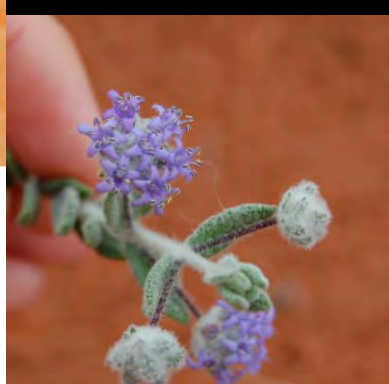
Tropicana Gold Project: Public Environmental Review



6. Existing Environment part 1

INDEPENDENCE GROUP NL

360 environmental

6. EXISTING ENVIRONMENT

The following chapter provides a description of the existing environment in a regional and local context and details the studies undertaken to describe it. Prior to the commissioning of baseline surveys for the Project there was limited environmental knowledge for the Great Victoria Desert Region within Western Australia. The work conducted historically in the region was restricted to Nature Reserves or to broad scale mapping completed by Beard in the 1970's (vegetation mapping complete to 1:1,000,000 scale) (Appendix 2-A1). This was identified as a limitation for the Project as it would make it challenging for the Joint Venture, regulators and the community to truly assess the significance of the data and potential impacts associated with the Project. To address this, the Joint Venture adopted a broad and holistic approach to baseline surveys to ensure that the appropriate level of regional information was obtained for the formal assessment process. As a result of this approach the Joint Venture has:

- developed detailed vegetation maps for approximately 230,000 ha of native vegetation within the region (Appendices 2-B6, 2-C2, 2-C5, and 2-D2);
- engaged threatened fauna specialists to conduct specific threatened fauna surveys as part of the Project baseline assessment (Appendix 2-F1, 2-F4 and 2-F5);
- commissioned a regional marsupial mole assessment (refer to Appendix 2-F2);
- conducted or assisted with threatened flora species assessments in the Queen Victoria Spring, Plumridge Lakes and Neale Junction Nature Reserves (Appendix 2-F6 and 2-F8);
- assisted with a terrestrial fauna survey (including short range endemic invertebrates) of the Neale Junction Nature Reserve; and,
- assisted with a feral camel density survey over the southern part of the Great Victoria Desert[2].

The survey work commissioned by the Joint Venture has resulted in a significant increase in scientific knowledge for the region. The remainder of this chapter aims to provide summaries of the key results of the baseline work commissioned by the Joint Venture or work supported by the Joint Venture. The chapter is structured to firstly provide project wide information and secondly to provide information specific to each key aspect of the Project (i.e. Operational Area; Pinjin Infrastructure Corridor etc.). The Joint Venture considers that the environmental aspects that have been described are defined at an appropriate level of detail to enable specific biological imperatives for each aspect to be more clearly examined. For specific detail on the potential impacts and management associated with the Project refer to Chapter 7 and Chapter 13.

[2] Feral camel survey data has not been included in this document as the information is part of a state wide Department of Environment and Conservation feral camel project.

6.1. PROPOSAL WIDE

6.1.1. Project Setting

The Project Operational and Water Supply Area are located within the Shires of Laverton and Menzies, on unallocated vacant crown land managed on behalf of the State by the DEC. The Infrastructure Corridors are located within the boundaries of the City of Kalgoorlie-Boulder and the Shire of Menzies, and traverse a mixture of gazetted and ungazetted roads, pastoral leases and unallocated vacant crown land.

The Project is located predominately within the GVD IBRA, the start of the Pinjin Infrastructure Corridor is located in the Murchison IBRA region and the southern proportion of the TT Corridor is located in a transition zone between the Coolgardie and Nullarbor IBRA regions (Figure 6.1).

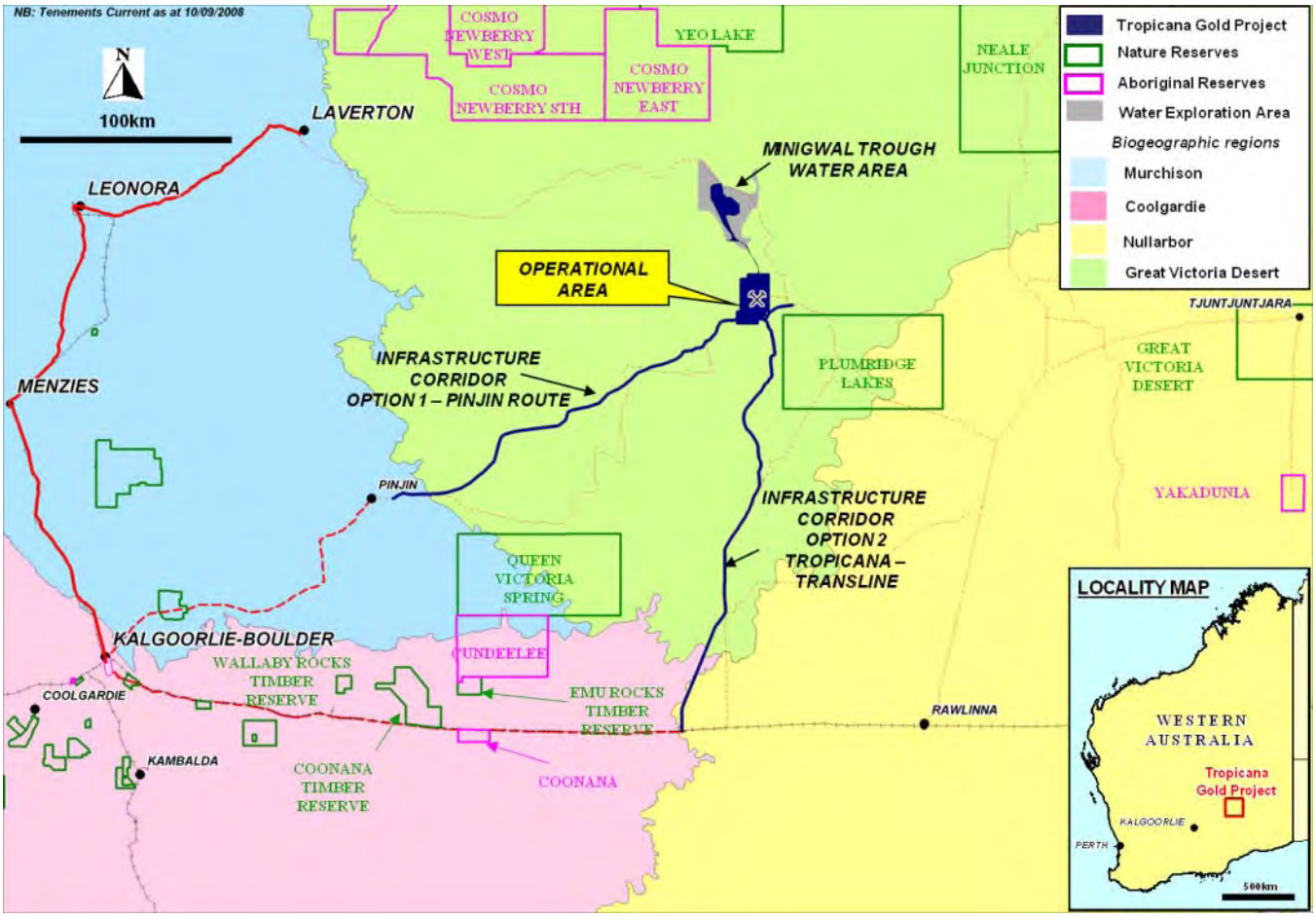


Figure 6.1: Interim Biogeographic Regions of Australia Associated with Tropicana Gold Project

Great Victoria Desert

The GVD bioregion covers an area of 418,800 km^2 of land within Western Australia and South Australia. Approximately 50% of the bioregion lies within Western Australia. The GVD is characterised by dunefields located between the Musgrave Ranges in the north and the Nullarbor Plain in the south (Australian Natural Resources Atlas 2008a) (Appendix 2-A1).

The GVD is described as an active sand-ridge desert of deep Quaternary Aeolian sands with a tree steppe of *Eucalyptus gongylocarpa*, mulga and *E. youngiana* over hummock grassland dominated by *Triodia basedowii* (McKenzie et al. 2002).

The GVD forms the southern part of the anti-clockwise whorl of dunefields of Australia as described in the Australian Natural Resources Atlas (2008a). The dominated landforms are dunes and swales. There are local occurrences of playa lakes, associated lee-sided mounds (lunettes) and rocky prominences. The drainage is a very minor feature. Creeks form within the swales and mostly drain lakewards. The broad regional relief indicates undulations and local variations that suggest an older palaeoform. These palaeoforms include marine landforms of the Cainozoic (less than 65 million years ago) Eucla Basin.

The climate is arid, with summer and winter rain averaging between 150 and 190 mm annually. Landforms consist of red sand plains with patches of aeolian dunefields, salt lakes on major valley floors with lake derived dunes, and silcrete-capped mesas and plateaus (breakaways) (McKenzie et al. 2002).

Murchison

The Murchison bioregion covers 281,200 km^2 of land within Western Australia. The bioregion comprises the interzone between the mulga/ spinifex country and the south-western eucalypt environments (Australian Natural Resources Atlas 2008b).

Habitats within the Murchison are described as:

> *"Murchison mulga low woodlands, often rich in ephemerals, on outcrop hardpan washplains and fine-textured Quaternary alluvial and eluvial surfaces mantling granitic and greenstone strata of the northern part of the Yilgarn Craton. Surfaces associated with the occluded drainage occur throughout with hummock grasslands on Quaternary sandplains, saltbush shrublands on calcareous soils and Halosarcia low shrublands on saline alluvia. Areas of red sandplains with mallee-mulga parkland over hummock grasslands occur in the east" (Environment Australia 2000).*

The Murchison bioregion has an arid climate with winter rainfall. The mean average annual rainfall is about 210 mm, ranging from 190 mm in the northeast to 240 mm in the southwest (Australian Natural Resources Atlas 2008b). Summers are hot and dry, with the average daytime temperature reaching daily 38°C in January and can exceed 40°C. Winters are mild with cool nights. Annual potential evaporation ranges from 3000 mm at Menzies to 3800 mm at Wiluna.

The western portion of the Pinjin Infrastructure Corridor is in the Murchison IBRA bioregion.

Nullarbor

The Nullarbor bioregion lies within the flat treeless Nullarbor Plain. The bioregion includes land within South Australia and Western Australia, totaling 197,200 km^2 (Australian Natural Resources Atlas 2008c). The majority of the bioregion (70%) lies within Western Australia. The south-eastern margin of the bioregion forms part of the Great Australian Bight coastline.

The Nullarbor bioregion extends over most of the onshore part of the Eucla Basin - an epeirogenic basin of Cretaceous and Tertiary sediments on an irregular basement predominantly of Precambrian granite and metamorphic rocks (McKenzie et al. 2002).

The Nullarbor bioregion has a semi-arid climate with mild winters. The summer is extremely variable. Daytime temperatures exceed 40°C and can be followed by mild cloudy days in the low 20s (Australian Natural Resources Atlas 2008c). Summer rainfall is unreliable, usually comprising localised heavy showers or coastal drizzle.

A small section of the southern portion of the TT Corridor is located in the Nullarbor IBRA bioregion. This section of the corridor is located in a transition zone between the Nullarbor and Coolgardie regions.

Coolgardie

The Coolgardie bioregion comprises 129,100 km^2 of land within Western Australia. The bioregion lies within a rich interzone between mulga/ spinifex country and the eucalypt environment. The sand plains, playas, laterite areas and granite outcrops support mallee and shrubs (Australian Natural Resources Atlas 2008d).

The Coolgardie bioregion lies within the Yilgarn Craton, a major geological province of the Eastern Goldfields in Western Australia (Australian Natural Resources Atlas 2008d). The Yilgarn Craton consists of greenstone belts and granites of Archaean age (2,400-3000 million years old). The bioregion is characterised by granite rocky outcrops, low greenstone hills, laterite uplands and broad plains. There are no major rivers or creeks within the bioregion. Numerous salt lakes of varying size occur across the region.

The southern portion of the TT Corridor crosses the Coolgardie bioregion.

6.1.2. Climate

Due to the remote location of the Project, there are no Bureau of Meteorology weather stations located near the Operational Area. To gain an understanding of likely regional weather conditions, data has been obtained from the Laverton Airport (approximately 230 km northeast) and Balgair (approximately 250 km southeast). This information suggests that the surrounding area has a semi-arid to arid climate with daily temperature ranges of approximately 5 - 48^{o}C in summer and -5 - 35 ^{o}C during winter (Figures 6.2 and 6.3) (Bureau of Meteorology 2008a and b). Rainfall generally comprises seasonal thunderstorms and cyclone related rain events during the summer months, and scattered showers during the winter months. Annual rainfall averages for Laverton and Balgair are approximately 275 – 290 mm, with lowest rainfall in spring (Figures 6.4) (Bureau of Meteorology 2008a & b). Summer rainfall is generally associated with cyclonic activity extending into the interior, and this may result in heavy rain events between January and April (Laverton Airport received over 200 mm in February 2004). The lowest recorded annual rainfall received in the area was 118.6 mm at Laverton Airport (2005) and 140.7 mm at Balgair (1991) (Bureau of Meteorology 2008a and b). This data suggests that the Project is likely to receive between 115 – 300 mm of rainfall per year.

As desert rainfall is often sporadic and localised, these average rainfall figures are indicative only as rainfall at the Operational Area may differ significantly from Balgair and Laverton on a daily/ annual basis. Daily temperatures could also vary significantly from Balgair and Laverton, however these monitoring sites do give an indication of conditions at the Operational Area. Review of climate maps located on the Bureau of Meteorology website has indicated that the Yamarna station located approximately 145 km to the northwest of the Operational Area is likely to be the most representative of long term meteorological conditions at the Operational Area, particularly with regard to rainfall and temperature (Appendix 2-B10). The Automatic Weather Station situated at Laverton captures weather data that are relatively cooler and wetter than Yamarna, and therefore the Operational Area (Appendix 2-B10). Consequently, the Yamarna station is considered the most appropriate for climate comparison with Operational Area conditions. Data was recorded from the Yamarna station between 1967 and 2008. This weather station is no longer in operation.

From analysis of the recorded historic data at Yamarna, the temperature of the Operational Area may be described as warm to hot. Average air temperatures during the day tend to be warm to hot, varying between 18.8°C and 20.8°C in winter and 34.2°C and 35.9ºC in summer. Average air temperatures during the night tend to be very cold to warm, varying between 4.2ºC and 5.9ºC in winter and between 19.1ºC and 20.6ºC in summer.

The rainfall experienced at both the Operational Area during 2008 and at Yamarna is low, most of which fell during the late spring and summer months. When compared with the median monthly rainfall recorded historically at Yamarna, the dataset recorded during 2008 at the Operational Area can be considered below the typical regional trend.

The Joint Venture has installed weather-monitoring equipment onsite, which will provide site-specific weather information for the area. During 2008, the weather station (located near the Resource Area) received 144 mm of rain. Eventually, this weather station will be upgraded to the standard required to enable the Bureau of Meteorology to generate weather forecasts for the Operational Area. Recorded temperature variance by month at the Operational Area for 2008 is presented in Figure 6.5. Additionally, overlayed in Figure 6.5 are the historic maximum/ minimum and mean maximum/ minimum temperatures recorded at the Yamarna station between 1967 and 1998. Figure 6.5 demonstrates recorded temperature for the Operational Area during 2008 is similar to historical measurements at Yamarna. The 2008 dataset is the best representative of the temperature likely to be experienced in the vicinity of the Operational Area (Appendix 2-B10).

Similar to the GVD, the Nullarbor bioregion has a semi-arid climate with mild winters. Weather in summer in the Nullarbor can be extremely variable. Mean summer temperature ranges from 18.2 - 32.9°C. Summer rainfall is unreliable. In winter, mean temperatures range from 4.4 - 13.8°C. Winter low-pressure systems rarely provide significant rainfall in the inland areas of the Nullarbor. The annual mean rainfall is generally between 100 - 200 mm across the bioregion (Australian Natural Resources Atlas 2008a).

The Murchison bioregion has an arid climate with winter rainfall. The mean average annual rainfall is about 210 mm, ranging from 190 mm in the northeast to 240 mm in the southwest. Rainfall is unreliable and most years can expect a dry spell of four to six months. Summers are hot and dry, with the average daytime temperature averaging 38°C in January and can exceed 40°C. Winters are mild with cool nights (Australian Natural Resources Atlas 2008b).

The Coolgardie bioregion experiences hot summers and mild wet winters. The average summer temperature ranges from 16.5 - 33.6°C. The average winter temperature ranges from 4.8 - 16.6°C. The median annual rainfall is between 200 and 300 mm (Australian Natural Resources Atlas 2008d).

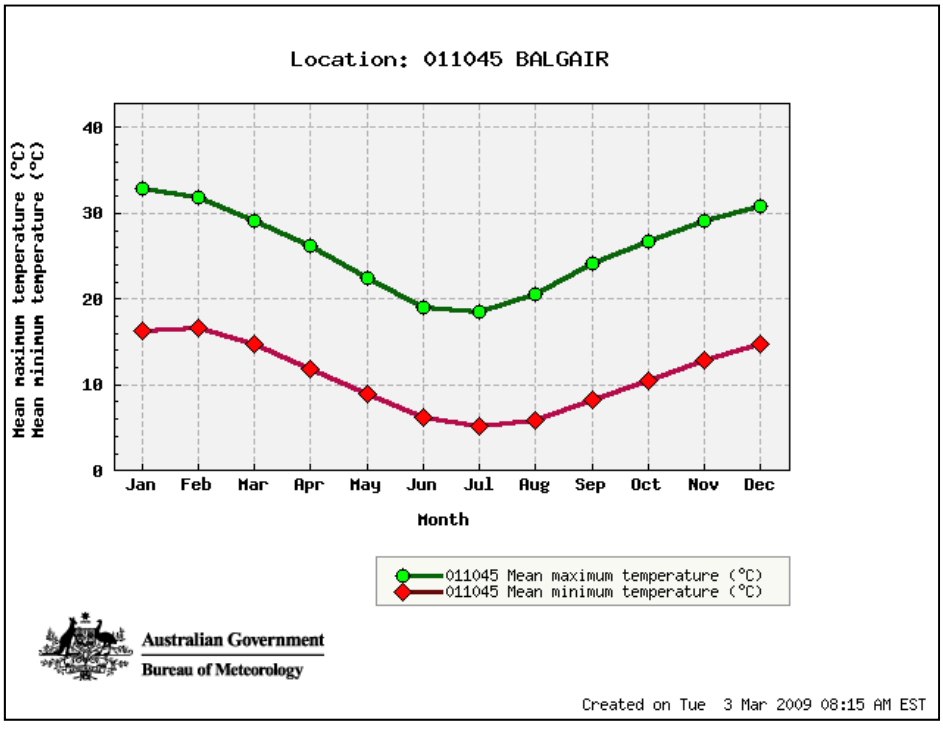


Figure 6.2: Mean Annual Temperature for Balgair (Bureau of Meteorology 2009)

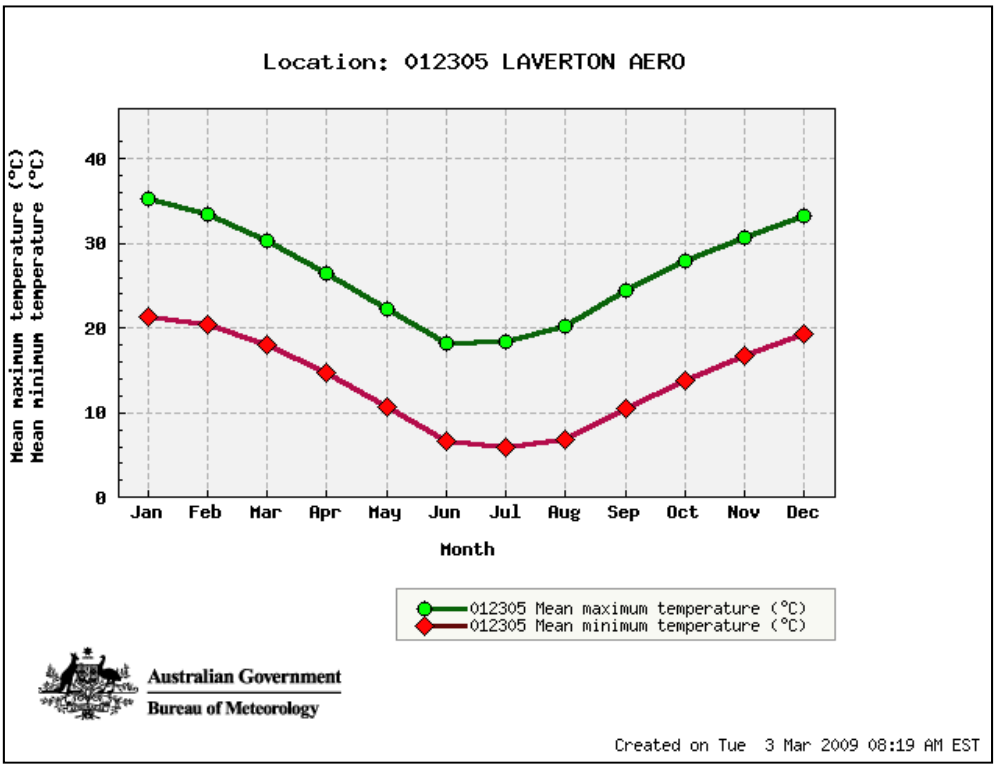


Figure 6.3: Mean Annual Temperature for Laverton (Bureau of Meteorology 2009)

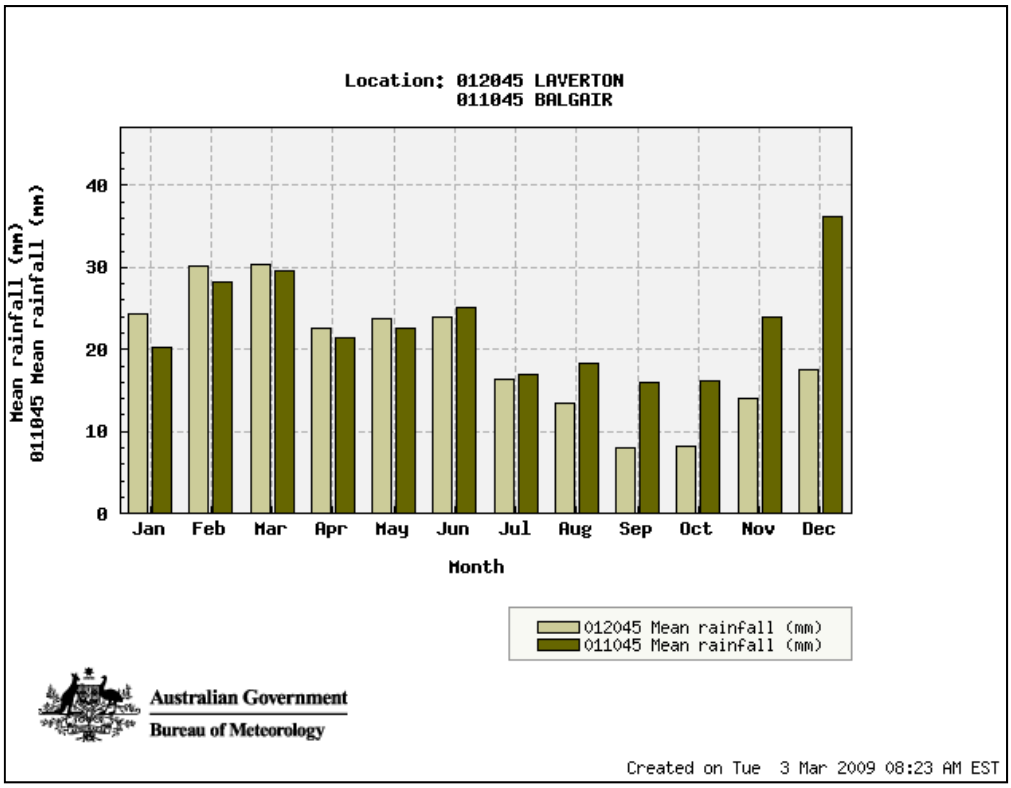


Figure 6.4: Mean Annual Rainfall for Laverton and Balgair (Bureau of Meteorology 2009)

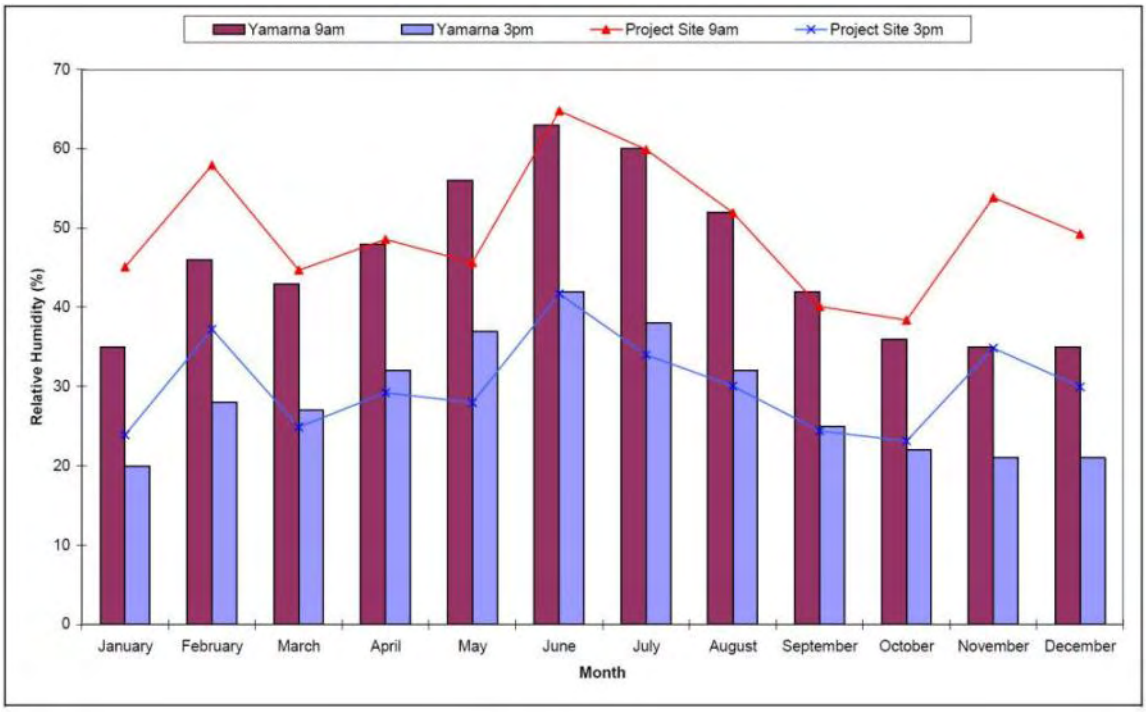


Figure 6.5: Comparison of Mean Weather Variables at Yamarna Stations and the Operational Area (Appendix 2B-10)

Plate 6.1: Longitudinal Sand Dunes and Interdunal Corridors with Historic Fire Scar from the Great Victoria Desert Near the Project

6.1.3. Landforms and Soils

The Project is located in the Southern Great Victoria Desert Zone within the Gunbarrel Province of the Sandy Desert Region (Tille 2006). This zone has an area of 87,550 km^2 and is located in the southern arid interior between Lake Minigwal and the South Australian border.

The GVD is dominated by longitudinal sand dunes with a predominant east-west orientation and ring dunes separated by interdune corridors (or swales) and sand plains (Plate 6.1). These sandplains sit at an elevation of 350-500 m Australian Height Datum, dropping to less than 300 m in the south. Other landforms present are scarpland-breakaways (Plate 6.2) and residuals of various forms (cuestas, mesas, buttes, stony hillocks and hills) (Tille 2006). Colluvium of silt, sand, pebbles of ferruginous laterite and silcrete accumulate in depressions and at the foot of breakaways. Colluvium of clay, silt and sand, partly saline occur in trunk valleys (van de Graff and Bunting 1977). Shallow valleys (with lakes, claypans, salt pans, calcrete platforms, sand dunes, kopi dunes and calcareous dunes) are usually a relatively minor component of the landscape.

In the western part of the GVD, moderately well developed laterite crust and ferruginised silcrete are exposed. These laterite and silcrete crusts form a resistant caprock broken in places by erosion which has carved out a typical mesa and butte topography, with flat tops and breakaways. Pediments are formed in front of the breakaways and are often covered by a thin veneer of alluvial and colluvial sediments. The western end of the GVD is underlain by basement rocks of the Archaean Yilgarn Craton. Tectonically reworked metamorphic rocks that form the eastern margin of the Yilgarn Craton host the resource. In the Joint Venture's tenure, the Archaean basement geology is dominated by poorly exposed granitoid rocks, felsic to mafic paragneiss and orthogneiss, and felsic to ultramafic intrusive and volcano-sedimentary rocks. Granulite and amphibolite-facies gneissic metamorphic rocks that form the immediate host rocks of the gold deposits are interpreted from geological mapping and detailed proprietary aeromagnetic data to be regionally extensive (Doyle et al. 2007). Neither the immediate metamorphic host rocks to the Tropicana-Havana deposits nor the mineralised zones are exposed at the surface due to the presence of widespread sand cover and rock sequences that are interpreted as Palaeozoic in age. Both the basement and Palaeozoic cover sequences have been overprinted by a Tertiary lateritic weathering profile to depths of approximately 40–50 m.

To the east of the transition zone lie the Gunbarrel and Officer Basins. The sedimentary rocks of the Gunbarrel Basin include sandstone, glacigene, marine and continental siliclastic and arenite. The Gunbarrel Basin overlies the Officer Basin, a former marine trough, which comes to the surface in the northeast of the GVD, and includes conglomerate, sandstone and arenite. Mesoproterozoic granite, dolerite, gabbro and ultra-basic intrusions, and gneiss of the Albany-Fraser Orogen are present in the southwest of the GVD (Tille 2006).

