# Targeted Flora Survey

# *Acacia* sp. East Fortescue

**Prepared for BHP Billiton Iron Ore Pty Ltd**
**November 2015**

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# 1.0 INTRODUCTION

A recent baseline flora and vegetation survey at the Orebody 31 project area by Onshore Environmental (2014a) recorded a new *Acacia* species, known as *Acacia* sp. East Fortescue [previously referred to as *Acacia* sp. nov (reticulate/anastomosing)]. A follow-up targeted flora survey defined numbers of plants and population boundaries (Onshore Environmental 2014b).

*Acacia* sp. East Fortescue occurs as a woody shrub with rounded growth form, ranging between 1.5 m and 5.0 m in height and 1.0 m to 5.0 m in width. However burnt stags suggest mature plants may reach up to 7.0 m in height. It has five diagnostic characters:

- flat phyllodes with anastomosing nerves;
- cylindrical spike;
- calyx lobes separated;
- gland about 10 mm above the pulvinus; and
- dense red brown glandular trichomes on new growth and edges of phyllodes (small hairlets).

It is so odd that its affinities are unknown (B. Maslin, pers. comm.). It is currently listed as a Priority 1 flora, but the conservation code may be increased to the status of Threatened Flora in the near future.

In 2015 BHP Billiton Iron Ore committed to undertaking targeted surveys aimed at recording and documenting the distribution and population sizes(s) of *Acacia* sp. East Fortescue, and furthering the understanding of its habitat and ecological requirements. This work was required to inform the conservation status and future management requirements for this recently discovered taxon.

# 2.0 METHODOLOGY

## 2.1 Phase 1 - Defining local populations at OB31

Targeted searches for *Acacia* sp. East Fortescue commenced by re-surveying known populations at OB31 to update population data and collate similarities in geology, landform, soil and vegetation across populations. The local survey effort was extended over 64 $km^2$ of BHP Billiton Iron Ore tenure surrounding the known populations (Figure 1). The area was divided into a 1 $km^2$ grid and transects were ground truthed at this scale. Binoculars were used to scan surrounding landforms during the field survey, and there was intensive survey of landform and vegetation associations that reflected the known populations.

## 2.2 Phase 2 - Targeted searches based on geology

Within the OB31 tenement, *Acacia* sp. East Fortescue appeared to be habitat specific, occurring on orange rock exposed from the weathering of eroded BIF ironstone present on low undulating hills (typically with overhangs and cave formations). More specifically, populations were positioned along the boundary of two geological formations, the Boolgeeda Iron Formation and Woongarra Rhyolite [1]. The intersection of these two geological formations (i.e. the alignment where the two formations meet) was used as the parameter to define the first regional phase of targeted searches. Broad scale geological mapping confirmed the distribution of the Boolgeeda Iron Formation and Woongarra Rhyolite across three broad areas (Figure 2):

[1] Interestingly, plants did not occur consistently across the entire range of this geology but was restricted to six localised populations.

1. South-east Pilbara - extending along an approximate 100 km strike aligned north-west to south-east from north of Newman to south-east of the Jimblebar Mine;
2. Karijini National Park - extending east-west (75 km strike) along the southern sector of Karijini National Park and fyrther south into the Mt Channar, Snowy Mountain and Turee Creek East region; and
3. Western Pilbara - extending north-west (175 km strike) from BHPBIOs Rocklea tenement to west of Pannawonica.

Given the wide extent of the target geology, it was proposed to focus the second phase of targeted seaches within the south-east Pilbara (Figure 3), with ground truthing commencing at the OB31 tenement and moving outwards following the favoured geological strikes. Fine scale geology mapping was sourced to provide accurate refinement of target areas and local road and track layers were overlayed to determine potential access by vehicle and on foot.

The first phase targeted survey was completed by two botanists working over a seven day period (25-31 March 2015). Targets identified during the desktop review (Figure 3) were accessed as close as possible by vehicle, however poor vehicular access into the majority of targets restricted thorough coverage on foot. Ground truthing of defined targets occurred along transects following the target geology. The area covered during the Phase 2 targeted survey is represented in Figure 4, noting that restricted access prevented coverage of the wider target areas.

## 2.3 Phase 3 - Targeted searches based on landform

The Phase 3 targeted field survey utilised a species distribution model (Atlas of Living Australia 2015) that linked records from known populations of *Acacia* sp. East Fortescue at the OB31 tenement with relevant environmental data, to predict areas that may be suitable for the species. The parameters selected for the model were elevation, slope, soil depth, and lithology age, along with temperature and rainfall. The models provided a number of targets with >80 percent similarity to the OB31 tenement (Figure 5). Five of the targets were situated within a 150 km radius of the OB31 tenement and intersected by the Great Northern Highway or arterial roads and tracks, providing access by vehicle and foot. The five targets were referred to as Jigalong, Balfour, Newman South East, Newman South West and Karijini (Figure 5).

