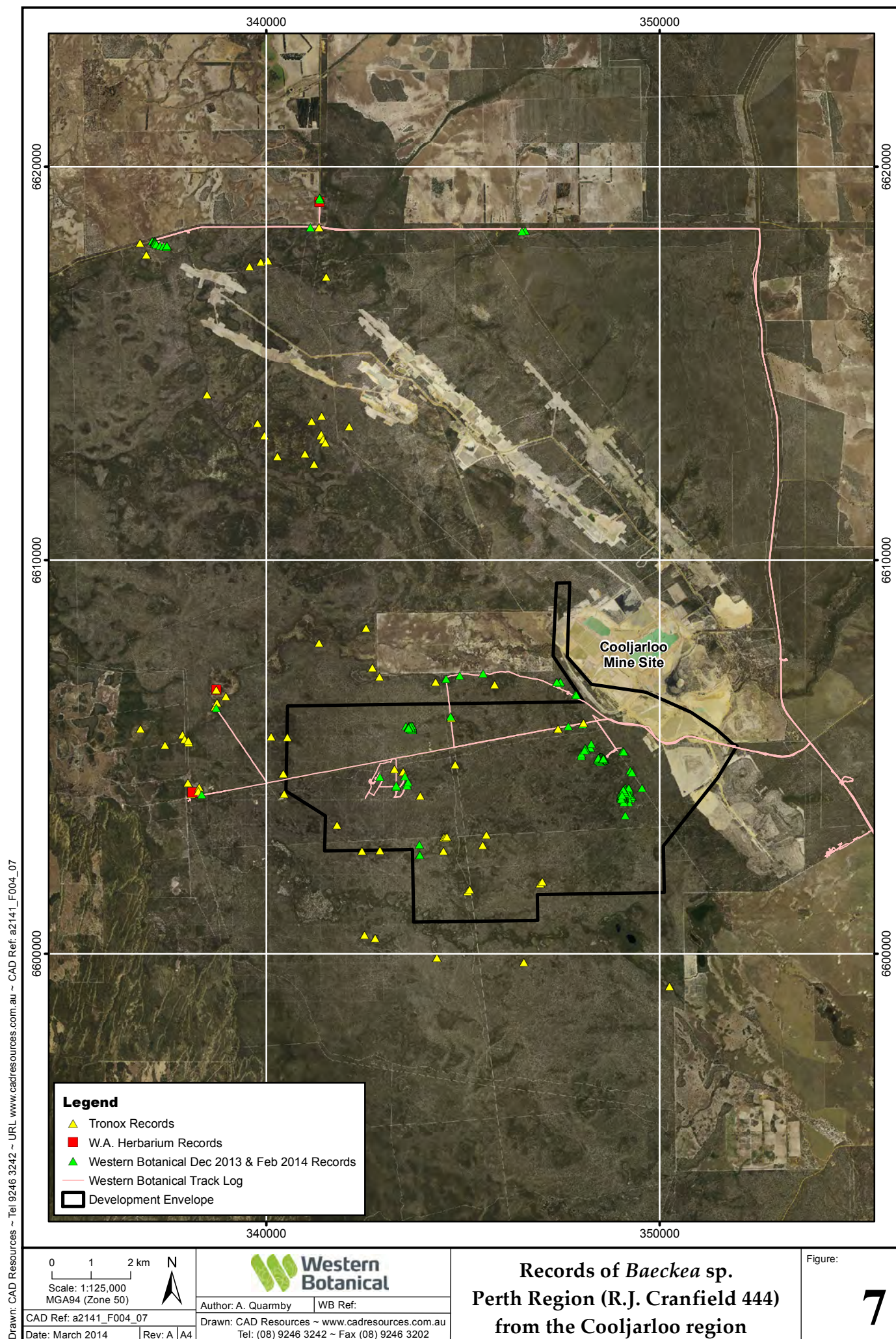


Plate 8 *Baeckea* sp. Perth Region (R.J. Cranfield 444) population 250m east of Keighery & Keighery (433) coordinates

Western Botanical also recorded new locations of *Baeckea* sp. Perth Region (R.J. Cranfield 444) within the Cooljarloo West Development Envelope and surrounding UCL and Nature Reserves. These new locations were all within ephemeral wetlands with heaths of *Banksia telmatiaea* and *Verticordia densiflora* (Figure 7, Plate 9). In most cases, *Baeckea* sp. Perth Region (R.J. Cranfield 444) was locally common and sometimes co-dominant. The coordinates and population estimates are provided in Appendix 4.