Plate 6.2: Silcretised Sediment Breakaway Located Within the Great Victoria Desert

6.1.4. Topography and Surface Water

The GVD is a vast sandbelt consisting of sandplains and dunes, the majority of which run east-west and parallel to each other. There are local occurrences of playa lakes, associated lee-sided mounds (lunettes) and rocky prominences (Australian Natural Resources Atlas 2008a). The local landscape at the Operational Area consists predominantly of sand plains, with a series of sand dune area forming east-west ridges as they do in the majority of the rest of the GVD. The Resource Area lies on a low ridge inside a broad valley between a local dunefield and a local high-point.

Two broad, low-relief drainage lines occur on either side of the Resource Area (Western Australian Geological Survey 1978). These drainage lines flow in a north-easterly direction, with outflow into an unnamed salt lake/ clay pan approximately 9 km north of the Resource Area (Plate 6.3).

Plate 6.3: Surface Drainage Feature Located North-east of the Operational Area

The drainage catchments upstream of the Project Operational Area and Infrastructure Corridors are generally characterised by low relief, poorly defined drainage lines and areas with strongly linear sand dunes and internal drainage. The regional geology is predominantly aeolian sands with high infiltration capacity, interspersed with areas of colluvial soils with lower infiltration capacity. As a result, stormwater runoff rates and volumes are generally low.

As discussed in section 6.1.2, potential evaporation in the region greatly exceeds rainfall. Rainfall and flood events are highly variable in size and timing, and are often influenced by tropical cyclones. Accordingly, stormwater flows are usually infrequent and of short duration, resulting from periods of intense rainfall. However, local drainage from less permeable soils has the potential to produce runoff that could impact on Project infrastructure, operations and the surrounding environment.

The landscape of the Murchison bioregion comprises low hills, mesas of duricrust separated by flat colluvium and alluvial plains (Australian Natural Resources Atlas 2008b). The eastern Murchison region is characterised by extensive areas of elevated red desert sandplains with minimal dune development. Broad plains of red-brown soils and breakaway complexes, as well as red sandplains, are typical of the eastern portion of the Murchison IBRA region (Cowan 2001).

The Nullarbor Plain is a tertiary limestone plain with subdued, arid karst features. It is a vast and remarkably flat treeless plain wholly contained within the much larger Bunda Plateau and has shallow calcareous soils, thinly mantling massive limestone in many places (McKenzie et al. 2002). Note that the Project does not anticipate interacting with the karstic elements of the Nullarbor (the only proposed infrastructure of the Project in the Nullarbor is the TT Corridor). No karst or limestone landforms will be disturbed by the Project.

The Coolgardie bioregion is characterised by granite rocky outcrops, low greenstone hills, laterite uplands and broad plains. There are no major rivers or creeks within the bioregion. Numerous salt lakes of varying size occur across the region.

6.1.5. Heritage

In broad terms, the Project area is at the boundary of the lands that may have been used by the Wongatha and Spinifex peoples. Prior to the Tropicana Gold Project, only a very limited number of formal studies had ever been undertaken within the region, as a result there exists only very limited documented knowledge of Indigenous occupation in the Project area.

Indigenous heritage sites are important in that they link Indigenous cultural tradition to place, land and people over time. Indigenous sites can be classified into two basic but overlapping categories:

- Archaeological sites – places where material remains such as campsites or artefacts associated with past Indigenous land use; and,
- Ethnographic/ Anthropological sites – places of spiritual importance such as ceremonial sites or mythological (Dreaming) sites.

Indigenous sites have been located at many locations across Western Australia, however, they are most common near geographical features including lakes, rivers, swamps, the coast and hills. There is a general absence of previously recorded archaeological and ethnographic sites surrounding the Project, which is almost certainly a reflection of the lack of survey effort prior to the Joint Venture's activities in the area. However, some features of the environment (including a lack of permanent water) do suggest that historical Indigenous activity in the area was likely to be sporadic, termed 'rain chasing' by Gould (1968, 1977a, 1977b). This involved people pursuing localised rainfall events, allowing them to move or disperse across their lands taking advantage of ephemeral water sources. Archaeologically, this settlement/ mobility pattern can be reflected in numerous small artefact scatters with poor assemblages dispersed across the landscape, together with a few large, diverse and complex artefact scatters at reliable water sources. For example, in 1875 William Ernest Powell Giles found numerous Indigenous artefacts and sighted people at Queen Victoria Spring, which is known to periodically fill with water after significant rainfall (Shepard 1995). Consultations are ongoing with a view to engaging with the more remote communities, with support to implement this is coming from Central Desert Native Title Services and members of the current Wongatha community. The dispersed nature of the more remote communities, cultural observances and logistics have acted against broadening the heritage consultations to date. In the event, any new heritage information comes to hand following these additional consultations it will be managed under the Heritage Management Strategy.

Waru Consulting Pty Ltd was commissioned by the Joint Venture to conduct archaeological and ethnographic surveys. Results are discussed in Chapter 8 and Appendices 2-A2 and 2-A3.

The potential for early settler heritage was considered to be most likely in the former settlement of Pinjin, an area historically associated with the mining and the pastoral industries. This is discussed in section 6.3.5.

6.1.6. Visual Amenity

As discussed above the GVD is dominated by longitudinal sand dunes with a predominant east-west orientation and ring dunes separated by interdune corridors (or swales) and sand plains. The dunes vary in height from 2-40 m and may run unbroken for up to 100 km. The Interdune corridors are generally 300-800 m wide, with higher dunes having wider corridors.

6.1.7. Existing Land Use and Social Environment

The majority of the GVD is vacant crown land (VCL) with some Conservation and Aboriginal Reserves. The bioregion includes land holdings of the Arangu Pitjantjatjara and part of the Maralinga Tjarutja lands in the eastern parts of the GVD (South Australia). Pastoral development in the bioregion is confined to a few peripheral areas in the south and west where water and feed are available in some years. Most of the bioregion is unsuitable for grazing as water is limited and fodder plants are sparsely distributed (Australian Natural Resources Atlas 2008a).

The Project is located on a combination of granted mining leases and miscellaneous licenses. Sections of both infrastructure corridors cross granted and pending exploration leases held by other exploration companies and a small proportion of the Pinjin Infrastructure Corridor is located on the Pinjin Pastoral Lease.

The closest significant residential populations to the Project are the City of Kalgoorlie-Boulder which has a population of over 30,000 people (ABS 2008) and the town of Laverton with a population of over 800 people (ABS 2008). Whereas the nearest actual residence to the proposed mine is over 200 km south at the Kandanah station. In the vicinity of the infrastructure corridors, there are a number homesteads and an Indigenous community (Coonana Community).

Within a 300 km radius of the Project there are several Indigenous communities: Coonana, Tjuntjuntjara, Wongatha Wonganarra, Mount Margaret and Cosmo Newberry. The Coonana, Tjuntjuntjara and Wongatha Wonganarra are the closest communities to the project (approximately 230, 250 and 220 km from the Operational Area respectively) and share existing infrastructure such as 4WD tracks into the region.

Evidence exists of past sandalwood harvesting in the wider region. This is believed to have last occurred in the 1950s and 1960s, and involving some of the local Indigenous people from the Wongatha community as harvesters.

The Tjuntjuntjarra community is a member of a larger group known as the ‘Spinifex People’. The Spinifex People temporarily left the northern part of their traditional country during a time of severe drought that coincided with the British nuclear testing program at Maralinga. During the 1950s and 1960s people moved southwest into Cundeelee Mission 200 km east of Kalgoorlie reconnecting with family groups dispersed by events to the east. Then in 1983/4 relocated from Cundeelee to a station called Coonana, and subsequently relocated back to their homelands at Tjuntjuntjarra. The population of Coonana is approximately 80 to 100; Tjuntjuntjarra has been estimated to be around 150 people. At Laverton, the Wongatha Wonganarra community’s population is estimated to be 240. The Wongatha people’s Native Title claim (WC99/1) over approximately 160,000 km^2 of Western Australia, including a significant proportion of the Project area, was dismissed by the Federal Court in February 2007. It is understood that a new Native Title Claim or claims may be lodged over the project area and the surrounding region by individuals largely from the former Wongatha claimant group. The Central Desert Native Title Services have the primary responsibility for the establishment of a new claim and are in the process of developing a new connection report in support of that new claim. Other claims may of course be lodged independently. It is unclear at this point in time when a new claim or claims will be lodged.

6.1.8. Reserves and Conservation Areas

The GVD has a number of areas protected for conservation purposes, the reserves in relatively close proximity to the Project area are the Queen Victoria Spring Nature Reserve (272,000 ha), the Plumridge Lakes Nature Reserve (310,000 ha) and the Neale Junction Nature Reserve (725,000 ha).

The Plumridge Lakes Nature Reserve is located approximately 14 km southeast of the Operational Area, the Queen Victoria Spring Nature Reserve approximately 20 km southeast of the proposed Pinjin Infrastructure Corridor and the Neale Junction Nature Reserve approximately 100 km northeast of the Operational Area. The reserves are classified as Class A for the purpose of conservation of flora and fauna (there is no recreational component) (Figure 6.1).

6.2. OPERATIONAL AREA

6.2.1. General

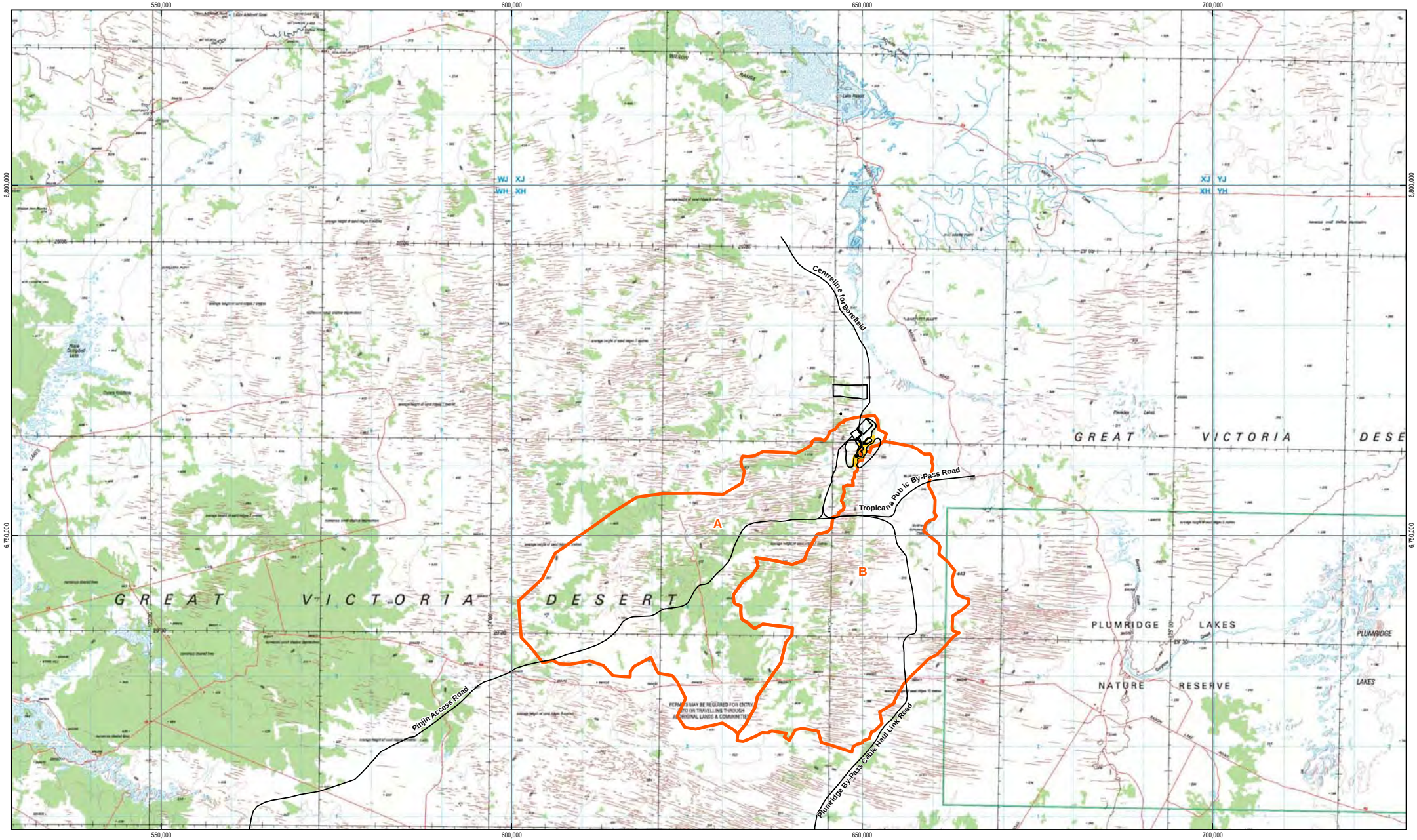
The Operational Area is located in the southwest corner of the GVD, 330 km east-northeast of Kalgoorlie and approximately 14 km northwest of the Plumridge Lakes Nature Reserve (Figure 2.1 and Figure 6.1).

6.2.2. Surface Hydrology

GHD was commissioned to assess the surface water hydrology within the Operational Area (Appendix 2-B8). Two external catchments lie upstream of the Operational Area (Figure 6.6). Drainage in these catchments is generally from the southwest to the northeast, toward the southern reaches of the Lake Rason system. Lake Rason is a large, intermittently-filled, saline wetland with regional significance located 50 km to the north. It is unlikely that Lake Rason ever fills to capacity and overtops. Water ponded in the lake is lost through a combination of evaporation and seepage. Ponding in Lake Rason and its associated drainage system does not appear to affect drainage or flooding at the Operational Area.

Both external catchments are characterised by soils with high infiltration rate, particularly in the upper catchment, so runoff is low. What little runoff does occur in the upper catchment is trapped by sand dunes, internally drained areas and poorly defined low-gradient drainage lines. The lower catchment contains colluvium soils which are more likely to produce runoff. This area still contains local depressions which retain stormwater and there are no well-defined watercourses, though drainage pathways are evident.

Runoff from areas around the Operational Area could impact on the mine infrastructure and operations. There is a drainage line/ valley through the lower parts of the Operational Area from the processing area, which will may convey stormwater during larger rainfall events. This stormwater will probably be sourced from a 23 km^2 catchment around the mine site area. There is also an area upstream of the processing plant that could pond stormwater, sourced from a 7 km^2 local catchment, for short periods after heavy rainfall.



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0 2.5 5 10 15 20

Kilometres

Map Projection Transverse Mercator
Horizontal Datum Geocentric Datum of Australia 1994
Grid Map Grid of Australia, Zone 51

N

LEGEND

Conceptual Site Layout
AngloGold Ashanti Australasia 200808

- Access Roads
- Proposed Mine Infrastructure
- US1000 Shell AngloGold Ashanti Australia 200707
- Catchments GHD 20080218

AngloGold Ashanti Australia Limited
Tropicana Surface Water Evaluation

Job Number	6121984
Revision	1
Date	5 September 2008

Regional Drainage

Figure 6.6

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239 Adelaide Terrace Perth WA 6004 **T** 61 8 6222 8222 **F** 61 8 6222 8555 **E** permail@ghd com au **W** www ghd com au

6.2.3. Hydrogeology

Pennington Scott (Appendix 2-B17) was commissioned to complete a hydrogeological assessment of the Operational Area in 2008. The objectives of the assessment were to identify any potential groundwater sources adjacent to the proposed Resource Area and to estimate the volume of water that may need to be managed during the life of the operation. A numerical groundwater model of the Operational Area has been developed to simulate abstraction rates and changes to groundwater levels and flowpaths associated with the mine dewatering and TSF management. Modeling impacts of pit dewatering on groundwater levels and resulting flowlines were determined by the groundwater model using a 15 year model scenario representing the cessation of mining. This section summarises the findings of that assessment, for more detailed information refer to the assessment report included in Appendix 2-B17.

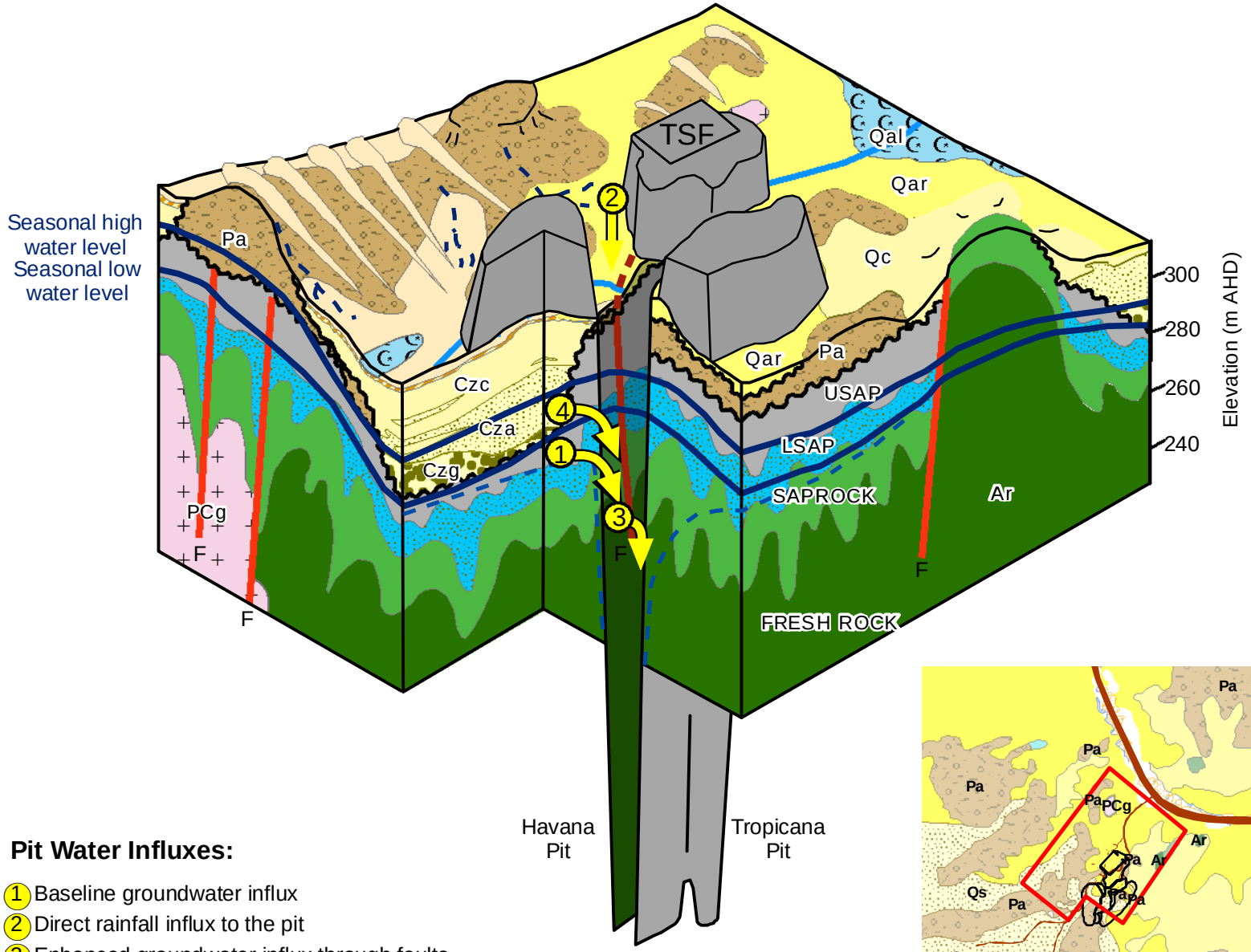
The Operational Area lies on the edge of the Albany-Fraser Range, an up-thrown horst block comprising mostly Achaean gneissic rocks in the foreland of the Albany-Fraser Orogen. The Achaean basement is discontinuously overlain by Permian fluvial-glacial-lacustrine deposits of the Paterson Formation, which are in turn buried beneath about 30 m of unconsolidated Cenozoic alluvium and clayey colluvium, and a veneer of Quaternary aeolian sheet sand and sand ridges. All of the pre-Quaternary rocks in the region have been subjected to deep lateritic weathering, leaving a ferruginous hard cap underlain by a zone of strongly oxidised clay (the upper saprolite), a zone of moderately weathered joint oxidation (the lower saprolite) and broken fresh rock (sap-rock).

Groundwater within the Operational Area occurs mainly in fractures and joints in the deeper basement rock, with most porosity and permeability occurring in the lower saprolite and the underlying sap-rock (Figure 6.7). The lower saprolite is about 10 - 20 m thick and occurs from 30 - 60 m below surface, whilst the sap rock extends up to 90 m below ground. Although the gravelly glacial tillite lenses at the base of the Paterson Formation appear to offer reasonable aquifer characteristics, the unit is mostly unsaturated due to its elevated position in the landscape.

As part of the baseline studies, the Joint Venture established twenty water level monitoring piezometers and four shallow production water bores (less than 70 m depth) within the Operational Area. Three of the four production bores produced yields around 70 kL/day, with the remaining bore producing 350 kL/day.

Groundwater recharge rates over the Albany-Fraser Range are very low, estimated at less than 0.5% of annual rainfall. Consequently, groundwater salinities are high, ranging from 10,000 to 40,000 mg/L TDS within the Operational Area, and likely up to hyper-saline (more than 100,000 mg/L TDS) at the Rason Palaeodrainage, several kilometres north of the mine.

Groundwater levels fluctuate between 20 and 30 m below ground and have a local groundwater gradient towards the Rason Palaeodrainage. The relatively high permeability basal gravels in the Cenozoic alluvial/ colluvial deposits appear to act as local sub-surface drains, keeping the water table hinged at the base of the alluvium.



Pit Water Influxes:

1. Baseline groundwater influx
2. Direct rainfall influx to the pit
3. Enhanced groundwater influx through faults
4. Enhanced seasonal groundwater influx after rainfall

Legend

- Drawdown after 15 years
- Static Water Level
- Drainage
- Fault
- Quaternary - Eolian Sandplain (Qs)
- Quaternary - Red Brown Alluvial Soil (Qa)
- Quaternary - Lacustrine Deposits (Qal)
- Permian - Paterson Formation (Pa)
- Ferruginous hard cap (Qzl)
- Saprock
- Cenozoic - Colluvium (Czc)
- Cenozoic - Alluvium (Cza)
- Cenozoic - Basal Gravel (Czg)
- Upper Saprolite (USAP)
- Lower Saprolite (LSAP)
- Protorozoic Granite Pluton (PCg)
- Archean Greenstone (Ar)

SOURCED FROM PENNINGTON SCOTT

LOCALITY MAP

METADATA RECORDED	PROJECTION
100%	MGA ZONE 51
HORIZONTAL DATUM	**HEIGHT DATUM**
GDA 94	N/A

CREATED BY	CHECKED BY	APPROVED
GWa	BP	FD
DATE	**REVISION**	**DRAWING ID**
30.07.09	0	351-2.03

Tropicana Joint Venture
TROPICANA GOLD PROJECT

Public Environmetal Review
Groundwater Box Profile
Figure 6.7

6.2.4. Soils and Landforms

The majority of the Operational Area lies in a broad valley between an extensive dunefield on the western side and the local high point on the northeast side (Figure 6.8).

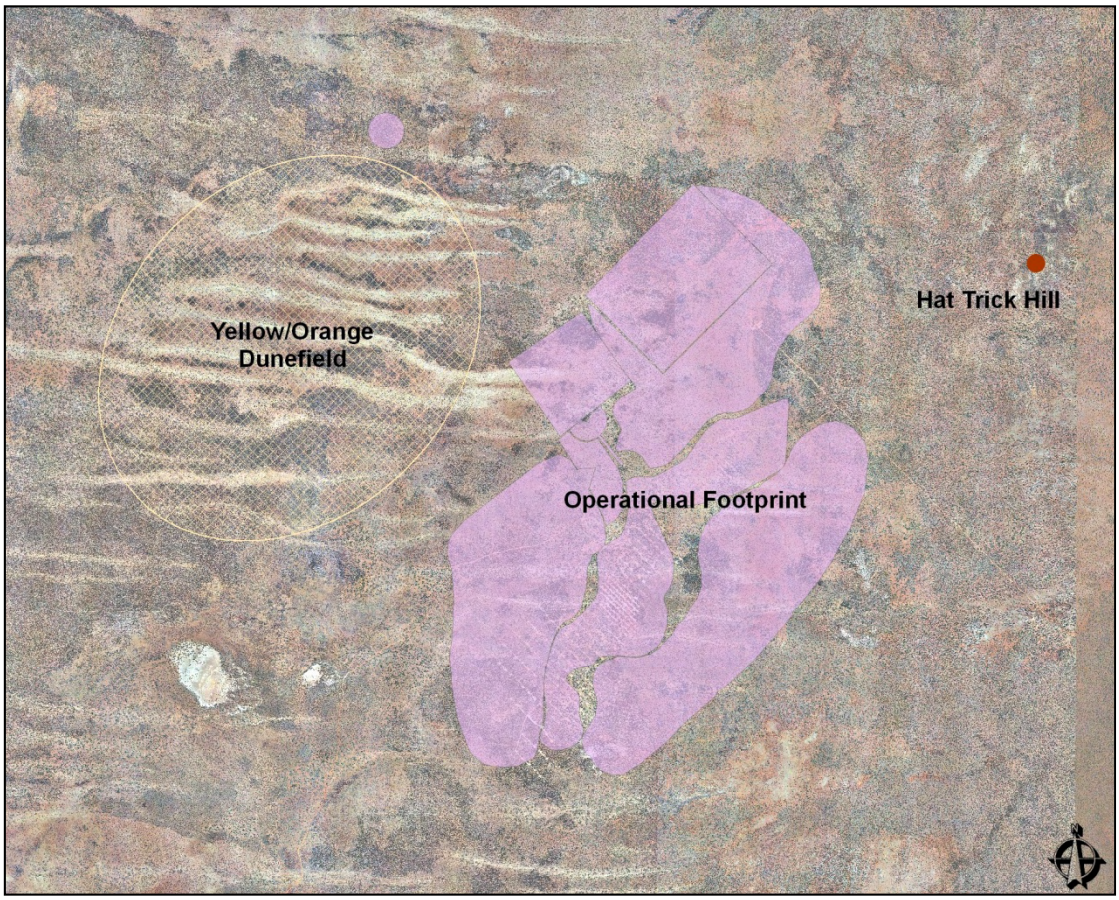


Figure 6.8: Local Landforms

The Operational Area contains, in roughly equal parts, Cenozoic Colluvium, Cenozoic Alluvium and Permian Paterson formation. Apart from the main drainage valley, there are also several subregional surface catchments that feed into the drainage over the Fraser Range, that also contain Cenozoic sediments. Two such shallow valleys drain north-northeast through the middle of the Resource Area and the proposed tailings storage facility location and join the Rason drainage several kilometres north of the mine.

Drilling within the Resource Area has revealed Cenozoic deposits comprise of several metres of fluvial infill, thickening to about 30 m in the central drainage area. The Cenozoic deposits are mostly a mixture of fine-grained interbedded silty and clayey fluvial and lacustrine deposits; however, several drill holes intersect 3 to 5 m of a basal gravel unit comprised of medium to coarse quartz sand with occasional clayey rounded pebble gravel.

The top few metres of the soil profile is an aggressive leaching zone in which tannic and carbonic acids from plant activity leach away relatively immobile haematite-goethite and silica minerals leaving behind friable red brown loam and hard pan soils and red brown alluvial loam.

The Paterson Formation is a mixed glacial, fluvial-glacial, and glacial-lacustrine sequence with a maximum thickness of about 100 m. In the mine area, the Paterson Formation is a discontinuous cover, with remnants exposed mainly on elevated ground, having been reworked and/ or eroded from the drainage valleys. Where present, the Patterson is weathered and lateritised white porcilinised clays and gravels.

Many of the higher hills around the Tropicana and Havana deposits are topped by a veneer of unconsolidated sandplain with regular west to north-northwest sand ridges up to several kilometres in length by 14 m high and about 200 m wide.

There are lateral dunes within the mine clearing footprint. Impacts to an extensive dunefield to the east of the Operational Area have been avoided where possible. Sand ridges are mostly comprised of yellow poorly sorted fine aeolian quartz sand with some clay. The upper 200 to 400 mm of the dunes tend to be relatively loose and readily excavated by shovel. However, below this depth the sand can often turn to a hard calcrete (as a result of evaporation of groundwater which results to precipitation of calcium carbonate). Of the few road cuttings and excavations through the dunes, there is evidence of macro pores in the upper few metres, remnants of shallow root systems of various dunal flora and burrowing activities of fauna.

The interdunal areas are often a veneer of one or two metres of sand sheet, but equally as often the interdunal zones are windswept, exposing the underlying red-brown earth, colluvium or the ferruginous hard cap.

Soil testing found that the soils were mainly between pH 6 and pH 8. Salinity generally increased with depth ranging from non-salty to moderately saline. Average nutrients for the Operational Area soil and regolith material were generally low for total nitrogen and all extractable nutrients, as is commonly found in arid zone soils.

Elemental analysis results indicated that chromium, copper, lead and nitrogen were regularly measured at levels above the limit of reporting, as were two individual sample results for zinc and mercury .Comparison of these results with average crustal abundances for these elements found that a few individual results for Chromium and Lead were above average crustal abundances in both the “Quaternary sand over laterite” and “Sandstone or ferricrete regolith types. Comparison with DEC Ecological Investigation Levels found all elemental concentrations were below respective Ecological Investigation Levels, with the exception of the average Chromium results for samples collected from “Quaternary sand over laterite” and “Sandstone or ferricrete” regolith (a natural process as Chromium gets concentrated into laterite (with iron and other cations).