The Phase 3 targeted survey was completed by two botanists from Onshore Environmental working over a five day period from the 2nd to the 6th August 2015. Where possible, target areas were accessed by vehicle. At locations determined worthwhile and prospective for *Acacia* sp. East Fortescue, transects were then completed on foot for up to 3 km in length. The area covered during the Phase 3 targeted survey is represented in Figure 4, noting that access restricted coverage of the wider target areas.

# 3.0 RESULTS

## 3.1 Description of *Acacia* sp. East Fortescue

*Acacia* sp. East Fortescue is a spreading rounded shrub, 1.5-4.0 m tall, branching at ground level into a number of spreading main stems, with rounded crowns which are bushy, dark green (Plate 1), and 1.0-4.0 m wide. Older plants have slightly gnarled appearance (not dissimilar to *A.levata, A.xiphophylla* and *A.cuthbertsonii).* Bark grey to dark grey, longitudinally fissured and fibrous towards the base of mature stems (Plate 2), becoming smoorth towards the ends of branches (Plate 3).

Branchlets terete, slightly angular at extremities, dense indumentum of appressed, short, flattened hairs, finely ribbed, ribs with a dense indumentum of red-brown, glandular trichomes, indumentum obscured by a moderately thick layer of yellow translucent resin, aging glabrous and grey. New shoots resinous with a dense indumentum of pale yellow to white appressed hairs, expanding phyllodes with a dense indumentum of red-brown glandular trichomes on the margin. Stipules triangular, red-brown, (0.4-)0.5–0.65 mm long. Phyllodes narrowly elliptic, (36-)38-72 mm long (occasionally interspersed with a few less than 35 mm long), 4.1-8.7 mm wide, l: w = 5.0-13.4, ascending to erect, straight to shallowly incurved or shallowly recurved, moderate indumentum of short, appressed hairs, green, resinous, indumentum and resin becoming sparse with age; longitudinal nerves numerous, 1-3 slightly more pronounced with longitudinal anastomosing minor nerves in between (Plate 4); marginal nerve pale yellow to white with a thin layer of translucent, red-brown resin becoming scattered to absent with age; apices acute to acuminate, straight to curved; pulvinus 2.0-5.3 mm long. Gland on upper margin of phyllode (2.9-)3.4-13.4 mm above the pulvinus, not prominent. Inflorescences simple or vestigial racemes 0.5-0.8 mm long, initiated in the axils of young phyllodes; peduncles 3.0-6.2 mm long, sparse to moderate indumentum of short, appressed hairs, resinous; basal peduncular bract single, ovate, 1.0-1.4(-1.65) mm long, yellow to red-brown, moderate indumentum of appressed, simple hairs; spike cylindrical, (10-)11.5-25(-27) mm long, flowers dense (Plate 5). Bracteoles 0.9-1.1 mm long; claws narrowly oblong to linear, glabrous; lamina ovate, thickened proximally, ciliolate and with scattered glandular trichomes. Flowers 5-merous; sepals united for up to ¼ (-almost ½ ) of their length, 0.5-1.1 mm long, narrowly ovate, slightly expanded at the apex, sparsely papillose on margins becoming denser at apex along with simple hairs, abaxial face at apex papillose; petals 1.3-1.8(-1.9) mm long, glabrous, 1-nerved; ovary densely sericeous. Pods (few seen, see Plates 6-7)[2] narrowly oblong, flat, scarcely raised over seeds and shallowly to moderately constricted between them, 17-32.5 mm long, 2.7-4.0 mm wide, coriaceous-crustaceous, straight, resinous but not sticky, green to brown, sparse indumentum of appressed, white hairs, numerous anastomosing longitudinal nerves; marginal nerve discrete, yellow. Seeds (1 seen, see Plates 8-9) longitudinal in pods, obloid-ellipsoid, 4.3 mm long, 2.2 mm wide, brown; areole ‘u-’ shaped, very small (0.3 mm long); funicle expanded into a small, terminal aril.

## 3.2 Flowering Period

Flowers have been recorded from the OB31 population between late April and early August (Plate 5). Pods containing one viable seed were first collected in September 2014 (Plate 6 and 7), with additional pods and seeds collected in mid October 2015.

## 3.3 Affinities

Initial inspection of specimens by *Acacia* specialist at the WAH, Mr Bruce Maslin, suggests the affinities are unknown (B. Maslin, pers. comm.).

Based on comparisons by Onshore Environmental it is aligned to *Acacia levata* and *Acacia cuthbertsonii* subsp. *cuthbertsonii. Acacia levata* is restricted to the central eastern sector of the Pilbara (around Marble Bar) occurring on undulating low rocky hills. It is differentiated by longer and wider phyllodes. *Acacia cuthbertsonii* subsp. *cuthbertsonii,* which does not appear to occur in the Pilbara[3], is differentiated by smaller and narrower phyllodes. However, neither of these two taxa occur within the vicinity of Orebody 31.

[2] The unattached pod was opened to examine the seed. Only one seed was present but there were also 12 aborted/unfertilised ovules. It can be assumed that had the ovules formed mature seeds then the pod would be much longer and possibly may not have been constricted between the seeds.
[3] There is one specimen of *A. cuthbertsonii* subsp. *cuthbertsonii* at the WAH collected from the Hamersley Range, but this record has not been verified despite intensive collecting over the past 20 years.

