2. Existing environment

2.1 Regional setting

The Project is located approximately 48 km south of the Perth CBD in an area of mixed land uses including sand mining, transport (Kwinana Freeway), rural residential and agriculture. The Project is also surrounded by conservation reserves including Rockingham Lakes Regional Park located approximately 5 km southwest, Lake Walyungup approximately 5 km northwest and Serpentine National Park located approximately 22 km east of the Project area.

The Project area is located within the Perth Basin on the Swan Coastal Plain. The Perth Basin is an intensely faulted trough, extending north to northwest for approximately 1000 km (GHD 2014). The basin has filled with a sedimentary sequence of varying continental and marine origin, thinning towards the east and overlain with coastal dune, alluvial and colluvial deposits (Davidson 1995).

2.2 Geology

The Rockingham Mapsheet in the Perth Metropolitan Region 1:50,000 Environmental Geology Series describes the geology across the majority of the Project area as 'Bassendean Sand' (Figure 4) which comprises predominately of light grey sand at the surface, becoming yellow with depth, fine to medium grained, sub-rounded, moderately well sorted sand of aeolian origin (Gozzard 1983). The underlying geology at six pockets in the Project area is described as 'Peaty Clay' comprising dark grey and black peaty clay with variable organic content and some sand in places, of lacustrine origin (Gozzard 1983). These pockets are associated with the six wetlands present in the Project area.

Two small slithers of 'Sand derived from Tamala Limestone' occur within the Project area adjacent to the western boundary which is described as pale yellowish brown, medium to coarse-grainer, sub angular quartz, trace of feldspar, moderately sorted, or residual origin (Gozzard 1983).

The balance of M70/1262 and the low lying land adjacent to the Serpentine River east of the Project Area is described as 'Guildford Formation clay ' and comprises a strong brown and dark grey clay, plastic in places, soft when wet, with variable silt content and of alluvial origin (Gozzard 1983). The geology to the west of the Project area is described as 'Sand derived from Tamala Limestone'.

The topography of the Project area is influenced by a north-south ridge located along the western Project area boundary and a gentle slope towards the banks of the Serpentine River in the east (Golder Associates 2006). The Project area remains relatively consistent with the pre-plantation topography and elevations vary between approximately 2 m and 13 m Australian Height Datum (AHD) (Figure 5).

Approximately 310 760 m^3 is proposed to be extracted annually and 1 553 800 m^3 extracted over the five year mine life.

The sand will be used predominantly in the construction industry.

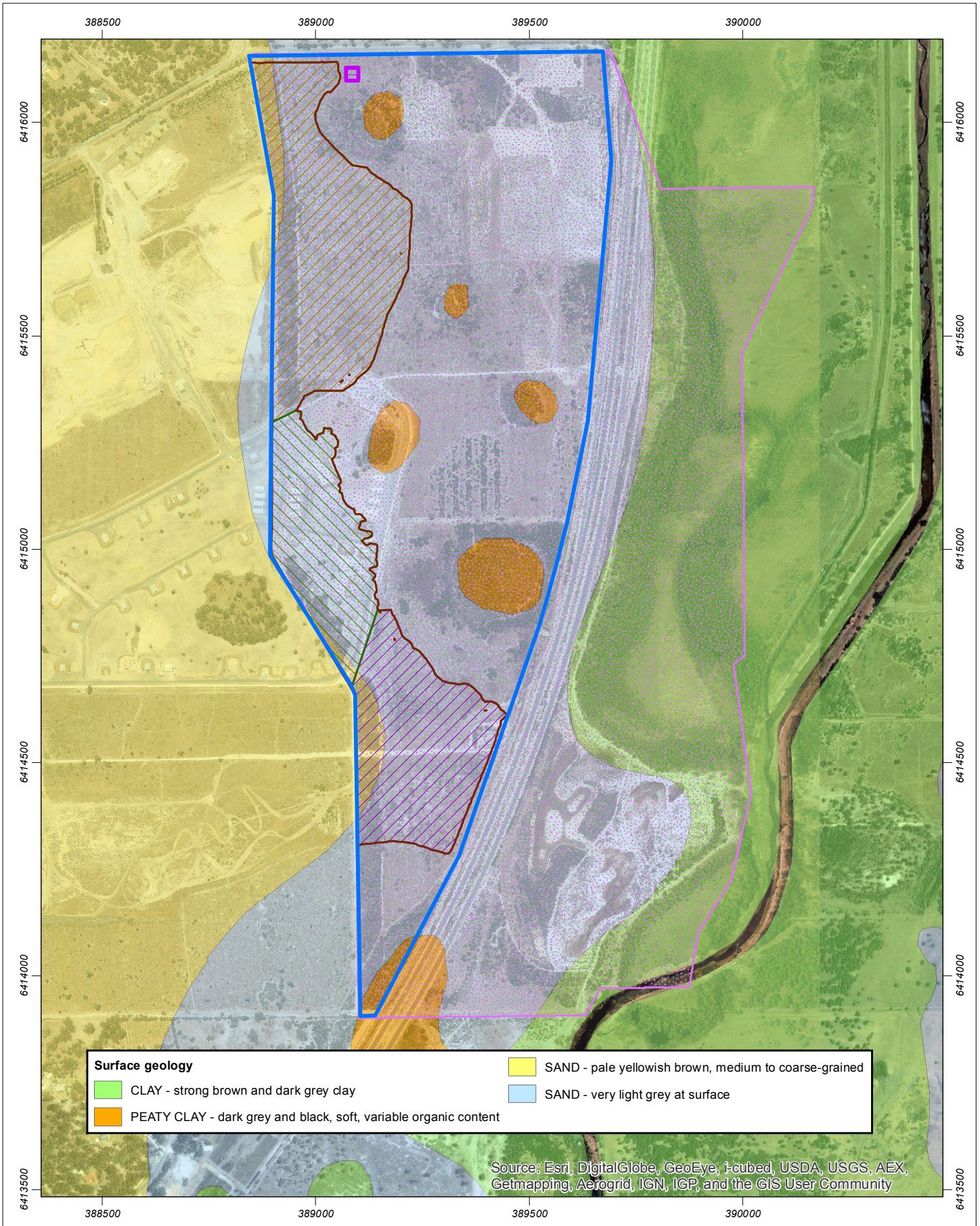

Figure 4: Regional geology of the Project area

Scale 1:12,000 at A4

0 100 200 300 m

N

Coordinate System: GDA 1994 MGA Zone 50
Note that positional errors may occur in some areas
Date: 17/06/2015
Author: JCrute
Source: Aerial image: Landgate, flown 11/2014. Background aerial image: ESRI online, approx. 2010. Geology 1:50,000: DMP 2014.

Legend

- Site compound boundary
- Project area
- Mine area
- Tenement M70/1262

Mining stages

- Stage 1
- Stage 2
- Stage 3

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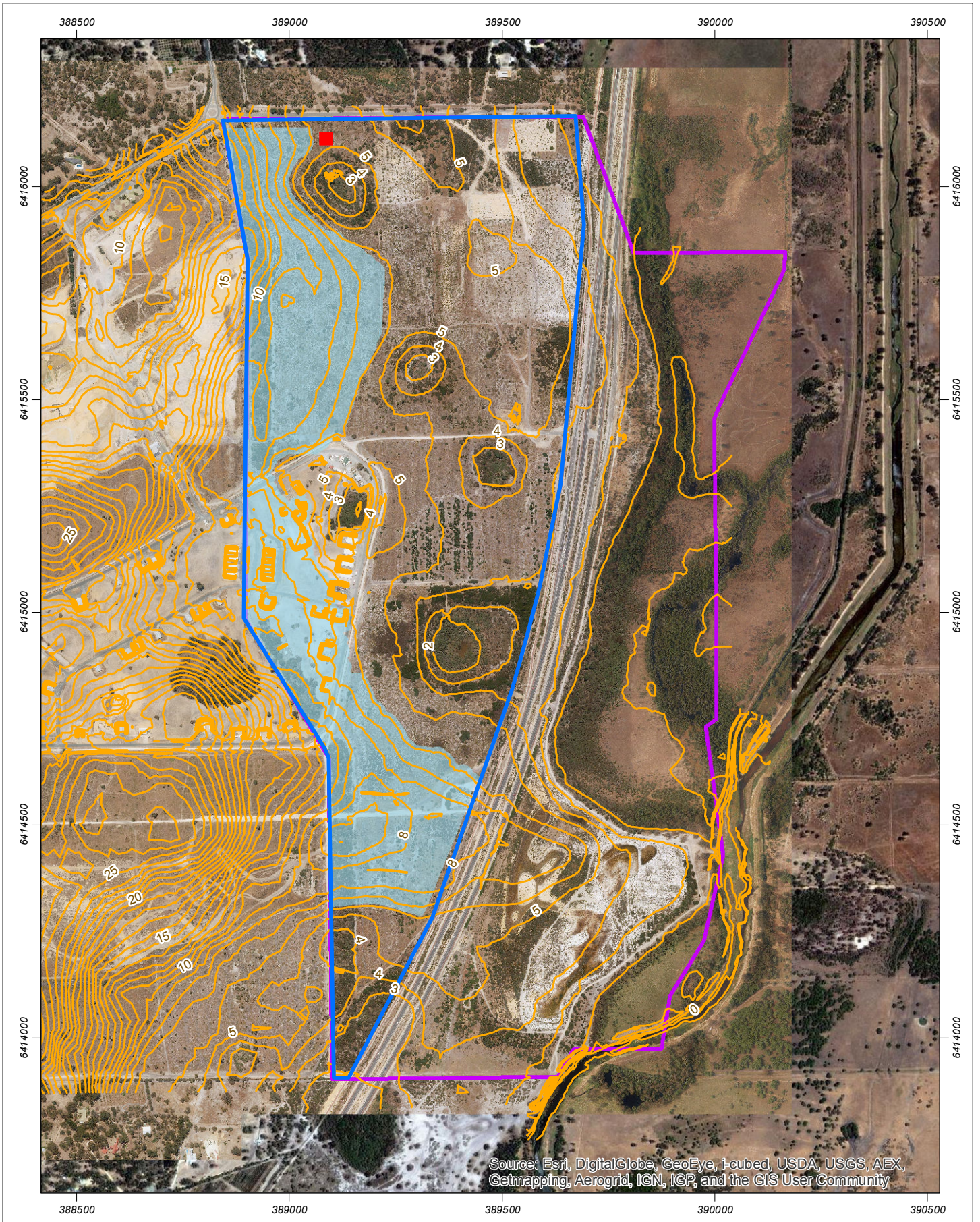

Figure 5: Topography of the Project area

Scale 1:12,000 at A4

0 100 200 300 m

N

Legend

- Surface elevation (mAHD)
- Site compound boundary
- Project area
- Mine area
- Tenement M70/1262

Coordinate System: GDA 1994 MGA Zone 50
Note that positional errors may occur in some areas
Date: 17/06/2015
Author: JCrute
Source: Aerial image: Landgate, flown 11/2014. Background aerial image: ESRI online, approx. 2010. Contours: Client 2015.

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2.3 Characterisation of waste rock and tailings

No waste rock or tailings will be generated as a result of the mining operations.

2.4 Soils and soil profiles

The Project area is located within the Swan Coastal Plain 2 (SWA2 – Swan Coastal Plain subregion) of Western Australia (Mitchell et al. 2002). The Swan Coastal Plain comprises five major geomorphological systems that lie parallel to the coast, namely (from west to east) the Quindalup Dunes, Spearwood Dunes, Bassendean Dunes, Pinjarra Plain and Ridge Hill Shelf (Churchward & McArthur 1980; Gibson et al. 1994). Each major system is composed of further subdivisions in the form of detailed geomorphological units (Churchward & McArthur 1980; Semeniuk 1990; Gibson et al.1994). Beard (1990) describes the Swan Coastal Plain as a low-lying coastal plain, often swampy, with sandhills also containing dissected country rising to the duricrusted Dandaragan plateau on Mesozoic, mainly sandy, yellow soils.

The Project area is characterised predominately by Bassendean Sand (Figure 4). Mining will target these Bassendean Sands that are predominately light grey at the surface before becoming yellow at depth and of aeolian origin.

2.4.1 Acid sulfate soils

Acid sulphate soils (ASS) are naturally occurring soils, sediments and peats that contain iron sulfide or sulfide oxidation products. When ASS are disturbed and exposed to oxidising conditions, the iron sulfides can oxidise to produce sulfuric acid, iron precipitates and low pH groundwater with elevated concentrations of dissolved metals such as aluminium, iron and arsenic. Although ASS are typically benign when undisturbed in the natural environment as they are in an anoxic state, the dewatering, excavation and/or stockpiling of ASS that lies below the naturally occurring watertable may promote the oxidation of these soils and the occurrence of these adverse environmental impacts (DoE 2003).

A search of the WA Atlas ASS Swan Coastal Plain risk map (Landgate 2015) (search conducted 21 April 2015) located six areas classified as Class 1 (High to Moderate risk of ASS occurring within 3 m of natural soil surface) within the Project area associated with the 'Peaty Clay' underlying the wetlands (Figure 6). The majority of the balance of the Project area is classified as Class 2 (Moderate to Low risk of ASS occurring within 3 m of natural soil surface) associated with the mapped 'Bassendean Sand'; however, there are two slithers of land adjacent the western Project area that is mapped as having nil ASS risk and are associated with the mapped 'Sand derived from Tamala Limestone' (Figure 6).

The mining area is mapped as either have a Class 2 or nil risk of ASS being encountered within the top 3 m of natural soil surface (Figure 6).

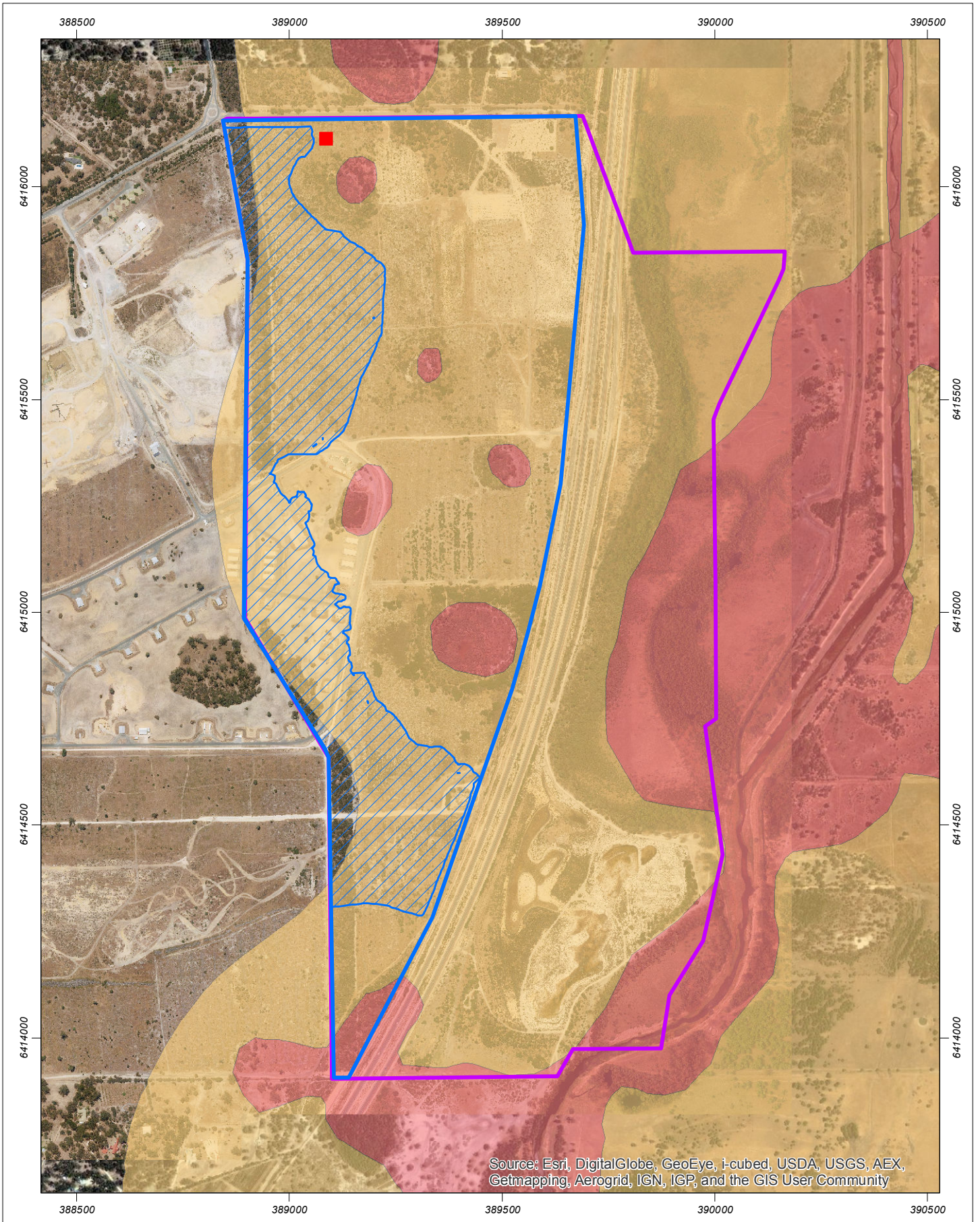

Figure 6: Acid Sulfate Soil mapping of the Project area

Scale 1:12,000 at A4

0 100 200 300 m

N

Legend

- Site compound boundary
- Project area
- Mine area
- Tenement M70/1262

ASS risk category

- High to moderate risk
- Moderate to low risk

Coordinate System: GDA 1994 MGA Zone 50
Note that positional errors may occur in some areas
Date: 17/06/2015
Author: JCrute
Source: Aerial image: Landgate, flown 11/2014. Background aerial image: ESRI online, approx. 2010. ASS: DER 2014.

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2.5 Hydrology

2.5.1 Surface water

The Project area lies in the catchment of the Serpentine River which flows the Peel-Harvey Estuary approximately 20 km south of the Project area. A small portion of the Project area near the north-eastern boundary is located within the 1 in 100-year Average Return Interval (ARI) floodway and flood fringe of Serpentine River (Figure 7); however, this part of the Project area will not be disturbed by the Project.