6.2.5. Material Characterisation and Contaminated Site Potential

Multi-element analysis of surface soil samples and near surface soil samples carried out by the Joint Venture and Outback Ecology Services (Appendix 2-B16) respectively over the Project Operational Area has provided a baseline for metal concentrations occurring naturally in the surrounding environment. Metal levels were assessed against the Australian Institute of Mining and Metallurgy (AIMM) average crustal abundance values (AIMM 2001). Average concentrations for the majority of elements fall below average crustal abundance levels, with the exception of arsenic, mercury, strontium and tellurium, although individual concentrations of a number of other elements also exceed respective average crustal abundance levels.

Multi-element analysis of overburden and waste materials collected at depth, ranging from one metre below surface to a depth of 323 m (Appendix 2-B18) indicate that nearly all average metal concentrations increase with depth by up to an order of magnitude. Of particular note, are increases in average barium, cobalt and copper levels, from 58 to 987 ppm, 2.4 to 26 ppm and 12 to 76 ppm, respectively. A decline in average mercury concentrations, from 0.10 to 0.03 ppm, was the only exception. Accordingly, the majority of average metal concentrations at depth exceed average crustal abundance levels (AIMM 2001), and a number also exceed respective site specific soil assessment trigger levels, which have been developed from baseline surface soil data. This variability with depth is associated with the weathering profile.

Geochemical characterisation of samples from the Project area undertaken by SRK Consulting (Appendix 2-B18) to investigate the acid generating potential of materials in this area, has shown that the majority of the waste material (70% - 75%) can be expected to be non acid forming (NAF). Approximately 8% percent of the waste material could be expected to be potentially acid form, although this could be as high as 15%. This material is associated with a small number of rock types including:

- Ferruginous cherts (ANC_{RT})
- Feldspathic Gneiss (undifferentiated) (ANFF)
- Sulfide rich sediments (AX)
- Schists
- Pegmatites

A further 10% to 22% of the waste material is classified as uncertain (UC). However, it should be noted, that an assessment of relative abundance of each lithological unit selected as part of the geochemical analysis program, showed a sampling bias towards sulfide mineralization and therefore acid generation potential may be overestimated.

Geochemical analysis indicated that the contribution to the acid neutralising capacity or potential (NP) appears to be a combination of reactive carbonates (predominantly calcium and magnesium carbonates) and less reactive aluminosilicates (which typically neutralise acid at slower rates and lower pH values). However, during high rates of acid generation, only carbonate minerals react sufficiently rapidly to neutralise the acidity and maintain neutral pH conditions, whilst silicate minerals will remain unreactive. The results of further geochemical analysis, including acid buffering characteristic curve testing, sequential NAG testing and kinetic NAG testing, suggest that the available neutralisation potential is best indicated by the carbonate equivalent NP (CarbNP) calculated from the inorganic carbon content and should be used for material classification.

CarbNP values calculated for each sample indicate that some rock types, including saprolite, Archaean gneiss, pegmatites and the Quaternary sediments have little or no neutralisation potential and therefore would not be expected to provide any buffering capacity. Conversely, waste material, comprising the Archaean amphibolitic gneiss, Permian sediments and garnet gneiss (undifferentiated) contain elevated CarbNP concentrations and low sulfide sulfur levels, and thus could be considered key sources of neutralisation capacity. Tertiary cover too, although having a lower neutralization capacity, could also be used to neutralize acid generating waste material, but might be best utilised as a cover material.

In recognition that some material contained elements with above average concentrations or substance with levels that are above the average crustal abundance may indicate a potential for these elements to leach from the waste material if exposed to weathering conditions, column kinetic tests have been carried out to assess changes in pH, sulfate and metal concentrations in the resulting kinetic test leachate. Preliminary results have indicated:

- That the majority of samples remained in the near neutral pH range over the extent of the test, indicating buffered pH conditions. However, pH levels for a ferruginous chert sample with a low CarbNP value rapidly acidified over the 32 weeks of the test, whilst pH levels in a second ferruginous chert sample with a higher CarbNP remained near neutral for approximately 28 weeks, and then declined over the next four weeks.
- Preliminary sulfate concentrations in the kinetic test leachates showed that all the tests underwent an initial ”flush” of sulfates, after which the concentrations decreased. This flush is attributed to the removal of oxidation products from the samples that accumulated whilst the samples were in storage. In subsequent weeks, sulfate concentrations, and as such, oxidation rates in the majority of the samples remained relatively consistent. Notable exceptions were steady increases in sulfate release rates (and hence oxidation rates) in ferruginous chert and sulfide-rich rock samples, which had not yet reached a maximum value by week 32 of the tests.

- Comparison of calculated rates of sulfide depletion against rates of CarbNP consumption indicated that the CarbNP were depleted well in advance of the depletion of the acid generation potential for all but the garnet gneiss (undifferentiated) sample which had the highest CarbNP. These results indicate that the majority of these samples might be expected to eventually become acidic. The results also indicate that the rate of oxidation is related to pH conditions and sulphur content, generally increasing with increasing sulphur content and decreasing pH. However as noted previously, the samples selected as part of the geochemical analysis are biased towards sulfide mineralization and therefore acid generation potential may be overestimated.
- Metal concentrations in the leach water fluctuate over the 32-week period. For metals such strontium, a peak concentration was released early but in subsequent weeks, concentrations steadily decreased. By week 32 the majority of metal release concentrations are continuing to decline or are at a relatively steady state.
- Release rates for a number of metals appear to be pH related and increase with decreasing pH. Not unexpectedly, concentrations of a number of analytes, including aluminium, beryllium, cadmium, cobalt, copper, manganese, nickel and zinc are notably higher in the kinetic test leachate for the ferruginous chert sample, than for any of the other samples, with the majority consistently exceeding respective groundwater SSTLs and DoE (2003) Fresh Water guideline levels.
- Conversely arsenic release occurs at near neutral pH conditions and is highest in non acid forming material from the garnet gneiss.
- Concentrations of numerous analytes in the sulfide rich rock sample, including aluminium, arsenic, cadmium, mercury, molybdenum, selenium and zinc, were above the DoE (2003) Fresh Water guideline levels, although only aluminium and molybdenum were above respective SSTLs.

Aluminium and barium concentrations in nearly all samples were generally above respective SSTLs, whilst cadmium and zinc were generally in exceedence of DoE (2003) Fresh Water guidelines. Work carried out by Landloch (Appendices 2-B11 and 2-B12) on water and wind erosion characteristics has indicated that the Operational Area shows little visual evidence of runoff from the existing dunes, which are stabilised by well established vegetation (Appendices 2-B11 and 2-B12). Infiltration tests show that dune material has a higher infiltration rate than its corresponding swale, which is consistent with other published data. A synthetic 100-year climate file was developed for the Operational Area, and the WEPP runoff/ erosion model run to consider potential runoff and erosion from a 40 m high slope on 14° gradient. The simulations showed that runoff for the 100-year period simulated was zero or negligible if the soil on the slope had a steady infiltration rate of 30 mm/h or greater. At a steady infiltration rate of 15 mm/h, predicted average annual runoff was 10 mm/y and erosion was 8 t/ha/y. As three of the four samples tested had infiltration rates >70 mm/h, it can be concluded that the potential for significant runoff and runoff-induced erosion is extremely small. However, Landloch indicate that there may be potential for wind erosion to be significant (Appendix 2-B12). Wind erosion modelling of the sand material on a 15˚ slope with wind data from Laverton suggests that wind erosion will need to be managed.

Following the detection of possible rare fibrous minerals in limited diamond drilling cores, a number of samples were submitted for Scanning Electron Microscopy analysis to determine fibre type and morphology. The assessment indicated that the dominant fibrous mineral present was actinolite, with a few other fibrous minerals presence. Some fibres could not be accurately classified were designated “amphibole”. The minerals were found to be long and thin, typically less than one micron in width and longer than 10 microns in length, with a very high length to width aspect ratio.

Fibres identified in these samples met the criteria for a respirable fibre, that is, small enough to reach the lungs. The criteria is usually defined as is less than three microns in width, greater than five microns in length, and a length to width aspect ratio of more than 3:1. Accordingly, these results indicate that some fibrous minerals present in the Resource could be potentially hazardous. Recorded occurrences observed since 2005 are very limited suggesting that fibrous mineral are present in very small amounts, although it is acknowledged that the

material may be widespread. Fibrous minerals are relatively common throughout the Goldfields and can be appropriately managed. The Joint Venture believes that this issue can be effectively managed by adopting dust management measures implemented at gold and nickel mines within the Goldfields.

A preliminary assessment of potential contamination risks associated with the operation of the Project has been carried out by 360 Environmental (Appendix 2-B1), and has identified a number of potential contamination sources that are typical for a mining operation (and managed by standard practices), such as the use of cyanide in ore processing and large quantities of hydrocarbon. Other potential sources relate to site specific factors, such as the presence of heavy metals in the waste that area either at or above the Ecological Investigation Levels or site specific trigger levels, the presence of small quantities of Potentially Acid Forming and low level fibrous minerals.

Material characterisation assessment is an iterative/ ongoing process and the work completed to date will be supplemented by additional work over the life of the project to confirm predictions and to confirm the contaminated site specific trigger recommend by 360 Environmental in Appendix 2-B1.

6.2.6. Air Quality

During dry conditions project activities have the potential to generate dust and particulate matter. For the purposes of assessing the potential air quality impacts from the operation, an estimation of existing ambient air quality is required.

The existing air quality in the vicinity of the Operational Area is associated with that of a rural arid environment. Natural sources of particulate matter, such as windblown dust from exposed surfaces, would be the main contributor in the vicinity of the operation. Due to a lack of industrial activities in the vicinity of the proposed Operational Area, the maximum increase in deposited dust level will be the governing goal for the operation.

Additionally, given the remote rural nature of the Operational Area, the existing concentrations of combustion related emissions are assumed to be negligible for the purposes of this assessment. It is acknowledged that combustion related emission will be present following lighting derived fires; between October and April as a result of localised thunder storms.

The Joint Venture commissioned Heggies to assess potential health and environmental impacts associated with changes in air quality resulting from the Project (Appendix 2-B10). This included an assessment of Volatile Organic Compounds (VOCs), nitrogen dioxide, sulfur dioxide, carbon monoxide, PM_{10} as well as general dust deposition.

Given the remote rural nature of the Operational Area, the existing concentrations of combustion related emissions are assumed to be negligible for the purposes of this assessment (Appendix 2-B10).

The mineralisation hosting the Tropicana and Havana resource does not contain significant amounts of copper; therefore problems with copper-cyanide complexing (during processing) are not expected. In addition the process does not require a roaster, therefore avoiding environmentally hazardous emissions.

A summary of the 2008 annual wind behaviour for the Project is presented as a wind rose (Figure 6.9). This wind rose displays occurrences of winds from all quadrants. Winds experienced at the Operational Area are predominately moderate to strong winds (between 5.5 m/s and 10.5 m/s upwards) from the east to southeast quadrant (approximately 36% combined). Calm wind conditions (wind speed less than 0.5 m/s) were recorded approximately 23% of the time throughout 2008 (Appendix 2-B10).The seasonal variation in wind behaviour at the Operational Area is presented in Appendix 2-B10. The seasonal wind roses indicate that:

- in spring, moderate to strong winds are experienced predominantly from the east to south (approximately 43% combined);

- in summer, moderate to strong winds are experienced predominantly from the east to south southeast (approximately 68% combined);
- in autumn, moderate to strong winds are experienced predominantly from the east to southeast (approximately 31% combined); and,
- in winter, moderate to strong winds are experienced predominantly from the east to southeast (approximately 26% combined).

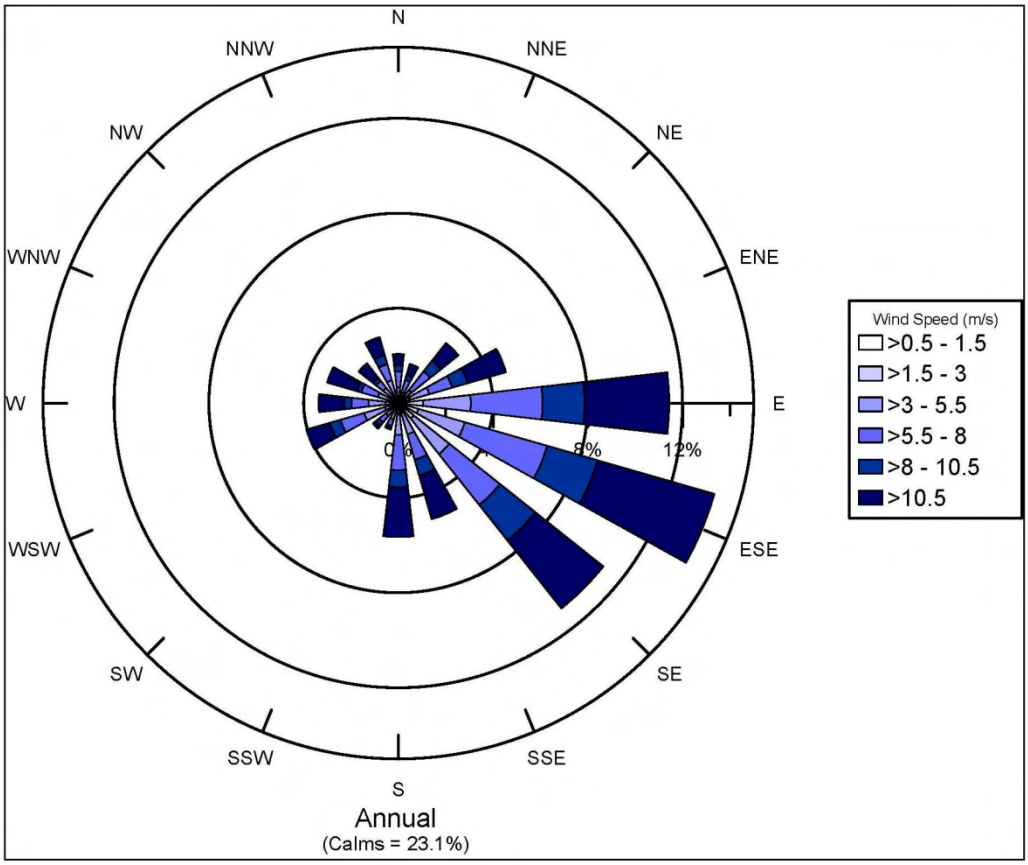


Figure 6.9: Annual Wind Rose for Tropicana Gold Project Operational Area - 2008

The existing weather station at the Project was established in October 2007. It is unclear if the recorded data is representative of conditions experienced long term. However, the 2008 wind rose recorded at the Operational Area has comparable wind speed and direction characteristics with the wind data recorded at the Bureau of Meteorology in Laverton. On the strength of this comparison, the 2008 wind dataset recorded at the Operational Area is considered representative (Appendix 2-B10).

It would be expected that the wind speeds during the daylight hours in particular would be higher in a desert region like that of the Project. According to Oke (2003), due to the vast diurnal variation in atmospheric conditions; including convective energy, temperature and atmospheric stability, and relatively bare surface characteristics, the daytime wind speeds would be expected to be significantly higher than night periods in desert regions. This is borne out by the wind observations at the Project in 2008.

6.2.7. Flora and Vegetation

ecologia Environment (*ecologia*) completed an assessment of vegetation and flora values of the region surrounding the Operational Area over several field trips between November 2006 and July 2008. The area surveyed covers some 131,000 ha which is five times larger than the Operational Area and 40 times larger than the proposed operational footprint. Prior to commencing the assessment *ecologia* also undertook a series of rare flora surveys of the exploration area (2005 - 2006). Figure 6.10 shows the area covered by the survey. The survey conducted over the Operational Area meets the requirements of a Level 2 survey as defined by the Environmental Protection Authority's Guidance Statement 51. The survey report upon which much of this section is based is included as Appendix 2-B6 along with a detailed description of the survey methods.

Biogeography

The Operational Area is situated in the Helms Botanical District, near the border of the GVD and the Nullarbor Plain, within the Eremaean Botanical Province. At a broad scale, Beard (1975) described four distinct vegetation units within the same area surveyed by *ecologia*, these being:

- *Acacia aneura* (mulga) low woodland between sand ridges;
- tree (*Eucalyptus gongylocarpa*, *E. youngiana*) and shrub steppe between sand hills with hummock grassland (*Triodia basedowii*);
- *Acacia aneura*/ *Casuarina cristata* (*C. pauper*) woodland (mulga and Sheoak); and,
- lightly wooded succulent steppe: *Acacia aneura* (mulga) with *Atriplex* (Saltbush) or *Kochia* (now *Maireana*).

The majority of the area is mapped as the first two units. Although the sand ridges are not individually mapped, Beard describes these as 'the spinifex is generally replaced by ericoid shrubs and larger shrubs such as *Grevillea stenobotrya*, *Acacia* species and small trees of *Callitris* sp (most likely *C. preissii*)' (Beard 1975).

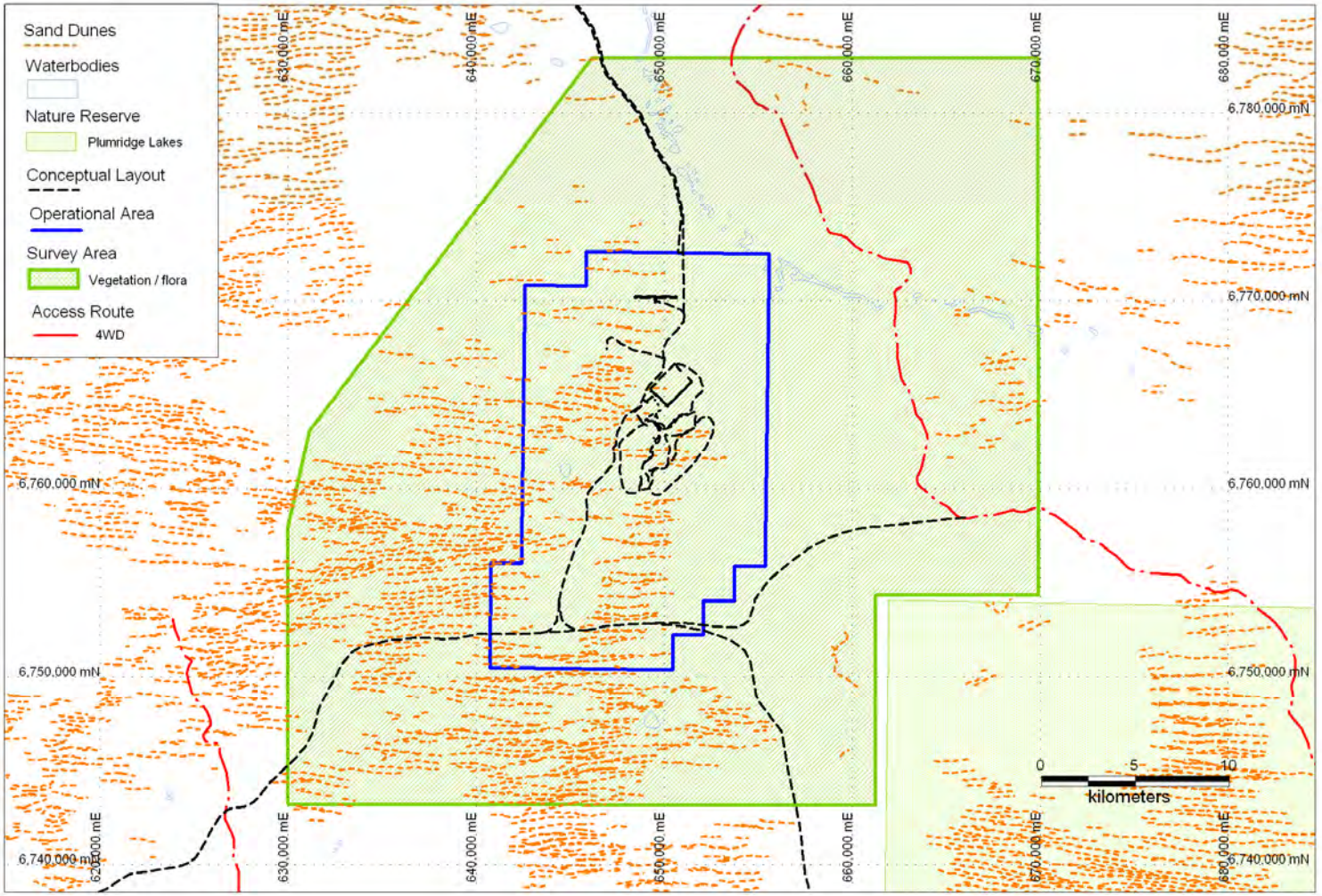


Figure 6.10: Operational Area Survey Area

Vegetation

The vegetation within the survey area is in good condition, although some areas are undergoing post-fire regeneration. Lightning derived fires are common in the region between October and March and can cause a significant amount of natural damage to the environment.

Eleven major vegetation communities were identified by *ecologia* (2009a) within the survey area. Some of the major communities have been broken down further into an additional 18 sub-communities. Of the vegetation communities identified only 17 could be clearly identified from aerial photography and thus geographically mapped. A map of the vegetation communities within the Operational Area and in the greater 131,000 ha is provided in Figure 6.11. Within the actual Operational Area 10 different communities or sub-communities have been identified. The 11 major communities are broadly broken down by landform and are described below.

1. Mixed eucalypt woodlands over mixed open shrubs and *Triodia basedowii*:
   - three subtypes; and,
   - Priority taxa *Dicrastylis nicholasii* and *Olearia arida* were recorded within this community.
2. *Eucalyptus gongylocarpa* (marble gum) over *Triodia desertorum* or *T. basedowii*:
   - two subtypes; and,
   - four Priority flora *Oleara arida, Dicrastylis nicholasii, Microcorys macredieana* and *Micromyrtus stenocalyx* were recorded within this community.
3. Scattered *E. gongylocarpa* over mixed shrubs and *Triodia desertorum* or *T. basedowii*.
   - two subtypes;
   - Declared Rare Flora species *Conospermum toddii* was recorded from one location within this community;
   - four Priority taxa; *Dicrastylis nicholasii*, *Microcorys macrodenia*, *Micromyrtus stenocalyx* and *Lepidobolus deserti* were recorded within this community; and,
   - new species *Caesia talinyka* (Tauss, in prep).
4. Undulating plains: open mallee *Eucalyptus concinna* over sparse to open low shrubs over open *Triodia scariosa:*
   - Priority taxa *Dicrastylis nicholasii* and *Daviesia purpurascens* were each recorded at one location within this community.
5. Clay Pan: Scattered *Acacia nyssophylla/ Grevillea sarissa* over open herbs and grasses.
   - no Priority taxa were recorded within this community.
6. Major saline clay pan complex:
   - six subtypes; and,
   - *Baeckea* sp. Gt. Victoria Desert (A.S. Weston 14813) was recorded in the fringing vegetation of this community.
7. Clay loam plains: *Acacia aneura* woodlands over soft grasses and *Triodia basedowii*:
   - three subtypes; and,
   - Priority species *Dicrastylis nicholasii* and *Baeckea* sp. Gt. Victoria Desert was recorded within this community.

8. Rocky breakaways and associated slopes:
   - open *Acacia quadrimarginea/ Dodonaea rigida* over sparse mixed shrubs over mixed soft grasses; and,
   - no Priority taxa were recorded.

9. Grasslands:
   - open to moderately dense *Casuarina pauper* woodland over open mixed shrubs and scattered soft grasses and/ or *Triodia scariosa*; and,
   - despite the relatively high diversity, there were no Priority taxa recorded.

10. Scattered trees over open low shrubs and moderately dense tussock grasslands
   - comprising two subtypes; and,
   - no Priority taxa were recorded.

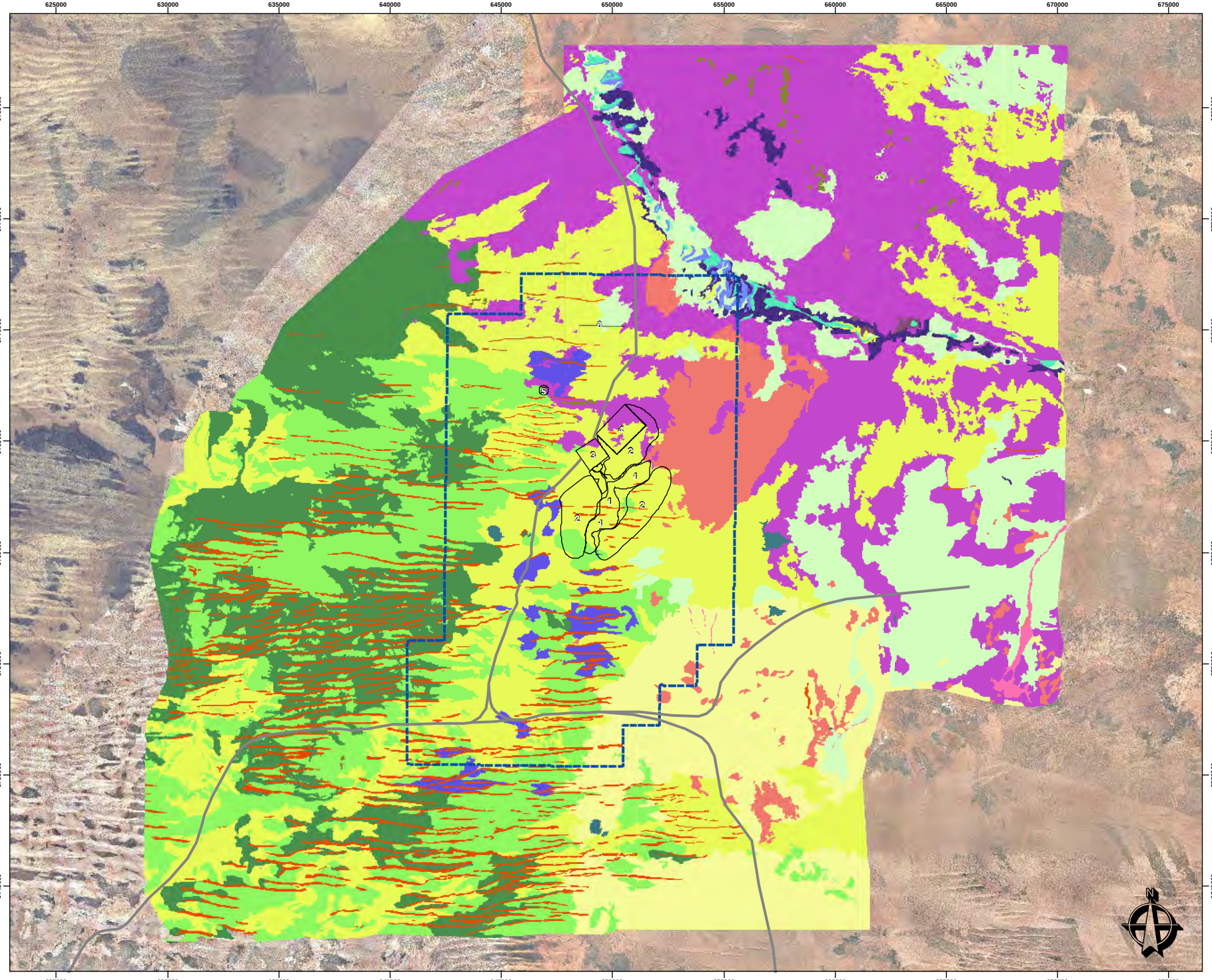
11. Narrow drainage channels:
   - sparse *Acacia aneura* over sparse to open shrubs and moderately dense tussock grasses; and,
   - no Priority taxa were recorded.

None of the vegetation communities identified are currently listed as Threatened Ecological Communities Federal legislation or are considered by the DEC to be threatened at the State level, however it is possible that the 'Scattered *E. gongylocarpa* over mixed shrubs and spinifex' located on the western side of the survey area may be a local variation of the 'Yellow sandplain communities of the Great Victoria Desert' which are currently listed as a Priority Ecological Communities. None of this area will be affected by the proposed site layout.