Field observation confirms that *Acacia ancistrocarpa* occurs with *Acacia* sp. East Fortescue at OB31 and has similar coloured phyllodes with variable anastomosing longitudinal nerves (not as prominent as *Acacia* sp. East Fortescue). *Acacia adsurgens* was recorded growing alongside *Acacia* sp. East Fortescue on breakway ridges and slopes, and has a similar growth form. Similarly, variable specimens within the *Acacia sibirica / kempeana* complex were recorded on target landforms during the field survey. Hybridisation within this group is known to occur and likely contributing to variability observed in the field.

## 3.4 Population Statistics

*Acacia* sp. East Fortescue (J. Bull & D. Roberts ONS A 27.01) was recorded as 567 plants from three populations[4] occurring across approximately 8.1 ha situated along the north-west boundary of BHP Billiton Iron Ore's OB31 tenement (Figure 6, Table 1). Populations ranged from 0.6 ha to 5.5 ha in area and supported between 105 plants and 348 plants.

**Table 1 Representation of *Acacia* sp. East Fortescue (J. Bull & D. Roberts ONS A 27.01) at OB31.**

| Population | MGA94 Easting | MGA94 Northing | No. sub-popns | No. plants | Approx. area (m) | Approx. area (ha) |
|---|---|---|---|---|---|---|
| 1a | 201663 | 7420296 | 3 | 209 | 200 by 100 | 2.0 |
| 1b | 201922 | 7420539 | 5 | 105 | 300 by 100 | 3.0 |
| 1c | 202307 | 7420698 | 2 | 34 | 100 by 50 | 0.5 |
| 2 | 202763 | 7420207 | 4 | 114 | 200 by 100 | 2.0 |
| 3a | 204014 | 7420180 | 2 | 72 | 100 by 50 | 0.5 |
| 3b | 204116 | 7420271 | 3 | 33 | 50 by 20 | 0.1 |

## 3.5 Habitat

*Acacia* sp. East Fortescue was recorded from low undulating hills at elevations ranging between 518 m and 555 m AHD (Plate 10). Approximately 44 percent of recorded plants occurred where slope angle was less than ten degrees, 49 percent of plants occurred where slope angle was between 10 and 20 degrees, and seven percent occurred where slope angle was between 20 and 28 degrees. Aspect did not appear to be a contributing factor.

Plants were concentrated around the breakaway slopes of relatively low undulating hills (overhangs and small caves were characteristic) and along adjacent minor drainage lines dissecting the low hills. Plants were less commonly recorded on neighbouring hill crests and larger unicised drainage lines supporting Mulga Forest. Soil was consistently a red to orange sandy loam.

*Acacia* sp. East Fortescue appeared to be habitat specific within the OB31 area, occurring along a fault line at the intersection of two geological formations that occur within the Hamersley Group BIFs; Boolgeeda Iron Formation and Woongarra Rhyolite (Plate 11). The Boolgeeda Iron Formation typically overlies the Woongarra Rhyolite. However, at OB31 *Acacia* sp. East Fortescue was recorded in areas where the Boolgeeda Iron Formation was heavily weathered, exposing the underlying Woongarra Rhyolite at surface.

The Boolgeeda Iron Formation is the youngest BIF in the Hamersley Group and consists predominantly of interbedded shaly BIF. It is described by Trendall (1995) as fine-grained,

[4] In biological terms, a population is a discrete group of interbreeding individuals of a species. For the purposes of this report, plants more than 500 m from a known population are considered to be a new population.

finely laminated, dark grey-brown to black flaggy iron-formation, minor chert, jaspilite, shale. Rhyolite is an igneous, volcanic rock, of felsic composition with a mineral assemblage of quartz, sanidine and plagioclase. Woongarra Rhyolite has been described as rhyolite, rhyodacite, rhyolitic volcaniclastic breccia and banded iron formation (Trendall 1995).

## 3.6 Vegetation Associations

*Acacia* sp. East Fortescue was recorded from breakaway ridges and minor ephemeral drainage lines dissecting relatively low undulating hills. At one site plants were recorded as established trees with dense Mulga along a medium drainage line. At all locations there was clear evidence of surface weathering of the Boolgeeda Iron Formation exposing the underlying Woongarra Rhyolite. Vegetation within the majority of populations had been subjected to a hot burn within the past three years. The following vegetation descriptions were made across the three populations:

- Hummock Grassland of *Triodia pungens* with Open Shrubland (to Shrubland) of *Dodonaea petiolaris, Eremophila latrobei* and *Acacia* sp. East Fortescue and Scattered Tall Shrubs of *Grevillea berryana* and *Acacia* sp. East Fortescue on breakaway hill slopes;
- Hummock Grassland of *Triodia pungens* and *Triodia* sp. Shovelanna Hill (S. Van Leeuwen 3835) with Low Open Shrubland of *Mirbelia viminalis, Solanum lasiophyllum* and *Solanum centrale* and High Open Shrubland of *Acacia* sp. East Fortescue and *Acacia adsurgens* on breakaway hill slopes;
- Open Hummock Grassland of *Triodia* sp. Shovelanna Hill (S. Van Leeuwen 3835) with Low Open Woodland of *Eucalyptus leucophloia* subsp. *leucophloia* and Low Open Shrubland of *Acacia hilliana* and *Acacia adoxa* subsp. *adoxa* on lower hill slopes fringing minor drainage lines;
- Hummock Grassland of *Triodia pungens* and *Triodia* sp. Shovelanna Hill (S. Van Leeuwen 3835) with High Open Shrubland of *Acacia* sp. East Fortescue and *Grevillea berryana* and Open Shrubland of *Eremophila latrobei* subsp. *latrobei, Senna stricta* and *Acacia* sp. East Fortescue on minor drainage lines dissecting undulating low hills;
- Closed Scrub of *Acacia monticola, Acacia bivenosa* and *Grevillea wickhamii* over Hummock Grassland of *Triodia pungens* with Low Open Woodland of *Eucalyptus leucophloia* subsp. *leucophloia* on minor drainage lines dissecting undulating low hills;
- Hummock Grassland of *Triodia pungens* and *Triodia* sp. Shovelanna Hill (S. Van Leeuwen 3835) with Shrubland of *Acacia* sp. East Fortescue, *Acacia aptaneura* and *Eremophila latrobei* subsp. *latrobei* and Low Open Woodland of *Eucalyptus leucophloia* subsp. *leucophloia* on upper reaches of minor drainage lines; and
- Low Closed Woodland of *Acacia aptaneura* over Hummock Grassland of *Triodia pungens* and *Triodia* sp. Shovelanna Hill (S. Van Leeuwen 3835) with Open Shrubland of *Acacia wanyu, Senna stricta* and *Eremophila latrobei* subsp. *latrobei* on unincised medium drainage lines at the base of low hills.

# 4.0 SUMMARY

*Acacia* sp. East Fortescue is a new taxon recorded as 567 plants from three populations occurring across approximately 8.1 ha situated along the north-west boundary of BHP Billiton Iron Ore's OB31 tenement. Populations ranged from 0.6 ha to 5.5 ha in area and supported between 105 plants and 348 plants.

Plants were concentrated along breakaway slopes of relatively low undulating hills (518 m and 555 m AHD) where overhangs and small caves were characteristic of the landform. The population typically extended onto lower hill slopes and into minor drainage lines dissecting the low hills.

The three known populations of *Acacia* sp. East Fortescue occur along a fault line at the intersection of two geological formations within the Hamersley Group BIFs; Boolgeeda Iron Formation and Woongarra Rhyolite. Plants were growing in areas where the Boolgeeda Iron Formation had been heavily weathered, exposing the underlying Woongarra Rhyolite at surface.

An intensive targeted survey covering 65 $km^2$ surrounding the three known populations of *Acacia* sp. East Fortescue at Orebody 31 failed to record any additional plants. Geological and landform modelling identified broad regional targets that were difficult to access by vehicle and on foot. Areas that could be accessed as part of targeted searches completed during 2015 did not record any additional populations of *Acacia* sp. East Fortescue. It is noted that there were significant limitations that restricted access during the regional targeted surveys. There are additional targets situated further east and south-east that are also of interest but cannot be safely accessed.