Rain falling on the Project area is expected to infiltrate due to the high permeability of the local sands. Surface water is not expected to flow from the Project area in the 1 in 100-year ARI event. The Project area is considered unlikely to receive runoff from the land adjacent to the west, given that this land is comprised of Tamala Limestone sands also with high infiltration rates.

If, during high rainfall events, there is surface water flow across the Project area, surface water would be expected to characteristically follow the natural topography to the east towards Kwinana Freeway and Serpentine River. The wetlands in and east of the Project Area, adjacent to the Serpentine River, are subject to seasonal inundation (Golder Associates 2006). Surface water management infrastructure is already be present along Kwinana Freeway and would convey any flows from the Project area (if any) to Serpentine River.

Wetlands

A north-south running chain of seasonally damp and inundated wetlands occur in the eastern portion of the Project area. The wetlands are isolated from each other by sparse areas of regrowth following pine plantation clearing, range from 0.3 to 3.1 ha in size and comprise predominately of remnant paperbark (Figure 7). All wetlands within the Project area were assessed in 2006 to have been in a degraded state and substantially invaded by weeds (Bancroft & Bamford 2006; Appendix 1). A recent inspection of these wetlands in May 2015 confirmed that the 2006 findings are still valid and the wetlands are degraded (Strategen 2015, Appendix 1).

Wetlands located within the Project area are ephemeral sumplands (i.e. only seasonally inundated) and include both Resource Enhancement and Conservation Category wetlands as determined by DER (Strategen 2010). These wetlands are considered to represent an expression of local groundwater levels.

2.5.2 Groundwater

Regional groundwater

The Project area is located within the Stakehill Mound groundwater subregion of the Perth Basin (GHD 2014). The subregion covers an area of approximately 150 km^2 and occurs within the superficial formations flow system that is recharged directly by rainfall infiltration (Golder Associates 2010). It is estimated that the average thickness of the aquifer is approximately 20 m with a minimum transmissivity of approximately 1000 m^2/day (Golder Associates 2010).

Groundwater levels and flow direction

Golder Associates undertook monthly groundwater level monitoring of the Project area and surrounds between March 2007 and March 2010 (Golder Associates 2010) and further quarterly groundwater monitoring was undertaken by Strategen between April 2013 and January 2014 (Strategen 2014).

Groundwater levels beneath the Project area fluctuate by approximately 1 m annually. Levels are generally at their maximum in September/October following winter, and minimum in April/May (Golder Associates 2010).

Groundwater levels for the Project area reflect the Assessment Groundwater Level (AGL) set through the Karnup District Water Management Strategy (DWMS) (GHD 2014). This document and the associated AGL has been approved by the Department of Water and the City of Rockingham. The AGL is proposed to be used to set finished levels for future urban development in the Karnup district. Data from the Project area was used in calibrating the AGL model (GHD 2014). The AGL has been set to represent a peak groundwater level under a wet rainfall scenario (GHD 2014), condition that have not been reflected in groundwater monitoring undertaken for the Project area. As such, the AGL is considered a conservative groundwater level for the area and is above water levels recorded on site (Strategen 2014).

The AGL is outlined in Figure 8 and is generally less than 3.25 mAHD beneath the Project area. Based on the AGL contours there appears to be a groundwater saddle present beneath the Project area with groundwater to the east of this saddle flowing east towards Serpentine River, while groundwater west of the saddle flows in a westerly direction towards the Indian Ocean.

Groundwater quality

Strategen undertook four quarterly groundwater monitoring events (monitoring of levels and quality) between April 2013 and January 2014 at two bores within and five bores surrounding the Project area (Strategen 2014). Monitoring demonstrated groundwater pH beneath the site and surrounds varies between 6.1 and 7.7 pH units and is generally within the ANZECC and AARMCANZ (2000) guideline values for slightly disturbed ecosystems of 6.5 to 8.5 pH units. Groundwater below the Project area and surrounds is generally fresh with electrical conductivity (EC) values varying between 0.20 mS/cm and 2.89 mS/cm. EC levels were generally within the ANZECC and AARMCANZ (2000) guideline values for slightly disturbed ecosystems in south-west Australia of 0.3-1.5 mS/cm (Strategen 2014).

Median nutrient concentrations were generally below the ANZECC & ARMCANZ (2000) guidelines and are considered comparatively low in the context of the broader Peel-Harvey catchment (Strategen 2014). Concentrations of heavy metals below the Project area and surrounds generally met ANZECC & ARMCANZ (2000) guideline values and is considered to be consistent with concentrations observed in the southern suburbs of Perth (Strategen 2014).

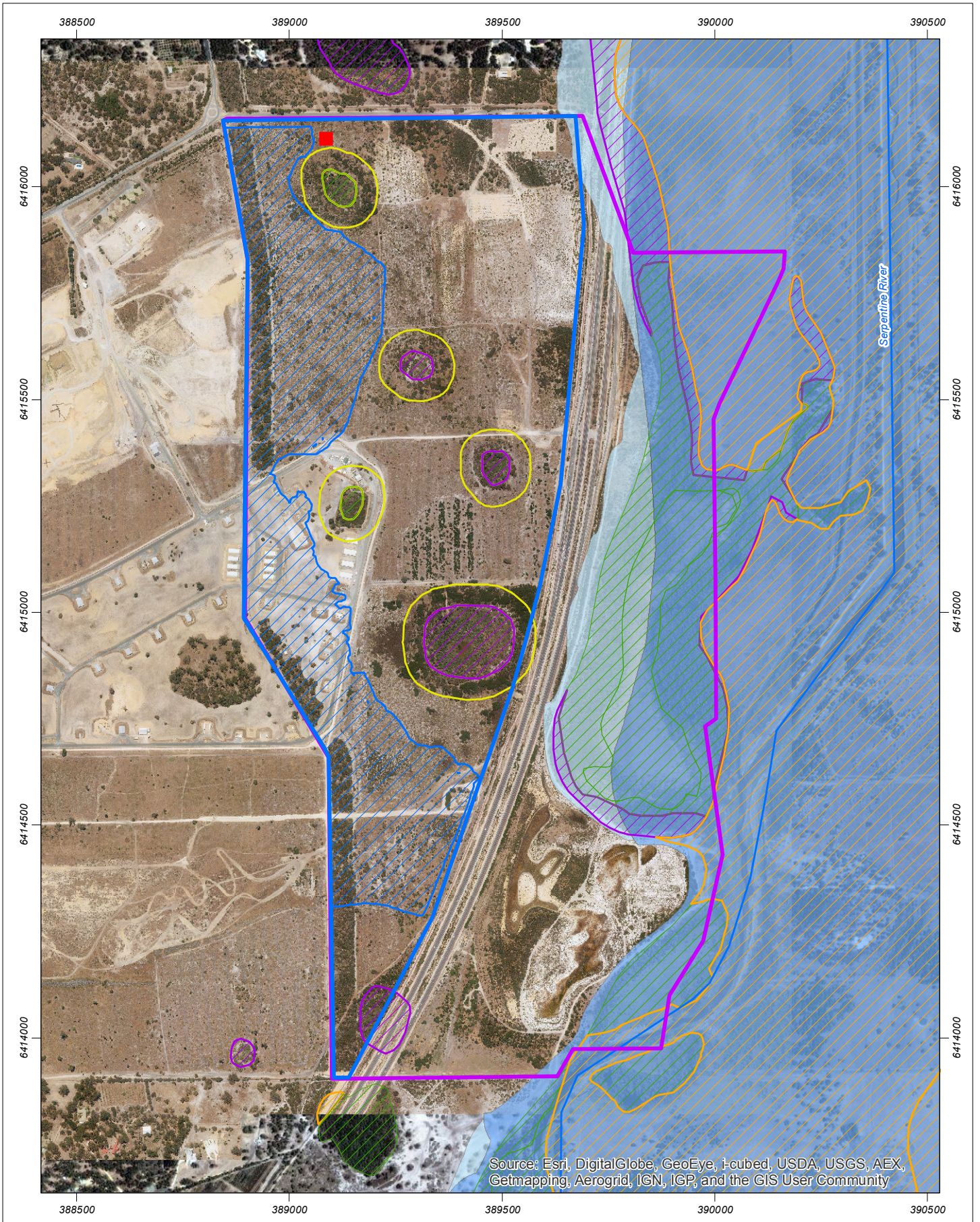

Figure 7: Surface water and wetlands of the Project area

Scale 1:12,000 at A4

0 100 200 300 m

N

Coordinate System: GDA 1994 MGA Zone 50
Note that positional errors may occur in some areas
Date: 17/06/2015
Author: JCrute

Legend

- River
- Site compound boundary
- Project area
- Mine area
- Tenement M70/1262
- Floodway
- Flood fringe
- 50m wetland buffer

Wetland classification

- Conservation
- Multiple Use
- Resource Enhancement

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Source: Aerial image: Landgate, flown 11/2014. Background aerial image: ESRI online, approx. 2010. Wetlands: DPAW 2014. Flood: DoW 2014.

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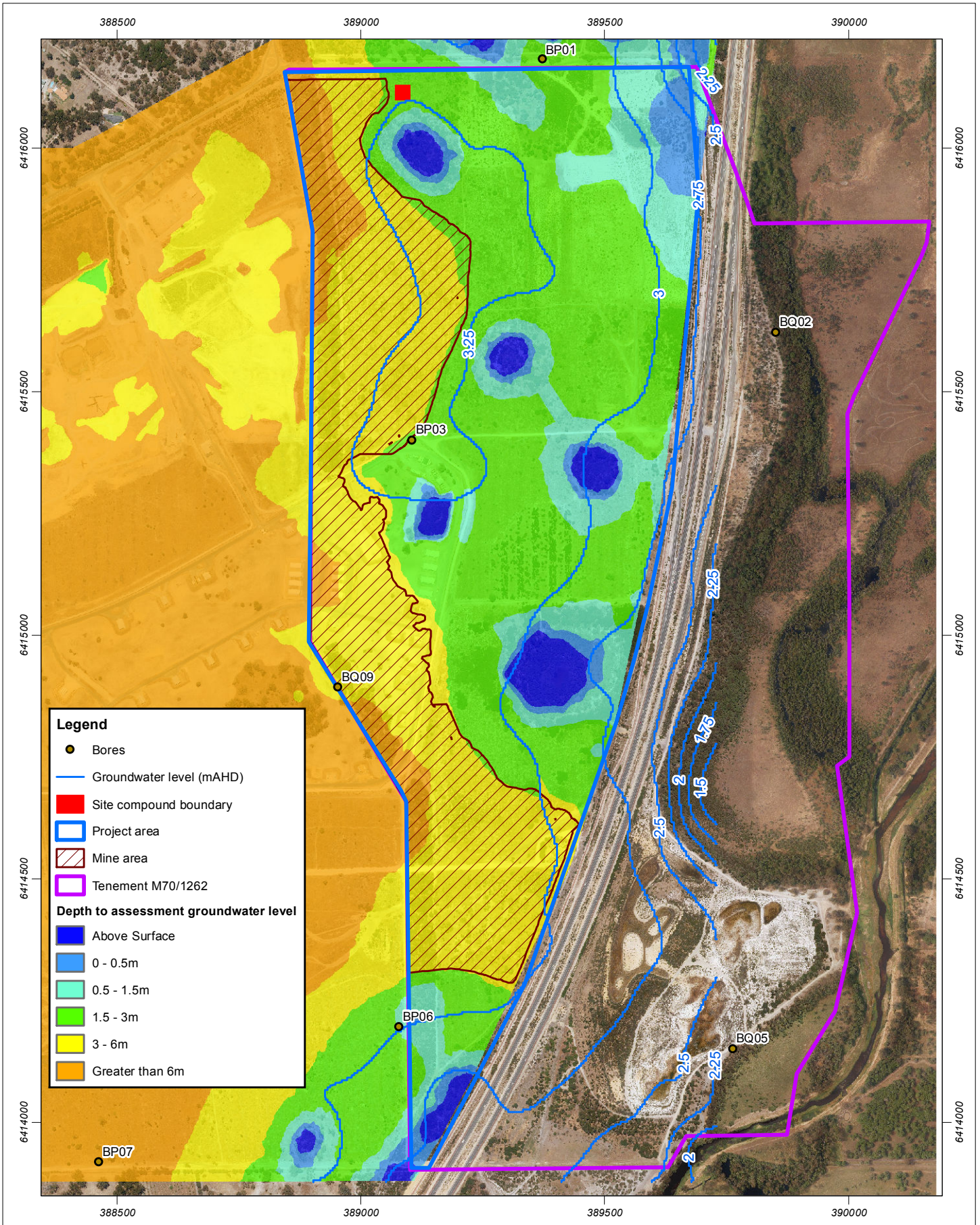

Figure 8: Groundwater of the Project area

Scale 1:10,500 at A4

0 100 200 300 m

N

Coordinate System: GDA 1994 MGA Zone 50

Note that positional errors may occur in some areas

Date: 17/06/2015

Author: JCrute

Source: Aerial image: Landgate, flown 11/2014. Background aerial image: ESRI online, approx. 2010. GW data: LandCorp 2014.

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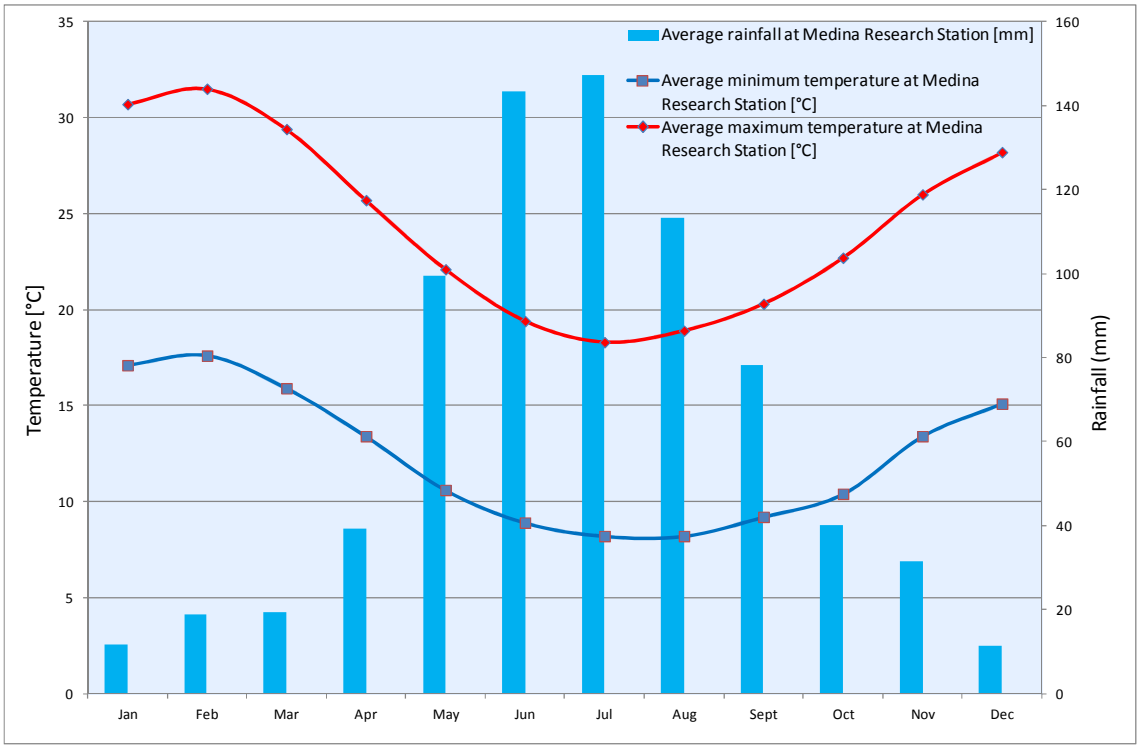
2.6 Climate

The Karnup locality experiences a Mediterranean climate characterised by mild, wet winters and warm to hot, dry summers. The nearest Bureau of Meteorology (BoM) weather station at Medina Research Station (Station No. 9194) provides average monthly climate statistics for the Karnup locality (Figure 9).

Average annual rainfall recorded at Medina since 1983 is 753.4 mm (BoM 2015). Rainfall may occur at any time of year; however, most occurs in winter in association with cold fronts from the southwest. Highest temperatures occur between December and March, with average monthly maximums ranging from 28.2°C in December to 31.5°C in February (BoM 2015). Lowest temperatures occur between June and September, with average monthly minimums ranging from 8.2°C in July to 9.2°C in September (BoM 2015).



Source: BoM (2015)

Figure 9: Average monthly climate statistics for Medina Research Station (Station No. 9194)

2.7 Flora and fauna

A flora and vegetation assessment and black cockatoo habitat assessment of the Project area was undertaken in May 2015 (Strategen 2015; Appendix 1). The flora and vegetation survey was designed to address the recommendations in the following guidance:

- EPA Position Statement No. 2 *Environmental Protection of Native Vegetation in Western Australia* (EPA 2000)
- EPA Position Statement No. 3 *Terrestrial Biological Surveys as an Element of Biodiversity Protection* (EPA 2002)
- EPA Position Statement No. 10 *Level of Assessment for Proposals Affecting Natural Areas Within the System 6 Region and Swan Coastal Plain Portion of the System 1 Region* (EPA 2006)
- EPA Guidance Statement No. 51 *Terrestrial Flora and Vegetation Surveys for Environmental Impact Assessment in Western Australia* (EPA 2004).

Results of a desktop fauna assessment identified three *Environmental Protection and Biodiversity Conservation Act 1999* (EPBC Act) listed black cockatoo species as the most likely species to occur in the Project area; consequently a field assessment of the Project area was undertaken in terms of its potential as habitat for these species (refer to Section 2.7.3 for further detail).

In addition to the black cockatoo species, the Rainbow Bee-eater is likely to occur in the general area in sandy soiled areas and surrounding wetlands; however, the habitat most likely to support the Rainbow Bee-eater is associated with wetland areas that will not be impacted by the Project. Therefore a detailed habitat assessment for the species was not undertaken.

2.7.1 Vegetation

Regional

The Project area occurs within the Swan Coastal Plain 2 'Interim Biogeographic Regionalisation for Australia' subregion which is dominated by *Banksia* or Tuart on sandy soils, *Casuarina obesa* on outwash plains and paperbark (*Melaleuca*) in swampy areas (Mitchell et al. 2002).