Legend

Operational Area Vegetation Communities

xZ.G	Isolated *Acacia* spp over *Ptilotus obovatus* / *Maireana* spp./ *Solanum* spp. over moderately dense tussock grasses
a1L.k1k2Z.G	Narrow drainage channel: Sparse *Acacia aneura* over sparse to open shrubs and scattered to moderately dense tussock grasses
a1L.GH	*Acacia aneura* woodlands over grasses +/- *Triodia basedowii*
a1L.al1a9S.t2H	Open to moderately dense *Acacia aneura* over *Aluta maisonneuvei* subsp. *auriculata* / *Acacia ramulosa* var. *ramulose* over *Eremophila forrestii* subsp. *forrestii* over *Triodia basedowii*
a14d4S.G	Rocky breadaways and associated slopes: Open *Acacia quadrimarginata* / *Dodonaea rigida* over sparse mixed shrubs over mixed soft grasses
c2ex.xS	Open to moderately dense Cauarina pauper woodland over open mixed shrubs and scattered soft grasses and/or Triodia scariosa
ex.Lt2H	Open *Eucalyptus youngiana* and sparse *Callitris preissii* over mixed shrubs over open to moderately dense *Triodia basedowii*
e19L.t2t7H	*Eucalyptus gonglyocarpa* over open shrubland over open *Dodonaea viscose* subsp. *angustissima* / *Eremophila platythamnos* subsp. *platythamnos* shrubland over *Triodia desertorum* or *T. basedowii*
e19exL.xS.t7H	*Eucalyptus gonglyocarpa* / *E. youngiana* / *E. concinna* over open mixed shrubland over *Triodia desertorum*.
xS.t2t7H	Occasional *Eucalyptus gongylocarpa* over mixed upper stratum over *Daviesia grahamii* / *Pityrodia loricata* / *Chrysocephalum puteale* low shrubland over sparse to open *Triodia desertorum* or *T. basedowii and Lomandra leucocephala* subsp. *robust*
a33g3S.G	Clay Pan: Scattered *Acacia nyssophylla* / *Grevillea sarissa* over open herbs and grasses.
kxZ.GF	White to grey-brown clay pans : Dwarf halophytic shrublands of variable composition over sparse to dense herbs and grasses
k3k1Z.G	Pale orange to orange clay pans: Low open to sparse scrub dominated by *Frankenia cinerea* / *Atriplex vesicaria* over sparse cover of *Eragrostis pergracilis* / *Aristida contorta*
m7S.kxZ.G	Shallow depressions and areas fringing some claypans: Moderately dense *Melaleuca interioris* shrubland over sparse Chenopods and soft grasses
exc2.kxZ.G	*Casuarina pauper* / mallee *Eucalypts* over *Dodonaea viscosa* subsp. *angustissima* / *Senna artemisioides* subsp. *petiolaris* over Chenopod species and soft grasses
e71LxZ.t8H	Undulating plains: Open mallee *Eucalyptus concinna* over sparse to open low shrubs over open *Triodia scariosa*



Legend

Proposed Infrastructure Corridor

Conceptual Site Layout
1: Resource Area
2: Waste Material Landforms
3: Processing Area
4: Tailings Storage Facility (TSF)
5: Village
6: Airstrip

Operational Area

Vegetation Communities

- xZ.G
- a1L.k1k2Z.G
- a1L.GH
- a1L.al1a9S.t2H
- a14d4S.G
- c2ex.xS
- ex.Lt2H
- e19L.t2t7H
- e19exL.xS.t7H
- xS.t2t7H
- a33g3S.G
- kxZ.GF
- k3k1Z.G
- m7S.kxZ.G
- exc2.kxZ.G
- e71LxZ.t8H

Refer to page 6-26 for vegetation description

Imagery is a composite of aerial and satellite photography

NOTE THAT POSITION ERRORS CAN BE >5M IN SOME AREAS
- AERIAL PHOTOGRAPHY SOURCED FROM LANDGATE 2007
- LOCALITY MAP SOURCED FROM ANGLOGOLD ASHANTI 2008

SCALE

0 1 2 4 6
Kilometers

LOCALITY MAP

METADATA RECORDED	PROJECTION
100%	MGA ZONE 51
HORIZONTAL DATUM	**HEIGHT DATUM**
GDA 94	N/A

CREATED BY	CHECKED BY	APPROVED
GWa	BP	FD
DATE	**REVISION**	**DRAWING NO.**
19.08.09	0	351-2.05

Tropicana Joint Venture
TROPICANA GOLD PROJECT

Public Environmental Review
Vegetation Survey of the Operational Area and Surrounds
Figure 6.11

Flora

A total of 445 taxa were recorded within the survey area, including three naturalised alien taxa. Fifty seven families were represented by 162 genera. The most diverse families were Poaceae (47 taxa), Chenopodiaceae (45 taxa), Mimosaceae (41 taxa), Myrtaceae (33 taxa) and Asteraceae (31 taxa). The dominant genera were *Acacia* (40 taxa), *Eremophila* (25 taxa) and *Eucalyptus* (19 taxa).

The collections which could not be identified beyond genus level or were identified to species level with some uncertainty within the Operational Area (54 collections) were not fully identified due to a lack of flowering material. Further investigation of these specimens is considered unlikely to provide a conclusive identification. The number of incomplete identified specimens is comparable with the number collected within the survey by Pearson (1994) within the Queen Victoria Spring Nature Reserve, in which 14% of the total inventory was unable to be fully identified to species level. This is not atypical within surveys within the Eremaean region as even during favourable seasonal conditions, not all species will be flowering concurrently (*ecologia* pers. comm. to B.Bastow 3 July 2009).

In order to evaluate the possibility that some of the sterile collections may be taxa not recorded elsewhere during the survey areas and potentially of conservation significance, a review of all taxa within these genera that have been previously recorded within the relevant GVD was conducted. There are six genera (from which eight incompletely identified collections occurred) that contain 13 DRF or Priority taxa that have previously been recorded within the GVD but were not recorded within the current survey. The probability that these collections are DRF or Priority taxa is low based on the known distribution and habitat preferences of each taxon. In some instances the non-reproductive characteristics of a Priority taxon are sufficiently distinctive from the unidentified specimens to allow exclusion using sterile material (*ecologia* pers. comm. to B.Bastow 3 July 2009).

Listed Flora Species

The following species of conservation significance were recorded across the survey area, (survey area covers 131,000 ha):

- *Conospermum toddii* (Victoria Desert Smokebush) - listed as Endangered and protected under both the EPBC Act, and WC Act (listed as Declared Rare flora (DRF); and,
- 13 Priority species (Table 6.1).

Figure 6.12 shows the location of the flora recorded in the survey area.

Table 6.1: Priority Flora located within the Operational Area and Surrounds.

Species	Conservation Status
Dampiera eriantha	P1
Baeckea sp. Sandstone (C.A Gardner s.n. 26 Oct 1963)	P1
Baeckea sp. Great Victoria Desert (A.S. Weston 14813)	P2
Dicrastylis nicholasii	P2
Malleostemon sp. Officer Basin	P2
Olearia arida	P2
Grevillea secunda	P2
Acacia eremophila numerous-nerved variant	P3
Acacia eremophila var. *variabilis*	P3
Microcorys macredieana	P3
Micromyrtus stenocalyx	P3
Daviesia purpurascens	P4
Lepidobolus deserti	P4

In the context of statutory requirements, the most significant flora species present within the survey area is *Conospermum toddii*. However, due to the extensive representation of this taxon with the Queen Victoria Spring Nature Reserve, it may be deemed relatively secure. Irrespective of this determination, impact to this taxon must not occur without State ministerial approval in each instance. None of the recorded *C. toddii* populations occur within the conceptual site layout and thus will not be directly impacted by the Project.

In the context of ensuring the survival of threatened species, the taxa considered most vulnerable are the Priority 1 taxon *Dampiera eriantha* and *Baeckea* sp. Sandstone. Prior to the current survey, specimens of *Baeckea* sp. Sandstone had been lodged from locations near Leinster, Sandstone and Agnew. The record within the Operational Area represents a significant south eastern extension. Currently no populations of these species are known within the conservation estate. For specific information on the possible impact on this two species refer to section 7.2.2.

Dampiera eriantha has previously been recorded from only two localised collections near the western boundary of Plumridge Lakes Nature Reserve. In both instances the records within the survey area represent a range extension.

Figure 6.12 shows the location of C*. toddii; B*. sp. Sandstone and *D. eriantha* within the survey area. The remaining listed species have been recorded during other surveys undertaken as part of this Project in a range of areas including nearby Nature Reserves and Joint Venture exploration tenements.

The known distribution of all of the listed species presented above can be located in the Level 2 Survey and Threatened Species Survey reports found in Appendices 2-B6 and 2-B7 respectively.

Section 7.2.2 provides specific information on the level of impact on the listed species located within the proposed operational footprint. It is worth pointing out at this point that many of the listed or conservation interest species recorded during the vegetation and flora survey are not affected by the Project.

Species of Conservation Interest

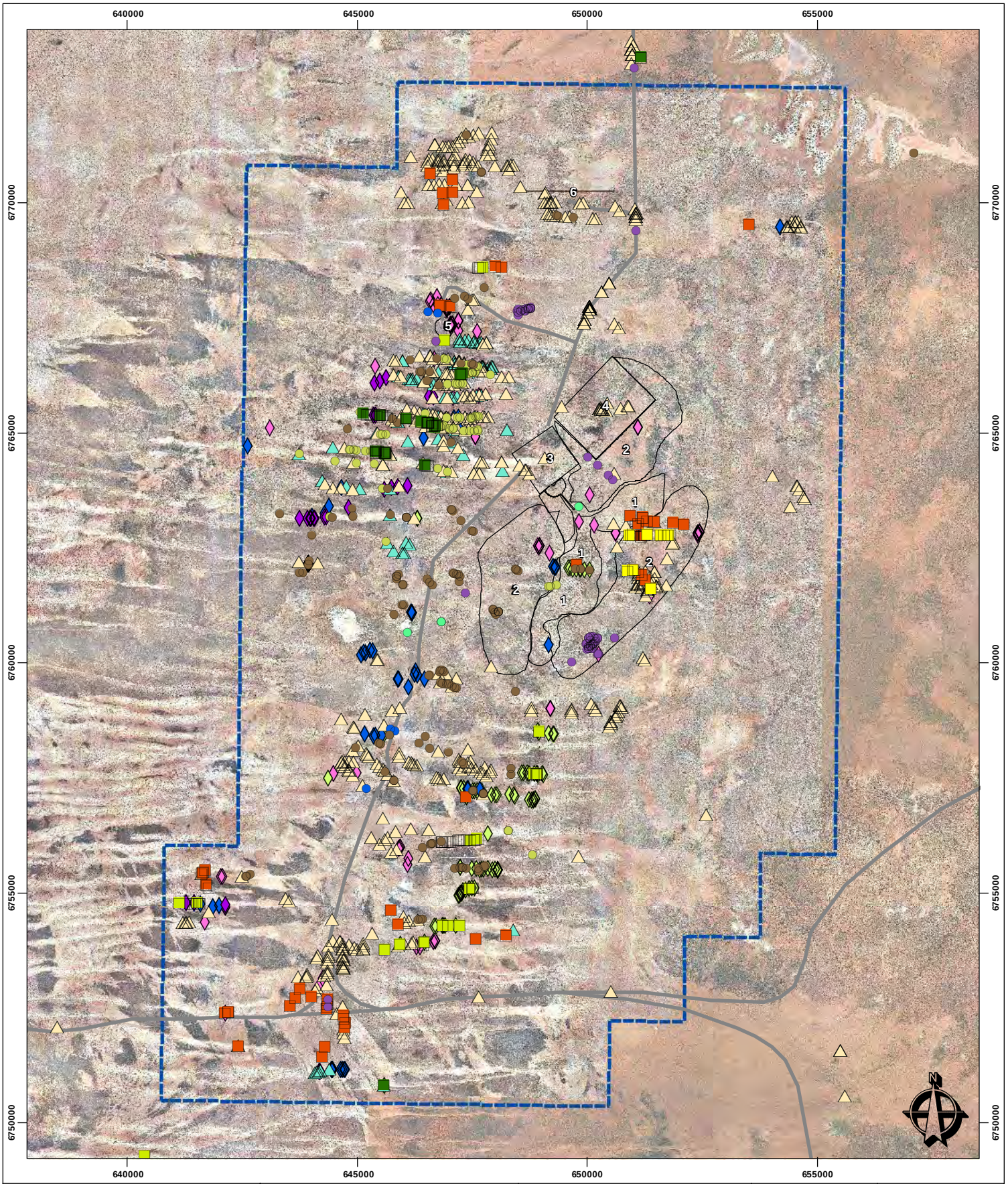
Other species of taxonomic interest and potential conservation significance recorded during the surveys include:

- *Lechenaultia divaricata*, a new record for Western Australia, which has been recommended to be listed as a Priority taxon;
- *Caesia talinyka*, a new species of Grass Lily endemic to the Great Victoria Desert is a previously undescribed taxon. In previous surveys this species was identified as *Caesia rigidifolia* or *Caesia*. *sp*. Great Victoria Desert (Priority 1). It is anticipated that the formal description for *Caesia. talinyka* will be published in 2009 (Tauss, unpub). *Caesia. talinyka* is distinguished from *Caesia viscida* by its more robust habit, leaf venation, subulate bracts, ascending inflorescence, and adaxially-appendaged, apiculate sepals, smooth testa, inland distribution and xeric habitat. *Caesia rigidifolia is* distinguished from *Caesia talinyka* by non-viscid leaves; thickened, pale leaf margins; fibrous roots; and globular seeds with a colliculate testa (Tauss, unpub). Although *C. talinyka* appears quite abundant, more surveys are required to determine if the area of occurrence is restricted. It may be listed as a Priority taxon and is being treated as such by the Joint Venture; and,
- *Tricoryne* sp. Great Victoria Desert western dunes (C. Slee 645-211) [syn*. Tricoryne* sp. Sunshine (C.C. Slee 211, 14/2/2006)], a previously unidentified species.

Introduced Flora Species

Three weed species were recorded in the surveys:

- *Sonchus oleraceus* (Sowthistle);
- *Spergulia rubra* (Red Sand Spurrey); and,
- *Erodium aureum*.



Legend

Listed Flora

- *Acacia eremophila* numerous-nerved variant
- *Acacia eremophila* var. *variabilis*
- *Baeckea* sp. Great Victoria Desert
- *Baeckea* sp. Sandstone
- *Caesia talingka* C. Tauss ms
- *Conospermum toddii*
- *Dampiera eriantha*
- *Daviesia purpurascens*
- *Dicrastylis cundeeleensis*
- *Dicrastylis nicholasii*
- *Grevillea secunda*
- *Lepidobolus deserti*
- *Malleostemon* sp. Officer Basin
- *Microcorys macredieana*
- *Micromyrtus stenocalyx*
- *Olearia arida*

Conceptual Site Layout
1: Resource Area
2: Waste Material Landforms
3: Processing Area
4: Tailings Storage Facility (TSF)
5: Village
6: Airstrip

Operational Area

Proposed Infrastructure Corridor

Imagery is a composite of aerial and satellite photography

NOTE THAT POSITION ERRORS CAN BE >5M IN SOME AREAS
- AERIAL PHOTOGRAPHY SOURCED FROM LANDGATE 2007
- LOCALITY MAP SOURCED FROM ANGLOGOLD ASHANTI 2008

SCALE

0 475 950 1,900 2,850 3,800

Metres

1:110,000 @ A4

LOCALITY MAP

METADATA RECORDED	PROJECTION
100%	MGA ZONE 51
HORIZONTAL DATUM	**HEIGHT DATUM**
GDA 94	N/A

CREATED BY	CHECKED BY	APPROVED
GWa	BP	FD
DATE	**REVISION**	**DRAWING ID**
11.08.09	0	351-2.06

Tropicana Joint Venture
TROPICANA GOLD PROJECT

Public Environmental Review
Flora Values of the Operational Area
Figure 6.12

6.2.8. Vertebrate Fauna

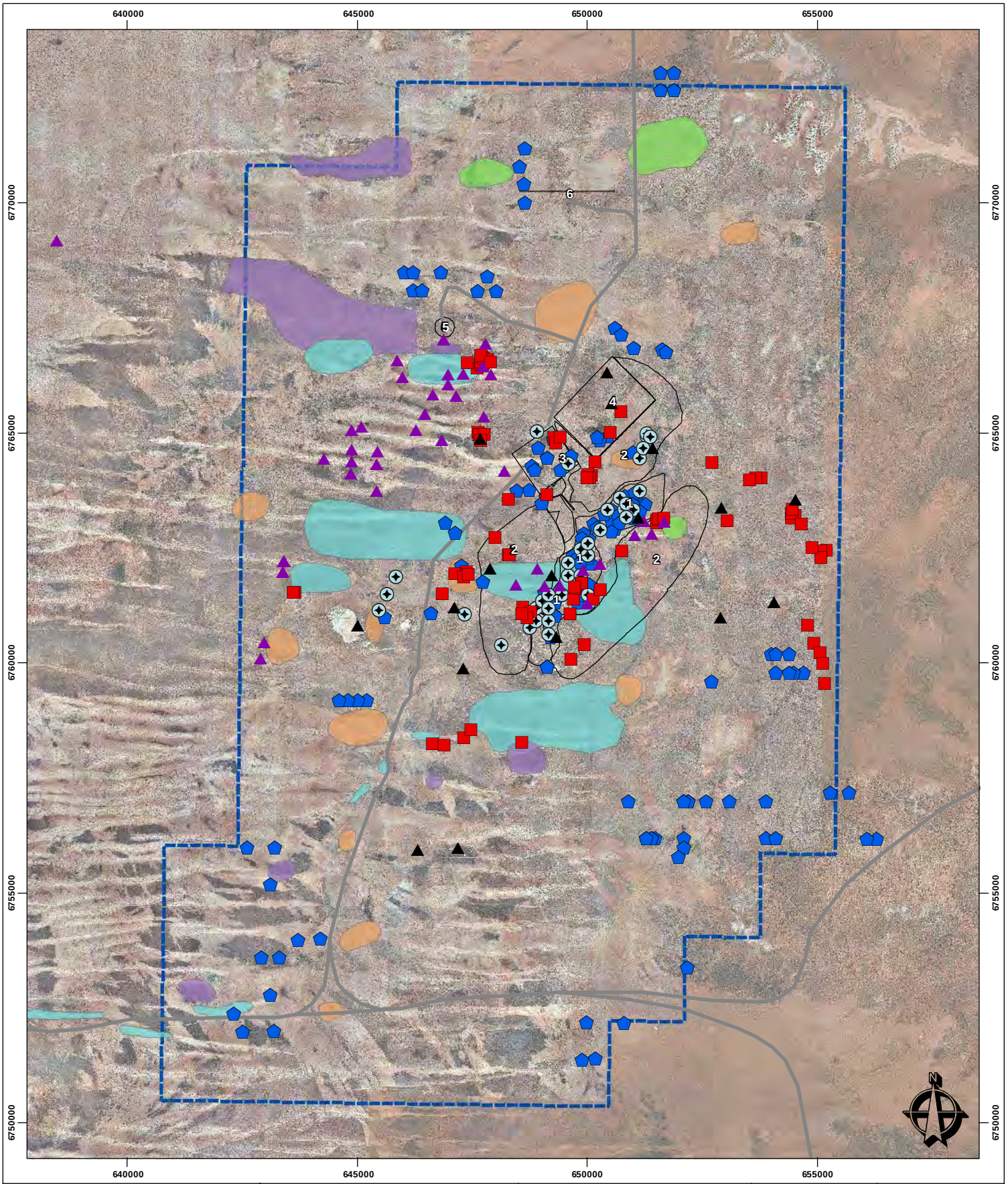
ecologia was commissioned to undertake a Level two vertebrate fauna survey over the Operational Area in 2006. The field work was undertaken in three trapping sessions in November 2006, March 2007 and March 2008 (Appendix 2-B5). The survey methodology was developed in consultation with the DEC and was designed in accordance with the requirements of the EPA Guidance Statement 56. Eighteen survey sites were established within the proposed Operational Area. Sites were selected to correspond with major vegetation communities and landforms present within the survey area and to correspond with main areas of potential impact. Thus, all major habitat types occurring in the proposed Operational Area were sampled. The survey was undertaken using a variety of sampling techniques, including systematic and opportunistic sampling.

To supplement the main fauna survey a number of targeted cryptic species surveys were also under take within the Operational Area. Some species of conservation significant fauna are known to be difficult to sample using the techniques employed in the general fauna survey by *ecologia* (Appendix 2-B5). These species include:

- Marsupial Mole (*Notoryctes typhlops*/ *Notoryctes caurinus*) (Schedule 1 under the WC Act and Endangered under the EPBC Act) (Appendix 2-B5);
- Malleefowl (*Leipoa ocellata*) (Schedule 1 under the WC Act and Vulnerable under the EPBC Act) (Plate 6.4) (Appendix 2-F4);
- Sandhill Dunnart Survey (*Sminthopsis psammophila*) (Schedule 1 under the WC Act and Endangered under the EPBC Act) (Plate 6.5) (Appendix 2-F1); and,
- Mulgara (*Dasycercus blythi*). Recently the Mulgara genus (*Dasycercus*) has undergone taxonomic review and it was found that what had been known as the single species *Dasycercus cristicauda* is actually two distinct species (van Dyck 2008). The distribution of the Brush-tailed Mulgara (*Dasycercus blythi*) lies within the Project area. At the time of the survey, the Crest-tailed Mulgara (*Dasycercus cristicauda*) was considered extinct in Western Australia and is believed to occur in South Australia. *D. blythi* is listed as Priority 4 by the DEC and *D. cristicauda* is listed as Vulnerable under the EPBC Act and Schedule 1 under the WC Act (Appendix 2-F4). The two genera are thought to have similar ecology, however it has been suggested that the Brush-tailed Mulgara occurs mostly in spinifex grasslands and the Crest-tailed Mulgara may prefer sand dune habitats, especially when vegetated with canegrass (*Zygochloa paradoxa*) (R. Southgate 2009 pers. comm. and Pavey et al. 2006). Due to the absence of canegrass in the Project area it further suggests that the Crest-tailed Mulgara is unlikely to occur.

The Joint Venture commissioned additional targeted surveys and did not rely on lack of captures to demonstrate absence of these species from the survey area. Rather, the Joint Venture took the approach that if potentially suitable habitat was present, then the species may be present, rather than absent based on a lack of direct capture evidence.

Table 6.2 and the following text provides an overview of the methodology used for each survey and the company/ specialist employed to complete each survey. Sampling locations are demonstrated in Figure 6.13.



Legend

- Fauna Sampling Location
- Marsupial Mole Sampling Location
- SRE Sampling Location
- Stygofauna Sampling Location
- Troglofauna Sampling Location

Conceptual Site Layout
1: Resource Area
2: Waste Material Landforms
3: Processing Area
4: Tailings Storage Facility (TSF)
5: Village
6: Airstrip

Threatened Terrestrial Fauna Habitat

- Malleefowl
- Malleefowl & Mulgara
- Mulgara
- Sandhill Dunnart - Potentially suitable habitat
- Operational Area
- Proposed Infrastructure Corridor

Imagery is a composite of aerial and satellite photography

NOTE THAT POSITION ERRORS CAN BE >5M IN SOME AREAS
- AERIAL PHOTOGRAPHY SOURCED FROM LANDGATE 2007
- LOCALITY MAP SOURCED FROM ANGLOGOLD ASHANTI 2008

SCALE

0 495 990 1,980 2,970 3,960

Metres

1:110,000 @ A4

LOCALITY MAP

METADATA RECORDED	PROJECTION
100%	MGA ZONE 51
HORIZONTAL DATUM	**HEIGHT DATUM**
GDA 94	N/A

CREATED BY	CHECKED BY	APPROVED
GWa	BP	FD
DATE	**REVISION**	**DRAWING ID**
09.09.09	0	351-2.07

Tropicana Joint Venture
TROPICANA GOLD PROJECT

Public Environmental Review
Fauna Sampling Sites of the Operational Area
Figure 6.13

Table 6.2: Summary of Methodologies for Targeted Fauna Surveys

Species	Company	Methodology
Marsupial Mole	*ecologia* Environment	Trenching surveys conducted between November 2006 and March 2008
Sandhill Dunnart Survey	Gaikhorst and Lambert and *ecologia* Environment	Desktop assessment, field confirmation and targeted trapping grids in March 2007 and March 2008.
Malleefowl	URS Australia Pty Ltd	Desktop assessment followed by foot transects of potential habitat and road surveys in April and August 2008
Mulgara	*ecologia* Environment and URS Australia Pty Ltd	Field inspection during the main Level 2 survey and desktop assessment followed by foot transects of potential habitat in April and August 2008

Marsupial Mole

Little is known regarding the habitat preference of the Marsupial Mole. They are most often recorded in arid regions in areas such as sand dunes associated with various acacias and shrubs (Benshemesh 2004). The vertical distribution of mole tunnels suggests that they spend most of their time 20-60 cm beneath the surface and prefer the dune crests and slopes to the swales and flats (Benshemesh 2008). There is evidence that the Marsupial Mole do occur in substrate between the dunes where deep sand rather than loam occurs. Marsupial mole tunnels have been found in association with patches of mallee (*Eucalyptus gamophylla*) with an open under storey of spinifex (*Triodia basedowii*) (Benshemesh 2004).

Survey methods used by *ecologia* to determine the presence of Marsupial Moles were devised following consultation with Dr. Joe Benshemesh from Monash University and review of the Manual for Marsupial Mole Survey and Monitoring by Trenches (Benshemesh 2005). The most efficient means of surveying marsupial moles is to count the number of mole tunnels underground. These signs persist for a number of years accumulating underground, providing a high yield of counts relatively easily (Benshemesh 2005). A total 75 sites consisting of 225 trenches were dug within the Operational Area. A further 41 sites consisting of 123 trenches were established to the east to the Operational Area as a regional comparison. Please refer to Appendix 2-B5 for specific trenching methodology.

Malleefowl

Malleefowl are largely confined to arid and semi-arid woodland that is dominated by mallee eucalypts on sandy soils, with less than 430 mm of rainfall annually. They may also be found in mulga (*Acacia aneura*) and other sclerophyllous associations and in Western Australia have been known to occur in coastal heath where shrubs produce sufficient leaf litter for use in nest mounds (DEC 2008).

Malleefowl build distinctive nests that comprise a large mound of soil covering a central core of leaf litter. These nest mounds range in diameter but on average span more than five metres and may be up to one metre high. A Malleefowl pair will often use the same nest site each season rather than build a new one.

Two targeted Malleefowl survey were conducted by URS in conjunction with a Mulgara below (refer below), a preliminary survey between 22 and 29 April 2008, and a follow-up survey between 6 and 12 August 2008. Prior to the field survey URS conducted a desktop assessment of aerial photography of the Survey Area to identify:

- potentially suitable Malleefowl habitat in which to conduct walking transect surveys. This habitat included eucalypt and/or mulga woodland with an understorey providing a reasonably high canopy cover (Appendix 2-F4); and,
- a route for the Malleefowl track surveys. The track survey routes were designed to traverse as much of the Survey Area as well as bisecting as much prospective Malleefowl habitat as possible.

URS conducted a baseline presence assessment of Malleefowl using survey methodology consistent with DEC requirements and Malleefowl survey protocol (Natural Heritage Trust 2007). These methods were discussed and designed in consultation with the DEC. Two methods were used, a survey utilising the track system that traversed the Survey Area, and a walking transect survey. The survey route covered a total length of 50.6 km.

The track survey involved the “clearing” of fauna tracks using a tyre grader dragged behind a 4WD vehicle (Plate 6.4). Prior to clearing, the location of any Malleefowl signs were recorded. In the following three mornings, the field team traversed the same roads to identify any new tracks. Once a track had been recorded, all tracks for the next 200 m made by the same species were ignored. This methodology is used to assess presence/absence and not a population assessment.

Walking transects were conducted at ten sites that appeared to provide appropriate Malleefowl habitat. These sites were predominantly within woodland that was dominated by mulga and/ or eucalypt, and contained understorey vegetation that was deemed to be dense enough to provide potential habitat for nesting purposes. These surveys were designed to assess Malleefowl presence, through observations of individuals, nesting sites, tracks or other secondary evidence. Transects were generally conducted by two to four people for periods of one to five hours, and covered a corridor of 40-100 m around the extremity of the search areas.

Plate 6.4: “Clearing” the Road with a Tyre Grader for the Malleefowl Survey (Appendix 2-F4)

Sandhill Dunnart

Based on a review of all known capture location data on the Sandhill Dunnart in Western Australia, the preferred habitat for Sandhill Dunnarts in the Western Australian portion of the GVD is comprised of:

- Deep yellow sands (occasionally orange) ranging from very gently undulating sandplains to well defined dunes up to 30 metres in height. The species can also be found in swale areas with association to dune areas.
- Preferred vegetation structure consists of tall mallee (10 - 30% cover), mixed shrubland (10 - 30% cover), and/or a combination of mallee, marble gum, *Callitris* and shrubland.
- Presence of dense, compact clumps of spinifex (at least 10 – 30% cover) which have been unburnt for between approximately 10 and 30 years with spinifex age classes of 2 to 3.5 (Figure 6.14).

Areas of habitat displaying a combination of these indicator features as well as an appropriate fire history are considered to be potential habitat for Sandhill Dunnarts.

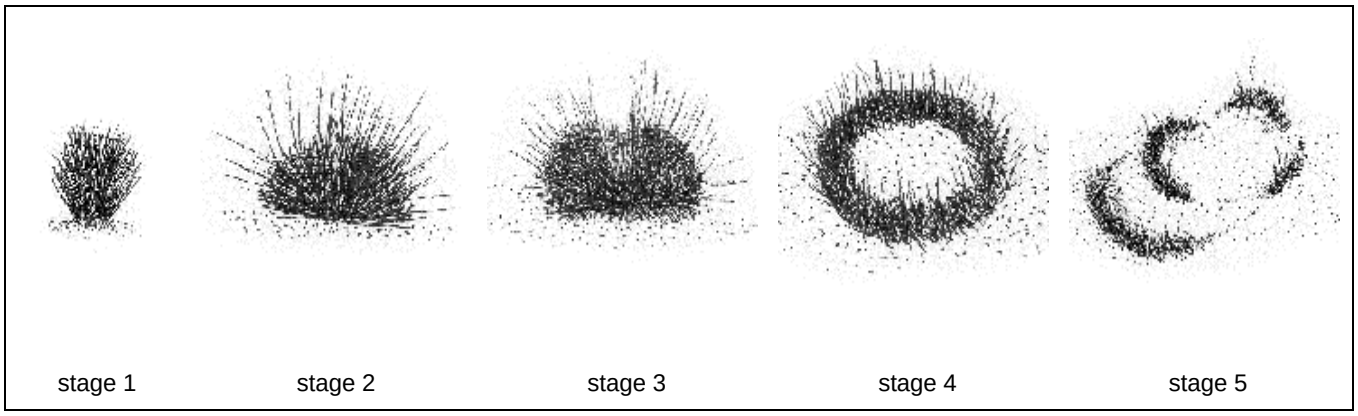


Figure 6.14: Spinifex Age Classes (sketches by V Reynolds)

A two stage approach was undertaken for assessing impact areas for the presence of Sandhill Dunnarts, a habitat assessment followed by trapping in potentially suitable habitat. This assessment was undertaken across the Operational Area, Pinjin Infrastructure Corridor and the Public Bypass by Gaikhorst and Lambert who have ten years of experience in survey and research for the Sandhill Dunnart. They each have nine years of field experience in the WA portion of the Great Victoria Desert. The survey methodology for this assessment was developed in consultation with Sue Churchill in 2000. Potential habitat for the Sandhill Dunnart in the survey area was initially identified through a desktop assessment of aerial photography. Following identification of these areas, ground truthing of each site was undertaken to confirm the results of the desktop assessment. Areas such as those shown in Plates 6.5 and 6.6 were considered to have potentially suitable habitat, based on the presence of indicator vegetation types/ cover and an appropriate fire history. The results of the ground truthing of each site are provided in Table 6.3. A trapping program was undertaken in areas considered potentially suitable for Sandhill Dunnarts.