# PLATES

**Plate 1 Habit**

**Plate 2 Bark at base of mature stems**

**Plate 3 Bark at ends of branches**

**Plate 4 Phyllodes**

**Plate 5 Influorescence**

**Plate 6 Sub mature pod**

**Plate 7** **Open pod. Note the number of aborted / unfertilized ovules.**

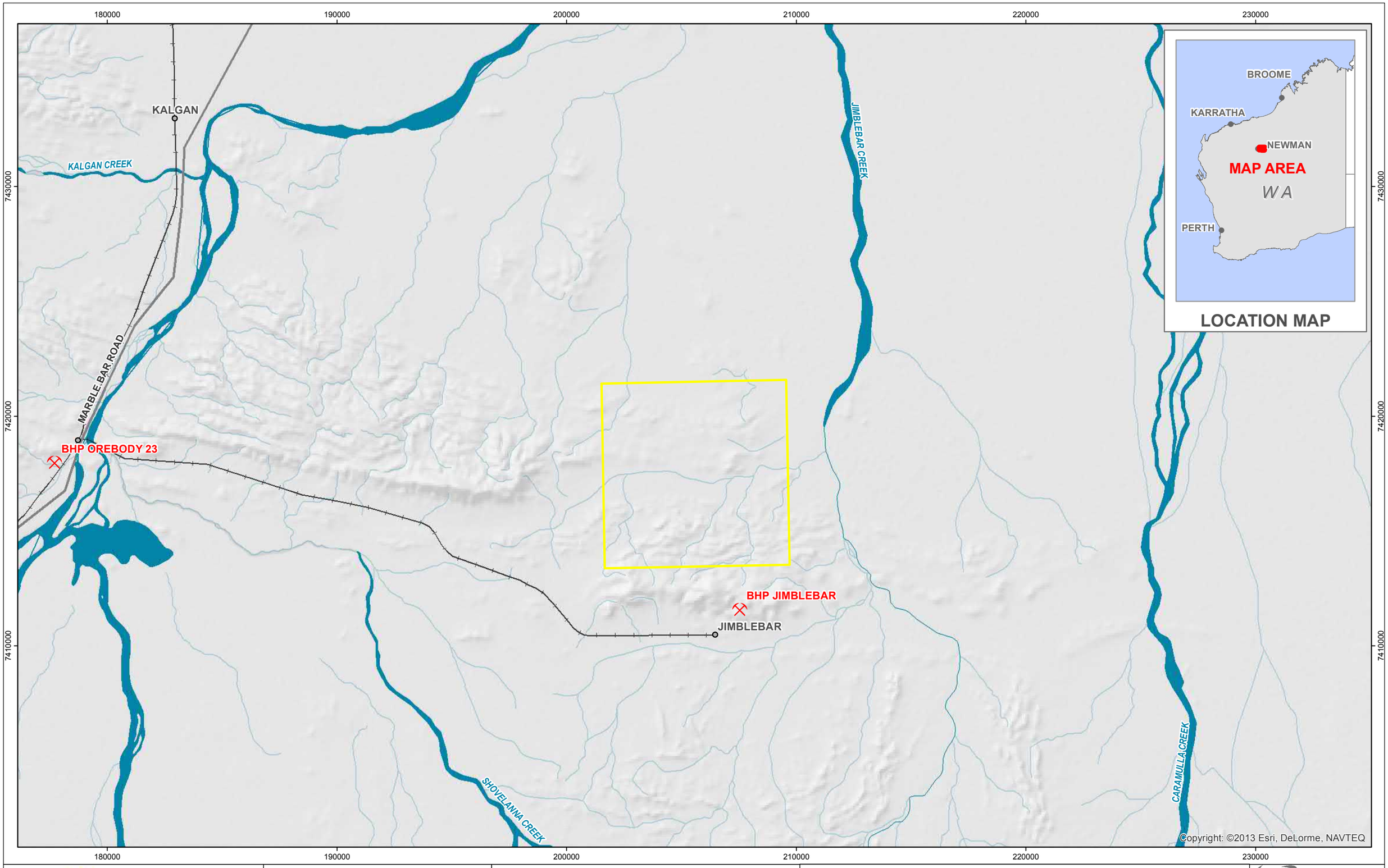
**Plate 8** **Seed. Note the small, obscure areole near the centre of the seed.**

**Plate 9 Aborted / unfertilized ovules.**

**Plate 10 Landform**

**Plate 11 Surface geology**

# FIGURES

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Kilometers

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Datum: GDA94

Projection: MGA Zone 51

# BHPBIO

## FIGURE 1

**Phase 1 targeted survey area for *Acacia* sp. East Fortescue, surrounding Orebody 31**

**Legend**

- Study Area
- Places
- Operating Mines
- Watercourses
- Roads
- Railways

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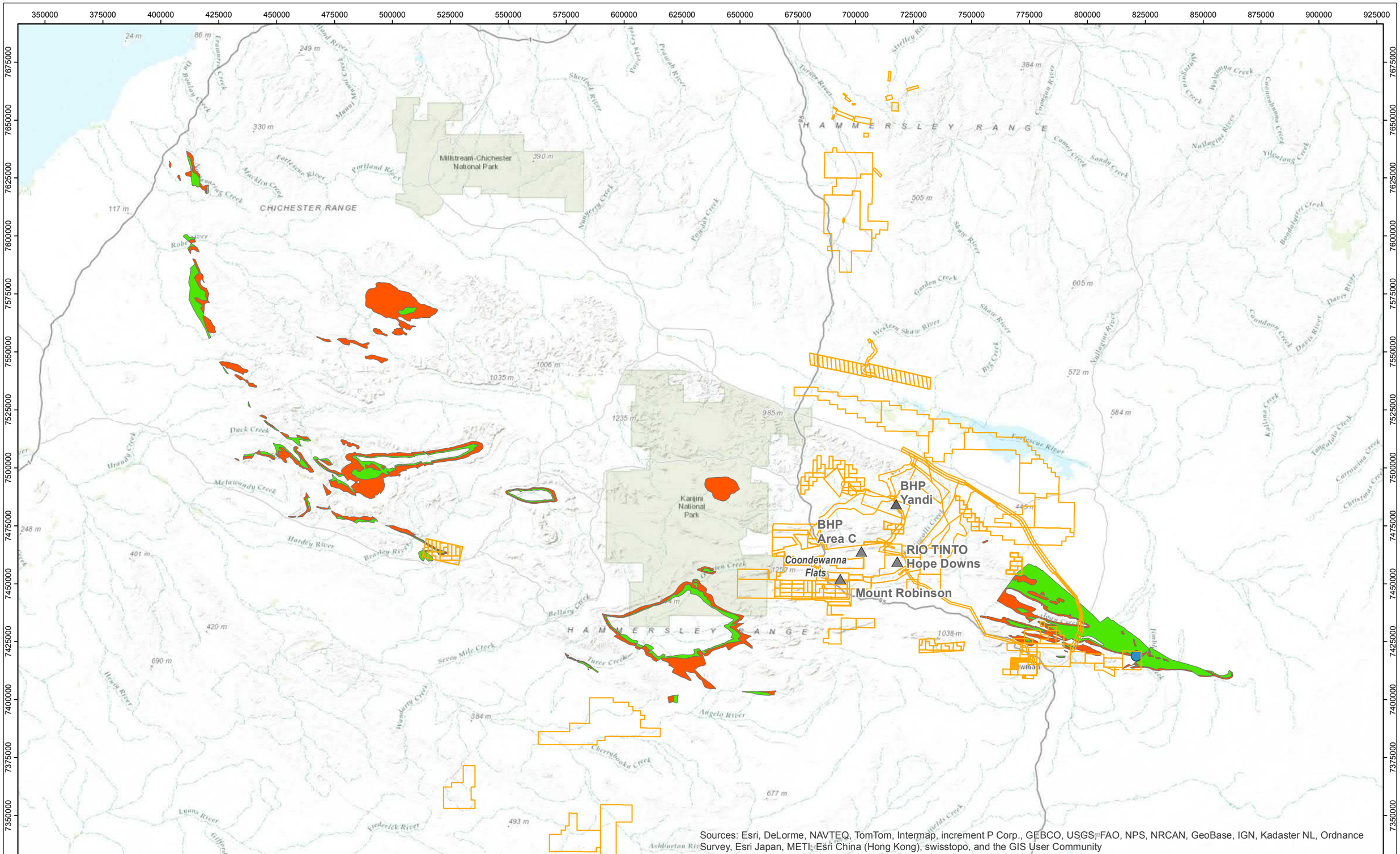