The project area occurs within the Drummond Botanical Subdistrict which is characterised by low *Banksia* woodlands on leached sands; *Melaleuca* swamps on poorly-drained depressions; and *Eucalyptus gomphocephala* (Tuart), *Eucalyptus marginata* (Jarrah) and *Corymbia calophylla* (Marri) woodlands on less leached soils (Beard 1990).

The Project area occurs at the interface between the Serpentine River and Karrakatta System 6 vegetation complexes as mapped by Heddle *et al.* (1980). These complexes can be described as:

- Serpentine River – closed scrub of *Melaleuca* spp. and fringing woodland of *Eucalyptus rudis* and *M. rhaphiophylla* along streams
- Karrakatta – predominantly open forest of *Eucalyptus gomphocephala – E. marginata – C. calophylla* and woodland of *E. marginata – Banksia* spp.

Project area

The flora and vegetation assessment and black cockatoo habitat assessment surveyed the majority of the Project area however did not include the Explosives Reserve Facility due to restricted access. The vegetation associated with this area has been inferred and a high level of confidence on this inference exists.

The majority of the Project area was identified to be in various stages of natural regeneration following the clearing of existing pine plantations from 2004 (approx.) (Strategen 2015; Appendix 1). Whilst the majority of this vegetation meets the definition of Good condition on the Keighery scale, it should be noted that this is reflective more of the amount of weed present and the vegetation structure based on species observed. The vegetation on site is immature, open and in the main could be readily traversed by a 4WD vehicle.

Five native vegetation types (VTs), in addition to cleared areas and residual pine plantation, were defined and mapped within the Project area (Strategen 2015; Figure 10) and are summarised in Table 3. The total area mapped within the Project area is 94.94 ha which includes cleared areas and pine plantations (Table 3). The dominant VT within the Project area was VT 1 which can be broadly described as an open shrubland of *Macrozamia fraseri, Daviesia triflora* and *Acacia stenoptera* with isolated *Xylomelum occidentale* and *Eucalyptus rudis* trees.

Table 3: Vegetation types mapped in the Project area

Vegetation Type	Description	Area (ha) within the survey area	Area (ha) within the mining area and site compound
1	*Macrozamia fraseri, Daviesia triflora* and *Acacia stenoptera* mid open shrubland over *Lyginia barbata, Conostylis aculeata* and *Phlebocarya ciliata* low open sedgeland with *Xylomelum occidentale* and *Eucalyptus rudis* occurring as isolated trees. Natural regeneration of cleared pine plantation.	59.37	22.97
2	*Banksia menziesii, B. attenuata, Allocasuarina fraseriana* and *Eucalyptus marginata* open woodland over *Kunzea glabrescens, Acacia pulchella* and *Macrozamia fraseri* mid sparse shrubland over *Hibbertia hypericoides, Conostephium pendulum* and *Gompholobium tomentosum* low sparse shrubland. Including 1.02 ha inferred VT2 within Explosives Reserve. Remnant vegetation.	7.91	6.54
3	*Jacksonia sternbergiana* and *Adenanthos cygnorum* subsp. *cygnorum* mid shrubland over *Conostylis aculeata* and *Lyginia barbata* low sparse sedgeland. Natural regeneration of cleared pine plantation.	2.02	1.32
4[1]	*Banksia menziesii, B. attenuata, Eucalyptus marginata* and *Allocasuarina fraseriana* low open woodland over *Jacksonia furcellata, Regelia ciliata* and *B. sessilis* mid sparse shrubland over *Tetraria octandra* and *Ficinia nodosa* low sparse sedgeland. Natural regeneration with rehabilitation.	9.36	-
5	*Eucalyptus* sp. (planted) open woodland over *Acacia saligna, Jacksonia furcellata* and *Kunzea glabrescens* tall sparse shrubland over **Eragrostis curvula* low sparse tussock grassland. Mixture of naturally regenerated vegetation with additional planting.	7.11	-
P[2]	Pine plantation (*Pinus pinaster*).	3.29	-
C[2]	Cleared areas.	5.88	1.77
-	Explosives Reserve (excludes 1.02 ha inferred VT2 within reserve).	-	9.36
TOTAL		**94.94**	**41.96**

1 This vegetation type appears to be the result of rehabilitation activities.

2 Cleared areas and pine plantations have been mapped but are not counted as a unique VT.

Vegetation condition within areas of natural regeneration was identified as Good as outlined by Figure 11. The vegetation condition for the balance of the Project area was mapped as follows (Strategen 2015; Appendix 1):

- Very good: retained *Banksia* woodland in the vegetated strip of land on the western boundary of the Project area
- Good: *Eucalyptus*/*Acacia* woodland along the southern boundary of the Project area
- Completely Degraded: cleared areas and pine plantations.

No Threatened Ecological Communities (TECs) or Priority Ecological Communities (PECs) were identified as having the potential to occur within the Project area. The closest PEC identified in proximity to the Project area was SCP 25 (Southern *Eucalyptus gomphocephala – Agonis flexuosa* woodlands). The outer edge of the Parks and Wildlife buffer for this community is approximately 1.3 km from the Project area (Strategen 2015; Appendix 1).

2.7.2 Flora

A desktop assessment identified 108 native vascular plant taxa from 40 plant families that have the potential to occur within the vicinity of the Project area, the majority of taxa were from within the Cyperaceae (15 taxa), Myrtaceae (9 taxa) and Fabaceae (8 taxa) families (Strategen 2015; Appendix 1). Of these 18 Threatened and Priority flora species potentially occurring within the Project area as outlined by Table 4; however, only three Threatened flora species (*Caladenia huegelii, Drakaea elastica* and *Drakaea micrantha*) and four Priority flora species (*Cardamine paucijuga, Sphaerolobium calcicola, Dillwynia dillwynioides* and *Jacksonia sericea*) were considered to have the potential to occur in the Project area based on specific habitat requirements (Strategen 2015; Appendix 1).

A total of 41 native vascular plant taxa from 34 plant genera and 18 plant families were recorded within the Project area during the Level 1 survey (Strategen 2015; Appendix 1). The majority of taxa were recorded within the Fabaceae (8 taxa), Myrtaceae (6 taxa) and Proteaceae (5 taxa) families.

No Threatened flora species pursuant to Schedule 1 of the Wildlife Conservation Act (WC Act) (as listed by Parks and Wildlife) or Priority flora species (as listed by Western Australian Herbarium) were recorded within the Project area (Strategen 2015; Appendix 1).

Database searches of Naturemap and the Parks and Wildlife Threatened Flora Database were undertaken to determine whether any Threatened or Priority flora species are known from within a 5 km radius of the Project area (Strategen 2015; Appendix 1). *Dillwynia dillwynioides* and *Schoenus capillifolius* were recorded in 2006 in wetlands which do not form part of the Project area. The location of these species and other known locations of Threatened and Priority Flora species in the area are shown in Figure 12.

2.7.3 Fauna

A desktop fauna assessment was conducted using a series of databases including NatureMap and the EPBC Protected Matters Search Tool. Bamford Consulting Ecologists undertook a fauna survey of an area encompassing some parts of the Project area and adjacent wetlands (Bancroft & Bamford 2006). It should be noted that in 2006, the majority of the Project area would have been occupied by pine plantation. During the most recent assessment undertaken by Strategen in 2015, the Project area comprised remnant native woodland vegetation, historical pine plantations and natural regeneration in areas which were previously cleared (Strategen 2015; Appendix 1).

A desktop assessment of the likelihood of conservation significant (Threatened or Priority) species occurring within the Project area was undertaken based on results presented by Bancroft & Bamford (2006) and results are presented in Table 5. The conservation status of each species was updated based on current listings provided by Parks and Wildlife (2007, 2014d) and Department of the Environment (DotE) (2015a, 2015b). Likelihood of occurrence was also updated (where required) based on the change in vegetation within the Project area between 2006 and 2015.

The only conservation significant fauna species considered to have suitable habitat present within the Project area and therefore are likely to occur are three species of black cockatoo (Carnaby's, Forest Red-tailed and Baudin's) and the Rainbow Bee-eater (Strategen 2015; Appendix 1). Threatened native mammals and ground-dwelling birds are unlikely to occur due to lack of suitable habitat and presence of introduced predators and competitors (cat footprints were observed and the area is home to a large number of goats). Migratory birds have the potential to utilise the Project area for habitat due to the presence of wetlands, but are unlikely to be present for prolonged periods of time (Strategen 2015; Appendix 1).

Black cockatoo habitat assessment

A summary of the value of each vegetation type as foraging habitat for black cockatoo species is presented in Table 6 (Groom 2011, Johnstone 2010a, Johnstone 2010b, Johnstone et al. 2011).

The highest quality foraging habitat for black cockatoos was noted within VT 2 which contained high densities of black cockatoo food species including eucalypts and *Banksia* spp. at canopy and midstorey levels. The lowest quality foraging habitat for black cockatoos (not including cleared areas) was noted within VT 5 which contained limited potential food resources for all three species of black cockatoos (refer to footnote following Table 6) and in the pine plantation which provides limited food resources for Carnaby's Black Cockatoo (CBC) only. Based on the results of the foraging assessment, the Project will result in the clearing of 6.54 ha of very good quality foraging habitat and 24.29 ha of low quality foraging habitat for CBC, Baudin's Black Cockatoo (BBC) and Forest Red-tailed Black Cockatoo (FRTBC) as outlined in Table 6 and Table 7. Signs of CBC foraging were observed in scattered occurrences within VT 2 (Strategen 2015; Appendix 1).

Table 4: Threatened and Priority flora potentially occurring within the Project area

Species	Conservation status		Description	Potential to occur
	EPBC Act	WC Act		
Andersonia gracilis	**Threatened** - Endangered	Threatened	A slender shrub to 50 cm tall with few, spreading branches. Flowers are pink to pale mauve. Habitat for this species occurs within seasonally damp, black sandy clay flats near swamps (Western Australian Herbarium 1998-, DotE 2015b).	**Unlikely –** Preferred soil type/habitat does not occur within the Survey area– wetland areas will not be impacted by the proposed mining.
Caladenia huegelii	**Threatened** – Endangered	Threatened	A slender orchid from 30 to 50 cm tall. One or two striking flowers characterised by a greenish-cream lower petal with a maroon tip. Other petals are cream with red or pink suffusions. Habitat for this species occurs within well-drained, deep sandy soils in low mixed Banksia, Allocasuarina and Jarrah woodlands (Western Australian Herbarium 1998-, DotE 2015b).	**Possible –** Preferred soil type/habitat occurs within the Survey area.
Centrolepis caespitosa	**Threatened** – Endangered	Priority 4	A diminutive, densely tufted, glabrous annual herb. Flowers are red/brown and are singular. Habitat for this species is relatively unknown. Brown et al. (1998) identified that this species occurs within winter-wet claypans dominated by low shrubs and sedges.	**Unlikely –** Preferred soil type/habitat does not occur within the Survey area– wetland areas will not be impacted by the proposed mining. It is worth noting that Parks and Wildlife have removed this species from its Threatened flora listing and is now classed as Priority 4.
Darwinia foetida	**Threatened** – Critically Endangered	Threatened	An erect, spreading shrub to 70 cm tall. Green flowers, visible from October to November. Habitat for this species occurs within wet/winter-damp clay under Myrtaceous shrubland (DotE 2015b).	**Highly unlikely –** Preferred habitat does not occur within the Survey area as wetland areas will not be impacted by the proposed mining. Additionally, both Western Australian Herbarium (1998-) and DotE (2015b) list this species' distribution to be highly restricted within the Muchea area (approximately 70 km north of Perth).
Diuris drummondii	**Threatened** – Vulnerable	Threatened	A perennial orchid to 105 cm tall. Often forms dense colonies with individuals displaying between three and eight widely spaced yellow flowers. Habitat for this species occurs in low-lying depressions in peaty and sandy clay swamps (DotE 2015b).	**Unlikely –** Preferred soil type/habitat does not occur within the Survey area– wetland areas will not be impacted by the proposed mining.
Diuris micrantha	**Threatened** – Vulnerable	Threatened	A slender orchid to 60 cm tall. Yellow flowers with reddish-brown markings measuring 1.3 cm across. Habitat for this species occurs within clay-loam substrates in winter-wet depressions or swamps (DotE 2015b).	**Unlikely –** Preferred soil type/habitat does not occur within the Survey area– wetland areas will not be impacted by the proposed mining.
Diuris purdiei	**Threatened** – Endangered	Threatened	A slender orchid to 45 cm tall. Unusually flattened flowers, marked with brown blotches on their under surface. Habitat for this species occurs in areas subject to winter inundation within dense heath with scattered Myrtaceous trees (DotE 2015b).	**Unlikely –** Preferred soil type/habitat does not occur within the Survey area – wetland areas will not be impacted by the proposed mining.
Drakaea elastica	**Threatened** – Endangered	Threatened	A slender orchid to 30 cm tall with a prostrate, round to heart shaped leaf. Singular, bright green, glossy flower. Habitat for this species is within bare patches of white sand over dark sandy loams on damp areas (DotE 2015b).	**Possible –** Preferred soil type/habitat occurs within the Survey area.

Species	Conservation status		Description	Potential to occur
	EPBC Act	WC Act		
Drakaea micrantha	**Threatened** – Vulnerable	Threatened	A tuberous, terrestrial orchid to 30 cm tall. Silvery-grey heart shaped leaf with prominent green veins. Red and yellow singular flower. Habitat for this species occurs within cleared, open sandy patches (Brown et al. 1998).	**Possible –** Preferred soil type/habitat occurs within the Survey area.
Lepidosperma rostratum	**Threatened** – Endangered	Threatened	A rhizomatous sedge to 30 cm in diameter. Stems are circular in cross section and flowers are spike-like and up to 4 cm long. Habitat for this species occurs in sandy soils among low heath comprised of *Banksia telmatiaea* and *Calothamnus hirsutus* in winter-wet swamps.	**Unlikely –** Preferred soil type/habitat does not occur within the Survey area – wetland areas will not be impacted by the proposed mining.
Synaphea stenoloba	**Threatened** – Endangered	Threatened	A caespitose shrub to 45 cm tall. Yellow flowers visible from August to October. Habitat for this species occurs within loamy soils in low lying areas that are seasonally inundated (DotE 2015b).	**Unlikely –** Preferred soil type/habitat does not occur within the Survey area – wetland areas will not be impacted by the proposed mining.
Acacia benthamii	Not listed	Priority 2	A shrub to 1 m tall. Flowers are yellow and visible from August to September (Western Australian Herbarium 1998-). Habitat for this species is typically on limestone breakaways.	**Unlikely –** Preferred soil type/habitat does not occur within the Survey area.
Cardamine paucijuga	Not listed	Priority 2	A slender, erect annual herb to 0.4 m tall. Flowers are white and visible from September to October (Western Australian Herbarium 1998-). Habitat for this species occurs in a broad range of settings.	**Possible –** Preferred soil type/habitat could occur within the Survey area.
Sphaerolobium calcicola	Not listed	Priority 3	A slender, multi-stemmed, scandent or erect shrub to 1.5 m tall. Flowers are orange-red and visible in June or from September to November (Western Australian Herbarium 1998-). Habitat for this species occurs in a broad range of settings.	**Possible –** Preferred soil type/habitat could occur within the Survey area.
Dillwynia dillwynioides	Not listed	Priority 3	A decumbent or erect, slender shrub to 1.2 m tall. Flowers are red and yellow/orange and visible in August to December (Western Australian Herbarium 1998-). Habitat for this species is in winter-wet depressions and sandy soils.	**Possible –** Preferred soil type/habitat occurs within the Survey area.
Schoenus capillifolius	Not listed	Priority 3	A semi-aquatic, tufted, annual grass-like herb to 5 cm tall. Flowers are green and visible from October to November (Western Australian Herbarium 1998-). Habitat for this species is in brown mud in claypans.	**Unlikely –** Preferred soil type/habitat does not occur within the Survey area – wetland areas will not be impacted by the proposed mining.
Stylidium longitubum	Not listed	Priority 3	An erect annual herb to 12 cm tall. Flowers are pink and visible from October to December (Western Australian Herbarium 1998-). Habitat for this species occurs in sandy clay in seasonal wetlands.	**Unlikely –** Preferred soil type/habitat does not occur within the Survey area – wetland areas will not be impacted by the proposed mining.
Jacksonia sericea	Not listed	Priority 4	A Low spreading shrub to 0.6 m tall. Flowers are orange and visible from December to February (Western Australian Herbarium 1998-). Habitat for this species occurs in calcareous and sandy soils.	**Possible –** Preferred soil type/habitat occurs within the Survey area.

Table 5: Threatened and Priority fauna potentially occurring within the Project area

Species	Conservation status[1]		Habitat description	Potential to occur
	EPBC Act	WC Act / Parks and Wildlife listing		
Reptiles				
Ctenotus gemmula (Jewelled Ctenotus)	Not listed	P3	Pale sands with heath and Banksia spp. or mallee woodlands.	**Possible** – areas of remnant banksia woodland.
Lerista lineata	Not listed	P3	Coastal heath on sand, shrubland.	**Unlikely** – lack of suitable habitat.
Morelia spilota imbricata (Carpet Python)	Not listed	Schedule 4 (Other specially protected fauna)	Undisturbed bushland and rocky outcrops.	**Unlikely** – while potentially present in the region, the lack of connecting habitat to Project area renders it unlikely this species would be present.
Neelaps calonotos (Black-striped Snake)	Not listed	P3	Dunes and sand plains with heath or eucalypt or banksia woodlands.	**Possible**.
Birds				
Oxyura australis (Blue-billed Duck)	Not listed	P4	Deep and well vegetated freshwater lakes, dams and swamps.	**Unlikely** – habitat not present within or near Project area.
Ardea alba (Great Egret)	Marine, migratory (CAMBA, JAMBA)	IA	Estuaries, tidal flats, rivers, freshwater lakes, sewage ponds and dams.	**Unlikely** – Project area does not comprise wetlands. Possibly present as a vagrant within adjacent wetlands but unlikely to be permanently reliant on these due to their poor quality.
Ardea ibis (Cattle Egret)	Marine, migratory (CAMBA, JAMBA)	IA	Paddocks, pastures, wetlands, and tidal mudflats.	**Unlikely**.
Ixobrychus minutus (Little Bittern)	Not listed	P4	Dense vegetation (reeds, rushes, sedges) in or adjacent to freshwater wetlands.	**Unlikely** – lack of suitable habitat within Project area and adjacent wetlands.
Botaurus poiciloptilus (Australasian Bittern)	**Threatened** (Endangered)	**Threatened**	Dense vegetation (reeds, rushes, sedges) in or adjacent to freshwater wetlands, drains and, occasionally, salt marshes.	**Unlikely** – lack of suitable habitat within Project area and adjacent wetlands.
Falco peregrinus (Peregrine Falcon)	Not listed	Schedule 4 (Other specially protected fauna)	Cliffs, gorges, timbered watercourses, and tall man-made infrastructure.	**Unlikely** – known from the area but unlikely to be resident in Project area.
Tringa nebularia (Common Greenshank)	Marine, migratory (Bonn, CAMBA, JAMBA, ROKAMBA)	IA	Estuaries, tidal flats, mangroves, rivers, wetlands, sewage ponds and saltfields.	**Unlikely** – lack of suitable habitat within Project area and adjacent wetlands.
Actitis hypoleucos (Common Sandpiper)	Marine, migratory (Bonn, CAMBA, JAMBA, ROKAMBA)	IA	Estuaries, tidal flats, mangroves, rivers, wetlands, sewage ponds and saltflats.	**Unlikely** – lack of suitable habitat within Project area and adjacent wetlands.