Plate 9 *Baeckea* sp. Perth Region (R.J. Cranfield 444) population within the Cooljarloo West Development Envelope (WP 211, PE 345)



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CAD Ref: a2141_F004_07
Date: March 2014
Rev: A A4

Populations in the Perth area.

The records of *Baeckea* sp. Perth Region (R.J. Cranfield 444) from the Perth area were also assessed in February 2014. The coordinates listed for each of these records were found to be incorrect; however, using the location descriptions the first two of the locations were re-confirmed (Keighery 12705 and Cranfield 1679) (Table 3 and Figure 8).

Table 3 Corrected records of *Baeckea* sp. Perth Region (R.J. Cranfield 444) from Perth

Collector & WA Herbarium Specimen I.D.	Site	Zone	Easting	Northing
Keighery, G.J. Coll No: 12705 PERTH 04099672	Record	50 H		
	Correct location	50 H		
Cranfield, R.J. Coll No: 1679 PERTH 03377962	Record	50 H		
	Correct location	50 H		
Cranfield, R.J. Coll No: 444 PERTH 03378454	Record	50 H		
	Correct location *	50 H		

* Estimation due to fenced, private properties

The Keighery 12705 record was estimated to have >1,000 plants, spanning more than a kilometre along Mundijong Road. In parts, it was the dominant plant and was associated with *Verticordia densiflora*, *Melaleuca viminea*, *Hakea varia*, *Meeboldina cana* and *Ficinia nodosa* (Plate 10).

The Cranfield 1679 record was found to be situated within a Bush Forever site (55) (Plate 11). *Baeckea* sp. Perth Region (R.J. Cranfield 444) was growing with *Verticordia densiflora*, *Leptospermum* sp., *Callitris pyramidalis*, *Regelia ciliata*, *Hypolaena pubescens*, and *Meeboldina cana*. The population extent and size was not quantified by Western Botanical.

The site of the Cranfield (444) record was not re-confirmed; however, it is possible that the original population may still exist. There were multiple private properties (properties not searched by Western Botanical) along Brentwood Road, some with winter wet depressions and possible suitable habitat.