Plate 6.5: Potentially suitable habitat for Sandhill Dunnarts (trap site 19B)

Plate 6.6: Potentially suitable habitat for Sandhill Dunnarts (trap site 19C)

Two surveys were conducted, between March – May 2008 (a 10 day period from the 5 to the 14 March 2008, and an 8 day period from the 21 to the 28 May 2008). Opportunistic sightings of other fauna were also recorded. Two trapping types were used, deep pitfall traps and Elliott traps (Plate 6.7).

Plate 6.7: Sandhill Dunnart Assessment Site

Table 6.3: Assessment of Potentially Suitable Sandhill Dunnart Habitat Sites

Assessment Area	Spinifex type and Dominant Vegetation (Assessed by AngloGold 2009)	% Spinifex cover (Assessment area 50m by 50m) (Assessed by AngloGold 2009)	Habitat Suitability (Assessed by Gaikhorst and Lambert 2008)	Comments (Gaikhorst and Lambert 2008)
Site 1A	*T. basedowii* Mulga over *Aluta maisonneuvii* canopy cover ~30%	60%, Healthy hummocks <3 m in diameter	Y	The area to the east of Site 1 grids had too much mulga, and the remainder was too recently burned, particularly along the southern edge, to be considered typical of Sandhill Dunnart habitat. However, as the vegetation gets older, it may become more typical and warrant investigation at a later date.
Site 1B	*T. basedowii* On dune. E. *gongylocarpa* over *Acacia* spp. Canopy cover ~ 10%	25% Relatively healthy, plants ~ 60 cm in diameter	Y	
Site 2A	*T. basedowii* *E. trivalvis* canopy cover ~10%	45% Senescing population	Y	Most of the area surrounding the Site 2 grids had been too recently burned (5 – 10 years) to be considered typical of Sandhill Dunnart habitat. However, as the vegetation gets older, it may become more typical and warrant investigation at a later date.
Site 2B	*T. basedowii* *E. trivalvis* canopy cover ~15%	45% Senescing population	Y	Site 2B was an isolated dune surrounded by mulga, but was considered possibly Sandhill Dunnart habitat due to the large dense Spinifex clumps with good over-storey.
Site 3	*T. basedowii* Transitional Mallee Mulga woodland Canopy cover ~25%	25% Senescing population, some hummocks	N	Vegetation too old to be considered typical of Sandhill Dunnart habitat.
Site 4A –	*T. basedowii* *E. trivalvis* canopy cover ~10%	60% Senescing population	Y	The area north of Site 4 had been too recently burned to be typical of Sandhill Dunnart habitat however, as the vegetation gets older; it may become more typical and warrant investigation at a later date.
Site 4B –	*T. basedowii* *E. trivalvis* canopy cover ~15%	50% Large healthy plants, plants ~60 – 80 cm in diameter	Y	

Assessment Area	Spinifex type and Dominant Vegetation (Assessed by AngloGold 2009)	% Spinifex cover (Assessment area 50m by 50m) (Assessed by AngloGold 2009)	Habitat Suitability (Assessed by Gaikhorst and Lambert 2008)	Comments (Gaikhorst and Lambert 2008)
Site 5A –	*T. basedowii* On dune, *E gongylocarpa, Callitris verrucosa*, over *Acacia* spp. Canopy cover ~15%	40% Hummocks ~ 2 m in diameter, senescing.	Y	Most of the area surrounding the Site 5 grids had been burnt within the last 5 – 10 years, so was not considered typical of Sandhill Dunnart habitat. However, as the vegetation gets older, it may become more typical and warrant investigation at a later date. Neither of the trapping grids were particularly typical either, as the soil was very red, and Spinifex was poor.
Site 5B –	*T. basedowii* On dune, *E gongylocarpa, Callitris verrucosa*, over *Acacia* spp. Canopy cover ~5%	45% Healthy population, individual plants ~ 30 – 50 cm in diameter.	Y	
Site 6 –	*T. basedowii* Mulga, canopy cover ~40%	25% Senescing population	N*	• There were isolated patches of approximately 30 years unburnt habitat, but these were considered too old to support a Sandhill Dunnart population. • Although this site is not currently typical of Sandhill Dunnart habitat, as the vegetation gets older, it may warrant investigation at a later date.
Site 7 –	*T. basedowii* Edge of Mulga population, on area burnt <6 years. Canopy cover ~ 30%	20% Relatively healthy population	N*	Although this site is not currently typical of Sandhill Dunnart habitat, as the vegetation gets older, it may warrant investigation at a later date.
Site 8 –	*T. basedowii* Transitional Mulga Mallee woodland over *A. maisonneuvii, Baeckea* sp GVD, *G. juncifolia* Canopy cover ~10%	30 % Small hummocks and partial hummocks. Individual plants ~25 cm diameter	N*	Although this site is not currently typical of Sandhill Dunnart habitat, as the vegetation gets older, it may warrant investigation at a later date.
Site 9	*T. basedowii* E. *gongylocarpa, A. burkittii,* over *E. forrestiana*: canopy cover ~15 %. On side of dune at the edge of a Mulga population.	45% Healthy population. Individual plants range in size from 15 – 80 cm in diameter.	Y	Although this area is typical of other Sandhill Dunnart capture sites, it was right on the edge of the 400m buffer zone, and if the road corridor stays within the 100m proposed zone, this area would not be disturbed.

Assessment Area	Spinifex type and Dominant Vegetation (Assessed by AngloGold 2009)	% Spinifex cover (Assessment area 50m by 50m) (Assessed by AngloGold 2009)	Habitat Suitability (Assessed by Gaikhorst and Lambert 2008)	Comments (Gaikhorst and Lambert 2008)
Site 10	*T. basedowii* E. *leptopoda?, A. maisonneuvii*, over *Sida* sp., canopy cover ~15%	35%	N*	Although this site is not currently typical of Sandhill Dunnart habitat, as the vegetation gets older, it may warrant investigation Site 11 at a later date.
Site 11	*T. basedowii* In Mulga, canopy cover ~30%	25% Majority of the population is senescing. Individual plants are small ~15 cm diameter; some larger ones are present ~30 cm diameter.	N*	
Site 12	*T. basedowii* Regenerating *E. gongylocarpa*, *C. artemisiodes* ssp. *filifolia*, in area burnt <6 yrs. Canopy cover ~5 %	40 % Relatively healthy population	N*	Although this site is not currently typical of Sandhill Dunnart habitat, as the vegetation gets older, it may warrant investigation at a later date
Site 13	*T. basedowii* *A. aneura* over *E, forrestiana*, canopy cover ~5%	25% Healthy population, individual plants ~80cm in diameter and ~40 cm in height.	N*	Although this site is not currently typical of Sandhill Dunnart habitat, as the vegetation gets older, it may warrant investigation at a later date.
Site 14	*T. basedowii* Mulga woodland. Canopy cover ~15%	40% Old hummocks, senescing population.	N*	Although this site is not currently typical of Sandhill Dunnart habitat, as the vegetation gets older, it may warrant investigation at a later date.
Site 15	*T. basedowii* Transitional woodland; *E. gongylocarpa* - A. *aneura*. Canopy cover ~10%.	50% Healthy population, individual plants average diameter ~30cm, spherical.	N*	Although this area had patches of habitat similar to other Sandhill Dunnart capture sites, it was considered too fragmented to warrant trapping. It was also right on the edge of the 400m buffer zone, and if the road corridor stays within the 100m proposed zone, this area would not be disturbed. As the vegetation of the burnt areas gets older, it may warrant investigation at a later date.

Assessment Area	Spinifex type and Dominant Vegetation (Assessed by AngloGold 2009)	% Spinifex cover (Assessment area 50m by 50m) (Assessed by AngloGold 2009)	Habitat Suitability (Assessed by Gaikhorst and Lambert 2008)	Comments (Gaikhorst and Lambert 2008)
Site 16	*T. basedowii* *E. youngiana* over *G. juncifolia*, canopy cover ~10%.	30% Healthy population, small plants individuals ~ 30 cm diameter.	N	This area had been too long unburned to be considered typical of Sandhill Dunnart habitat.
Site 17A	*T. basedowii* Open Sand Plain	25% Healthy population, individual plants are ~ 50cm diameter, some hummocks	Y	• The area of dune to the east of the Site 17 grids has been burned within 5 – 10 years, and although not currently typical of Sandhill Dunnart habitat, as the vegetation gets older, it may warrant investigation at a later date. • The area of dune to the west of the Site 17 grids, Although this area had patches of habitat similar to other Sandhill Dunnart capture sites, it was considered too fragmented to warrant trapping.
Site 17B	*T. basedowii* Dune crest and slope. *E. gongylocarpa* and *E. leptopoda*? over *A. maisonneuvii*, and *Baeckea* sp. GVD. Canopy cover ~10%	45% Hummocks up to 2 m in diameter, and individual plants 40 cm in diameter.	Y	
Site 18	*T. basedowii* Transitional *E. gongylocarpa*, *Callitris verrucosa*, and Mulga. Canopy cover 10%	35% Approx 30 cm high, mixture of individual plants and hummocks	N*	Although this site is not currently typical of Sandhill Dunnart habitat, as the vegetation gets older, it may warrant investigation at a later date.
Site 19A	*T. basedowii* *E gongylocarpa* over *E. youngiana*, adjacent tall yellow dune with *C. toddii*. Canopy cover 5%	20% Relatively small plants	Y	The remainder of Site 19 surrounding the trapping grids was also quite typical of Sandhill Dunnart habitat, however we consider the area to have been sufficiently sampled.
Site 19B	*T. basedowii* *E. gongylocarpa* over *Callitris verrucosa*, *Casuarina* sp. Canopy cover 5% over heath understorey	30% Average plant diameter 20- 30 cm	Y	
Site 19C	*T. basedowii* *E. gongylocarpa* over *E. youngiana*, over *Lepidobolus desertii*	30% Average plant diameter 20- 30 cm	Y	

Assessment Area	Spinifex type and Dominant Vegetation (Assessed by AngloGold 2009)	% Spinifex cover (Assessment area 50m by 50m) (Assessed by AngloGold 2009)	Habitat Suitability (Assessed by Gaikhorst and Lambert 2008)	Comments (Gaikhorst and Lambert 2008)
Site 19D	*T. basedowii* Yellow dune, *E.gongylocarpa* over Mallee, over *G.juncifolia*, and *C. todii* Canopy cover 10%	30% Average plant size 40 cm diameter, large clumps and hummocks	Y	
Site 20	*T.basedowii* Transitional *Eucalyptus gongylocarpa* and *Callitris verrucosa*, burned < 5yrs Canopy cover <10%	25% small plants <25 cm diameter	N*	Although this site is not currently typical of Sandhill Dunnart habitat, as the vegetation gets older, it may warrant investigation at a later date.
Site 21	*T. basedowii* Transitional Mallee Mulga Canopy cover 15%	40% 40 cm diameter, some hummocks	N*	Although this site is not currently typical of Sandhill Dunnart habitat, as the vegetation gets older, it may warrant investigation at a later date.

** Represents sites that are too recently burned to currently be considered typical of Sandhill Dunnart habitat, but which may have potential in another 5 – 10 years.*

Mulgara

Mulgara predominantly inhabit hummock grasslands (e.g. *Triodia* spp.) and shrublands with medium to dense cover on sandy soils (Menkhorst and Knight, 2001; Woolley 2008). Mulgara burrow in the flat areas between sand dunes or on the low sides of sand dunes (Woolley 2008; Northern Territory Government 2008a and 2008b). Burrows vary geographically in shape and size. In the Pilbara region of Western Australia, burrows have been observed with between two and nine entrances, tunnels mostly on a single level and to a depth of about 300 mm, shaped typically as an arch over a flat bottom with a height of 70-80 mm and width of 80-100 mm at the base. Internal tunnels are mostly 50-70 mm wide leading to grass lined nests. Both males and females use two to nine burrows but average about three. Burrows are confined to a small area as home ranges may only be approximately 440 m^2 (Thompson and Thompson 2007). It is generally a solitary species that hunts at night, although it is not strictly nocturnal (Woolley 2008).

Initially a desktop assessment of aerial photography of the Operational Area was conducted by URS to identify potentially suitable Mulgara habitat based on knowledge of the Mulgara's preferred habitat. Sites containing sizeable clumped grassland (*Triodia* spp.) and shrubland habitats at a mature age structure and high canopy cover were selected.

The field component of the survey was conducted by two personnel during 22-29 April and 6-12 August 2008. The surveys were conducted in accordance with Guidance Statement No. 56 *Terrestrial Fauna Surveys for Environmental Impact Assessment in Western Australia* (EPA 2004d). The area was assessed at a broad, habitat scale from aerial photography and site reconnaissance. The selected sites deemed appropriate habitat for Mulgara were ground-truthed and additional survey sites were selected during site reconnaissance for suitability (based on size, density and maturity of hummock grass and shrubland).

Sites with potentially suitable habitat were surveyed on foot by searching for secondary evidence of Mulgara (burrows, digging, scats, and tracks). Searches concentrated on areas around the base of clumps of mature grasses (e.g. *Triodia* spp.) and shrubs. Walking transects were conducted at 15 appropriate sites. Transects were conducted for periods of one to five hours, and covered a corridor of approximately 40-100 m around the extremity of the search areas. This methodology for this species was agreed in consultation with the DEC (D. Pearson, 2008 pers. comm.) and is believed to provide a more accurate assessment of the presence/absence than trapping, and a more efficient use of survey time (Appendix 2-F4).

Much of the vegetation within the Operational Area (including the proposed disturbance footprint) was determined to be unlikely to support populations of Mulgara based on habitat characteristics due to either:

- the vegetation structure (e.g. low canopy cover woodland with minimal understorey density);
- the maturity and size of the *Triodia* hummocks;
- the low percentage cover provided by the *Triodia* hummocks; and,
- the soil substrate.

Native Mammals

Twenty-three species of native mammal were recorded within the Operational Area across all the surveys. This total does not include a species of Stick-nest Rat (*Leporillus* sp.) which formerly occurred in the wider area, based on the presence of old, abandoned nests in breakaways. The total does include Marsupial Moles which were only inferred to be present based on the presence of fresh tunnels thought to be traces of this species (vide infra) within sand dunes and some interdunal areas.

The remaining native mammals recorded comprise:

- four species of Dunnart (*Sminthopsis crassicaudata, S. dolichura, S. hirtipes* and *S. ooldea*);
- Mallee Ningaui (*Ningaui yvonnae*);
- three species of macropod (Red Kangaroo [*Macropus rufus*], Euro [*Macropus robustus*] and Western Grey Kangaroo [*Macropus fuliginosus*]);
- eight bat species (*Chalinolobus gouldii, Nyctophilus geoffroyi, Scotorepens balstoni, Tadarida australis*, *Taphozous hilli, Vespadelus finlaysoni, Mormopterus planiceps* [species 3] and *Nyctophilus timoriensis*);
- three native rodents (Spinifex Hopping Mouse [*Notomys alexis*], Sandy Inland Mouse [*Pseudomys hermannsburgensis*] and the Desert Mouse [P*. desertor*]);
- the Dingo (*Canis lupus dingo*); and,
- the Echidna (*Tachyglossus aculeatus*).

Listed Mammals Species

No mammalian species of conservation interest were captured during the surveys in the Operational Area survey. The surveys did however identify habitat suitable for the Marsupial Mole and Mulgara. Chapter 7 describes the potential impacts on the Marsupial Mole and Mulgara habitats within the Operational Area.

Marsupial Mole

Traces of Marsupial Moles were found in all of the sand dune surveyed within the Operational Area, with the majority in the soft, sandy dune systems on the western side of the Operational Area (Figure 6.15). A total of 41 survey sites were found to have traces of Marsupial Moles (Appendix 2-B5).

Regional marsupial mole surveys recorded Marsupial Mole traces at five survey sites in areas not generally associated with preferred mole habitat. Three of these records came from flat sandy plains with relatively compact reddish sands (Appendix 2-B5).

Sandhill Dunnart

No Sandhill Dunnarts were found in the Operational Area, and no sites currently match all the requirements for what is considered to be typical of Sandhill Dunnart habitat (Appendix 2-F1). In the Operational Area all sites had red soil not yellow or yellow/orange. Spinifex quality varied from life stage 2-4 which mostly was suitable but available habitat was very patchy between recently burnt areas and long unburnt areas (Appendix 2-F1).

Mulgara

The URS survey of Mulgara habitat within the Operational Area identified areas of hummock grasslands that could be considered suitable Mulgara habitat. However, the habitat was mostly patchy and the percentage ground cover and maturity of the habitat was highly variable. No Mulgara burrows or other signs of recent presence were identified in the searched transects.

No direct recent or historical evidence of Mulgara was noted during the surveys. Given this study was conducted in accordance with recommended DEC methodologies at a high intensity throughout the most suitable habitat around, and within the Operational Area, URS concludes that it is unlikely that resident populations of Mulgara currently inhabit the Operational Area (Appendix 2-F4).

Native Mammal Species of Conservation Interest

During the Operational Area surveys, several mammalian species of conservation interest were recorded:

- the Echidna was recorded as a south-eastern range extension on previous records in Western Australia (WA Museum FaunaBase);
- the record of the Desert Mouse is significant since the species has been recorded only once in the southern Great Victoria Desert;
- three bat species recorded in the Operational Area are also of conservation interest. The record of Taphozous hilli is approximately 150 km south of its previous known range; and,
- a number of abandoned Stick-nest Rat nests were observed within small caves and overhangs in breakaway areas in the Operational Area. Stick-nest Rats are presumed to be extinct on mainland Australia, being last recorded in the Gibson Desert in the early 1900s (Strahan 1998). The nests observed were all old, inactive and in the process of decay.

Birds

In total, 75 bird species from 36 families were recorded in the Operational Area. The most speciose families were the Honeyeaters (Meliphagidae; nine species); Warblers (Acanthizidae; seven species), and Butcherbird/ Woodswallow group (Artamidae; six species).

Listed Bird Species

During the Operational Area surveys, three species of conservation interest were recorded (Figure 6.12):

- Peregrine Falcon (*Falco peregrinus*) which is EPBC listed and listed as Schedule 4 (WC Act). One individual was opportunistically sighted during the survey;
- Australian Bustard (*Ardeotis australis*) which is listed as DEC Priority 4 (Plate 6.8). Several individuals were recorded during the surveys, both as sighted individuals and observations of the species distinctly identifiable tracks; and,
- Rainbow Bee-eater (*Merops ornatus*) which is listed as Migratory (EPBC Act). Rainbow Bee-eaters were recorded commonly during the first phase of surveying.

The URS surveys also confirmed the historical presence of Malleefowl with the Operation Area. No Malleefowl tracks were recorded during the road surveys. Three Malleefowl mounds were located during the road survey, though none of the mounds were active or showed signs of recent use (Appendix 2-F4). Ten Malleefowl mounds were located within habitat considered to be suitable for Malleefowl survival in the transect survey though none of the mounds were active or showed signs of recent use (Plate 6.9).

Plate 6.8: Australian Bustard

Plate 6.9: Malleefowl Mound located within the Operational Area

Bird Species of Conservation Interest

In addition to the listed bird species, evidence of four other species of conservation interest were recorded within the Operational Area. These species are considered to be of conservation interest because they were recorded at or outside the edge of their previously known range:

- Red Wattlebird (*Anthochaera carunculata*);
- Purple-crowned Lorikeet (*Glossopsitta porphyrocephala*);
- Brown Honeyeater (*Lichmera indistincta*); and,
- Grey Currawong (*Strepera versicolor*).

Section 7.2.3 discusses the occurrence of the listed and conservation interest bird species within the proposed Operational footprint; although it is not envisaged that the project will have an adverse effect on any of the recorded species.

Herpetofauna

One species of burrowing frog (*Neobatrachus* sp.) and 74 species of reptiles were recorded within the Operational Area, including:

- 28 skink species (Scincidae);
- 11 dragon species (Agamidae);
- 11 gecko species (Gekkonidae) (Plate 6.10);
- 10 front-fanged snake species (family Elapidae);
- One python species (family Boidae);
- six goanna species (Varanidae);
- five legless lizard species (Pygopodidae); and,
- two blind snake species (Typhlopidae).

Plate 6.10: Smooth Knob-tail Gecko (*Nephrurus laevissimus*)

Herpetofauna of Conservation Interest

One listed reptile species, the Woma Python was recorded in the Operational Area. The Woma Python is listed as DEC Priority 1. One listed species, the Great Desert Skink (*Egernia kintorei*), which is listed as Vulnerable under the EPBC Act, was not recorded in the survey but has low potential to occur in this area.

Introduced Fauna

House mouse (*Mus musculus*), European fox (*Vulpes vulpes*), feral cats (*Felis catus*) and camels (*Camelus dromedarius*) were all recorded within the Operational Area.

6.2.9. Vertebrate Fauna Habitat

The presence of seven distinct fauna habitats were identified in the Operational Area. These were:

- yellow sand dune areas with an overstorey of scattered *Eucalyptus* mallees;

- mulga (*Acacia aneura*) woodland with a dense understorey of mature *Triodia basedowii* hummock grassland;
- soft sandy plains with vegetation communities that include burnt and unburnt *Eucalyptus* woodlands, and *Acacia* woodlands over spinifex and other small shrubs;
- low red sand dunes with an overstorey of *Callitris columellaris* pines and *Eucalyptus* sp. mallee trees;
- sandy dune vegetation;
- eucalypt mallee woodland with an understorey of mixed *Acacia* shrubs and *Triodia* hummock grasses; and,
- *Casuarina pauper* woodland with an open understorey of low mixed shrubs and scattered soft grasses.

None of the faunal habitats or ecosystems identified within the Operational Area are listed as TECs under the WC Act or the EPBC Act. The most distinctive habitat within the Operational Area and the wider GVD area are the yellow and orange sand dunes. The yellow/ orange dunes on the western side of the Operational Area may be a local variation of the '*Yellow sandplain communities of the Great Victoria Desert*' which has recently been listed as a Priority Ecological Community.

6.2.10. Terrestrial Invertebrate Fauna and Habitat

Some invertebrates, known broadly as short range endemic (SRE) species, are particularly sensitive to habitat alteration and are an increasingly important consideration as part of the EIA process. SREs have been broadly defined as species with a natural range of less than 10,000 km^2 (Harvey 2002), and many species have a natural range that is considerably less, sometimes from a single locality (New and Sands 2002). Many SRE species rely on moist conditions and are very selective of particular microhabitats, often favouring south-facing slopes, fallen logs and deep litter (Harvey 2002). The susceptibility of SREs to changes in the availability of their preferred microhabitat (either through disturbance or removal) and their general inability to disperse to a more favourable microhabitat means that a disturbance within the range of an SRE can result in a significant impact.

ecologia was commissioned to undertake an assessment of the potential occurrence of terrestrial SRE invertebrate fauna within the Operational Area. The SRE field surveys were undertaken in the latter part of 2006 (September – October), in the middle of 2008 (May - September) and in March to May 2009. In addition to this work, the Joint Venture commissioned a DNA project to further investigate the taxonomy of particular species. The survey methods were developed in consultation with the DEC and were designed in accordance with the requirements of the EPA Guidance Statements 54, 54a and 56 (level 2 survey).

Figure 6.13 in the previous section shows the location for each of the sampling points utilised for the SRE survey within the Operational Area. The findings of these surveys are demonstrated in Figure 6.12, summarised in this section and the full reports are included as Appendices 2-B4, 2-B4a and 2-B4b.

Putative Short Range Endemic Invertebrates

The work completed to date has identified 43 terrestrial invertebrate taxa in the Operational Area and its surrounds, of which 17 morphologically defined species are considered to be putative SREs (pending taxonomic verification) (Figure 6.15). None of the species are currently listed as protected species and their conservation significance results from the fact that all are new to science and/ or belong to genera composed predominantly of SRE species. The species were predominantly Mygalomorph spiders; the remainder was represented by *Pseudoscorpionida* (Pseudoscorpion), *Polzoniida* (Millipede) and *Isopoda* (slater). Of the 17 species of conservation interest, one (*Kwonkan* sp. 2 (Plate 6.11)) has only been located within the proposed operational footprint. Up until recently, the operational footprint of the waste material landform was also expected to disturb the only known sampling location of *Aganippe* sp. 4 (Plate 6.12). The Joint Venture has re-designed the footprint

of one of the waste landforms and the sampling location of *Aganippe* sp. 4 is now approximately 800 m from the waste landform footprint.

Plate 6.11: *Kwonkan* sp. 2

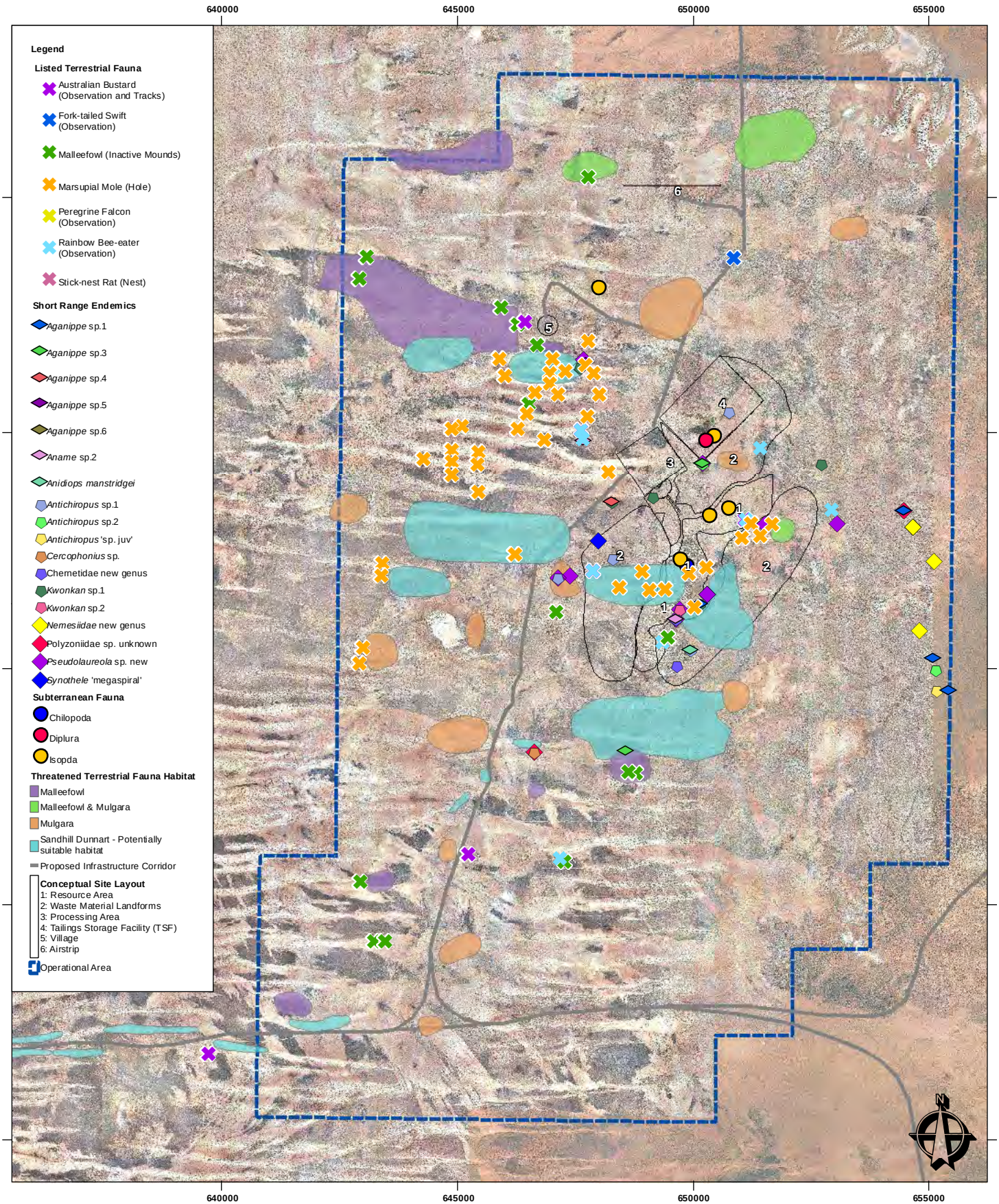
Plate 6.12: *Aganippe* specimen collected in April 2009

It is important to note that the Project is located in an area that is relatively unsurveyed and relatively uniform therefore the likelihood of finding *Kwonkan* sp. 2 outside the footprint is considered to be high. In Appendix 2-B4b *ecologia* describes the habitat preferences of the *Kwonkan* genus and the habitat at the single sampling location of *Kwonkan* sp. 2. There are currently six described species of *Kwonkan* in Australia: *K. wonganensis, K. anatolion, K. eboracum, K. goongarriensis, K. moriartii,* and *K. silvestris* (Main 1983). Most of these species are found in loamy to sandy soils within the leaf litter of open *Eucalyptus* woodlands or heath, constructing cryptic burrows with small funnel entrance. Only one of these species, *K. wonganensis,* prefers open ground of pebbly loam soils and constructs a turret of pebbles and soil at entrance resembling burrows of wolf spiders (Main 1983).