Species	Conservation status[1]		Habitat description	Potential to occur
	EPBC Act	WC Act / Parks and Wildlife listing		
Calyptorhynchus banksii subsp. *naso* (Forest Red-tailed Black-Cockatoo)	**Threatened** (Vulnerable)	**Threatened**	Open forests and woodlands, suburban gardens.	**Likely** – known to breed in the Baldivis area.
Calyptorhynchus latirostris (Carnaby's Cockatoo (short-billed black-cockatoo)	**Threatened** (Endangered)	**Threatened**	Open forests and woodlands, Kwongan heath, sand plains, suburban vegetation and pine plantations.	**Likely** – known to breed in the Baldivis area.
Calyptorhynchus baudinii (Baudin`s Cockatoo)	**Threatened** (Vulnerable)	**Threatened**	Jarrah, Marri and Karri forests, woodlands, coastal scrub.	**Likely** – though may forage in the general area during the non-breeding season.
Ninox connivens connivens (Barking Owl)	Not listed	P2	Open forests, woodlands, dense scrub and timbered watercourses.	**Unlikely**.
Merops ornatus (Rainbow Bee-eater)	Marine, migratory (JAMBA)	IA	Open woodlands, sand ridges, sand pits, riverbanks, beaches, dunes, cliffs, mangroves and man-made grassed fields.	**Likely** – known to be present in the vicinity of the Project area.
Tringa glareola (Wood Sandpiper)	Marine, migratory (Bonn, CAMBA, JAMBA, ROKAMBA)	IA	Well-vegetated, shallow, freshwater wetlands, such as swamps, billabongs, lakes, pools and waterholes.	**Unlikely** – due to lack of suitable habitat.
Mammals				
Dasyurus geoffroii (Chuditch)	**Threatened** (Vulnerable)	**Threatened**	Wet and dry sclerophyll forest, mallee.	**Unlikely** – to be present due to lack of large remnants.
Isoodon obesulus fusciventer (Southern Brown Bandicoot, Quenda)	Not listed	P5	Sandy soils with low ground cover. Prefers areas that are regularly burnt. Highest densities occur in association with wetlands and damplands.	**Possible**.
Macropus irma (Brush Wallaby)	Not listed	P4	Open dry sclerophyll forests with open, seasonal wet flats with low grasses and open scrub.	**Unlikely** – due to lack of large remnants.
Falsistrellus mackenziei (Western False Pipistrelle)	Not listed	P4	Karri, Jarrah and Tuart forests and Banksia woodlands.	**Unlikely** – due to lack of large remnants.
Hydromys chrysogaster (Water Rat, Rakali)	Not listed	P4	Permanent bodies of fresh or brackish water.	**Unlikely** – due to lack of permanent water bodies.

Source: BCE 2006, DotE 2015a, DotE 2015b, Parks and Wildlife 2007, Parks and Wildlife 2014.

[1] Bonn – Bonn Convention, CAMBA – China – Australia Migratory Birds Agreement, JAMBA – Japan – Australia Migratory Birds Agreement, ROKAMBA – Republic of Korea – Australia Migratory Birds Agreement, IA – International Agreement.

Table 6: Vegetation types and black cockatoo foraging species within the Project area

Vegetation type	Description	Black cockatoo foraging species	Survey area (ha)	Mining and site compound area (ha)
1	*Macrozamia fraseri, Daviesia triflora* and *Acacia stenoptera* mid open shrubland over *Lyginia barbata, Conostylis aculeata* and *Phlebocarya ciliata* low open sedgeland with *Xylomelum occidentale* and *Eucalyptus rudis* occurring as isolated trees.	CBC – *E. rudis* BBC – Nil FRTBC – Nil.	59.37	22.97
2	*Banksia menziesii, B. attenuata, Allocasuarina fraseriana* and *Eucalyptus marginata* open woodland over *Kunzea glabrescens, Acacia pulchella* and *Macrozamia fraseri* mid sparse shrubland over *Hibbertia hypericoides, Conostephium pendulum* and *Gompholobium tomentosum* low sparse shrubland. Including 1.02 ha inferred VT2 within Explosives Reserve.	CBC – *B. menziesii, B. attenuata, A. fraseriana, E. marginata* BBC – *A. fraseriana, E. marginata* FRTBC – *A. fraseriana, E. marginata*.	7.91	6.54
3	*Jacksonia sternbergiana* and *Adenanthos cygnorum* subsp. *cygnorum* mid shrubland over *Conostylis aculeata* and *Lyginia barbata* low sparse sedgeland.	CBC – Nil BBC – Nil FRTBC – Nil.	2.02	1.32
4	*Banksia menziesii, B. attenuata, Eucalyptus marginata* and *Allocasuarina fraseriana* low open woodland over *Jacksonia furcellata, Regelia ciliata* and *B. sessilis* mid sparse shrubland over *Tetraria octandra* and *Ficinia nodosa* low sparse sedgeland.	CBC – *B. menziesii, B. attenuata, B. sessilis, A. fraseriana, E. marginata, J. furcellata* BBC – *B. sessilis, A. fraseriana, E. marginata* FRTBC – *A. fraseriana, E. marginata*.	9.36	-
5	*Eucalyptus* sp. (planted) open woodland over *Acacia saligna, Jacksonia furcellata* and *Kunzea glabrescens* tall sparse shrubland over **Eragrostis curvula* low sparse tussock grassland.	CBC – *A. saligna, J. furcellata, E.* sp. (planted)* BBC – *E.* sp. (planted)* FRTBC – *E.* sp. (planted)*.	7.11	-
P	Pine plantation (*Pinus pinaster*).	CBC – *P. pinaster* BBC – Nil FRTBC – Nil.	3.29	-
C	Cleared areas.	CBC – Nil BBC – Nil FRTBC – Nil.	5.88	1.77

*The *Eucalyptus* species present in this vegetation type was unable to be identified at the time of assessment. The species did not appear to be native to Western Australia and was likely planted in the Project area. All three species of black cockatoos may forage on this species; however this is not likely to constitute significant foraging species for black cockatoos.

Table 7: Quality of black cockatoo foraging habitat within the Project area

Vegetation type	Foraging quality	Justification
1	Low	Low density of species suitable for foraging by black cockatoos (i.e. foliage cover of suitable species 10-20%) and presence of food sources at only one stratum (i.e. canopy).
2	Very good	High density of species suitable for foraging by black cockatoos (i.e. foliage cover of suitable species >60%) and presence of food sources at several strata (i.e. canopy, midstorey and understorey).
3	Nil	No suitable foraging species for black cockatoos present.
4	Good	High density of species suitable for foraging by black cockatoos (i.e. foliage cover of suitable species >60%) but food sources only present at one or two strata (i.e. canopy and midstorey).
5	Low	Low density of species suitable for foraging by black cockatoos (i.e. foliage cover of suitable species 10-20%) and presence of food sources at only one stratum (i.e. canopy).
Pine plantation	Low (CBC only)	Low density of species suitable for foraging by black cockatoos (i.e. foliage cover of suitable species 10-20%) and presence of food sources at only one stratum (i.e. canopy).
Cleared areas	Nil	Cleared areas - no vegetation present.

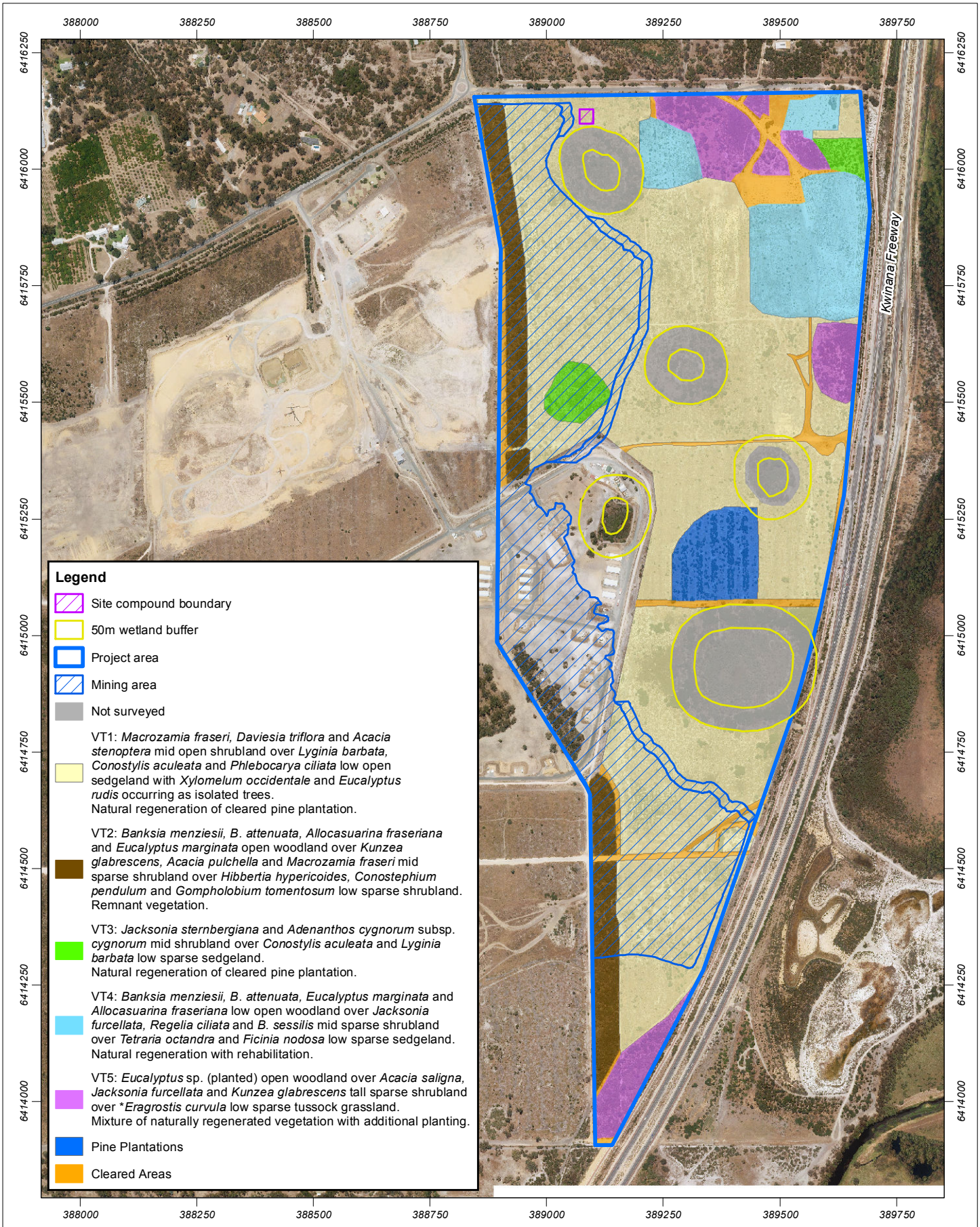


Figure 10: Vegetation types mapped within the Project area

Scale 1:10,997 at A4

0 50 100 150 200 250 Meters

N

Coordinate System: GDA 1994 MGA Zone 50
Note that positional errors may occur in some areas
Date: 30/06/2015
Author: JCrute
Source: Aerial image: Landgate, flown 11/2014.

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Path: Q:\Consult\2015\URE\URE15096.01\ArcMap_documents\R002\RevB\URE15096_01_R002_RevB_F010.mxd

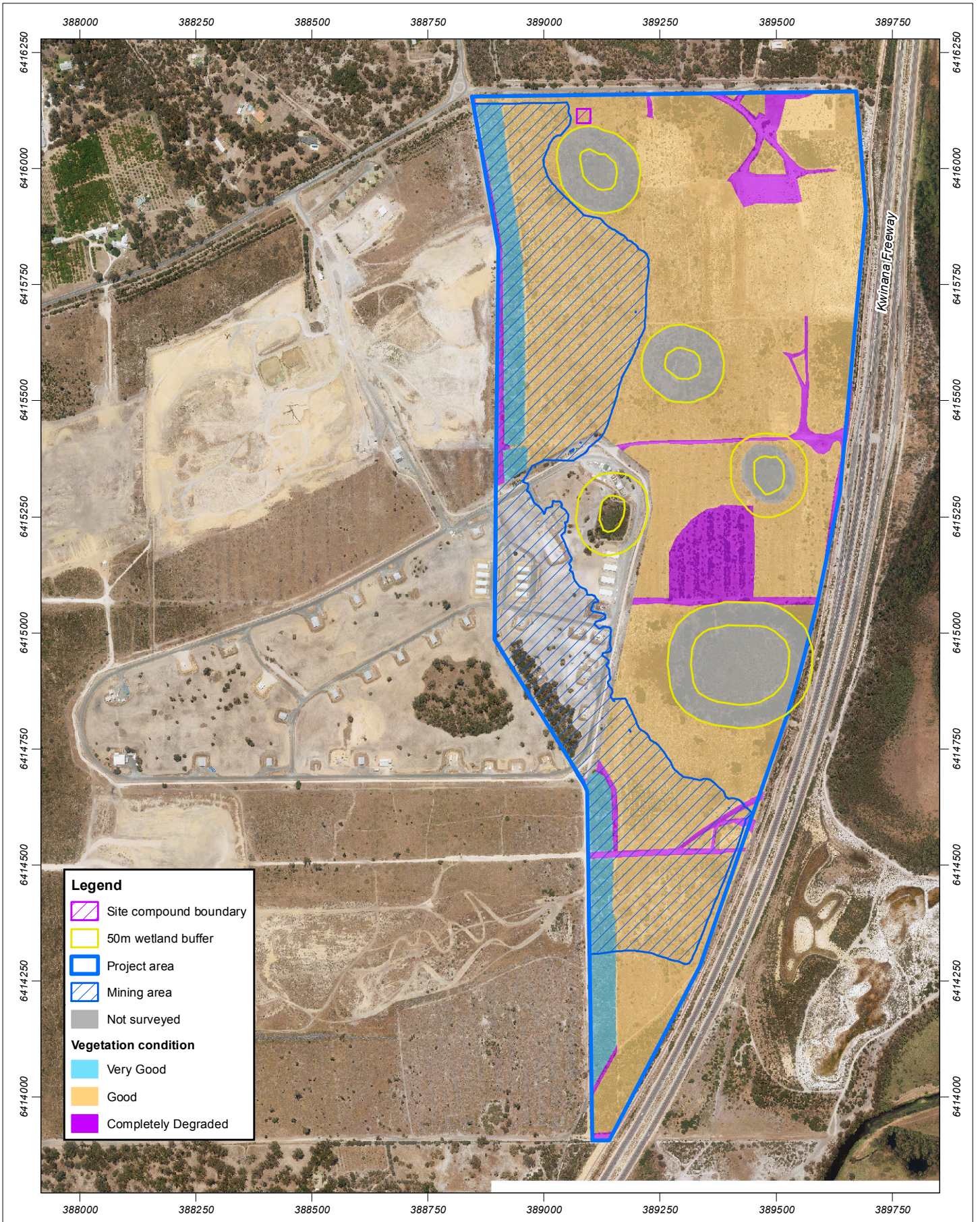

Figure 11: Vegetation condition mapped within the Project area

Scale 1:10,997 at A4

0 50 100 150 200 250 Meters

N

Coordinate System: GDA 1994 MGA Zone 50
Note that positional errors may occur in some areas
Date: 17/06/2015
Author: JCrute
Source: Aerial image: Landgate, flown 11/2014.