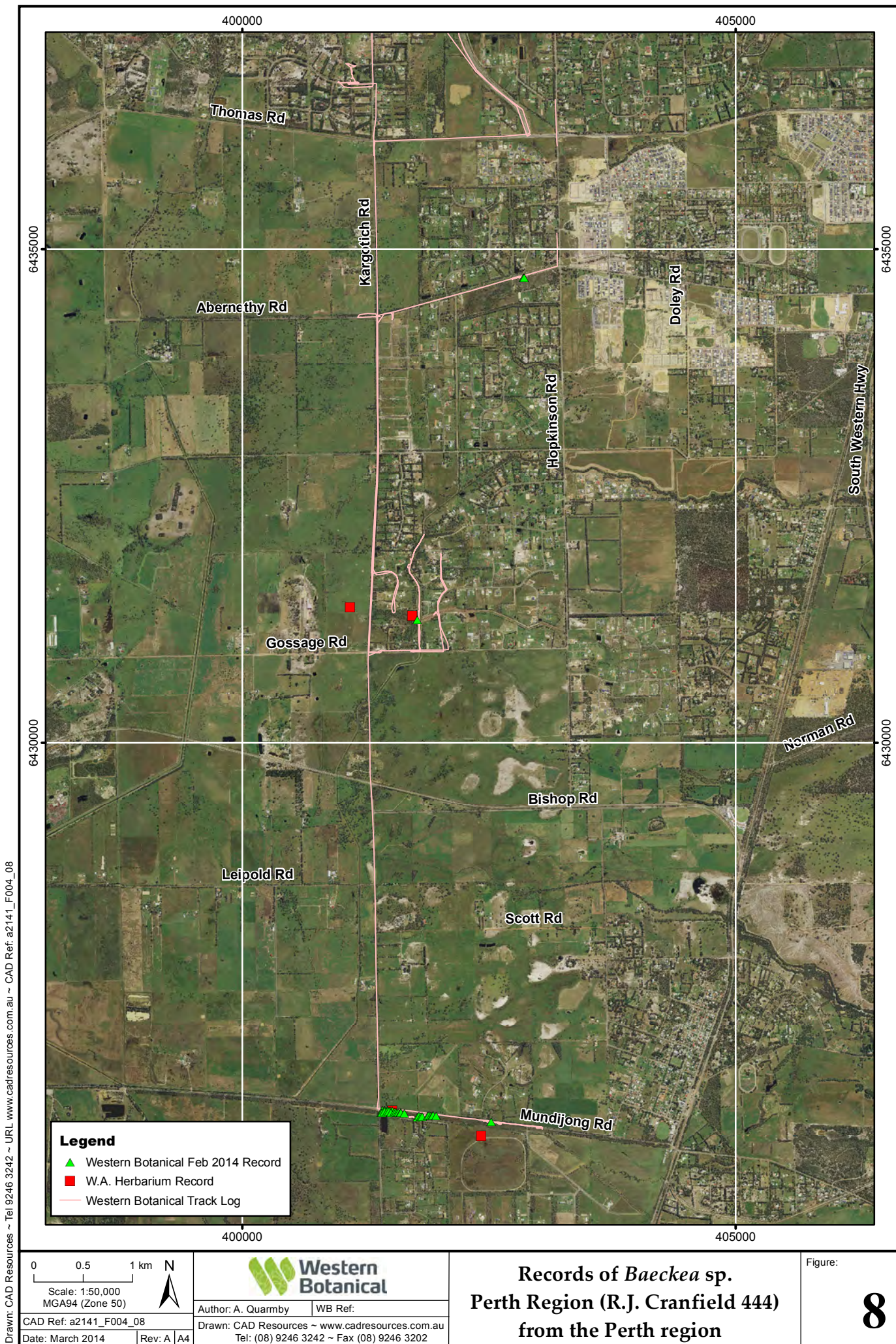
A new population was also recorded while searching for the records. This population may be under threat as there were only two plants, situated along a private fence line.



Plate 10 Site of Keighery 12705 record of *Baeckea* sp. Perth Region (R.J. Cranfield 444)



Plate 11 Site of Cranfield 1679 record of *Baeckea* sp. Perth Region (R.J. Cranfield 444)



3.3. Other Threatened or Priority Flora

During the surveys Western Botanical opportunistically recorded individuals of some threatened and other priority species (Table 4). Each of these records will be lodged with DPaW via *Threatened and Priority Flora Report Forms*.

Table 4 Records for non-target Threatened and Priority Flora

Field Label	No of Plants	Map Grid Cell	Easting	Northing	Location
<i>Andersonia gracilis</i> (DRF)	1	50J			Near Lake Guraga
<i>Calothamnus brevifolius</i> (P2)	>50	50J			Near Lake Guraga
<i>Hypocalymma</i> sp. (possible new species)	>50	50J			Near Lake Guraga
<i>Isopogon panduratus</i> subsp. <i>palustris</i> (P2)	1	50J			Wongonderrah
<i>Isopogon panduratus</i> subsp. <i>palustris</i> (P2)	<100	50J			Wongonderrah

4. Discussion

4.1. *Malleostemon* sp. Cooljarloo (B. Backhouse s.n. 16/11/88)

Western Botanical was able to re-confirm three of the existing records of *Malleostemon* sp. Cooljarloo (B. Backhouse s.n. 16/11/88). This included the population in the southern corner of the Tronox mining lease and two from east of Lake Guraga.