The sampling site where the *Kwonkan* sp. 2 was collected in 2006 is located within the larger vegetation unit of low woodland; *Acacia aneura* (mulga) (Beard 1975). On a small scale, however, the site is characterised as open low woodland of *Eucalyptus gongylocarpa*, over *Eucalyptus trivalvis* sparse mallee, over open low shrubs and *Triodia basedowii* moderately dense hummock grassland, with moderate leaf litter, mainly under trees and sparse wood litter, and with orange sand soils. Transects walked from the original sampling site north-east, east, and south-east, across the proposed eastern waste material landform and out of the operational footprint showed that pockets of this habitat type extend a minimum of 6 km beyond the footprint. This habitat is interspersed with pockets of the open low-lying areas subject to sheet-flooding dominated by *Triodia* that is preferred by *Aganippe sp*. 1 (located both inside and outside the footprint), and also by open *Acacia aneura* woodland over open low

shrubs and *Triodia basedowii* that is preferred by *Aganippe* sp. 7 (located both inside and outside the footprint). The low genetic diversity of *Aganippe* sp. 1 (0.0-0.3%) and *Aganippe* sp. 7 (0.0-1.7%) within this area presents evidence that no barriers to dispersal exist across these habitat pockets and that the individual spiders belong to a larger population extending over a minimum of several kilometers beyond the TGP mining and infrastructure footprint (Appendix 2-B4b). It is therefore reasonable to assume that the population of *Kwonkan* sp. 2 in this area is subject to the same natural conditions and that it follows the same patterns of distribution and dispersal, both inside and outside the proposed operational footprint. This assumption is supported by the data on the known geographic distribution of another species from the family Nemesidae found in the Operational Area in 2008 (Appendix 2-Ba). This species, which was until recently unknown to science, prefers pockets of habitat with open *Casuarina* woodland and it inhabits areas outside the operational footprint over a distance of at least 12 km.

In summary, distribution of habitat preferred by *Kwonkan* sp. 2 suggests that the species is not restricted to the operational footprint. The population of *Kwonkan* sp. 2 is, therefore, expected to be partially impacted by the proposed Project, however this impact is likely to be insignificant to the species.



Imagery is a composite of aerial and satellite photography

NOTE THAT POSITION ERRORS CAN BE >5M IN SOME AREAS
- AERIAL PHOTOGRAPHY SOURCED FROM LANDGATE 2007
- LOCALITY MAP SOURCED FROM ANGLOGOLD ASHANTI 2008

SCALE

0 475 950 1,900 2,850 3,800

Metres

1:110,000 @ A4

LOCALITY MAP

METADATA RECORDED	PROJECTION
100%	MGA ZONE 51
HORIZONTAL DATUM	**HEIGHT DATUM**
GDA 94	N/A

CREATED BY	CHECKED BY	APPROVED
GWa	BP	FD
DATE	**REVISION**	**DRAWING ID**
09.09.09	0	351-2.08

Tropicana Joint Venture
TROPICANA GOLD PROJECT

Public Environmental Review
Fauna Values of the Operational Area
Figure 6.15

6.2.11. Subterranean Fauna

Stygofauna

Stygofauna (aquatic subterranean fauna) are obligate, groundwater dwelling fauna. They are strongly adapted for the subterranean environment, with features such as lack of pigmentation, elongated appendages, filiform (worm like) body shape and reduced or absent eyes. Many of these fauna have other primitive features which link them to geological periods when vast areas of Australia where covered by tropical forests. They are, therefore, regarded as 'relict' fauna which have survived in aquifers over geological timeframes (Danielopol and Stanford 1994; Humphreys 1993, 2001). Stygofauna are generally dominated by crustaceans, nevertheless complex stygofauna assemblages may also include gastropod molluscs, water mites (Acarina), insects (Coleoptera), fish and several other groups (Humphreys 2006a).

A two stage approach was adopted for the subterranean fauna assessment; whereby a desktop assessment was completed prior to field surveys. A preliminary desktop assessment of the Operational Area could not rule out the presence of Stygofauna in the groundwater underneath the Operational Area. Stygofauna surveys were conducted by *ecologia* during September 2007, November 2007 and May 2008 (Appendix 2-B2). The surveys involved the sampling of 40 bores within and adjacent to the resource and seven regional bores south of the Operational Area. Eleven bores were sampled during September 2007, 23 bores were sampled in November 2007, and 30 bores were sampled in May 2008, therefore the total sample size for the area was 64, of which 57 was inside the Operational Area. This sample size is consistent with the EPA guidance statement 54 (EPA 2003).

Figure 6.13 in the previous section shows the location for each of the sampling points utilised for stygofauna surveys within the Operational Area. The findings of these surveys are summarised in this section and the full report is included in Appendix 2-B2.

The surveys did not yield any stygofauna species. The slotting of the bores within the Resource Area was not the optimal size for sampling stygofauna species with a slotting diameter of less than 3 mm. While this may have affected the sampling of larger Stygofauna species this would not prevent the sampling of the smaller species or larvae of larger species. For example:

- Copepods are 0.05 – 2 mm
- Ostracods are 0.5 – 1.5 mm
- Annelids are 1 - 5 mm
- Syncarids are 1 - 10 mm
- Isopods are 2 - 25 mm
- Amphipods are 1 - 25 mm

There is an apparent lack of suitable stygofauna habitat in the Operational Area. No stygofauna have been collected despite extensive survey effort within and around the Operational Area or in regional bores [Appendix 2-B2]), therefore, there is a very low probability that they exist in the Operational Area. The salinity of the water and the nature of the aquifer with the Resource Area are not considered suitable for stygofauna species. This lack of regional stygofauna occurrences maybe associated with the periodic marine incursions during the Cretaceous period and more recently in the Eocene making the environment unsuitable for freshwater stygofaunal species.

Troglofauna

Troglofauna are communities of terrestrial subterranean animals that inhabit air chambers in underground caves or small, humid voids. A species is considered truly troglobitic if it displays morphological characteristics that

appear to restrict it to subterranean habitats (Howarth 1983). These include a significant reduction or a complete loss of eyes, pigmentation, wings and a circadian rhythm (24-hour biological cycle), as well as development of elongated appendages, slender body form and, in some species, a lower metabolism. Troglobitic faunal assemblages are dominated by arthropods such as schizomids, pseudoscorpions, spiders, harvestmen, centipedes, millipedes, diplurans and mites.

ecologia completed the desktop assessment in the second half of 2007, this assessment suggested that based on the geology in the Operational Area, it was not prospective for troglofauna because there was no evidence of cavities or voids found in the weather material site above the basement rock. Despite this finding, a phased sampling regime was commissioned by the Joint Venture (Appendix 2-B3). Sampling was carried out in both the 'dry season' (September-November 2007) and the 'wet season' following rain (April - June 2008, August – October 2008 and October – December 2008, May - June 2009). Only the phases conducted during wet season yielded troglofauna. This approach is consistent with the EPA Guidance Statement 54 (EPA 2003).

In total, 87 successful samples from 53 drill holes were collected inside the Operational Area and infrastructure footprint and 109 successful samples from 75 drill holes were collected outside the Operational Area and infrastructure footprint (Figure 6.13). This sample size is consistent with the EPA Guidance Statement 54 (EPA 2003), which recommends that at least 60 samples should be collected from areas considered likely to have significant troglofaunal values. As the Operational Area in not in a high risk area the Guidance Statement's requirement has been well surpassed. All sampling was conducted by troglofauna traps baited with litter (1-3 traps per drill hole). This approach is consistent with the EPA Guidance Statement 54 (EPA 2003).

This first round of work did not locate any troglofauna. However, stygofauna sampling undertaken at the same time located two troglobitic species. Subsequent sampling of an additional 168 drill holes has located a total of three troglobitic species (Figure 6.12). The following three troglobitic species were recorded:

- Isopoda (slater) (Plate 6.13);
- Diplura (dipluran) (Plate 6.14); and,
- Chilopoda (centipede).

Appendices 2-B3 and 2-B3a contain full details of the troglofauna sampling undertaken between 2007 and 2009. Currently, only the isopod has been located outside the Operational Area footprint. *ecologia* has been commissioned to undertake further work to demonstrate that the dipluran and centipede occur more widely. Section 7.2.4 provides more information on this matter as well as proposed management strategies.

Plate 6.13: Isopod

Plate 6.14: Dipluran

Subterranean Habitat Assessment

Preliminary examination of core samples from the Operational Area revealed no obvious habitat suitable for troglofauna colonisation. Only two zones showed some degree of porosity – a part of gneiss rock at 49 mbgl which was below the water table and therefore not suitable for troglofauna, and a layer of saprolitic clay with root mats from surface vegetation, at approximately 6 - 7 mbgl (Plate 6.15). Further consideration of the weathered profile suggests that suitable troglofauna habitat may occur in the laterised gravels, sandstone and siltstone (1 – 20 mbgl) and within fractures/ shears within the regolith profile.

Plate 6.15: Interface of the Saprolitic Clay and Root Mats approximately 6 mbgl

Green Diamonds in Figure 6.16 indicate sites at which Troglofauna have been recorded.

The Joint Venture has undertaken a review of regolith around the Operational Area in order to describe the distribution of potential habitat for troglofauna (Appendix 2-B20). Due to their specific habitat requirements and often their restricted range, sustained troglofauna presence in a particular area requires the continuous maintenance of suitable conditions since colonisation, in some cases over millions of years. Thus geologically old and stable terrain provides the best opportunity to support the continuous presence of troglofauna.

The regolith of the Operational Area and surrounds is the product of a long weathering history, having evolved on a stable land mass over millions of years. Across the Operational Area elevated exposures comprising ferricrete and silcrete outcrop, and less commonly laterite, as remnant mesas, butts, rubble mounds, and breakaways on the margin of ridges, occur. Regolith components incorporated in these duricrust comprise multigenerational palaeo-valley-fill sequences and frequently contain abundant mixed coarse rounded alluvial fragments and sands. Some of the duricrust sequences are underlain by friable white clay-rich and mottled-clay profiles, remnant of poorly drained and reduced sub-surface regolith within the palaeo-drainage channel. Other *in situ* duricrust sequences are less dramatically exposed at low stratigraphic positions in the landscape where they are partially buried by more recent, relatively unconsolidated, colluvial, alluvial, and aeolian sedimentary sequences. These duricrust comprise alluvial and colluvial regolith materials that have undergone multiphase seasonal drying and silicification, and preservation as pedogenic valley-crete in broad drainage catchments.

Strongly indurated silcrete slabs and pavements from a few centimeters up to three meters thick cap on the duricrust surfaces. Fractures, and other zones of structural weakness in the duricrust caprock, such as root canals, allow local water access. Underneath the caprock, the regolith is less indurated, with interconnected cavities, such as interstitial voids, solution pipes, and root casts, inherent at the time of formation. Deeper fractures, and other zones of palaeo-water access, such as root canals and previously unconsolidated gravel

materials, are preferentially silicified during silcrete formation and provide subterranean support to the duricrust. Between these supports, the regolith is commonly moist and friable, and is thus prone to disaggregation and reworking by biological activity and contains roots and organic debris. These provide a fertile sub-surface biozone where root growth, microorganisms and their decay products provide food in the ecosystem.

The indurated caprock protects the subsurface profile from water and sediment inundation, and flooding during episodes of high rainfall and from dehydration during extended dry periods. The caprock also insulates the sub-surface profile from extreme fluctuations in external temperature and maintains a uniform ambient environment. Additionally, the caprock duricrust is a barrier to capillarity rise and serves to keep the sub-surface environment constantly moist and humid in an otherwise hot-dry climate. These features allow the profile to be well ventilated and provide access of water and oxygen and an allochthonous food supply for the subterranean ecosystems. It could then be concluded that the duricrust provide a stable regolith environment and highly favourable conditions necessary to sustain subterranean troglofauna habitation in Operational Area.

The buried duricrust provides an equally favourable environment for troglofauna habitat but being under soil cover, access of water, air and food is potentially moderated. The surface cover sequences are generally shallow (less than a metre in depth) and unconsolidated, apart from clay-rich horizons that mark the extent of water penetration. The clay horizon is likely to be a barrier to flooding and dehydration but is still sufficiently permeable to allow moisture access into the subsurface.

With multiple generations and forms of duricrust development in the regolith over a long period of time there is the possibility that as the landscape evolved under changing weathering conditions from humid-wet to dry-arid, so did the habitat for troglofauna and the organisms themselves. The potential exists for multiple isolated populations with varied evolutionary trajectories, some isolated in remnant habitat formed in earlier eras, and other populations evolved by successively colonising new environments. The elevated, most prominent silcrete and ferricrete exposures are the oldest forms of duricrust in the landscape and are potential hosts to troglofauna since their formation under wet-humid climates. In contrast, the more recently formed pedogenic valley silcrete-calcrete duricrust is largely invisible in the landscape, typically buried under soil cover, but affords the most widespread habitat for troglofauna in the Operational Area regolith.

The exposure of these duricrust materials at small breakaways, as pavements at the margins of present day drainage creeks and floodplains, within inter-dunal corridors, and at the margins of salt lakes; and the exposure of pedogenic calcrete, locally uplifted as calcrete nodules at the base of large trees and as float within the colluvial cover, indicates that they are wide-spread under the present-day shallow cover sequences. Thus, they are likely to be well preserved as a regionally extensive sub-surface pavement. On a broader scale, the Operational Area is at the juncture of three regionally extensive bio domains, the Great Victoria Desert, the Eucla Basin-Nullarbor Plain, and the Yilgarn Craton (including the eastern Goldfields, Murchison and the Coolgardie biogeographic regions) that are also the product of wet-humid to semi-arid to arid weathering regimes. Individually these domains cover a vast area of many 100's km^2 with only slight variations in climate, biogeography, and landform and regolith expression. With the exception of the Great Victoria Desert proper where sand dune cover is extensive, remnant regolith duricrust similar to those described at the Operational Area are exposed, and represents about 15 to 25 percent of the cover throughout these regions. It is probable that a further 25 to 30 percent of the area is underlain by pedogenic valley silcrete-calcrete duricrust.

In conclusion, the presence of troglofauna at the Operational Area has been confirmed by the location of three species in drill holes. Although to date their actual habitat has not been clearly defined, the surrounding area has regolith highly favourable to the formation of stable subterranean troglofauna habitat, and thus is likely to support their presence in the region. Due to the broad range of similar climate, biogeography, landform and regolith settings, similar subterranean habitat to that found within the Operational Area is present over large proportions of the Great Victoria Desert, the Eucla Basin-Nullarbor Plain, and the Yilgarn Craton. It is therefore probable that all three troglofauna species recorded within the Operational Area, and in particular the two species (dipluran and centipede) that have only been located within the Project footprint, are also located in the surrounding areas.

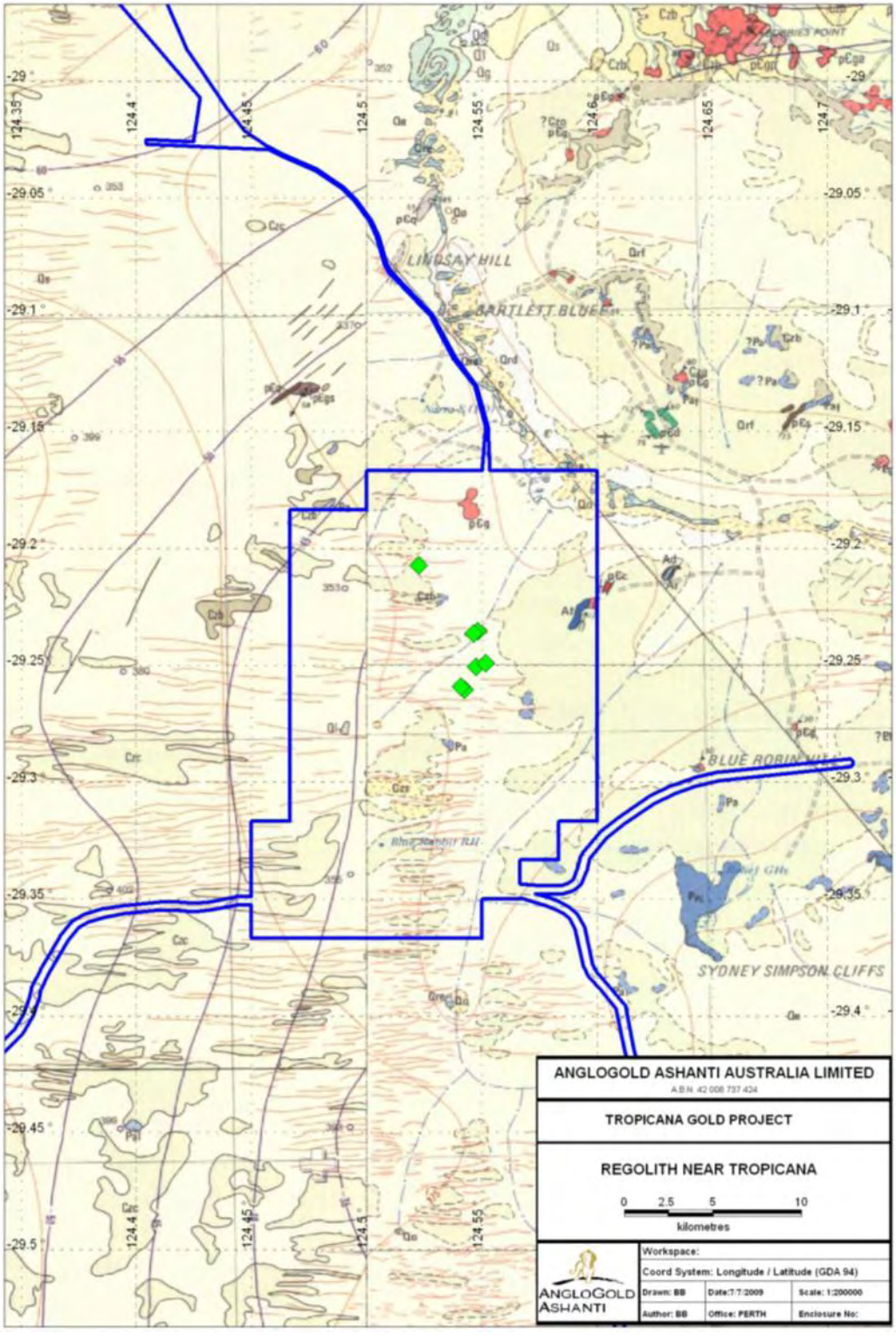


Figure 6.16: Regolith of the Operational Area and it surroundings

6.3. PINJIN INFRASTRUCTURE CORRIDOR

6.3.1. General

The Pinjin Infrastructure Corridor extends for 210 km from Pinjin Homestead (approximately 200 km northeast of Kalgoorlie) to the proposed Operational Area. A Bypass Road will also be established to divert authorised non-Project traffic away from the Operational Area. The proposed Pinjin Infrastructure Corridor is located south of the Operational Area, within the Helms Botanical District of the Eremaean Province (Beard 1990), to Pinjin Station, which is located in the Austin Botanical District of the Eremaean Province. At Pinjin, the corridor connects with the existing gravel road infrastructure to Kalgoorlie.

6.3.2. Flora and Vegetation

Mattiske Consulting Pty Ltd (Mattiske) was commissioned to survey and map the vegetation and flora values of the proposed Pinjin Infrastructure Corridor and Bypass Road (Appendix 2-C5, Figures 6.17a-m and 6.18a-m). The survey involved mapping vegetation, and identifying listed flora species and communities within the Project's granted tenure, which is a 200 – 500 m wide corridor of 210 km length. Survey efforts also included areas outside of the granted tenure. The corridor route was designed using aerial photography and existing threatened species information and knowledge to avoid areas of higher conservation interest such as sand dunes. The total area mapped was approximately 20,000 ha which is approximately 34 times larger than the proposed disturbance footprint. The main field work was undertaken in December 2007 and March 2008, with some areas revisited in May 2008. Fires resulting from lightening strikes during November 2007 significantly altered the condition of flora and vegetation in some sections in the proposed corridor, approximately 35% of the corridor was affected (Plates 6.16 and 6.17). Given the lack of remaining vegetation, identification of what may have been the vegetation communities and plant species prior to the fire was not possible. Specific surveys for fire resistant DRF species have been completed with negative results. It is anticipated that as a result of the intensive fire it will be years to decades before the area returns to the pre-fire state.

To support the vegetation and flora mapping undertaken by Mattiske Consulting, the Joint Venture commissioned Botanic Parks and Garden Authority to conduct a molecular assessment (DNA analysis) of regenerating mallees located within the burnt regions of the corridor. The samples included in the study were obtained from mallee populations located in area with similar soil characteristics to those of nearby populations of the DRF *Eucalyptus articulata* (Myrtaceae) (Appendix 2-F7). The focus of the study was to determine whether the DRF occurs along the corridor.

The survey conducted over the Pinjin Infrastructure Corridor and the Bypass Road was designed to meet the requirements of a Level 1 survey as defined by the EPA Guidance Statement 51 (EPA, 2008). The survey report upon which much of this section is based is included as Appendix 2-C5 along with a detailed description of the survey methods.

Targeted Flora Surveys

Targeted surveys for *Conospermum toddii* were conducted on, and in areas adjacent to, yellow and yellow orange sand dunes (preferred habitat) within and adjacent to the Pinjin Infrastructure Corridor. A targeted search for *Eucalyptus articulata* was undertaken by botanists from Mattiske Consulting during March and May 2008 (Appendix 2-F7). This species was intensively searched for within and outside of the Pinjin Infrastructure Corridor. This species has previously been observed on substrates of dull orange-brown or deep red-orange sandy loams with arkose rock cover and occasional weathered granite outcropping on upper or mid slopes. *E. articulata* has been recorded from the following vegetation types, approximately 20 km south of the Pinjin corridor (DEC data):

- Low Open Woodland of *Eucalyptus concinna* with *Acacia ayersiana* and *Acacia aneura* over *Acacia burkittii, Eremophila oldfieldii* and *Scaevola spinescens* and other mixed shrubs over *Triodia* spp.;
- Low Open Woodland of *E. articulata* and mixed *Eucalyptus* spp. over *Triodia* spp. with mixed low shrubs.

Biogeography

The Pinijn Infrastructure Corridor is located within the GVD and Murchison Bioregions of the IBRA classification system. The vegetation of the Helms Botanical District is very consistent and is characterised by tree steppe of *Eucalyptus gongylocarpa* and *Triodia basedowii* (Beard 1974). Overall, the sandy areas are a mosaic of tree and shrub communities. However, *Eucalyptus gongylocarpa* is dominant on sand dunes only where it occurs locally between them (Beard 1990).

The Austin Botanical District is essentially mulga (*Acacia aneura*) woodlands associated with red loams over siliceous hardpans on the plains (van Vreeswyk 1994) reducing to scrub on the rises and hills (Beard 1990). Mulga and *Eremophila* shrublands dominate on stony plains, whilst chenopod communities are more often associated with duplex soils (Pringle 1994).

Vegetation

The vegetation varies in condition from pristine, in non-disturbed areas of native vegetation at the eastern end, to good in areas that have been altered by fire (based on the criteria as developed by Keighery [1994]). Six major plant communities were identified along the corridor (Figure 6.17a-m), these major communities were then broken up into 36 sub-communities based on structure, dominant and associated species and geographic factors. Table 6.4 lists the communities and provides a brief description of each one. The vegetation at the Pinjin end of the corridor is dominated by mixed shrublands and woodlands of *Casuarina* and *Acacia* where as at the Operational end of the corridor the vegetation is dominated by *Eucalyptus* and *Acacia* woodlands.

Plate 6.16: Example of the Burnt Vegetation from a November 2007 Bush Fire

Plate 6.17: Intensively Burnt Yellow Sand Dunes

Table 6.4: Vegetation Communities of the Pinjin Survey Corridor

Vegetation Code	Description
Eucalyptus Woodland	
E1	Low woodland of *Eucalyptus oleosa* over *Senna artemisioides* subsp. *filifolia, Exocarpos aphyllus*, *Eremophila* spp., *Scaevola spinescens, Acacia hemiteles* and mixed shrubs over *Triodia scariosa* and *Olearia muelleri*. This community occurs on orange-red sandy loams on flats.
E2	Low woodland of *Eucalyptus gracilis* over mixed shrubs. This community occurs on red-orange sandy loams on minor drainage lines.
E3	Low woodland of *Eucalyptus trivalva* and *Eucalyptus concinna* over mixed shrubs over *Triodia* spp. This community occurs on red sandy loams on flats.
E4	Low woodland to low open woodland of *Eucalyptus gongylocarpa* with *Callitris preissii* and *Eucalyptus* spp. over mixed shrubs over *Triodia* spp. This community occurs on orange, red-orange, yellow-orange and yellow sandy loams on mixed topographies.
E5	Low woodland to low open woodland of *Eucalyptus concinna* over *Acacia sibina, Acacia hemiteles* and mixed shrubs over *Triodia* spp. This community occurs on orange sandy loams on flats.
E6	Low woodland to low open woodland of *Eucalyptus transcontinentalis* over *Melaleuca eleuterostachya*, *Melaleuca hamata, Eremophila dempsteri, Acacia colletioides* with mixed shrubs over *Triodia scariosa*. This community occurs on orange sandy loams on flats.
E7	Low open woodland of *Eucalyptus salubris* and *Casuarina pauper* over *Eremophila scoparia, Cratystylis subspinescens, Scaevola spinescens, Acacia colletioides, Acacia hemiteles* over *Ptilotus obovatus* and *Maireana* spp. This community occurs on red sandy loams on flats.
E8	Low open woodland of *Eucalyptus oleosa* with *Acacia ayersiana* over mixed open shrubs over *Triodia* spp. This community occurs on red sandy loams with occasional calcrete outcropping.
E9	Low open woodland of *Eucalyptus concinna* with *Eucalyptus* spp. over *Eremophila scoparia, Acacia hemiteles, Acacia colletioides, Scaevola spinescens* and *Eremophila caperata* over *Triodia scariosa*. This community occurs on orange sandy loams on flats.
E10	Low open woodland of *Eucalyptus ?ebbanoensis* and *Eucalyptus salicola* with *Callitris preissii* over *Allocasuarina helmsii, Allocasuarina acutivalvis* subsp*. acutivalvis* and *Dodonaea stenozyga*. This community occurs on white sand with quartz rock cover on mid slopes.

Vegetation Code	Description
E11	Low open woodland of *Eucalyptus gongylocarpa* with *Callitris preissii* over *Bertya dimerostigma, Dicrastylis cundeeleensis* (P3), *Lomandra leucocephala, Dodonaea viscosa* subsp. *angustissima* and mixed low shrubs. This community occurs on orange sand dunes.
E12	Open shrub mallee to very open shrub mallee of *Eucalyptus platycorys, Eucalyptus oleosa, Eucalyptus horistes* and other *Eucalyptus* spp. over *Westringia cephalantha, Acacia sibina, Acacia hemiteles* over *Triodia* spp. This community occurs on orange sandy loams on flats.
E13	Open shrub mallee to very open shrub mallee of *Eucalyptus leptophylla* with *Eucalyptus trivalva*, *Eucalyptus youngiana* and *Callitris preissii* over *Acacia helmsiana, Hakea francisiana* over *Triodia rigidissima.* This community occurs on orange-yellow sandy loams on flats and undulating plains.
E14	Very open shrub mallee of *Eucalyptus rosacea* with *Callitris preissii* over *Acacia sibina, Phebalium laevigatum* and low Myrtaceous shrubs over *Triodia* spp. This community occurs on orange sandy loams on flats.
E15	Very open shrub mallee of *Eucalyptus youngiana* and mixed *Eucalyptus* spp. over *Acacia desertorum* var. *desertorum, Bertya dimerostigma, Westringia cephalantha, Cryptandra distigma* with mixed shrubs over *Triodia desertorum*. This community occurs on orange sandy loams on lower slopes.
Casuarina woodland	
C1	Low open woodland of *Casuarina pauper* over *Eremophila* spp., *Senna artemisioides* subsp. *filifolia*, *Dodonaea lobulata* and *Acacia* spp. over *Scaevola spinescens*, *Ptilotus obovatus* and *Olearia muelleri*. This community occurs on red sandy loams with quartz rock cover.
C2	Low open woodland of *Casuarina pauper* with *Acacia aneura* var. *aneura* over *Dodonaea lobulata*, *Acacia burkittii, Scaevola spinescens, Maireana sedifolia, Senna artemisioides* subsp. *filifolia* and *Ptilotus obovatus.* This community occurs on red-orange sandy loams on low rocky rises.
C3	Low open woodland of *Casuarina pauper* with *Acacia aneura* var. *aneura* and *Acacia aneura* var. *conifera* over *Acacia burkittii, Dodonaea lobulata, Senna artemisioides* subsp. *filifolia* and *Scaevola spinescens* with mixed shrubs. This community occurs on red-orange sandy loams on flats.
Acacia woodland	
A1	Low woodland of *Acacia ayersiana* and *Acacia aneura* var. *aneura* over *Ptilotus obovatus* with mixed low shrubs. This community occurs on red-orange sandy loams on flats.
A2	Low woodland to tall shrubland of *Acacia ayersiana* and *Acacia aneura* var. *aneura* with *Acacia aneura* var. *argentea* over *Eremophila* spp., *Aluta maisonneuvei* subsp. *auriculata* and *Prostanthera* spp. This community occurs on orange sandy loams with a covering of gravel on lower slopes or flats.
A3	Low open woodland to tall open shrubland of *Acacia ayersiana* and *Acacia aneura* var. *aneura* over *Acacia* spp. and mixed shrubs. This community occurs on orange sandy loams.
A4	Low open woodland to tall open shrubland of *Acacia aneura* var. *aneura* over *Maireana sedifolia* with *Ptilotus obovatus* and *Enneapogon caerulescens*. This community occurs on orange-red sandy loams on flats.
A5	Tall shrubland of *Acacia ayersiana* and *Acacia aneura* var. *aneur*a with *Eucalyptus trivalva* over mixed shrubs over *Triodia* spp. with *Eragrostis eriopoda*. This community occurs on red sandy loams on flats.
Shrubland	
S1	Tall open scrub of *Callistemon phoeniceus*. This community occurs on pink-brown clay adjacent to a seasonally wet area.
S2	Tall shrubland of *Allocasuarina acutivalvis* subsp. *acutivalvis* with *Callitris preissii* over low mixed shrubs with emergent *Eucalyptu*s spp.
S3	Tall shrubland of *Acacia burkittii* and *Acacia tetragonophylla* with emergent *Casuarina pauper*. This community occurs on red-orange clay loams on minor drainage lines and seasonally wet areas.
S4	Open heath of *Melaleuca hamata* over *Aluta maisonneuvei* subsp. *auriculata* with *Grevillea acuaria*. This community occurs on orange sandy clay in low lying seasonally wet areas.
S5	Open shrubland of *Grevillea juncifolia, Cryptandra distigma, Acacia desertorum* var. *desertorum* and mixed low shrubs over *Triodia desertorum, Lepidobolus deserti* (P4) and *Chrysitrix distigmatosa* with occasional emergent *Eucalyptus gongylocarpa*. This community occurs on yellow to yellow-orange sand on slopes.
S6	Open mixed shrubland with occasional emergent *Acacia* spp. This community occurs on orange sandy loams with granite outcropping.
S7	Low shrubland of *Cratystylis subspinescens* with *Tecticornia undulata, Tecticornia* spp., *Atriplex nummularia* and mixed low shrubs. This community occurs on orange clay sands in low lying saline flats.