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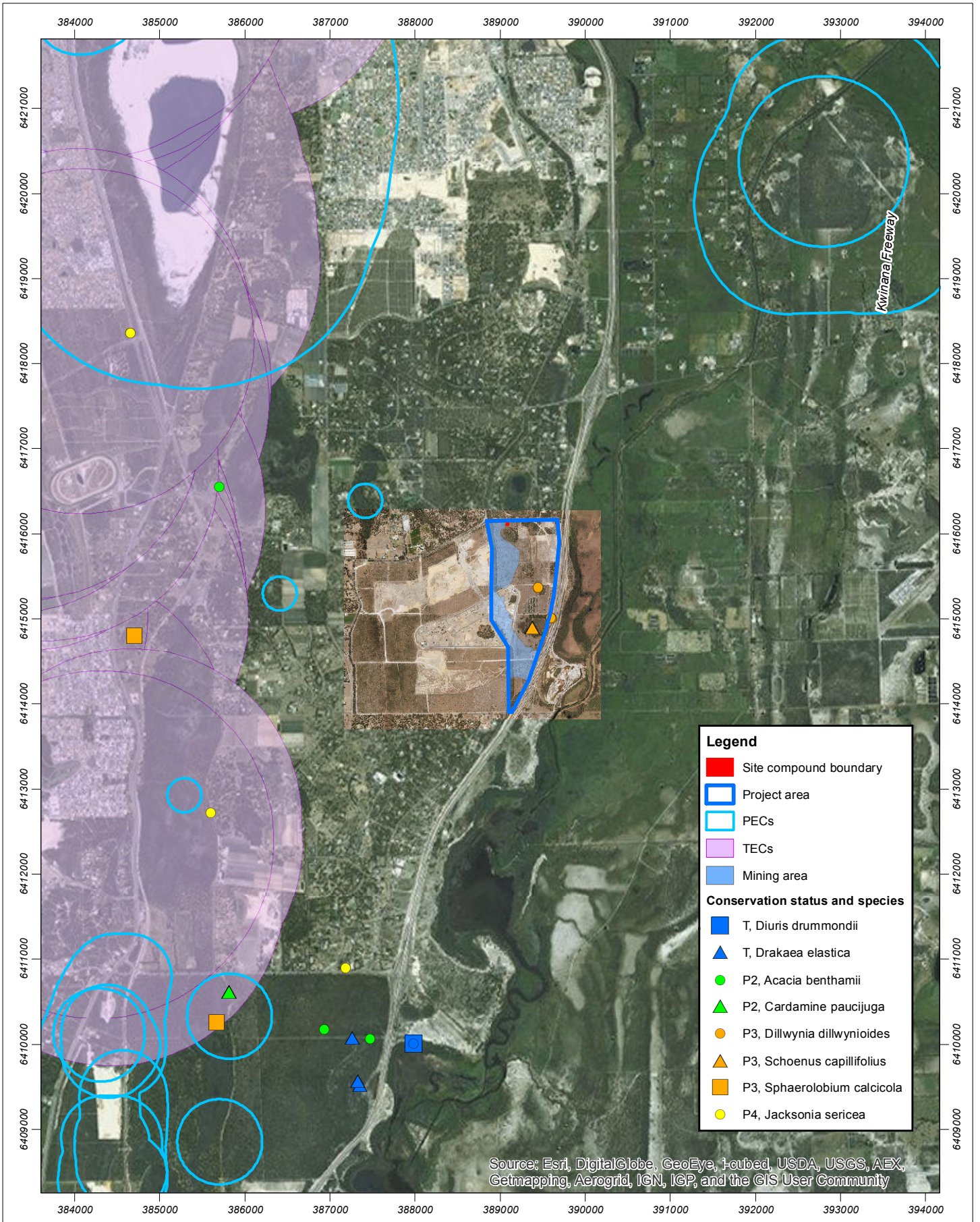

Figure 12: Location of Threatened and Priority Flora, TECs and PECs surrounding the Project area

Scale 1:60,000 at A4

0 0.5 1 1.5 2 km

N

Coordinate System: GDA 1994 MGA Zone 50
Note that positional errors may occur in some areas
Date: 17/06/2015
Author: JCrute
Source: Aerial image: Landgate, flown 11/2014. Background aerial image: : ESRI online, approx. 2010. TEC/PEC & Flora: DPAW 2015.

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2.8 Social environment

2.8.1 Aboriginal heritage

A search of the Department of Aboriginal Affairs (DAA) *Aboriginal Heritage Inquiry System* (DAA 2015) was conducted on 24 April 2015 of the Karnup locality found one Registered Aboriginal Site, and one Other Heritage Places within the Project area (Figure 13).

In addition to the database search, an indigenous cultural heritage survey was conducted by Big Island Research Pty Ltd (Big Island) in March 2013 to inform the Baldivis (housing) Development Project and included the Project area (Big Island 2013; Appendix 1).

The Registered Aboriginal Heritage Site (ID: 3582; Legacy ID: S02407) identified as Serpentine River is a Ceremonial, Mythological Site and covers the entire Project area. This site is not protected and there are no gender restrictions; however, the exact location of the site is restricted.

Site 28186 (Other Heritage Places) Nyitting Booya Binja was also identified within the Project area. It covers approximately 50% of the Project area and is registered as an Artefacts/Scatter. The site location is restricted; therefore, the exact location is unknown.

Site 31842 Keralup Artefact Scatter 3 was identified fringing the southern boundary of M70/1262 and outside the Project area. Site 31842 is outside the Project area and is registered as an Artefacts/Scatter. There is no gender, file or access restrictions.

Site ID 3561 (Legacy ID: S02444), Karnup, is also registered as an Artefacts/Scatter site and borders the north-eastern boundary of the Project area. This site consists of approximately thirty “low quality artefacts” covering an area of 60 m*5 m (Big Island 2013; Appendix 1).

To ensure no heritage artefacts are disturbed, Urban Resources would engage a heritage consultant to undertake a site walkover prior to any disturbance of the Project area. Urban Resources would also implement heritage management procedures to ensure no inadvertent disturbance of any unknown heritage sites. Heritage management measures are discussed in further detail in Section 5.

2.8.2 European heritage

There are no sites listed on State Register of Heritage Places (Heritage Council State Heritage Office 2015) or the City of Rockingham Municipal heritage inventory (City of Rockingham 2012) within the Project area.

The Baldivis Tramway Reserve is approximately 22 km in length and 20-70 m in width that traverses the City of Cockburn, Kwinana and Rockingham. The Baldivis Tramway Reserve starts at Baldivis Road and traverse this road in a north-south direction and ends at Stakehill Road which is immediately north of the Project area (ERM 2000). The City of Rockingham has identified the Baldivis Tramway Reserve as an important area for conservation and recreation values and it was included on the register held by the Heritage Counsel of Western Australia as a significant heritage area (ERM 2000); however, it has not been registered on the State Register of Heritage Places as a heritage site. The Baldivis Tramway Reserve does not occur within the Project area.

The Geogrup Lakes Area (Place No. 16083, also known as the Serpentine River Wetlands) is registered on the Register of Heritage Places (Heritage Council State Heritage Office 2015) and may occur to the east of the Project area adjacent to the Serpentine River as the site is described as occurring from Barragup to Karnup but the heritage site outline is not defined.

2.8.3 Other social receptors

Residents

Baldivis comprises a combination of residential, rural and natural land use. Land neighbouring the Project area is rural residential and rural, including properties with uncleared vegetation, market gardens, horse paddocks and vineyard. The closest residents are located along Stakehill Road and the closest residence is approximately 200 m north of the Project area.

Kwinana Freeway and local traffic

The Kwinana Freeway is a major state transport route providing access to the Perth CBD and major roads between Perth and Pinjarra. A dedicated bicycle path traverses the same alignment immediately adjacent to the freeway. Both the freeway and the bicycle path intersect Mining Tenement M70/1262 but are located outside the Project area. It is expected that the civil design of the freeway and bike path would currently manage any surface water overflow from the Project area as it flows east towards the Serpentine River.

There is no direct access from the freeway to Stakehill Road and the nearest freeway access from the Project area would be approximately 2 km via Baldivis and Karnup Rd approximately. The increased levels of traffic in the local area (up to 260 truck movements per day) from the Project area is expected to integrate with the current traffic from the adjacent Holcim sand mining operation and local traffic. The increase in traffic as a result of the Project would not be expected to have a significant impact on the capacity of the existing intersections.

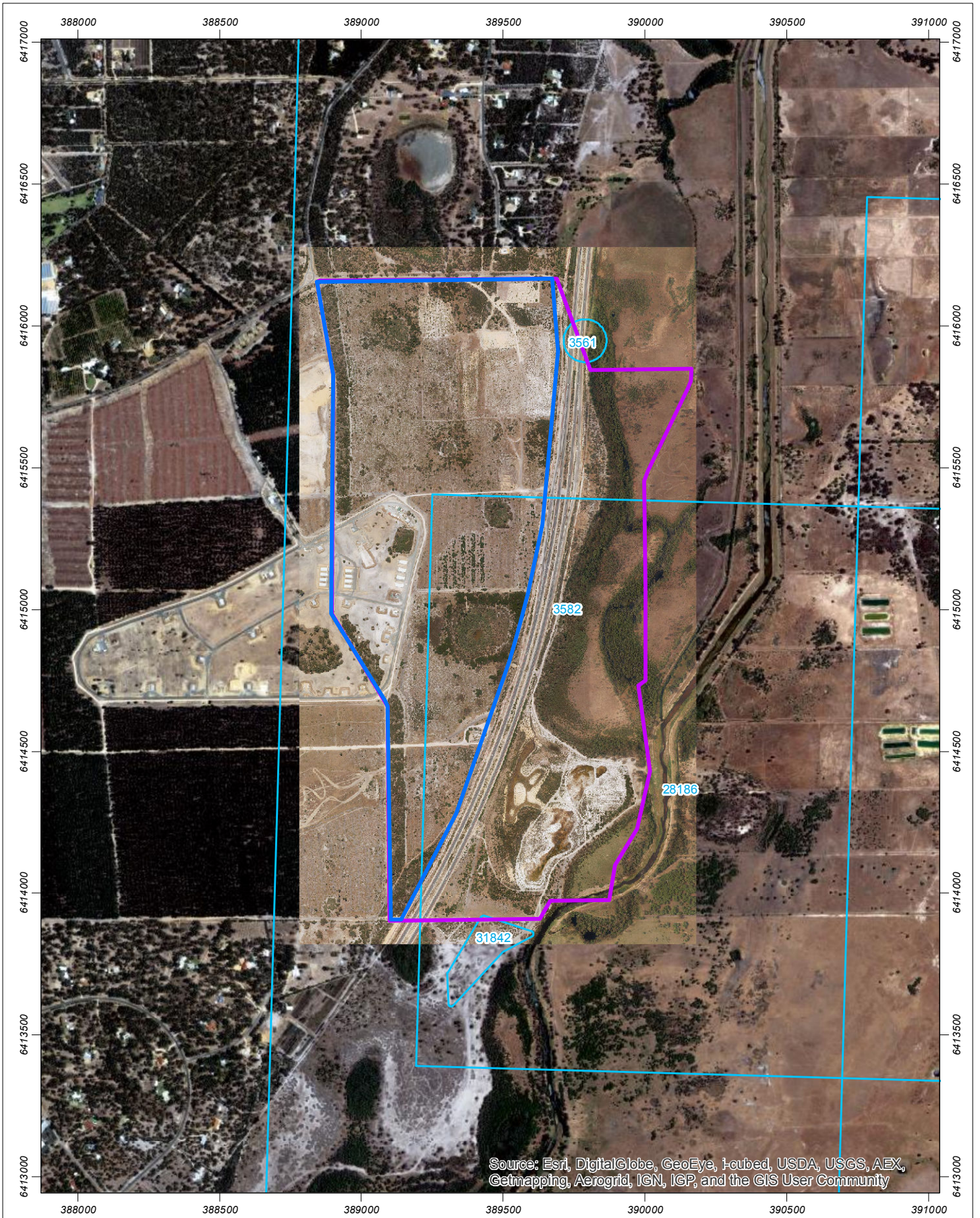

Figure 13: Aboriginal heritage sites within the Project area

Scale 1:18,000 at A4

0 100 200 300 m

N

Legend

- Project area
- Tenement M70/1262
- Aboriginal heritage sites

Coordinate System: GDA 1994 MGA Zone 50
Note that positional errors may occur in some areas
Date: 29/05/2015
Author: JCrute
Source: Aerial image: Landgate, flown 11/2014. Background aerial image: ESRI online, approx. 2010. Heritage: DIA 2012.

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3. Project description

3.1 Area of disturbance table

The total mine footprint will be approximately 41.96 ha (including mining area, stockpiles and site compound). Table 8 details the disturbance area. Excluding a strip of vegetation along the western boundary of the Project area, the Project will cause no new disturbance as it is proposed in an area previously disturbed by a pine plantation operation.

Table 8: Description of mining disturbances (hectares)

Mining disturbance description	M70/1262
Sand mining area	39.61 ha
Haul roads and access tracks	1.6 ha (within 39.61 ha sand mining area)
Overburden and vegetative stockpiles	2.26 ha
Plant site and mining infrastructure including offices, ablutions, laydown/hardstand areas including generator and storage	900m2 (0.09 ha)
Total disturbed land	41.96 ha
Undisturbed land	183.64 ha
TOTAL (should equal tenement area)	**225.6 ha**
Tenement area	**225.6 ha**

– locations to be determined during detailed design

3.2 Mining operations

A total of approximately 310 760 m^3 is proposed to be extracted and transported from the site annually and approximately 1 553 800 m^3 will be mined over the 5 year mine life. If material requires screening, a Works Approval will be applied for under Part V of the EP Act and screening will be undertaken in accordance with the Works Approval.

The mining operation, including construction will involve the following:

1. The vegetation to be cleared would be marked out accurately before clearing vegetation. Vegetation will be stockpiled prior to minor for later use in revegetation of the mining area.
2. Topsoil will be stripped and stockpiled separately to overburden to preserve the native seed bank for use in rehabilitation activities.
3. Haul and access roads will be marked out and constructed before the mining support infrastructure is established/constructed.
4. Overburden will be removed and stored in temporary stockpiles for later use in the closure phase, proposed to be used as backfill.
5. Mining will commence in a staged manner starting in the west of the Project area at the highest areas before progressing east. The mining process will involve excavation of sand using front end loaders and loading of sand into semi trailers for transport to market.
6. Rehabilitation to be undertaken in a stage manner once mining stages are completed.
7. Final rehabilitation and closure to commence at the end of mine life.

Other key characteristics of the mining operation, including indicative machinery list, transport and workforce characteristics, are outlined in Table 9.

Table 9: Key characteristics of the mining operation

Mining operation component	Description of key characteristic
Indicative machinery list	
Water cart	40 000 and 12 000 kL capacity, used for dust suppression of haul road, pit floor and stockpiles.
Front end loaders	Two Komatsu 470 loaders or similar.
Semi trailers	Would be provided by customers and expected to range in six from 10 m^3 to 25 m^3 capacity. Vehicles used will be classified as General Access by Main Roads Western Australia (i.e. Total mass <50 tonnes).
Grader	One JD 872 grader or similar will be utilised on site for maintaining roads on an as required basis.
Service truck	A service truck with a 5000 L diesel fuel capacity will be used to re-fuel site equipment as required. The service truck will also have tanks for separate lubricants, including a waste oil tank and evacuation pump and will only brought on site as required.
Light vehicles	Two for site operators.
Power generation	Diesel generators for the supply of power to offices.
Water supply	Bottled water will be supplied to staff as drinking water. Rainwater will be captured and stored on site. Additional water for purposes such as dust suppression will be trucked on site using a water cart as required.
Transport	
Truck movements and hours	Approximately 260 loaded and return truck movements per day of operation (depending on truck size).
Workforce	
Operation	2–3 personnel during operations.
Hours of operation	0600 to 1800 Monday to Saturday.

Mining will be undertaken in three main stages as identified in Figure 3 due to access constraints and agreements with DMP and LandCorp related to the presence and re-location of the DMP Explosives Reserve Facility. Stage 1 will involve mining north of the DMP Explosives Facility and buffer, Stage 2 will involve mining the DMP Explosives Facility and buffer once it has been re-located off site and Stage 3 will involve mining south of the DMP Explosives Facility.

Dewatering is not required for mining operations as mining of sand will occur down to 4.2 – 4.5 m mAHD which is expected to be at least 1.2 m above the AGL.

The stockpiles for overburden will be located at the edge of the mining area up to 20 m from the extent of mining. Overburden material is expected to consist of organic matter and some rock, and is likely to be up to 2 m high. Volumes are unknown but overburden depth is expected to be minimal due to the nature of the sand mining process.

Product stockpiles will be located within the mining area. Allowance will be made to store enough product to supply the market for up to seven days if excavation activities were to cease temporarily.

Excavation will begin on the western-most side of each stage, to allow easy access. A fence will surround each excavation area, with lockable gates securing the access road entrances outside of operating hours.

The indicative machinery proposed for the Project is listed in Table 9.

3.3 Sand processing

Due to the nature of the sand mine, sand will not be processed on site.

3.4 Tailings storage

There will not be any tailings or any other waste produced by the Project; however, cleared vegetation, topsoil and overburden which will consist of organic material (mostly pine tree roots) and any rocky material present, will be stored in temporary stockpiles before being used for rehabilitation purposes.

3.5 Support facilities

Support facilities at a site compound area will include (Figure 3):

- temporary office (donga)
- temporary ablutions block equipped with pump out septic tanks
- bottled water will be provided to quarry personnel
- hardstand for staff and visitor vehicle parking area
- static wheel wash (washdown bay) on limestone
- generator (20 kVA) (no fuel will be stored on site).

3.6 Workforce

Personnel will commute to the site each day. During the construction phase, there will be 2-3 personnel on site. During operations there will be approximately 2–3 personnel on site.

Operating hours will be Monday to Saturday 0600 to 1800 for the duration of the mine life. The site will not operate on Sundays or public holidays.

3.7 Transportation corridors

A purpose built haul road from the active mining areas to Stakehill Road will be used to access and haul sand from the site during Stage 1. Following completion of Stage 1, Holcim will construct a haul road within Miscellaneous Licence tenement L70/160 to be used by both Holcim and Urban Resources staff and customers. Urban Resources will extend the haul road to access and transport sand from Stages 2 and 3.

The haul road will be constructed of crushed limestone with a usable running surface width of 8 m. The haul road will not be sealed. Dust will be managed via wetting of the haul road surface with water when necessary with a water cart or sprinkler system. The total width of disturbance of the haul road is assumed to be 12 m, allowing for 2 m buffer on either side. A grader will be used on an as required basis to maintain access roads.

Customers will be responsible for transporting the product unless otherwise agreed with Urban Resources. This entails supplying the trucks, choosing the appropriate transport route once departing the site and managing any transportation impacts.

There will be approximately 260 loaded and return truck movements per day, depending on the size of truck used and customer demand. All loads leaving the site will be loaded using 'Loadrite' scale system equipped front end loaders. Urban Resources personnel will advise customers that all loads are to be covered upon leaving the Project area for transport to market.

The Project area will be fenced with an access gate near Stakehill Road. The access gate will be secure and locked outside of operating hours. Warning signs will be erected to the standard required by the City of Rockingham and DMP.

3.8 Resource requirements

3.8.1 Power supply

One 20kva diesel generator will be established on site to provide power to the site compound area. Diesel, oil, lubricant will be brought on site as required by a mobile service truck.