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# BHPBIO

## FIGURE 2
## Distribution of the Boolgeeda Iron Formation and Woongarra Rhyolite

**Legend**

- BHP Tenure

**500k Geology**

- BOOLGEEDA IRON FORMATION
- WOONGARRA RHYOLITE

**Significant**

- *Acacia* sp. East Fortescue

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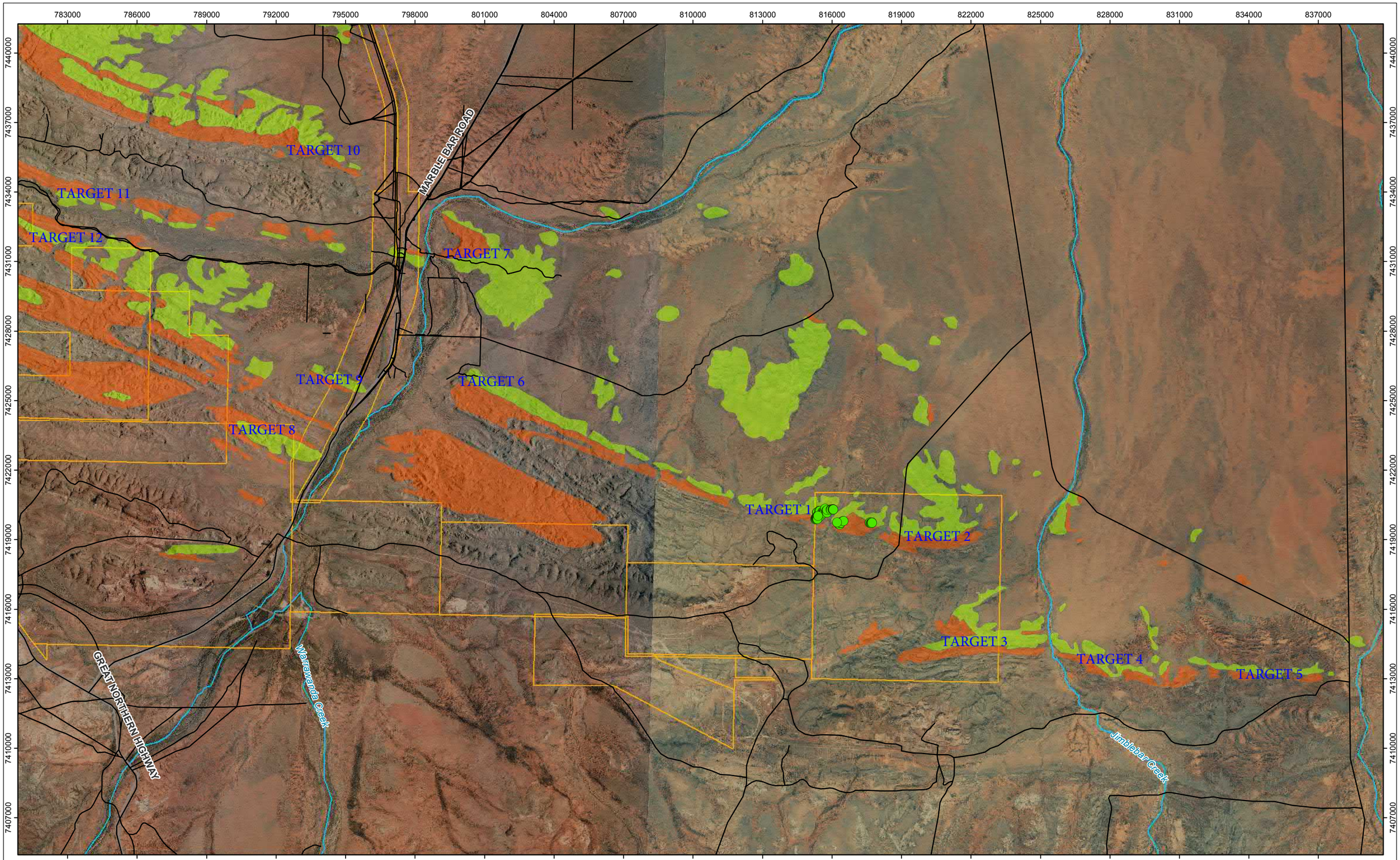