Vegetation Code	Description
S8	Low shrubland of *Acacia desertorum* var. *desertorum* with *Grevillea juncifol*ia, low Myrtaceous shrubs and mixed low shrubs with occasional emergent *Eucalyptus youngiana* and *Eucalyptus* spp. This community occurs on pale orange sandy loams on flats and lower slopes.
S9	Low shrubland of *Leptosema chambersii*, *Baeckea* sp. Great Victoria Desert (P2), *Homalocalyx thryptomenoides, Enekbatus eremaeus, Cryptandra distigma* with mixed low shrubs and occasional emergent *Eucalyptus* spp. This community occurs on yellow-orange sandy loams on lower and mid slopes.
S10	Low open shrubland of *Maireana pyramidata* and *Cratystylis spinescens* with mixed low shrubs and occasional emergent *Hakea preissii, Eremophila scoparia* and *Dodonaea lobulata*. This community occurs on red sandy loams with some quartz rock cover on flats.
S11	Low open shrubland of *Thryptomene biseriata, Lomandra leucocephala, Pityrodia lepidota, Scaevola basedowii, Chrysocephalum puteale* with mixed low shrub over *Triodia* spp. and *Lepidobolus deserti* (P4) with occasional emergent *Eucalyptus* spp. This community occurs on yellow or yellow-orange sand dunes
Grassland	
G1	Open grassland of *Eragrostis eriopoda, Aristida contorta* and *Enneapogon caerulescens* with occasional emergent *Senna artemisioides* subsp. *petiolaris, Dodonaea viscosa, Acacia aneura* var. *aneura* and *Acacia ayersiana.* This community occurs on red sandy loams on flats.
Chenopod Shrubland	
CH1	Low open Chenopod shrubland of *Atriplex* ?*vesi*caria with *Frankenia setosa* and *Frankenia ?cinerea* with low mixed shrubs and Chenopods. This community occurs on orange sands on flats, adjacent to weathered calcrete outcropping.
CH2	Low Chenopod shrubland of *Tecticornia* spp. with F*rankenia setosa, Hemichroa diandra, Lawrencia squamata* and *Eragrostis pergracilis*. This community occurs on orange sandy clays in low lying saline flow areas.

The November 2007 fire has temporarily altered flora and fauna communities in the area, resulting in the death of mature trees and probable death of DRF and Priority Flora that may have existed in the area. All of which are likely to regenerate naturally in due course.

Six plant communities within the survey corridor have been identified as of conservation interest; these were S11, E10, E11, S1, S4 and S9. These communities were identified as being of importance, either because they supported a DRF species (S11) or other conservation interest species (S9), or because of their limited distribution within the Pinjin Infrastructure Corridor.

No Threatened Ecological Communities (TECs) as defined under the EPBC Act or the DEC were observed in the survey area. One Priority Ecological Community (PEC) defined by the DEC in late 2008, may exist within the Pinjin Infrastructure Corridor, and is described as the 'Yellow sandplain communities of the Great Victoria Desert'. This PEC is not well understood, and little information is available (J. Pryde, DEC, pers. comm.). The possible extent of this PEC is further discussed in section 6.5.

Section 7.2.2 contains details on the potential impacts and the management measures proposed.

Legend

Pinjin Vegetation Communities

A1 Low Woodland of *Acacia ayersiana* and *Acacia aneura* var. *aneura* over *Ptilotus obovatus* with mixed low shrubs

A2 Low Woodland to Tall Shrubland of *Acacia ayersiana* and *Acacia aneura* var. *aneura* with *Acacia aneura* var. *argentea* over *Eremophila* spp., *Aluta maisonneuvei* subsp. *auriculata* and *Prostanthera* spp.

A3 Low Open Woodland to Tall Open Shrubland of *Acacia ayersiana* and *Acacia aneura* var. *aneura* over *Acacia* spp. and mixed shrubs

A4 Low Open Woodland to Tall Open Shrubland of *Acacia aneura* var. *aneura* over *Maireana sedifolia* with *Ptilotus obovatus* and *Enneapogon caerulescens*

A5 Tall Shrubland of *Acacia ayersiana* and *Acacia aneura* var. *aneura* with *Eucalyptus trivalva* over mixed shrubs over *Triodia* spp. with *Eragrostis eriopoda*

C1 Low Open Woodland of Casuarina pauper over *Eremophila* spp., *Senna artemisioides* subsp. *filifolia*, *Dodonaea lobulata* and *Acacia* spp. over *Scaevola spinescens*, *Ptilotus obovatus* and *Olearia muelleri*

C2 Low Open Woodland of *Casuarina pauper* with *Acacia aneura* var. *aneura* over *Dodonaea lobulata*, *Acacia burkittii*, *Scaevola spinescens, Maireana sedifolia, Senna artemisioides subsp. filifolia* and *Ptilotus obovatus*

C3 Low Open Woodland of *Casuarina pauper* with *Acacia aneura* var. *aneura* and *Acacia aneura* var. *conifera* over *Acacia burkittii*, *Dodonaea lobulata*, *Senna artemisioides* subsp. *filifolia* and *Scaevola spinescens* with mixed shrubs

CH1 Low Open Chenopod Shrubland of *Atriplex ?vesicaria* with *Frankenia setosa* and *Frankenia ?cinerea* with low mixed shrubs and Chenopods

CH2 Low Chenopod Shrubland of *Tecticornia* spp. with *Frankenia setosa*, *Hemichroa diandra*, *Lawrencia squamata* and *Eragrostis pergracilis*

E1 Low Woodland of *Eucalyptus oleosa* over *Senna artemisioides* subsp. *filifolia*, *Exocarpos aphyllus*, *Eremophila* spp., *Scaevola spinescens, Acacia hemiteles and mixed shrubs over Triodia scariosa* and *Olearia muelleri*

E2 Low Woodland of *Eucalyptus gracilis* over mixed shrubs

E3 Low Woodland of *Eucalyptus trivalva* and *Eucalyptus concinna* over mixed shrubs over *Triodia* spp.

E4 Low Woodland to Low Open Woodland of *Eucalyptus gongylocarpa* with *Callitris preissii* and *Eucalyptus* spp. over mixed shrubs over *Triodia* spp.

E5 Low Woodland to Low Open Woodland of *Eucalyptus concinna* over *Acacia sibina*, *Acacia hemiteles* and mixed shrubs over *Triodia* spp.

E6 Low Woodland to Low Open Woodland of *Eucalyptus transcontinentalis* over *Melaleuca eleuterostachya*, *Melaleuca hamata*, *Eremophila dempsteri*, *Acacia colletioides* with mixed shrubs over *Triodia scariosa*

E7 Low Open Woodland of *Eucalyptus salubris* and *Casuarina pauper* over *Eremophila scoparia*, *Cratystylis subspinescens*, *Scaevola spinescens*, *Acacia colletioides*, *Acacia hemiteles* over *Ptilotus obovatus* and *Maireana* spp.

E8 Low Open Woodland of *Eucalyptus oleosa* with *Acacia ayersiana* over mixed open shrubs over *Triodia* spp.

E9 Low Open Woodland of *Eucalyptus concinna* with *Eucalyptus* spp. over *Eremophila scoparia*, *Acacia hemiteles*, *Acacia colletioides*, *Scaevola spinescens* and *Eremophila caperata* over *Triodia scariosa*

E10 Low Open Woodland of *Eucalyptus ?ebbanoensis* and *Eucalyptus salicola* with *Callitris preissii* over *Allocasuarina helmsii*, *Allocasuarina acutivalvis* subsp. *acutivalvis* and *Dodonaea stenozyga*

E11 Low Open Woodland of *Eucalyptus gongylocarpa* with *Callitris preissii* over *Bertya dimerostigma*, *Dicrastylis cundeeleensis* (P3), *Lomandra leucocephala*, *Dodonaea viscosa* subsp. *angustissima* and mixed low shrubs

E12 Open Shrub Mallee to Very Open Shrub Mallee of *Eucalyptus platycorys*, *Eucalyptus oleosa*, *Eucalyptus horistes* and other *Eucalyptus* spp. over *Westringia cephalantha*, *Acacia sibina*, *Acacia hemiteles* over *Triodia* spp.

E13 Open Shrub Mallee to Very Open Shrub Mallee of *Eucalyptus leptophylla* with *Eucalyptus trivalva*, *Eucalyptus youngiana* and *Callitris preissii* over *Acacia helmsiana*, *Hakea francisiana* over *Triodia rigidissima*

E14 Very Open Shrub Mallee of *Eucalyptus rosacea* with *Callitris preissii* over *Acacia sibina*, *Phebalium laevigatum* and low Myrtaceous shrubs over *Triodia* spp.

E15 Very Open Shrub Mallee of *Eucalyptus youngiana* and mixed *Eucalyptus* spp. over *Acacia desertorum* var. *desertorum*, *Bertya dimerostigma*, *Westringia cephalantha*, *Cryptandra distigma* with mixed shrubs over *Triodia desertorum*

G1 Open Grassland of *Eragrostis eriopoda*, *Aristida contorta* and *Enneapogon caerulescens* with occasional emergent *Senna artemisioides* subsp. *petiolaris*, *Dodonaea viscosa*, *Acacia aneura* var. *aneura* and *Acacia ayersiana*

S1 Tall Open Scrub of *Callistemon phoeniceus*

S2 Tall Shrubland of *Allocasuarina acutivalvis* subsp. *acutivalvis* with *Callitris preissii* over low mixed shrubs with emergent *Eucalyptus* spp.

S3 Tall Shrubland of *Acacia burkittii* and *Acacia tetragonophylla* with emergent *Casuarina pauper*

S4 Open Heath of *Melaleuca hamata* over *Aluta maisonneuvei* subsp. *auriculata* with *Grevillea acuaria*

S5 Open Shrubland of *Grevillea juncifolia*, *Cryptandra distigma*, *Acacia desertorum* var. *desertorum* and mixed low shrubs over *Triodia desertorum*, *Lepidobolus deserti* (P4) and *Chrysitrix distigmatosa* with occasional emergent *Eucalyptus gongylocarpa*

S6 Open Mixed Shrubland with occasional emergent *Acacia* spp

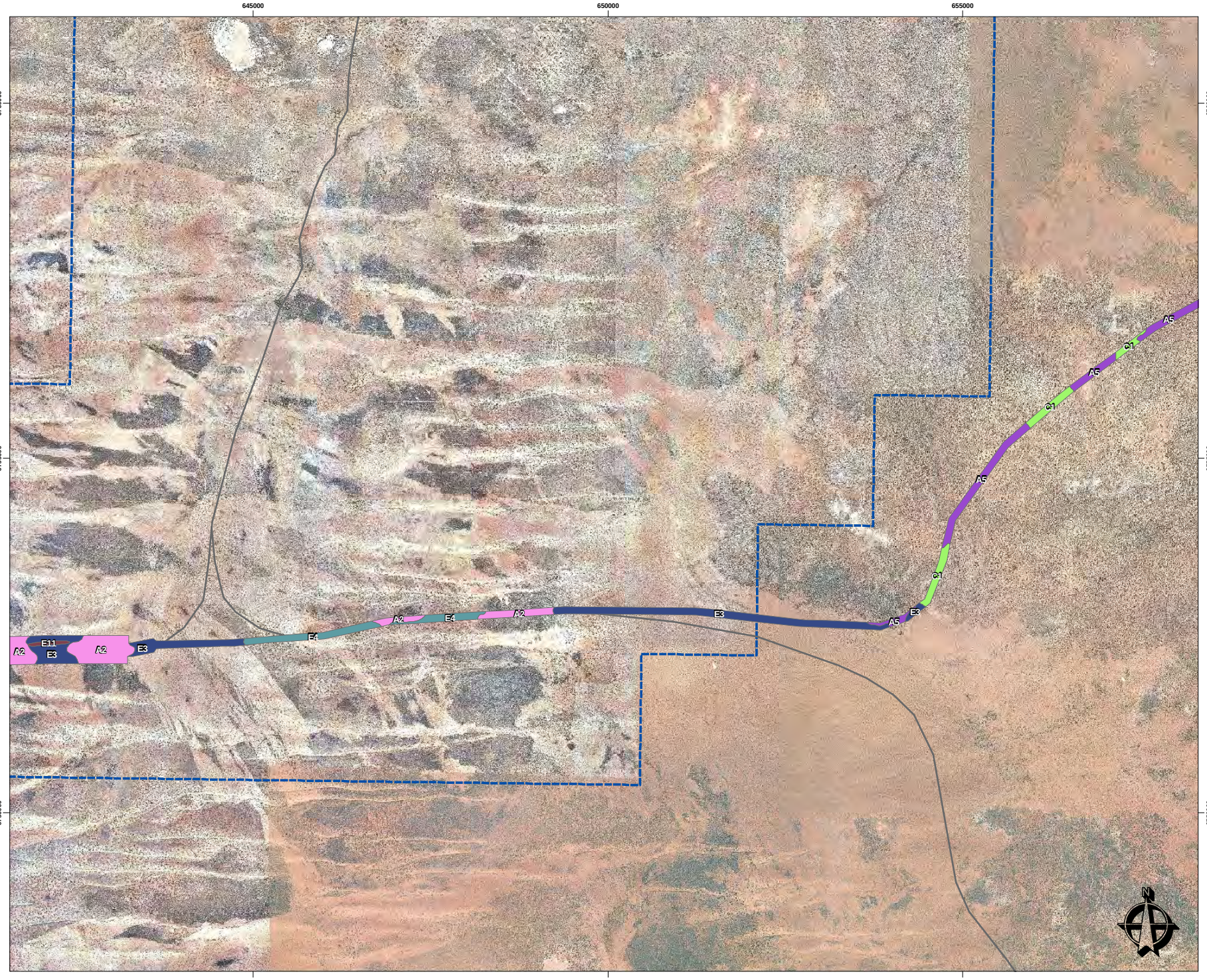
S7 Low Shrubland of *Cratystylis subspinescens* with *Tecticornia undulata*, *Tecticornia* spp., *Atriplex nummularia* and mixed low shrubs

S8 Low Shrubland of *Acacia desertorum* var. *desertorum* with *Grevillea juncifolia*, low Myrtaceous shrubs and mixed low shrubs with occasional emergent *Eucalyptus youngiana* and *Eucalyptus* spp

S9 Low Shrubland of *Leptosema chambersii*, *Baeckea* sp. Great Victoria Desert (P2), *Homalocalyx thryptomenoides*, *Enekbatus eremaeus*, *Cryptandra distigma* with mixed low shrubs and occasional emergent *Eucalyptus* spp.

S10 Low Open Shrubland of *Maireana pyramidata* and *Cratystylis spinescens* with mixed low shrubs and occasional emergent *Hakea preissii*, *Eremophila scoparia* and *Dodonaea lobulata*

S11 Low Open Shrubland of *Thryptomene biseriata*, *Lomandra leucocephala*, *Pityrodia lepidota*, *Scaevola basedowii*, *Chrysocephalum puteale* with mixed low shrub over *Triodia* spp. and *Lepidobolus deserti* (P4) with occasional emergent *Eucalyptus* spp.



Legend

Vegetation Communities

- A2
- A5
- C1
- E11
- E3
- E4
- Operational Area

Refer to page 6-63 for vegetation description

Imagery is a composite of aerial and sate lite photography

NOTE THAT POSITION ERRORS CAN BE >5M IN SOME AREAS
- AERIAL PHOTOGRAPHY SOURCED FROM LANDGATE 2007
- LOCALITY MAP SOURCED FROM LANDGATE 2008

SCALE

0 0 25 0 5 1 1 5 2

Kilometers

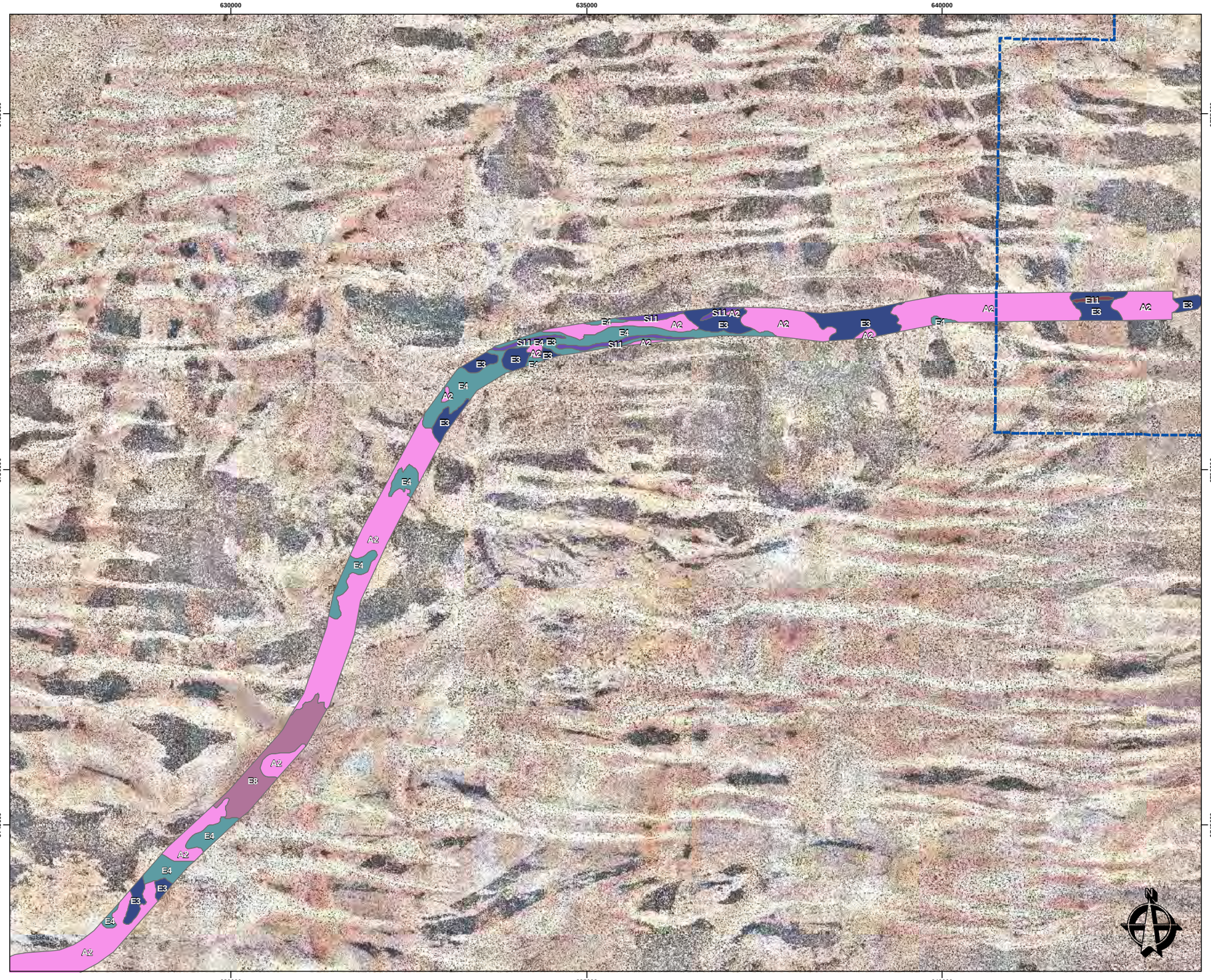
LOCALITY MAP

METADATA RECORDED	PROJECTION
100%	MGA ZONE 51
HORIZONTAL DATUM	**HEIGHT DATUM**
GDA 94	N/A

CREATED BY	CHECKED BY	APPROVED
GWa	BP	FD
DATE	**REVISION**	**DRAWING NO.**
19.08.09	0	351-2.09a

Tropicana Joint Venture
TROPICANA GOLD PROJECT

Public Environmental Review
Vegetation of the Pinjin Bypass Infrastructure Corridor
Figure 6.17a



Legend

Operational Area

Vegetation Communities

- A2
- E11
- E3
- E4
- E8
- S11

Refer to page 6-63 for vegetation description

Imagery is a composite of aerial and satellite photography

NOTE THAT POSITION ERRORS CAN BE >5M IN SOME AREAS
- AERIAL PHOTOGRAPHY SOURCED FROM LANDGATE 2007
- LOCALITY MAP SOURCED FROM LANDGATE 2008

SCALE

0 0.25 0.5 1 1.5 2

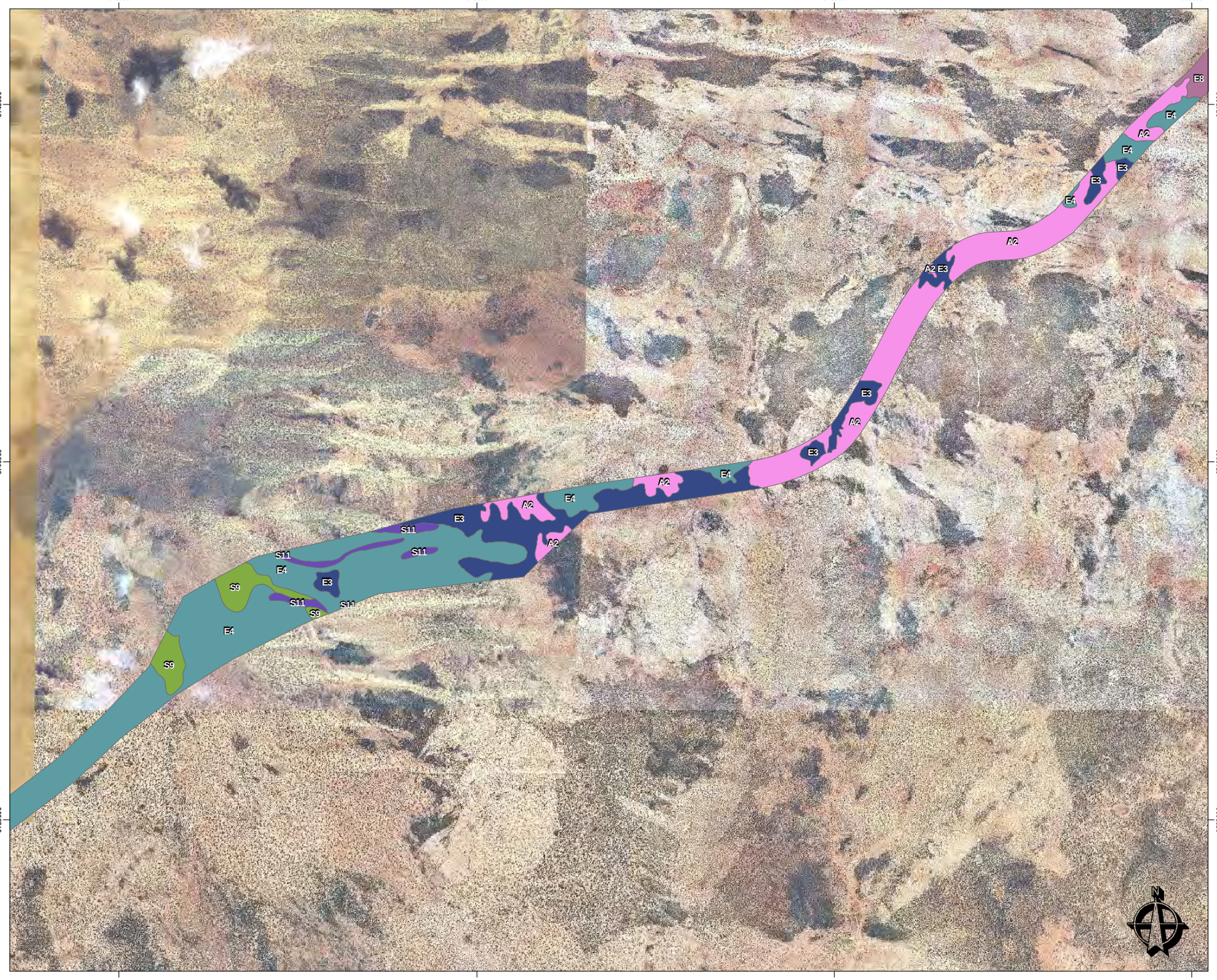
Kilometers

LOCALITY MAP

METADATA RECORDED	PROJECTION	
100%	MGA ZONE 51	
HORIZONTAL DATUM	**HEIGHT DATUM**	
GDA 94	N/A	
CREATED BY	**CHECKED BY**	**APPROVED**
GWa	BP	FD
DATE	**REVISION**	**DRAWING NO.**
19.08.09	0	351-2.09b

Tropicana Joint Venture
TROPICANA GOLD PROJECT

Public Environmental Review
Vegetation of the Pinjin Infrastructure Corridor
Figure 6.17b



Legend

Vegetation Communities

- A2
- E3
- E4
- E8
- S11
- S9

Refer to page 6-63 for vegetation description

Imagery is a composite of aerial and satellite photography

NOTE THAT POSITION ERRORS CAN BE >5M IN SOME AREAS
- AERIAL PHOTOGRAPHY SOURCED FROM LANDGATE 2007
- LOCALITY MAP SOURCED FROM LANDGATE 2008

SCALE

0 0.25 0.5 1 1.5 2

Kilometers

LOCALITY MAP

METADATA RECORDED	PROJECTION
100%	MGA ZONE 51
HORIZONTAL DATUM	**HEIGHT DATUM**
GDA 94	N/A

CREATED BY	CHECKED BY	APPROVED
GWa	BP	FD
DATE	**REVISION**	**DRAWING NO.**
19.08.09	0	351-2.09c

Tropicana Joint Venture
TROPICANA GOLD PROJECT

Public Environmental Review
Vegetation of the Pinjin Infrastructure Corridor
Figure 6.17c

Legend

Vegetation Communities

- A2
- E13
- E4
- S8

Refer to page 6-63 for vegetation description

Imagery is a composite of aerial and satellite photography

NOTE THAT POSITION ERRORS CAN BE >5M IN SOME AREAS
- AERIAL PHOTOGRAPHY SOURCED FROM LANDGATE 2007
- LOCALITY MAP SOURCED FROM LANDGATE 2008

SCALE

0 0.25 0.5 1 1.5 2

Kilometers

LOCALITY MAP

METADATA RECORDED	PROJECTION
100%	MGA ZONE 51
HORIZONTAL DATUM	**HEIGHT DATUM**
GDA 94	N/A

CREATED BY	CHECKED BY	APPROVED
GWa	BP	FD
DATE	**REVISION**	**DRAWING NO.**
19.08.09	0	351-2.09d

Tropicana Joint Venture
TROPICANA GOLD PROJECT

Public Environmental Review
Vegetation of the Pinjin Infrastructure Corridor
Figure 6.17d

Legend

Vegetation Communities

- A2
- E12
- E14
- E4
- E7
- S2
- S3
- S4
- S8
- S9

Refer to page 6-63 for vegetation description

Imagery is a composite of aerial and satellite photography

NOTE THAT POSITION ERRORS CAN BE >5M IN SOME AREAS
- AERIAL PHOTOGRAPHY SOURCED FROM LANDGATE 2007
- LOCALITY MAP SOURCED FROM LANDGATE 2008