3.8.2 Water supply

Bottled water will be supplied to staff as drinking water. Additional water for purposes such as dust suppression will be trucked on site using a water cart as required.

3.9 Compliance with legalisation and other approvals

3.9.1 Tenement conditions

No tenement conditions have yet been assigned to M70/1262 or L70/160 by DMP as these tenements have not yet been granted and are still pending.

3.9.2 Environmental approvals

Various environmental approvals may be required for the Project under legislation other than the *Mining Act 1978*. These include:

1. Native Vegetation Clearing Permit (NVCP) under Part V of the EP Act (delegated authority). The application for the NVCP is expected to be submitted to and assessed by DMP concurrently with the Mining Proposal.
2. Works Approval, Prescribed Premises Licence and/or Registration under Part V of the EP Act for the construction and operation of the mobile screening plant if required. The relevant documentation for these approvals will be prepared and submitted to Department of Environment Regulation for assessment under Part V of the EP Act a minimum of three months before construction of the Prescribed Premises commences.

The Project is to be referred to the DotE under the EPBC Act for the Australian Government to determine if the Project will significantly impact National Matters of Environment Significance (MNES) that are protected under the Act. The requirement for the referral relates to the clearing of foraging habitat for Black Cockatoo species. The potential impact to these species will also be considered during the NVCP application.

The Project will not be referred under Part IV of the EP Act as it is considered that the Project will impact minimal environmental factors and these can be assessed and managed under the *Mining Act 1978* in accordance with the MOU between the EPA and DMP.

A '5C Licence to Take Groundwater' is not required under the *Rights in Water and Irrigation Act 1914* as groundwater will not be abstracted at the site. Water for operations will be trucked to site by water carts and stored in tanks on site.

4. Environmental impacts and management

4.1 Land clearing

A total of 30.83 ha of vegetation will be cleared to facilitate sand mining within M70/1262 during the life of the Project for construction and operation of the mine.

The following activities or aspects of the sand mining operation requiring management to minimise the following potential land clearing impacts:

- direct removal of vegetation communities
- direct loss of habitat for terrestrial fauna
- wetland and land degradation.

Land clearing impacts have the potential to affect surface water, flora, fauna and ecosystems within and surrounding the Project area. In addition, clearing if not managed appropriately may result in indirect impacts to surrounding residents as a result of dust and noise impacts. Management measures to be implemented for dust and noise are described further in Section 4.9.1.

Land clearing will be managed through implementation of the following measures including but not limited to:

- minimising clearing to include the mining area, haul road and required infrastructure
- obtaining clearing approvals and delineating clearing footprint boundaries prior to and during clearing
- stockpiling cleared vegetation for reuse in future rehabilitation
- stripping topsoil and overburden prior to construction earthworks and managing these materials for closure.

4.2 Water

4.2.1 Surface water

Potential surface water impacts of the Project include:

- erosion or scour at drainage outlets, occurring when the velocity of surface flows are increased by drainage design
- changes to natural hydrology (surface flows, erosion, inundation and surface/groundwater interaction).

Due to the sandy nature of the Project area, there is expected to be minimal stormwater runoff from the mine area as the Bassendean Sands have a high hydraulic conductivity and rainfall infiltrates rapidly. Flooding is not considered an issue in the mine areas due to the high infiltration capacity of the sands and the relatively high clearance to the groundwater table (greater than 1 m) in the area to be mined.

The mine area will be designed, constructed and operated to avoid disruption of surface water flows and ensure that potential contaminants are not released to the environment. The following management practices will be implemented to manage the potential effects on water quality from the discharge of stormwater with elevated sediment levels or any other contaminants:

- staged clearing and retention of tree stumps as long as possible prior to mining to assist with soil stabilisation and reduce surface water flow velocities
- a buffer zone of 50 m will be maintained between mining operations and naturally vegetated geomorphic wetlands
- each stage will be progressively rehabilitated at completion. Vegetation cover will be established to encourage spreading and reduce velocities of surface water flow
- riffle zones and contour sills will be used downslope of the run of mine pad
- hydrocarbon management measures will ensure surface water contamination does not occur
- Urban Resources will provide spill response equipment at the site.

4.2.2 Groundwater

There are not expected to be any direct impacts to groundwater by the Project as there will be no dewatering activities or groundwater abstraction for water supply to facilitate mining.

Adequate sand will be retained on the site (i.e. 1.2 m above AGL) to ensure that waterlogging and inundation will not occur after rainfall events as a result of the Project. Groundwater flow directions will not be affected by the Project.

Dewatering

No pit dewatering or groundwater abstraction for water supply is proposed as part of this Project and there will be no impact to groundwater from such activities.

4.2.3 Storage and usage of hydrocarbons and chemicals

The storage and usage of hydrocarbons, chemicals and other materials at the Project area such as fuel, oils, greases and degreasers, lubricants, solvents, detergents, glues, paints and sewage has the potential to cause atmospheric, soil or water contamination and human health issues if incorrectly stored, used or disposed of.

Minimal hydrocarbons and chemicals are proposed to be stored on site. Urban Resources will not service machinery or construct a fuel farm on site. Fuel, oil, coolant and lubricant will be brought on site as required by a fully contained mobile service truck. The service truck has separate tanks for lubricants, including a waste oil tank and evacuation pump. As a result, there will be no storage of hydrocarbon waste on site.

Any hydrocarbon or chemical leaks or spills have the potential to contaminate the surface water and seep into the groundwater if not readily contained and cleaned up. The materials will be managed in accordance with the measures detailed in Section 4.7.

4.3 Flora, fauna and ecosystems

No threatened flora species pursuant to Schedule 1 of the WC Act or listed under the EPBC Act have been recorded within the Project area (Strategen 2015). *Dillwynia dillwynioides* and *Schoenus capillifolius* were recorded by Bennett (2006); however, these species were recorded in wetlands which will not be disturbed as part of the Project.

No TECs or PECs were identified as having the potential to occur within the Project area (Strategen 2015). No Declared Plant species pursuant to Section 22 of the *Biosecurity and Agriculture Management Act 2007* (BAM Act) were recorded within the Project area.

Three EPBC Act listed black cockatoo species were identified in a desktop assessment as the most likely species to occur in the Project area. In addition to the black cockatoo species, the Rainbow Bee-eater is likely to occur in the general area in sandy soiled areas and surrounding wetlands. The habitat most likely to support the Rainbow Bee-eater is associated with wetland areas that will not be impacted by the Project.

A field survey conducted by Strategen (2015) assessed the potential for black cockatoo habitat. The survey identified signs of Carnaby's Black Cockatoo foraging within the Project area. The highest quality foraging habitat for black cockatoos was noted within VT 2 which contained high densities of black cockatoo food species including eucalypts and *Banksia* spp. at canopy and midstorey levels. The lowest quality foraging habitat for black cockatoos (not including cleared areas) was noted within VT 5 which contained limited potential food resources for all three species of black cockatoos.

Based on the results of the foraging assessment, the survey area is considered to contain 6.54 ha of very good quality foraging habitat and 24.29 ha of low quality foraging habitat for CBC, BBC and FRTBC.

Six seasonally damp and inundated geomorphic wetlands also occur within the Project area, however these are not impacted.

The following environmental activities or aspects of the sand mining operation have been identified as requiring management to ensure protection of flora, fauna and ecosystem values:

- land clearing which may result in the direct loss of some individuals of conservation significant flora species not identified during surveys of the Project area
- land clearing may reduce and/or fragment the habitat of conservation significant fauna species
- clearing and construction works may result in the death or injury of conservation significant fauna species
- increased vehicular traffic may result in increased number of fauna road kills, and may promote the spread of weeds
- increased human activities and rubbish may encourage habitation of introduced fauna species
- direct and indirect disturbance from light, noise and dust may reduce habitat quality in areas surrounding the disturbance area.

The potential impacts associated with the Project will be managed and mitigated through the following management measures:

- clearing to stay within approved footprint by clearly delineated clearing footprint boundaries
- access to non-operational areas will be restricted to authorised personnel and only on the designated haul road, unless in case of emergency
- land clearing to take place in stages to allow for local migration of fauna into adjacent areas
- no clearing to be undertaken within 50 m of the naturally vegetated geomorphic wetlands within the Project area
- designated vehicle routes (haul road) and appropriate speed limits to be enforced to minimise fauna vehicle interactions
- any sightings of native or exotic fauna (including sightings, injuries and mortalities) to be reported to the site manager
- include fauna awareness in inductions and environmental awareness training sessions

- prohibit domestic pets on site
- installing relevant signage on roads and entry points to the mine noting presence of fauna.

Sand mining activities are highly unlikely to result in a change in status of conservation for any fauna or flora species, and will not significantly impact the regional distribution of fauna habitat for conservation species due to heavily impacted nature of the site and the wide extent of vegetation communities and fauna habitat remaining in the local and regional area. Geographical distribution and productivity of fauna at species and ecosystem levels will be maintained through the outlined management and mitigation measures.

Rehabilitation will occur in a progressive manner as detailed further in the MCP (Appendix 2).

4.4 Topsoil and soil profiles

Prior to ground disturbance, the topsoil (nominally the top 15 cm of the soil profile) will be stripped and stockpiled away from the mining area to create a bund of no more than 2 m high to maintain biological integrity. Stockpiles will be located a sufficient distant from mining operations so that they will not be disturbed prior to being used in rehabilitation.

As the proposed activities will not disturb the ground below the water table or any areas of high probability of ASS occurrence, it is unlikely that any ASS will be exposed or disturbed.

According to the DEC guideline 'Identification and investigation of acid sulphate soils and acidic landscapes', sites should be investigated for ASS if extractive industry works are proposed around high to moderate risk PASS soils and wetlands as found in the proposed tenement. Accordingly, Urban Resources will exclude mining from a 50 m buffer around mapped high to moderate risk PASS soils (including 50 m around all wetlands whether mapped as high to moderate risk or not).

Urban Resources plan to manage ASS and overburden in the following manner:

- avoid disturbance of high ASS risk areas
- overburden will be stockpiled and used for rehabilitation
- excavation will not intersect the water table
- overburden and oversize material stockpiles will be used to backfill and rehabilitate the excavations at mine closure and are thus temporary
- Urban Resources commits to the exclusion of mining from a 50 m buffer around mapped high to moderate risk PASS soils (including 50 m around all wetlands whether mapped as high to moderate risk or not).

4.5 Domestic and industrial waste products

Wastes will be managed in order to prevent visual impacts, contamination of groundwater, soil and surface water, and human health issues. Urban Resources apply the waste management principles of reduce, re-use and recycle. The following wastes may potentially be produced by the proposed project:

- hydrocarbon and chemical contaminated wastes (such as used oil, empty drums and containers, spill absorbent materials etc). This will be minimal as no hydrocarbons will be stored on site, but brought on site as required by a mobile service truck and removed immediately
- general waste (such as kitchen waste, paper, cardboard etc)
- sewage and domestic wastewater.

Hydrocarbons will be managed as per Section 4.7. All other wastes types will be contained on-site and be removed by an appropriately licensed contractor.

4.6 Waste rock management

There will be no waste rock associated with the Proposal.

4.7 Hydrocarbon management

During construction and operation of the Project, hydrocarbons will be required for a range of proposed activities. The transport, storage and use of hydrocarbons on site can present risks to the environment if not managed appropriately. Spills and leaks resulting from inappropriate storage or procedures may result in contamination of soil, surface water and groundwater.

Minimal hydrocarbons are proposed to be stored on-site. Urban Resources will not service machinery or construct a fuel farm on site. Fuel, oil, coolant and lubricant will be brought on site as required by a fully contained mobile service truck. The service truck has separate tanks for lubricants, including a waste oil tank and evacuation pump. As a result, there will be no storage of waste hydrocarbons on site.

Urban Resources will also implement the following management actions to minimise this risk to the environment from hydrocarbons:

- purchase, storage and transport of fuel will comply with *Poisons Act 1964*, Poisons Regulations 1965, *Mines Safety and Inspection Act 1994*, Mines Safety and Inspection Regulations 1995, *Dangerous Goods Safety Act 2004,* Dangerous Goods (Storage) Regulations 2007 and Dangerous Goods (Road Transport) Amendment Regulations 1988
- all Hydrocarbon spills will be cleaned up and contaminated soil disposed offsite at a licensed landfill, in the event that hydrocarbon spills occur.

4.8 Dangerous goods and hazardous substances

No dangerous goods or hazardous substances, other than hydrocarbons, will be used on the Project site. Hydrocarbon management has been addressed in Section 4.7.

4.9 Atmospheric pollution and noise

4.9.1 Atmospheric pollution

Atmospheric pollution from the Project is limited primarily to dust emissions. Combustion emissions from power generation and vehicles are also anticipated, however, these are not likely to lead to a decline in the local air quality.

Excessive dust can have adverse impacts on both workers and health of surrounding vegetation. Dust generated from the proposed mine is expected to be minor and localised. Dust may be generated by:

- earthworks during the construction and operational phase
- clearing and stripping
- excavation
- loading and transport
- movement of vehicles
- wind erosion of exposed surfaces.

Urban Resources have made allowance for water cart operation, and ensuring the disturbed area exposed is kept to a minimum at all times. To satisfy the requirements of the *Mines Safety and Inspection Act 1994 and Regulations 1995* in regard to occupational health risks from dust, Urban Resources will ensure that all personnel will have access to efficient dust masks and that a water cart is available during mining operations.

Access roads and internal road will be constructed of compacted crushed limestone (they will not be sealed). Dust will be managed via the use of water carts where necessary to prevent dust generation.

Standard dust suppression measures will be implemented during construction and operation to minimise impacts on surrounding vegetation. Management strategies to be undertaken are as follows:

- dust suppression measures, such as water sprays/carts, will be implemented as necessary, in the event that high levels of dust are observed
- dust will be visually monitored daily during operations and construction to ensure control measures are effective
- areas will be progressively cleared and progressively rehabilitation to limit the area of bare earth at any one time
- access roads will be constructed of crushed limestone
- activities with high dust-causing potential, such as stripping, will not be carried out in sensitive areas during adverse wind conditions
- material drop heights between loaders and trucks and trucks to stockpiles will kept to the minimum practical height
- any complaints will be investigated immediately.

A Dust Management Plan will be prepared, based on the DER publication (Department of Environment and Conservation 2011).

4.9.2 Noise

Noise generated by the proposed mine is expected to be localised and due to:

- operation of earthmoving equipment throughout the construction and operational phases
- traffic along the transport routes.

Noise impacts are managed by providing all necessary hearing protection, and conducting inductions and educational programs for all staff. There will be no blasting or breaking of a dense duricrust required due to the local geology within the area. Operational noise for mining sand is expected to be less than other forms of mining. Vibration disturbance is expected to be minimal as the proposal does not include blasting. Urban Resources will also not be crushing or operating any particularly noise plant or processing equipment.

Urban Resources does not expect significant noise issues to arise during their operations and the distance between existing dwellings is considered to offer sufficient buffers to not adversely impact residents.

A noise impact assessment will be undertaken prior to the commencement of construction to confirm that the noise emissions comply with the requirements of the *Environmental Protection (Noise) Regulations 1997* and the *Mining Act 1978* at all times.

Management measures that will be implemented to minimise noise emissions include:

- operations will occur between 0600 – 1800 Monday - Saturday to minimise the likelihood of noise nuisance
- all mobile equipment will be maintained, with efficient mufflers and noise shielding
- mobile equipment without audible reversing alarms will be used if possible.

Any complaints received regarding noise disturbance will be recorded and investigated immediately.

4.10 Summary of environmental impacts

The key environmental impacts and the management commitments to be implemented are detailed in Table 10.