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Projection: MGA Zone 51

# BHPBIO

## FIGURE 3

## Phase 2 Targeted survey locations for *Acacia* sp. East Fortescue

**Legend**

BHP Tenure

**Significant**

*Acacia* sp. East Fortescue

**Target Geology**

Boolgeeda Iron Formation

Woongarra Rhyoloite

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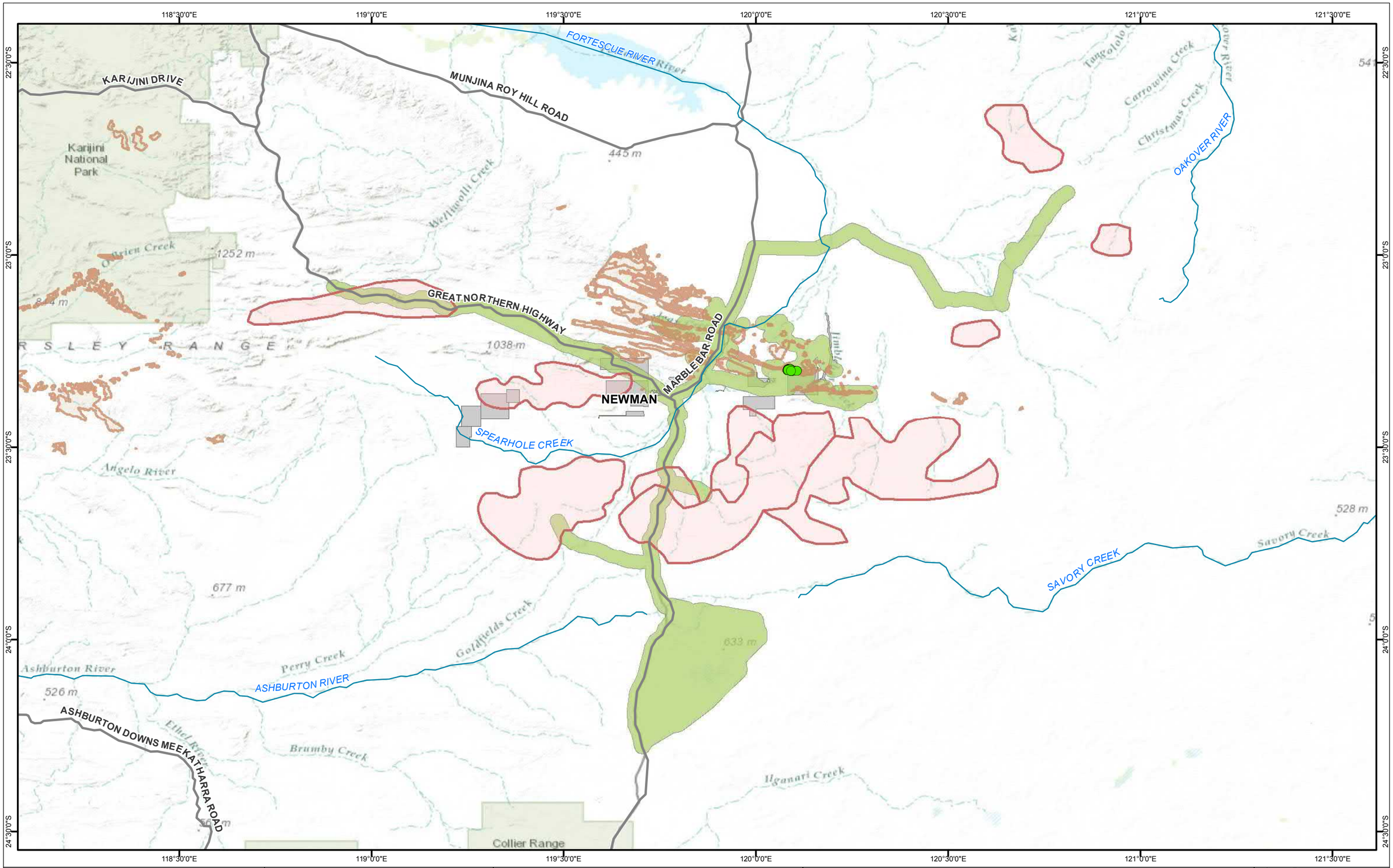