The Mattiske record (41,553 plants) of *Malleostemon* sp. Cooljarloo from within the Cooljarloo West Development Envelope was found to be *Baeckea* sp. Perth Region (R.J. Cranfield 444). No new populations of *Malleostemon* sp. Cooljarloo were found within the Cooljarloo West Development Envelope. Due to survey effort limitations, Western Botanical was unable to search all ephemeral wetlands within the Development Envelopment that might be suitable habitat for *Malleostemon* sp. Cooljarloo..

It is also possible that there may be further *Malleostemon* sp. Cooljarloo sub populations within the south eastern corner of the Tronox Mining lease near the site of the type location.

4.2. *Baeckea* sp. Perth Region (R.J. Cranfield 444)

Baeckea sp. Perth Region (R.J. Cranfield 444) was found to occur within most ephemeral winter-wet depressions that were searched by Western Botanical in the Cooljarloo area. As such, Western Botanical believes that the occurrence of this species within the Cooljarloo West Development Envelope is far more extensive than current records indicate, The majority of the records from the Cooljarloo region have not been quantified, either in numbers of plants present or area of occupancy.

The taxonomic review of *Baeckea* sp. Perth Region (R.J. Cranfield 444) by Mr. Malcolm Trudgen found that plants from the two disjunct regions varied in the number of ovules and morphology of the anthers. As such it is likely that this species will be split into two subspecies. Furthermore, it appears that there is hybridisation in the Cooljarloo region between this species and *Malleostemon* sp. Cooljarloo (B. Backhouse s.n. 16/11/88) (Malcolm Trudgen *et. al.*, in prep.). If taxonomic separation occurs, the Perth region populations will likely be seen as at higher risk because of its proximity to the Perth metropolitan area, with habitat loss from development, leaving small remnants in less secure tenure. The northern populations at Cooljarloo-Wongonderrah will likely retain the current P3 ranking as it is the larger, and is still in relatively undisturbed vegetation.

As predicted, most of the older records at the WA Herbarium were found to have incorrect coordinates. It is believed they have been have been estimated from maps during database preparation at the WA Herbarium.as hand held GPS devices were not readily available.

5. Limitations

Due to the large area available for survey at Cooljarloo and Perth and limitations on time in the field, it was not possible to search all ephemeral wetlands that represent potential habitat for either *Malleostemon* sp. Cooljarloo (B. Backhouse s.n. 16/11/88) or *Baeckea* sp. Perth Region (R.J. Cranfield 444) within the Cooljarloo West Development Envelope, adjacent Unallocated Crown Land, DPaW managed lands and private holdings

6. Acknowledgements

We wish to thank Mr Malcolm Trudgen for review and confirmation of specimens of *Malleostemon* sp. Cooljarloo and *Baeckea* sp. Perth Region and for his advice on the taxonomic status of the latter.

7. References

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Western Botanical (2014), WB819 *Paracaleana dixonii* Targeted Regional Surveys, *Prepared for Tronox Management*.

8. List of Participants

Project Manager /Senior Botanist	Geoff Cockerton
Botanist	Alice Quarmby
Consulting Botanist (M.E. Trudgen and Associates)	Malcolm Trudgen

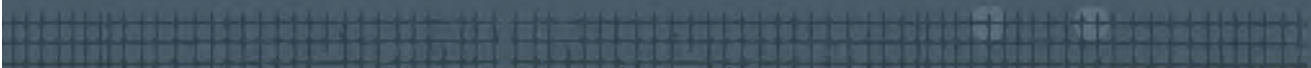
Appendix 1, 2, 3, 4, & 5 have been omitted due to confidentiality requirements



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Zone	Easting	Northing	# Plants	Comments
Population outline				

[illegible]



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