Table 10: Summary of environmental impacts and management commitments

Environmental Impact	Management commitment implementation	Timelines
Direct loss of vegetation communities and associated fauna habitat Wetland and land degradation	Minimising clearing to include the mining area, haul road and required infrastructure.	At all times
	Obtaining clearing approvals and delineating clearing footprint boundaries prior to and during clearing.	Prior to commencement of land clearing
	Stockpiling cleared vegetation for reuse in future rehabilitation.	During clearing
	Stripping topsoil and overburden prior to construction earthworks and managing these materials for closure.	During clearing
Land clearing which may result in the direct loss of some individuals of conservation significant flora species not identified during surveys of the Project area	Clearing to stay within approved footprint by clearly delineated clearing footprint boundaries.	At all times
Land clearing may reduce and/or fragment the habitat of conservation significant fauna species	Clearing to stay within approved footprint by clearly delineated clearing footprint boundaries.	At all times
	Revegetate black cockatoo habitat following mining.	Completion of mining
Clearing and construction works may also result in the death or injury of conservation significant fauna species	Designated vehicle routes (haul road) and appropriate speed limits to be enforced to minimise fauna vehicle interactions.	At all times
	Include in inductions fauna awareness and environmental awareness training sessions.	Induction phase
	Installing relevant signage on roads and entry points to the mine noting presence of fauna.	At all times
Increased vehicular traffic may result in increased number of fauna road kills, and may promote the spread of weeds	Clearing to stay within approved footprint by clearly delineated clearing footprint boundaries.	At all times
	Land clearing to take place in stages to allow for local migration of fauna into adjacent areas.	During clearing
	Designated vehicle routes (haul road) and appropriate speed limits to be enforced to minimise fauna vehicle interactions.	At all times
increased human activities and rubbish may encourage habitation of introduced fauna species	Any sightings of native or exotic fauna (including sightings, injuries and mortalities) to be reported to the site manager.	At all times
	Prohibit feeding of fauna on-site.	At all times
	Prohibit domestic pets on site.	At all times
direct and indirect disturbance from light, noise and dust may reduce habitat quality in areas surrounding the disturbance area	Include in inductions fauna awareness and environmental awareness training sessions.	Induction phase
Erosion as a result of surface water. Changes to natural hydrology	Staged clearing and retention of tree stumps as long as possible prior to mining to assist with soil stabilisation and reduce surface water flow velocities.	During clearing
	A buffer zone of 50 m will be maintained between mining operations and naturally vegetated geomorphic wetlands.	During mining activities

Environmental Impact	Management commitment implementation	Timelines
	Stockpiles of erodible material will be located away from limestone hardstand areas to minimise sediment transport in runoff.	During mining activities
	Each stage will be progressively rehabilitated at completion.	Completion of each stage
	Vegetation cover will be established to encourage spreading and reduce velocities of surface water flow.	Completion of mining
	Riffle zones and contour sills will be used downslope of the run of mine pad.	During mining activities
	Bunds and v drains will be established at limestone hardstand areas of the Project area, such as the haul road and the site compound area, to contain stormwater runoff and capture sediment on site.	During mining activities
	Hydrocarbon management measures will ensure surface water contamination does not occur.	At all times
	Urban Resources will provide spill response equipment at the site.	At all times
Atmospheric, soil or water contamination	Urban Resources will provide spill response equipment at the site.	At all times
Disturbance to soils resulting expression of ASS	Avoid disturbance of high ASS risk areas.	At all times
	Overburden will be stockpiled and used for rehabilitation.	During mining activities
	Excavation will not intersect the water table.	During mining activities
	Overburden and oversize material stockpiles will be used to backfill and rehabilitate the excavations at mine closure.	Mine closure
	Urban Resources commits to the exclusion of mining from a 50 m buffer around mapped high to moderate risk PASS soils (including 50 m around all wetlands whether mapped as high to moderate risk or not).	During mining activities
	If mining is proposed within the 50 m buffer, Urban Resources commits to the provision of a management plan which will include the results of ASS investigations and will incorporate the results into management strategies.	Prior to mining within 50 m of a wetland
Contamination of groundwater, soil and surface water as a result of domestic and industrial waste products	Waste will be contained on site and be removed by an appropriately licensed waste contractor.	During mining activities
Contamination of groundwater, soil and surface water as a result of hydrocarbon spills	Purchase, storage and transport of fuel will comply with Poisons Act 1964, Poisons Regulations 1965, Mines Safety and Inspection Act 1994, Mines Safety and Inspection Regulations 1995, *Dangerous Goods Safety Act 2004,* Dangerous Goods (Storage) Regulations 2007 and Dangerous Goods (Road Transport) Amendment Regulations 1988.	During mining activities
	All Hydrocarbon spills will be cleaned up and contaminated soil disposed offsite at a licensed landfill, in the event that hydrocarbon spills occur.	At all times
Dust impacts on surrounding vegetation, wetlands and local amenity	Dust suppression measures, such as water sprays/carts, will be implemented as necessary, in the event that high levels of dust are observed.	During mining activities
	Dust will be visually monitored daily during operations and construction to ensure control measures are effective.	During clearing and mining activities
	Areas will be progressively cleared and progressively rehabilitation to limit the area of bare earth at any one time.	During clearing
	Access roads will be constructed of crushed limestone.	During construction
	Activities with high dust-causing potential, such as stripping, will not be carried out in sensitive areas during adverse wind conditions.	During clearing and mining activities

Environmental Impact	Management commitment implementation	Timelines
	Material drop heights between loaders and trucks and trucks to stockpiles will kept to the minimum practical height.	During clearing and mining activities
	Any complaints will be investigated immediately.	At all times
Noise impacts to surrounding residents	Stockpiles/bunding will be located to provide substantial noise suppression between the nearest dwellings.	During mining activities
	Operations will occur between 0600 – 1800 Monday - Saturday to minimise the likelihood of noise nuisance.	At all times
	All mobile equipment will be maintained, with efficient mufflers and noise shielding.	At all times
	Mobile equipment without audible reversing alarms will be used if possible.	At all times

5. Social impacts

5.1 Heritage

5.1.1 European heritage

No European heritage sites were identified within the Project based on a search of the State Register of Heritage Places (Heritage Council State Heritage Office 2015) or the City of Rockingham Municipal heritage inventory (City of Rockingham 2012).

The City of Rockingham has identified the Baldivis Tramway Reserve as an important area for conservation and recreation values and it was included on the register held by the Heritage Council of Western Australia as a significant heritage area (ERM 2000); however, it has not been registered on the State Register of Heritage Places as a heritage site. The Baldivis Tramway Reserve is outside of this proposal and will not be impacted.

The Geogrup Lakes Area (Place No. 16083, also known as the Serpentine River Wetlands) is registered on the Register of Heritage Places (Heritage Council State Heritage Office 2015) and may occur to the east of the Project area adjacent to the Serpentine River as the site is described as occurring from Barragup to Karnup but the heritage site outline is not defined.

No registered European heritage sites will be impacted as a result of the Project.

5.1.2 Aboriginal heritage

A search of the DAA *Aboriginal Heritage Inquiry System* (DAA 2015) and a Aboriginal Ethnographic and Archaeological Heritage Assessment (Big Island 2013) have been undertaken of the Project area which identified four sites of significance, including:

- the Serpentine River Registered Aboriginal Heritage (Site ID: 3582; Legacy ID: S02407) which is registered as a ceremonial, Mythological site which covers the entire Project Area- . As the site is related to the Serpentine River itself and there is no intersection of the river with the mining tenement, the Project would not result in any impacts to the registered heritage site (Big Island 2013)
- the Nyitting Booya Binja Other Heritage Place (Site 28186) which is within and bordering the Project area
- the Karnup site (Site ID 3561;Legacy ID: S02444), which is registered as an artefacts/scatter within and bordering the Project area
- The Keralup Artefact Scatter 3 (Site 31842) which is registered as an artefacts/scatter fringing the southern boundary of M70/1262. As the site is outside the Project area there are no anticipated impacts to the registered heritage site.

None of the identified Sites are considered to have the potential to be impacted by the Project. All sites are known or are likely to occur outside of the Project area. Site 28186, however the Site is mapped over a wide area and the Project area is not situated centrally to the mapped area and therefore it is unlikely that the Site intersects with the Project Area. Additionally Site 28186 is registered as an Artefacts/Scatter. Areas of the Project area proposed to be disturbed have previously been disturbed by clearing, pine plantation and clearing of the pine plantation again, including removal of stumps and roots.

To ensure no heritage artefacts are disturbed, Urban Resources proposes to consult with the relevant aboriginal community to engage an appropriate community member to conduct site inspection prior to topsoil removal.

Should any aboriginal sites be uncovered, all activities will cease in accordance with *Aboriginal Heritage Act 1972*-and an aboriginal heritage assessment will be undertaken by a recognised consultant. Prior to the disturbance of any known sites a Section 18 application will be submitted to the Department of Indigenous Affairs under the *Aboriginal Heritage Act 1972*.

Site inductions will brief personnel on:

- the potential for unidentified buried archaeological material to occur
- Urban Resources obligations under the *Aboriginal Heritage Act 1972*
- the response procedures in the event that unidentified buried material is found during sand extraction. This includes ceasing work and reporting to the Mine Manager.

5.2 Land use and community

Baldivis comprises a combination of residential, rural and natural land use. The closest residents are located along Stakehill Road with the closest residence 200 m north of the Project area. No impacts to this residential home are anticipated.

Key impacts associated with sand extraction that have the potential to impact residents are dust and noise. Management of these factors are detailed in Section 4.9.

5.3 Stakeholder consultation

The following stakeholder consultation has been undertaken:

1. **City of Rockingham**: consultation included discussion on final land use, groundwater levels and final finished levels. Further information regarding impacts on flora and fauna were provided to the City. The City will seek further information from the executive team once the proposed mine plan is finalised.
2. **DMP**: consultation has included briefings with the DMP through meetings and email and telephone correspondence in relation to the proposed mining operations and proposed final land use. Urban Resources will continue to liaise with DMP through submission of the Mining Proposal and MCP document and following approval.
3. **LandCorp**: consultation included discussion on final land use, groundwater levels and final finished levels and future plans for the Project area. Outcomes of the consultation included agreement on final groundwater levels, confirmation of proposed final land use and preparation of a proposed schedule for presentation of proposed mine plan and submission of approvals documents.
4. **Holcim**: consultation included discussion regarding the Miscellaneous Licence.

5.4 Social environment

The Project will create a number of jobs for local people and work for businesses offering services such as sand cartage, contract work and waste removal. The Project is therefore considered to have a positive local social impact. No negative social impacts are anticipated as a result of the Project.

5.5 Workforce induction and training

Urban Resources will develop an environmental induction that all personnel must complete prior to work commencing on site. The induction package will summarise the potential issues and relevant environmental and social management strategies detailed in Sections 4 and 5.

6. Mine closure

The following section outlines the decommissioning and rehabilitation that will be undertaken following cessation of mining operations for relinquishment of Mining Lease M70/1262 to the State and transfer of the site to LandCorp as a Parks and Recreation Reserve to support the adjacent future residential development.

6.1 Post mining land use

Urban Resources proposed to develop agreed final landforms and post-mining land use(s) consistent with stakeholder expectations. The overall post-mining land use is expected to that consistent with the site's, zoning of Parks and Recreation. The City of Rockingham have identified that the area is proposed to support regional sporting facilities and open space support the adjacent proposed future residential development and to satisfy a broader regional requirement for such facilities. The area will contain open parklands suitable for active recreation and a vegetated linear corridor on the western boundary of the Project area. This will provide passive recreation, serve as an ecological corridor and will provide food resources for Black Cockatoos.

The key considerations in determining the final land use are:

1. Relevant to the environment in which the mine will operate.
2. Achievable in the context of post-mining land capability.
3. Acceptable to key stakeholders.
4. Ecologically sustainable in the context of the local and regional environment.

The land use hierarchy as presented in the mine closure planning guidelines (DMP & EPA 2015) will provide a guide to determine post-mining land use(s) as follows:

1. "Natural" ecosystems will be reinstated as similar as possible to the original ecosystem.
2. An alternative land use with higher beneficial uses than the pre-mining land use will be developed.
3. The pre-mining land use will be reinstated.
4. An alternative land use will be developed with beneficial uses other than the pre-mining land use.

Acknowledging the final end land use of the site as primarily parks and recreation with potentially some urban development, Urban Resources will establish a safe and stable landform consistent with LandCorp's and the City of Rockingham's requirements until the site is developed.

It is understood that the post land use requirements for the condition of the project area at transfer of ownership are:

- all infrastructure (including barriers, tracks, buildings and signs) to be removed unless retention is agreed in writing with relevant Government agencies and the local Shire
- any overburden/topsoil/vegetative material stockpiles will backfilled into mine void or respread on site
- all constructed landforms and disturbed areas are to be stable and resistant to erosion, or at least comparable to naturally-occurring erosion in the area
- drainage should be consistent with LandCorp's requirements for future land use
- flora and vegetation on the linear vegetated strip (Strategen 2015) is representative of the target ecosystem as defined by species richness, diversity, and density, weed species number and weed density targets to be developed.

6.2 Rehabilitation

The objective of rehabilitation at the site is attainment of a stable landform, consistent with LandCorp's and the City of Rockingham's requirements. Completion criteria will be developed and refined, where applicable and appropriate, through the lifetime of the Project.

To achieve closure, the following processes will be implemented:

- stockpiling of cleared vegetation for use during rehabilitation
- stockpiling of topsoil in windrows to enable the soil profile to be reinstated during rehabilitation
- decommissioning and removal of mine and ancillary infrastructure
- treatment (or removal) of any localised soil contamination if required
- re-profiling of surfaces using site specific criteria developed from studies conducted to determine final design and levels in accordance with the Mine Plan
- mechanical treatment of compacted surfaces (ripping and scarifying)
- replacement of topsoil
- spreading of stockpiled vegetation
- direct seeding of future development areas with pasture species
- potential revegetation of the linear corridor on the western boundary of the Project area via seeding with appropriate local species to be confirmed following further discussion and agreement with LandCorp, monitoring to collect data on revegetation and to demonstrate the ability of the area to support the post-mining land use
- development of contingency actions to address any deficiencies identified from the rehabilitation monitoring.

Following rehabilitation, sign off by landholders and other key stakeholders that rehabilitation is complete will be required.

6.3 Strategic framework for mine closure

Regulatory agencies and industry bodies have established guidelines (industry best practice) to assist mining companies achieve acceptable standards of mine rehabilitation and closure. Industry best practice guidelines for rehabilitation and closure are included in the following key documents:

- *Guidelines for Preparing Mine Closure Plans* (DMP & EPA 2015)
- *Strategic Framework for Mine Closure* (ANZMEC & MCA 2000)
- *Mine Closure and Completion Handbook* (Department of Industry, Tourism and Resources [DITR] 2006).

All key documents mentioned above have been taken into consideration when preparing the MCP (Appendix 2) to ensure the strategic framework for managing mine closure is in accordance with industry best practice.

6.4 Submission of Mine Closure Plan documents

This Mining Proposal is supported by a Mine Closure Plan (MCP; Appendix 2) in accordance with the requirements of the Mining Act as amended in 2010 and in conformance with the *Guidelines for Preparing Mine Closure Plans* (DMP & EPA 2015). The purpose of the MCP is to:

- consider legislative requirements and appropriate industry guidelines
- describe the closure strategy for the Proposal and outline the proposed closure vision, post
- closure land use and objectives for closure to meet these aims of the strategy
- outline the closure planning and review process
- outline the possible closure approach.

Information gaps in the MCP will be addressed in subsequent revisions. The MCP is considered a dynamic document to be reviewed and updated throughout the life of mine as more information becomes available. Given the short life of the mine, the MCP will be subject to review within the recommended three year timeframe. The continued update of the MCP will be documented in the Annual Environmental Report. The ultimate aim of this continual update is the Final Closure Plan which will contain specific details on how closure will be achieved and include final objectives, completion criteria, management measures and monitoring requirements to assess progress against completion criteria.

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Appendix 1
Environmental studies

ETHNOGRAPHIC AND ARCHAEOLOGICAL HERITAGE ASSESSMENT

FINAL REPORT

Metropolitan Area Indigenous Groups
Landcorp Baldivis Development Project

Prepared for:
Strategen on behalf of Landcorp

Survey Date:
25 March 2013

Big Island Research

Executive Summary

Big Island Research Pty Ltd (Big Island) was commissioned by Strategen Environmental Consultants (Strategen) on behalf of Landcorp in March 2013 to provide Indigenous cultural heritage consultancy services to inform the Baldivis (housing) Development Project.

The proposed project area is located about 40 minutes south of Perth CBD, bordering Stakehill Road to the north within the municipal boundary of the city of Rockingham.

The survey area comprises two locations, at the eastern, and western sides of a larger project area, most of which has been previously assessed for Aboriginal heritage (McDonald & Coldrick 2007) (Map 1).

The land within the two survey areas has been extensively disturbed. The western area is the location of farmland, housing and a former horse racetrack. The eastern survey area intersects with Baldivis Explosives Reserve, which was established in 2003. Only three small areas of remnant bushland remain in the eastern survey area.

The "dithered area" of one registered Department of Indigenous Affairs (DIA) site intersects the survey areas: DIA site ID 3582, *Serpentine River*, classified as ceremonial and mythological.

Ethnographic consultations with Traditional Owners took place on site over one day, 25th March 2013, and were conducted by Big Island anthropologists Drs Guy Wright and Amanda Harris. In addition to the Aboriginal consultants and representatives of Big Island, Hugh Chevis, Principal, from Strategen was present.

The archaeological survey was carried out at the same time as the ethnographic survey by Big Island archaeologists, Wendy Reynen and Anys Price.

Results

No new ethnographic or archaeological sites or materials were identified during the survey. The Gnaala Karla Booja survey team members concluded that there were no ethnographic or archaeological impediments to the proposed works.

The eastern survey area sits within the dithered area for Site ID 3582, Serpentine River. However, the survey area does not extend near to the river and consequently there should be no need to further refer to the *Aboriginal Heritage Act* 1972 in respect of the area.

Monitoring

The survey participants requested that cultural monitoring should take place during the initial ground disturbing activities to ensure that any artefacts that may exist sub-surface might be found and preserved.

Recommendations

Big Island Research Pty Ltd recommends the following.,

1. Aboriginal cultural monitors should be engaged on a rotational basis during future ground disturbing works.

2. If, during ground excavations, any subsurface archaeological material is encountered, all work in the vicinity should be stopped and archaeological material left *in situ* while are notified and agreed management processes are determined, with professional assistance as required.

3. If human skeletal material is uncovered the police must be notified immediately, as required by law and the Department of Indigenous Affairs and the Gnaala Karla Booja Traditional Owners notified to enable, if required, culturally appropriate management of buried material.

Ownership of Information

This report has been prepared for submission to Strategen, acting on behalf of Landcorp. Any cultural information contained within the report is the property of the people who provided the information. This report and the information it contains may not be copied in whole or part without written consent of the Landcorp and Big Island Research Pty Ltd. However, it is written for the purpose of assisting the Landcorp with its Aboriginal heritage approvals processes and any copying associated with this purpose is permitted.

Report Authors

Ethnographic: Guy Wright PhD, Amanda Harris PhD

Archaeological: Wendy Reynen BA(Hons), Anys Price MSc

Disclaimer

Big Island is not responsible for omissions and inconsistencies that may result from information not available at the time this report was prepared.

Contents

Introduction

Big Island Research Pty Ltd (Big Island) was commissioned by Strategen Environmental Consultants (Strategen) on behalf of Landcorp in March 2013 to provide Indigenous cultural heritage consultancy services to inform the Baldivis Development Project. Strategen has been commissioned by Landcorp to complete all environment and planning approvals for the development.

The survey area comprises two locations at the eastern and western perimeter of the larger project area, most of which has been previously surveyed (McDonald & Coldrick 2007) (Map 1).

The ultimate timeframe for completion of this development was said to be between 30 and 40 years. The purpose of these consultations is to assist Landcorp in addressing heritage issues at the planning stage. The developmment will entail the construction of housing and associated infrastructure.

Ethnographic consultations with Gnaala Karla Booja Traditional Owners took place on site on 25th March 2013, and were conducted by Big Island anthropologists Drs Guy Wright and Amanda Harris. In addition to the Aboriginal consultants and representatives of Big Island, Hugh Chevis, Principal, from Strategen was present.

The archaeological survey was carried out at the same time as the ethnographic survey by Big Island archaeologists, Wendy Reynen and Anys Price.

A total of eight Nyoongar individuals participated in the ethnographic consultations. These people were drawn from a list of nominees provided by the South West Aboriginal Land and Sea Council (SWALSC), as having a "right to speak" about cultural matters in the Baldivis region.