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## FIGURE 4
## Overview of Phase 1, 2 and 3 targeted survey areas defined, and actual area surveyed in the field

**Legend**

- Survey Effort
- Phase 2 target areas - geology
- Phase 3 target areas - elevation, slope, soil depth
- Previous Surveyed Areas

**Genus / Species**

- *Acacia* sp. East Fortescue

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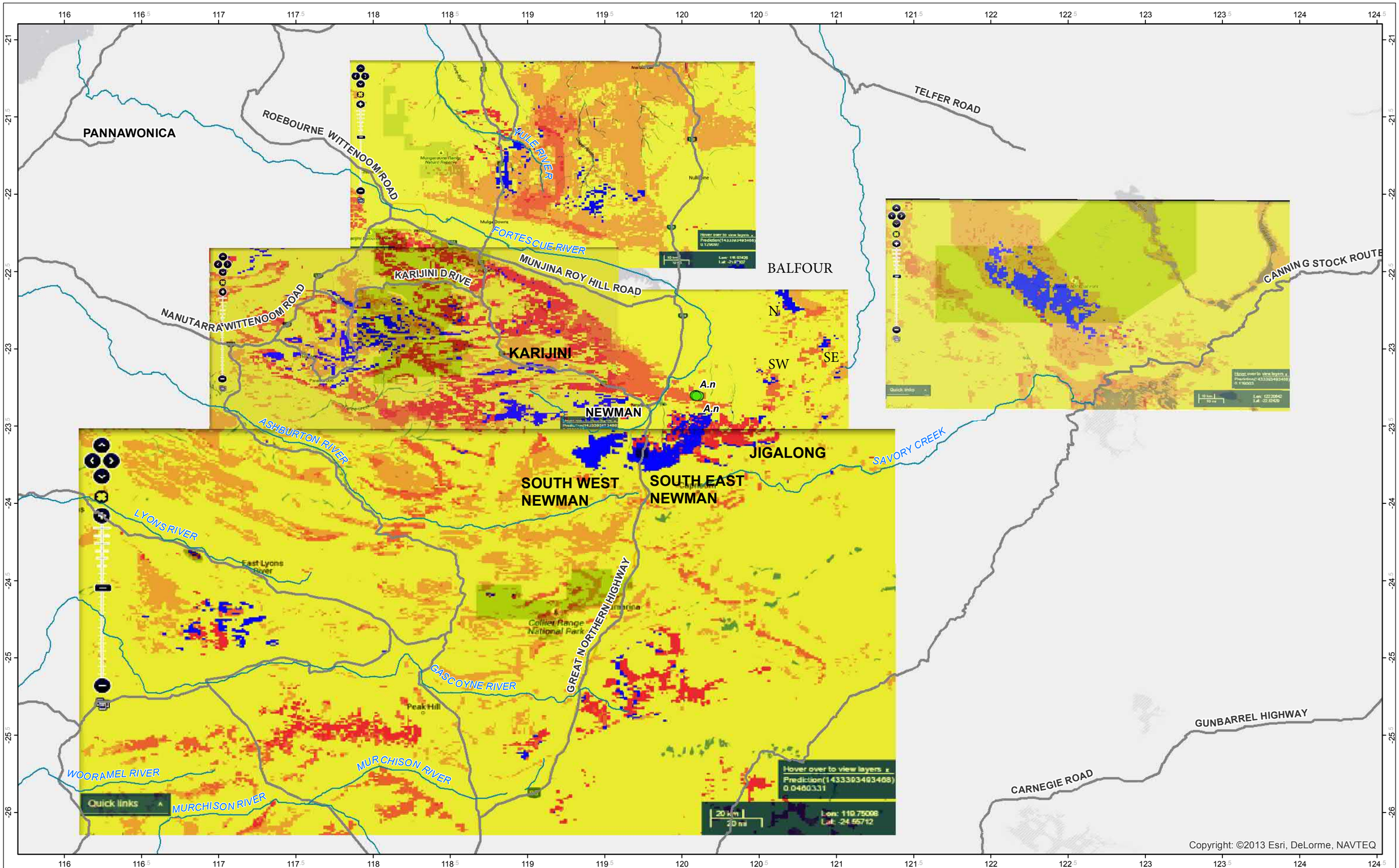


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Datum: GDA94

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## FIGURE 5

**Phase 3 Targeted survey locations for *Acacia* sp. East Fortescue (circled pink)**

**Legend**

**Significant Species**

- *Acacia* sp. East Fortescue

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200000 201000 202000 203000 204000 205000 206000

7422000

7421000

7420000

7419000

Population 1

Population 2

Population 3

ML 244SA

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Projection: MGA Zone 51

**BHPBIO**

**FIGURE 6**

**Distribution of the three populations of *Acacia* sp. East Fortescue**

**Legend**

Tenement Boundary AML244SA

**Significant Species**

*Acacia*sp. East Fortescue (J. Bull and D. Roberts ONS A 27.01)

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