Synopsis

Location, Environment and Disturbance

The proposed project area is located about 50 kilometres south of Perth CBD, bordering Stakehill Road to the north within the municipal boundary of the City of Rockingham (Maps 1 and 2). The project area is on land owned by Landcorp (Map 2).

The project area is situated within a wider wetland region around a kilometre west of the Serpentine River. Stakehill Swamp lies to the northwest of the project area and a series of swamps remain to the east, running in a north-south direction. Remnant swamps remain within the project area and at least one, according the Traditional Owners, has been filled in within or close to the project area during previous developments. The swamps belong to the Stakehill suite of wetlands, which are a series of local sumplands in inter-dunal swales of the Spearwood dune system. The wetlands are seasonally inundated basins, which have water above the ground for part of the year and are dry for the remainder (WAPC 2010).

The land within the two survey areas has been extensively disturbed. The western area is the location of farmland, housing and a former racetrack. The eastern survey area intersects with Baldivis Explosives Reserve, which was established in 2003. Only three areas of bushland remain in the eastern survey area. The rest of the area consists of cleared land, storage facilities, roads and associated infrastructure. The remaining natural vegetation includes remnant tuart (*Eucalyptus gomphocephala*), some marri (*Corymbia calophylla*) and jarrah (*Eucalyptus marginata*) trees.

Plate 1. Remnant bushland and seasonal swamp (dry at the time of survey) within the eastern survey area.

Survey Areas

The nominated survey areas are located south of Stakehill Road in Baldivis and comprise an eastern (0.3205 sq. km, Table 1) and a western survey area (0.2048 sq. km, Table 2).

Table 1. Boundary Point coordinates for the eastern survey area.

BP #	mE	mN
1	388853	6416161
2	389113	6415438
3	389230	6415347
4	389234	6415271
5	389104	6414647
6	388835	6414983

Table 2. Boundary Point coordinates for the western survey area.

BP #	mE	mN
1	386965	6415775
2	387184	6415694
3	387264	6415693
4	387267	6415354
5	387349	6415175
6	387304	6415077
7	386973	6415078

During the archaeological survey it was noted that ground surface visibility was extremely low (0% - 40%) within areas of remnant bush land due to a thick ground cover of leaf litter and seasonal grasses and shrubs (Plate 2).

Plate 2. View east across area of remnant bush in eastern survey area, showing low visibility of ground surface.

Heritage Framework

Ethnographic Context

The identity of the Aboriginal peoples occupying the wider region of the survey areas at the time of British contact was reported by both Tindale (1974) and Berndt (1979) as the Pinjarup socio-linguistic group. An alternative picture is reported by Daisy Bates (1979) who referred to the people of the area as the *Kuri Wongi*. According to Bates the *Kuri Wongi* belonged to the larger grouping known as the *Bibbulmun*. Tindale (1974) described the boundary of this group as delineated by a line than joined Rockingham, or Mangles Bay, to Jarrahdale in the northeast, southeast to Collie and then west to Bunbury.

As reported by a number of researchers, ethnographic and archaeological evidence suggests that occupation of the land by Aboriginal groups was concentrated along the riverways, inland lakes and wetlands. Movement into the coastal dunes was on an opportunistic basis (Hallam 1975, O'Connor & Coldrick 2007, O'Connor, Quartemaine & Bodney 1989, Lock & Harris 1990).

Currently the members of the Gnaala Karla Booja group claim native title rights within the area and can be assumed to be descended from the groups who have lived in this area from time immemorial. The Gaala Karla Booja native title claim group is represented by the South West Aboriginal Land and Sea Council (SWALSC).

Archaeological Context

The Swan Coastal Plain and the adjoining Darling Scarp has been inhabited by Aboriginal people for at least 40,000 years. The oldest known sites in this area are located near major river systems on the Swan Coastal Plain, with the earliest evidence for occupation radiocarbon dated to 39,500BP +/- 2300 years BP at Upper Swan Bridge (Pearce and Barbetti 1981), and 27,000 years ago at Helena River, in Midland (Schwede 1983). Numerous other sites in this area have provided radiocarbon dates including 10,000 years ago at Minim Cove in Mosman Park (Clarke and Dortch 1977), 8,000 years ago at Walyunga in Upper Swan (Pearce 1978), 4,500 years ago at Orchestra Shell Cave in Wanneroo (Hallam 1975) and 2,500 years ago at Brigadoon in Millendon (Schwede

1990). These sites confirm the human occupation of the Swan Coastal Plain and Darling Scarp over tens of thousands of years.

To date, more than 1,000 Aboriginal sites have been recorded in the greater Perth Metropolitan area, mostly as a result of development-driven consulting. Archaeological sites range from large, complex artefact scatters with diverse stone assemblages including backed blades, grinding material and retouched artefacts to small discrete artefact scatters dominated by unretouched quartz flakes (Hallam 1987: 20). Despite massive disturbance from commercial and residential developments, surveys and excavations have established that subsurface archaeological material including stone artefacts and human skeletal remains is still found in the Perth Metropolitan area (Fisher *et al* 2002; Fisher *et al* 2000; Przywolnik and Harrison 2000).

Ethnographic and historical documents highlight the importance of water sources such as rivers, lakes and wetlands to Noongar land use patterns, ceremonial cycles and mythological tracks (Hallam 1975; Hammond 1933). Archaeological research has demonstrated that the lakes and wetlands of the coastal and riverine zones were more intensively used than the Darling Scarp or the seaward margin of the coastal zone (Hallam 1987:23). The majority of archaeological sites are found in close proximity to water sources on the Swan Coastal Plain, with the largest sites located on elevated dunes and sand ridges near the Swan River and its tributaries, and other lakes and wetlands (Anderson 1984; Hallam 1975, 1987; Bowdler *et al* 1991; Strawbridge 1988). Lake, wetland and riverine areas typically contain a high number of large artefact scatters with diverse assemblages. Available evidence suggests a seasonal model of occupation in which Noongar groups focused on the resource rich areas of the Swan Coastal Plains during the summer months (November to March) and dispersed into smaller groups through the wider hinterland of the Darling Scarp during the winter and spring (April to October) (Anderson 1984: 36-38).

Previously Recorded Sites

One registered DIA site intersects the survey areas: DIA site ID 3582, *Serpentine River*, classified as ceremonial and mythological. The spatial boundary of site 3582 is denoted by a two kilometre square and encompasses the entirety of the eastern survey area (Map 2). This large square is a 'dithered' area generated by DIA that extends well beyond the

Serpentine River site *per se*. The western area of the site that encompasses the eastern survey area is not necessarily the location of Site ID 3582. As a Closed site, further investigation of the site was not possible without the permission of the original informants. Traditional Owners were cognizant of the possible proximity of this registered site during the survey.

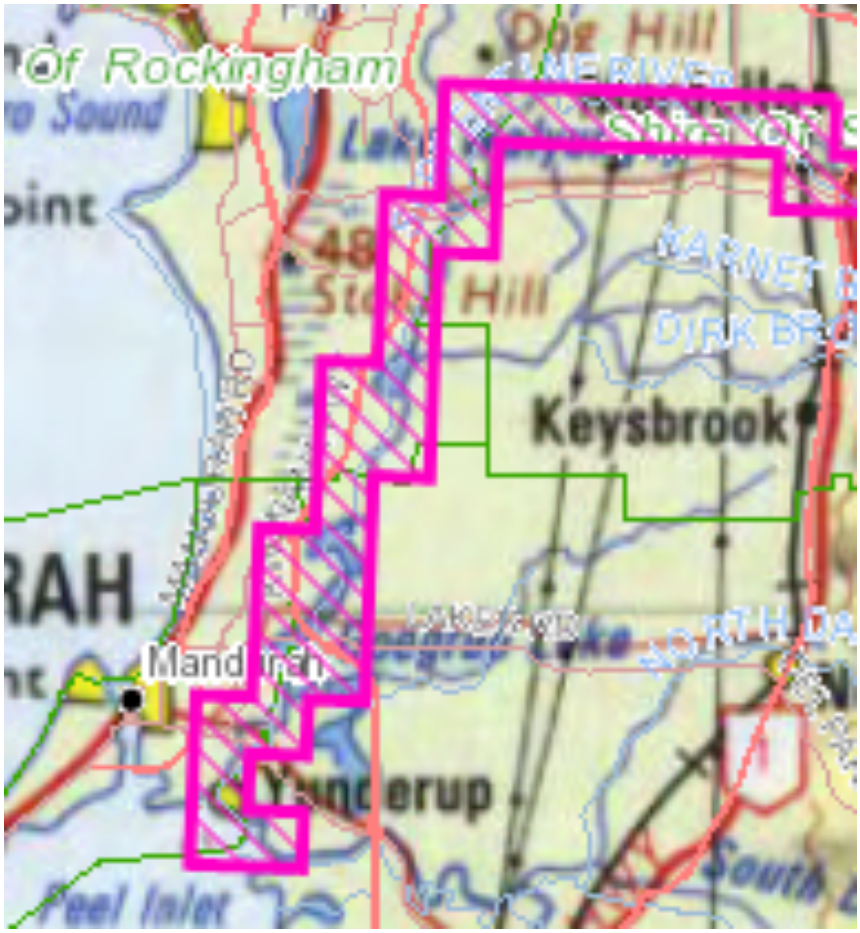

Figure 1. Dithered area of the western end of Serpentine River.

Two other DIA heritage places sites are located in the vicinity of the project area and are listed in Table 3 below and shown on Map 2. These are site ID 28186, *Nyitting Booya Binja* and site ID 3561, *Karnup*. Site ID 28186 is an artefact scatter and its western boundary is within several metres of the eastern survey area. This is a Lodged site with "closed" and "male only" access. Site ID 3561, Karnup, is also an artefact scatter and is approximately 800 metres east of the eastern survey area. This site consists of approximately thirty "low quality artefacts" covering an area of 60 metres x 5 metres (O'Connor & Quartermaine 1987). Neither of these sites will be impacted by the development.

Table 3: DIA sites/heritage places in the vicinity of the project area

Site ID/Name	Status/Access	Site Type	Comments
3582/ Serpentine River	Registered/Closed	Ceremonial, Mythological	Eastern survey area is entirely within dithered area of Site
28186/ Nyiting Booya Binja	Lodged/Closed (male only access)	Artefact scatter	Survey area is outside the Site
3561/Karnup	Stored data/Open	Artefact scatter	Survey area outside the Site

Survey Participants

The following people participated in the survey on Monday 25th March 2013.

Big Island Research	
Guy Wright	Director, Anthropologist
Amanda Harris	Anthropologist
Wendy Reynen	Archaeologist
Anys Price	Archaeologist

A total of eight Nyoongar individuals participated in the ethnographic consultations. With one exception these people were nominated by the South West Aboriginal Land and Sea Council (SWALSC) as people who have a relevant "right to speak" about cultural matters in the Perth metropolitan region.

South West Aboriginal Land and Sea Council (SWALSC)

SWALSC typically nominates people from the existing native title claim and negotiation. For this survey SWALSC provided Big Island with a list of suitable individuals from which consultants could be drawn. In consultation with elder Harry Nannup, Big Island Research was able to confirm the participation of eight people in the survey. Attempts were made to contact other SWALSC nominees, however the contact details provided by SWALSC were incorrect. Members of SWALSC who participated in the survey are shown below. Of these, Angus Walley was not nominated in the SWALSC list but was highly recommended by Harry Nannup and a person who knows this area very well.

Monday 25 March 2013, 10.00am

SWALSC	
Harry Nannup Snr	Franklyn Nannup
Gloria Kearing	Kerri-Ann Kearing-Salmon
Harry Nannup Jnr	May McGuire
Angus Walley	Trevor Walley *

* Trevor Walley met separately at 1.15pm on the same day.

Also present during the consultations were:

Strategen Environmental Consultants	
Hugh Chevis	Principal, Strategen

Plate 3. Survey Team (left to right, Harry Nannup Snr, Angus Walley, Franklyn Nannup, Kerri-Anne Kearing Salmon, Harry Nannup Jnr, Gloria Kearing, May McGuire) Trevor Walley was not available for the photo.

Ethnographic Survey

Survey Method

Anthropologists Guy Wright and Amanda Harris of Big Island met Hugh Chevis of Strategen and the Gnaala Karla Booja (GKB) representatives at the corner of Stakehill Road and Harvey Road on Monday 25th March 2013. Guy Wright provided an overview of the project before Hugh Chevis of Strategen, briefed meeting participants on the proposed works. The purpose of the project, background and timeline were explained with the aid of maps made available to participants.

Consultations commenced at the eastern boundary of the western survey area. The survey team travelled the length of the area to its south-eastern boundary along Harvey Road and were given the opportunity to enter the survey areas at several locations. When the GKB representatives agreed that they had seen sufficient of the western area, the survey team drove to the eastern survey area. Entry was gained with the assistance of staff at the Baldivis Explosive Reserve. Reserve staff accompanied the survey team while on the Reserve.

Participants were given ample opportunity to traverse the survey areas, present their views, discuss the project and ask questions. Trevor Walley attended the survey separately. He and his sister, Cheryl Martin, came at 1330 and were shown through the two survey areas in the same pattern as the other GKB representatives.

When the GKB representatives were satisfied with the survey and discussions, a private discussion continued with the Big Island anthropologists. The position and views of the group were discussed further and clarified.

Results

The GKB representatives demonstrated their knowledge and association with the area. Harry Nannup described the years he spent driving cattle through the area on horseback from the western Stakehill Road area to the Serpentine River, before some of the swamps were filled in, paddocks and fences existed, pine forests had been planted or the

Kwinana Freeway existed. "I've been around this area all my life", he said. The group felt that the trails he would have made and travelled along then were important to them.

Angus Walley described the waterholes that exist in the area. He showed the location of past waterholes that have since been filled by development works. Franklyn Nannup pointed out that while the Serpentine River would have been the place where Aboriginal people would have more frequently lived, the waterholes would have been important areas for trapping animals. "There would have been pockets of people here", suggested Angus, "not lots". Like Harry Nannup, Angus' family has also worked the area; they played a part in establishing the pine plantations in the 1960s.

Franklyn Nannup placed the survey areas within the wider region by pointing out and naming other places on the horizon. The group remarked on the extensive amount of disturbance that had occurred in the area and the unlikeness of finding any material of archaeological significance on the surface due to the disturbance and the high levels of ground cover. However, their view was that artefacts could still exist beneath the surface.

The group requested that Aboriginal monitors are present for all future ground disturbing works. Hugh Chevis assured the group that the need for monitoring would be taken into account prior to the commencment of ground disturbing works.

Trevor Walley spoke about the times he used to travel through the eastern survey area and camp by the Serpentine River. He said he grown up in the area, mainly in camps nearby and knew it well. He described the *jilgies* they used to catch and the kangaroo they hunted. Trevor pointed out several edible plants growing within the survey areas including the fruit of the "snotty gobble", which is also one of his family's totems, he said. He spoke about the small spirit people, or *woodarchies*, they had seen in the area after dark. Trevor also spoke about one particular *karnup* spirit, that of a woman who was known to travel through the area and cry out thrice during the night.

The GKB representatives acknowledged the extensive disturbance that had already occurred within the two survey areas. No ethnographic impediments to the proposed works were identified.

Archaeological Survey

Survey Method

A series of parallel transects some 30-50 m apart was walked by archaeologists Wendy Reynen and Anys Price along the length and breadth of the western survey area. Areas of remnant bush were targeted as part of this approach. As much of the eastern survey area has been extensively disturbed, a sampling method was used to inspect this area. It was agreed, following discussion with the GKB representatives that there was no point in looking for artefacts in the areas that had been extensively disturbed. The remaining three areas that contained remnant bush were inspected on foot by a series of parallel transects some 10-30 m apart. These remnant bush areas comprise 62,361 sq. m, or approximately 20% of the eastern survey area.

Results

Archaeological survey of nominated survey areas has been completed (Map 1). No archaeological sites were identified during the survey.

General Conclusions

Traditional Owners said that they were satisfied with the conduct of the ethnographic and archaeological surveys. No new ethnographic or archaeological sites or materials were identified during the survey. The GKB representatives concluded that there were no ethnographic or archaeological impediments to the proposed works.

The eastern survey area sits within the dithered area for Site ID 3582, Serpentine River. However, Site ID 3582 is the Serpentine River itself. In the past, the Aboriginal Cultural Material Committee, which has a responsibility to evaluate places alleged to be associated with Aboriginal people, has taken a view that 30 metres landward from the ordinary banks of major waterways should be accepted as being within the cultural site, where the river constitutes a site. So, for example, the Swan and Canning rivers in Perth are sites recognised by the AHA and are protected, including the area 30 metres from their banks. Section 18 consent to use this land is required. In this case, the Serpentine River is more than 30 metres away from the areas that were assessed for heritage values. Although the "dithered" area shown on the DIA mapping extends into the eastern assessed area, this is not a representation of the site *per se*.

Monitoring Requested

All participants requested that cultural monitoring should be supported to ensure there is an appropriate Noongar presence during the disturbance of the spiritual values of the sites, and that artefacts that may exist beneath the surface of the area might be located.

Recommendations

Big Island Research Pty Ltd recommends the following.

1. Aboriginal cultural monitors should be engaged on a rotational basis during future ground disturbing works.

2. If, during ground excavations, any subsurface archaeological material is encountered, all work in the vicinity should be stopped and archaeological material left *in situ* while Gnaala Karla Booja Traditional Owners are notified and agreed management processes are determined, with professional assistance as required.

3. If human skeletal material is uncovered the police must be notified immediately, as required by law and the Department of Indigenous Affairs and the Combined Metropolitan Native Title Holders (CMNTH) notified to enable, if required, culturally appropriate management of buried material.

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Appendix 1 – Site Definitions

The following links provide Aboriginal site definitions as defined by the Department of Indigenous Affairs:

http://www.dia.wa.gov.au/en/Heritage-and-Culture/Aboriginal-heritage/Aboriginal-sites/

and

http://www.dia.wa.gov.au/en/Heritage-and-Culture/Aboriginal-heritage/Aboriginal-sites/Aboriginal-site-types/

Appendix 2 – Abbreviations

Big Island	Big Island Research Pty Ltd
DIA	Department of Indigenous Affairs
Strategen	Strategen Environment Consultants
the Act	*The Aboriginal Heritage Act* 1972