SCALE

0 0.25 0.5 1 1.5 2

Kilometers

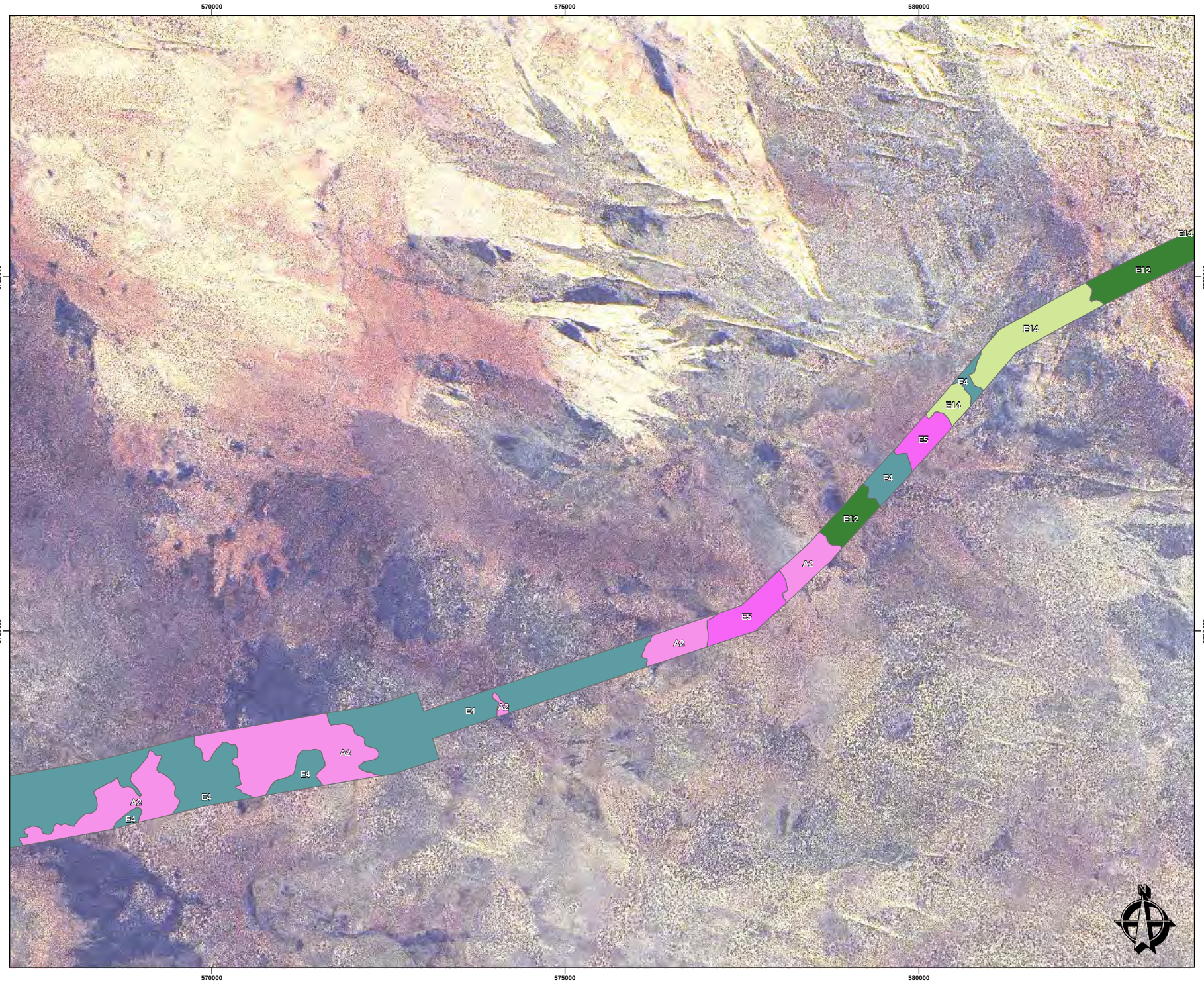
LOCALITY MAP

METADATA RECORDED	PROJECTION
100%	MGA ZONE 51
HORIZONTAL DATUM	**HEIGHT DATUM**
GDA 94	N/A

CREATED BY	CHECKED BY	APPROVED
GWa	BP	FD
DATE	**REVISION**	**DRAWING NO.**
19.08.09	0	351-2.09e

Tropicana Joint Venture
TROPICANA GOLD PROJECT

Public Environmental Review
Vegetation of the Pinjin Infrastructure Corridor
Figure 6.17e



Legend

Vegetation Communities

- A2
- E12
- E14
- E4
- E5

Refer to page 6-63 for vegetation description

Imagery is a composite of aerial and satellite photography

NOTE THAT POSITION ERRORS CAN BE >5M IN SOME AREAS
- AERIAL PHOTOGRAPHY SOURCED FROM LANDGATE 2007
- LOCALITY MAP SOURCED FROM LANDGATE 2008

SCALE

0 0.25 0.5 1 1.5 2

Kilometers

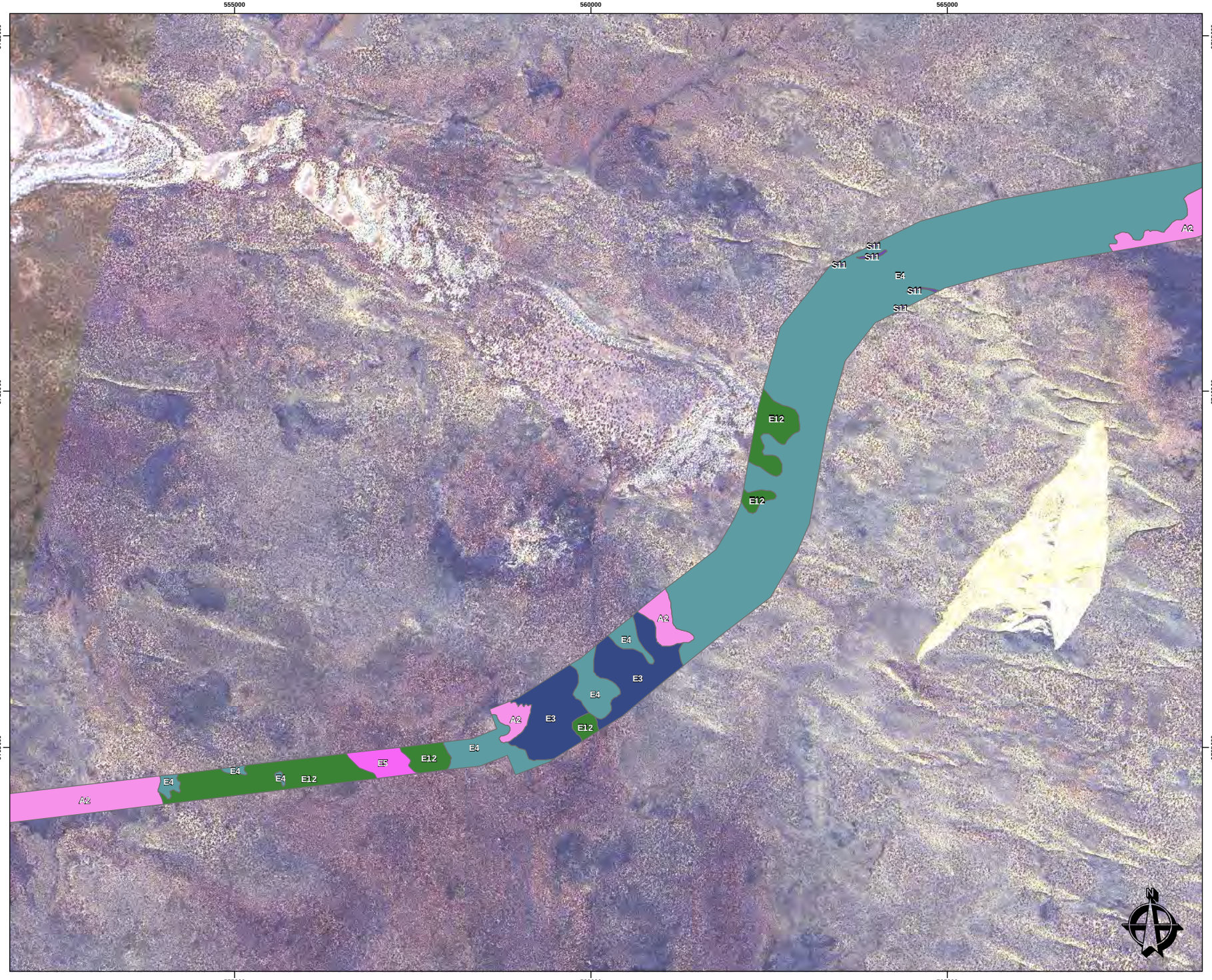
LOCALITY MAP

METADATA RECORDED	PROJECTION
100%	MGA ZONE 51
HORIZONTAL DATUM	**HEIGHT DATUM**
GDA 94	N/A

CREATED BY	CHECKED BY	APPROVED
GWa	BP	FD
DATE	**REVISION**	**DRAWING NO.**
19.08.09	0	351-2.09f

Tropicana Joint Venture
TROPICANA GOLD PROJECT

Public Environmental Review
Vegetation of the Pinjin Infrastructure Corridor
Figure 6.17f



Legend

Vegetation Communities

- A2
- E12
- E3
- E4
- E5
- S11

Refer to page 6-63 for vegetation description

Imagery is a composite of aerial and satellite photography

NOTE THAT POSITION ERRORS CAN BE >5M IN SOME AREAS
- AERIAL PHOTOGRAPHY SOURCED FROM LANDGATE 2007
- LOCALITY MAP SOURCED FROM LANDGATE 2008

SCALE

0 0.25 0.5 1 1.5 2

Kilometers

LOCALITY MAP

METADATA RECORDED	PROJECTION
100%	MGA ZONE 51
HORIZONTAL DATUM	**HEIGHT DATUM**
GDA 94	N/A

CREATED BY	CHECKED BY	APPROVED
GWa	BP	FD
DATE	**REVISION**	**DRAWING NO.**
19.08.09	0	351-2.09g

Tropicana Joint Venture
TROPICANA GOLD PROJECT

Public Environmental Review
Vegetation of the Pinjin Infrastructure Corridor
Figure 6.17g

Habitats of potential interest were indentified on aerial imagery and the corridors subsequently surveyed were wider to allow for future design flexibility.

Legend

Vegetation Communities

- A2
- E1
- E4
- E5
- S11
- S5
- S9

Refer to page 6-63 for vegetation description

Imagery is a composite of aerial and satellite photography

NOTE THAT POSITION ERRORS CAN BE >5M IN SOME AREAS
- AERIAL PHOTOGRAPHY SOURCED FROM LANDGATE 2007
- LOCALITY MAP SOURCED FROM LANDGATE 2008

SCALE

0 0.25 0.5 1 1.5 2

Kilometers

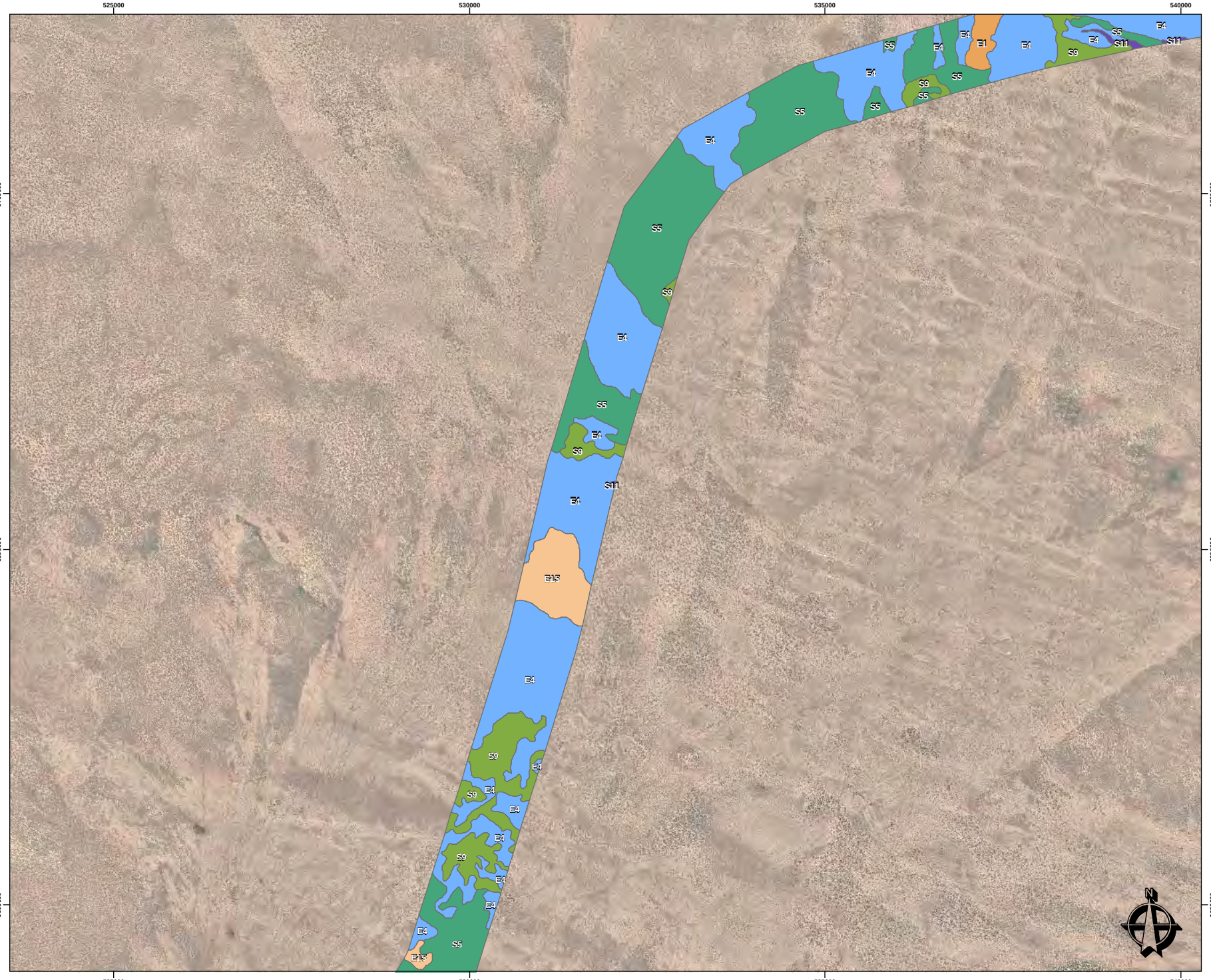
LOCALITY MAP

METADATA RECORDED	PROJECTION
100%	MGA ZONE 51
HORIZONTAL DATUM	**HEIGHT DATUM**
GDA 94	N/A

CREATED BY	CHECKED BY	APPROVED
GWa	BP	FD
DATE	**REVISION**	**DRAWING NO.**
19.08.09	0	351-2.09h

Tropicana Joint Venture
TROPICANA GOLD PROJECT

Public Environmental Review
Vegetation of the Pinjin Infrastructure Corridor
Figure 6.17h



Legend

Vegetation Communities

- E1
- E15
- E4
- S11
- S5
- S9

Refer to page 6-63 for vegetation description

Imagery is a composite of aerial and satellite photography

NOTE THAT POSITION ERRORS CAN BE >5M IN SOME AREAS
- AERIAL PHOTOGRAPHY SOURCED FROM LANDGATE 2007
- LOCALITY MAP SOURCED FROM LANDGATE 2008

SCALE

0 0.25 0.5 1 1.5 2

Kilometers

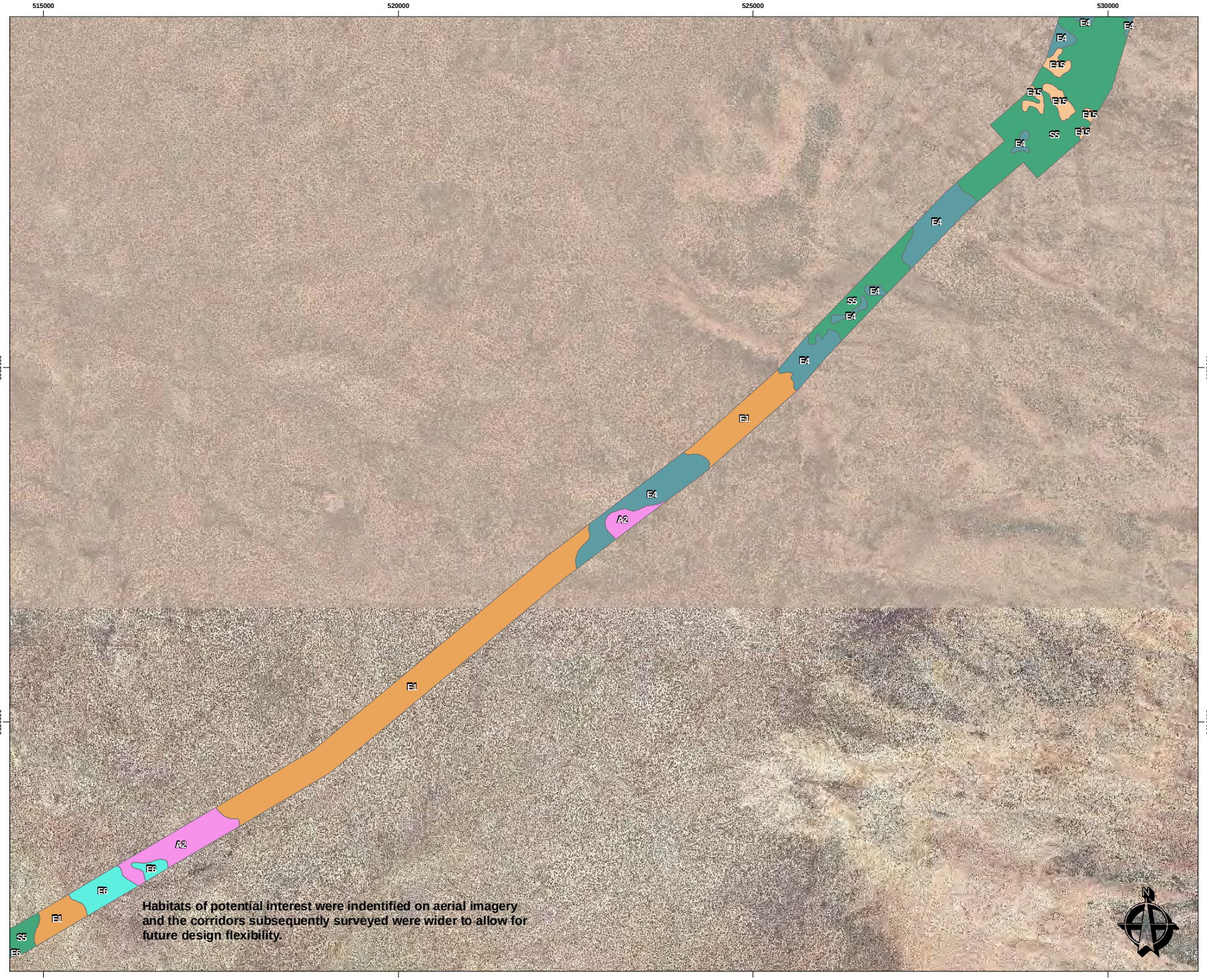
LOCALITY MAP

METADATA RECORDED	PROJECTION
100%	MGA ZONE 51
HORIZONTAL DATUM	**HEIGHT DATUM**
GDA 94	N/A

CREATED BY	CHECKED BY	APPROVED
GWa	BP	FD
DATE	**REVISION**	**DRAWING NO.**
19.08.09	0	351-2.09i

Tropicana Joint Venture
TROPICANA GOLD PROJECT

Public Environmental Review
Vegetation of the Pinjin Infrastructure Corridor
Figure 6.17i



Legend

Vegetation Communities

- A2
- E1
- E15
- E4
- E6
- S5

Refer to page 6-63 for vegetation description

Imagery is a composite of aerial and satellite photography

NOTE THAT POSITION ERRORS CAN BE >5M IN SOME AREAS
- AERIAL PHOTOGRAPHY SOURCED FROM LANDGATE 2007
- LOCALITY MAP SOURCED FROM LANDGATE 2008

SCALE

0 0.25 0.5 1 1.5 2

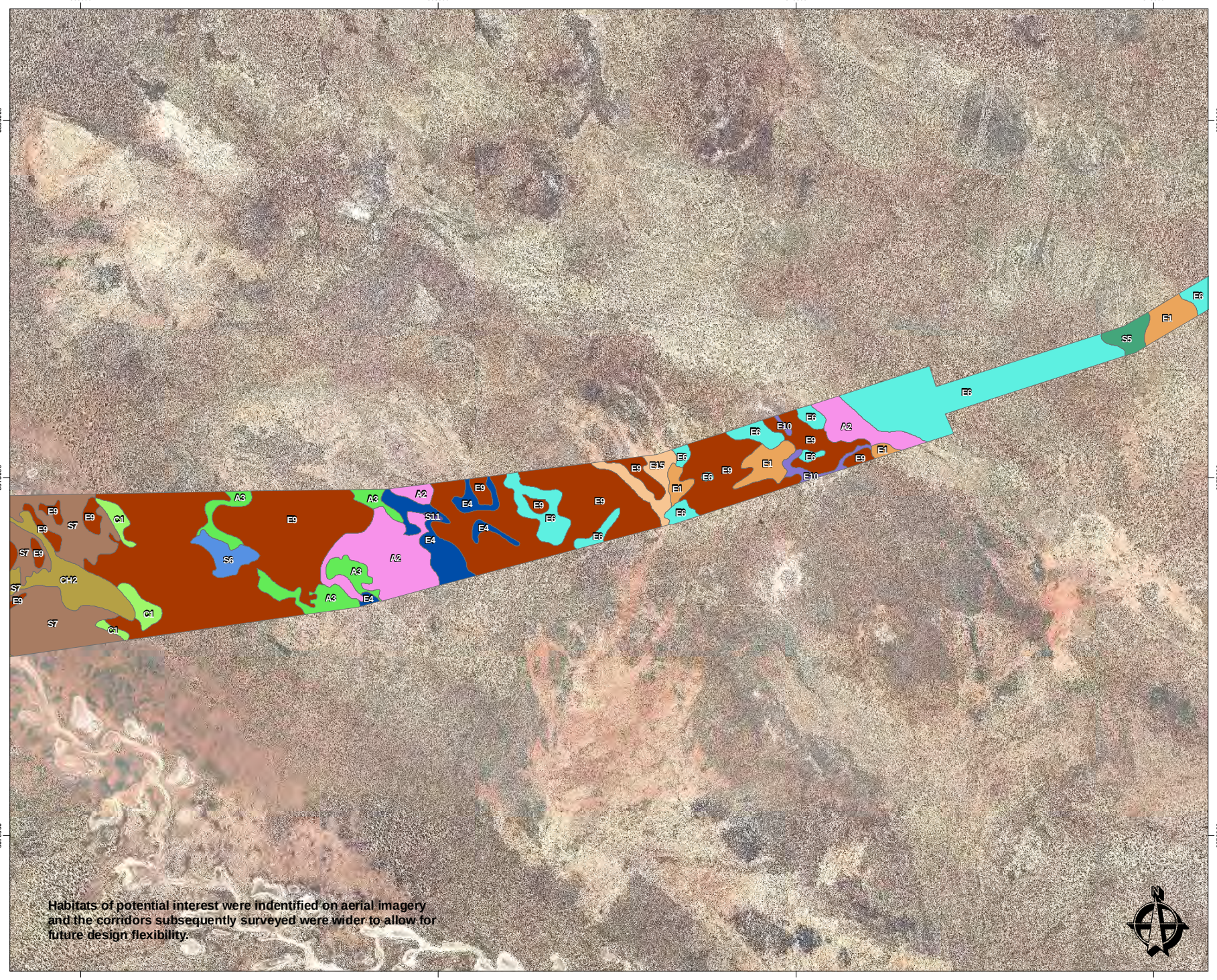
Kilometers

LOCALITY MAP

METADATA RECORDED	PROJECTION	
100%	MGA ZONE 51	
HORIZONTAL DATUM	**HEIGHT DATUM**	
GDA 94	N/A	
CREATED BY	**CHECKED BY**	**APPROVED**
GWa	BP	FD
DATE	**REVISION**	**DRAWING NO.**
19.08.09	0	351-2.09j

Tropicana Joint Venture
TROPICANA GOLD PROJECT

Public Environmental Review
Vegetation of the Pinjin
Infrastructure Corridor
Figure 6.17j



Legend

Vegetation Communities

- A2
- A3
- C1
- CH2
- E1
- E10
- E15
- E4
- E6
- E9
- S11
- S5
- S6
- S7

Refer to page 6-63 for vegetation description

Imagery is a composite of aerial and sate lite photography

NOTE THAT POSITION ERRORS CAN BE >5M IN SOME AREAS
- AERIAL PHOTOGRAPHY SOURCED FROM LANDGATE 2007
- LOCALITY MAP SOURCED FROM LANDGATE 2008

SCALE

0 0 25 0 5 1 1 5 2

Kilometers

LOCALITY MAP

METADATA RECORDED	PROJECTION
100%	MGA ZONE 51
HORIZONTAL DATUM	**HEIGHT DATUM**
GDA 94	N/A

CREATED BY	CHECKED BY	APPROVED
GWa	BP	FD
DATE	**REVISION**	**DRAWING NO.**
19.08.09	0	351-2.09k

Tropicana Joint Venture
TROPICANA GOLD PROJECT

Public Environmental Review
Vegetation of the Pinjin Infrastructure Corridor
Figure 6.17k

Legend

Vegetation Communities

- A3
- A4
- C1
- CH1
- CH2
- E9
- S6
- S7

Refer to page 6-63 for vegetation description

Imagery is a composite of aerial and satellite photography

NOTE THAT POSITION ERRORS CAN BE >5M IN SOME AREAS
- AERIAL PHOTOGRAPHY SOURCED FROM LANDGATE 2007
- LOCALITY MAP SOURCED FROM LANDGATE 2008

SCALE

0 0.25 0.5 1 1.5 2

K lometers

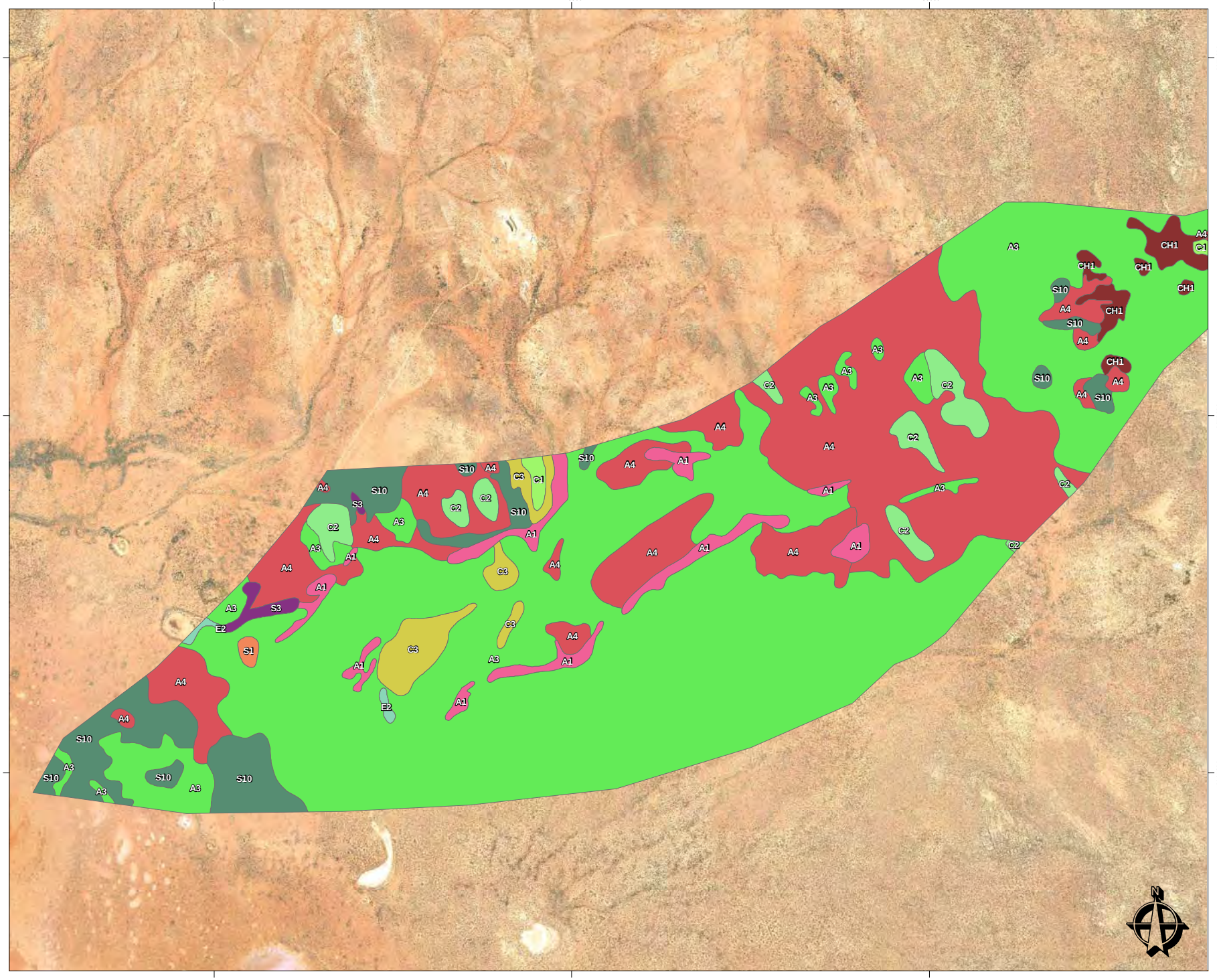
LOCALITY MAP

METADATA RECORDED	PROJECTION
100%	MGA ZONE 51
HORIZONTAL DATUM	**HEIGHT DATUM**
GDA 94	N/A

CREATED BY	CHECKED BY	APPROVED
GWa	BP	FD
DATE	**REVISION**	**DRAWING NO.**
19.08.09	0	351-2.09l

Tropicana Joint Venture
TROPICANA GOLD PROJECT

Public Environmental Review
Vegetation of the Pinjin Infrastructure Corridor
Figure 6.17l



Legend

Vegetation Communities

- A1
- A3
- A4
- C1
- C2
- C3
- CH1
- E2
- S1
- S10
- S3

Refer to page 6-63 for vegetation description

Imagery is a composite of aerial and satellite photography

NOTE THAT POSITION ERRORS CAN BE >5M IN SOME AREAS
- AERIAL PHOTOGRAPHY SOURCED FROM LANDGATE 2007
- LOCALITY MAP SOURCED FROM LANDGATE 2008

SCALE

0 0.25 0.5 1 1.5 2

K lometers

LOCALITY MAP

METADATA RECORDED	PROJECTION
100%	MGA ZONE 51
HORIZONTAL DATUM	**HEIGHT DATUM**
GDA 94	N/A

CREATED BY	CHECKED BY	APPROVED
GWa	BP	FD
DATE	**REVISION**	**DRAWING NO.**
19.08.09	0	351-2.09m

Tropicana Joint Venture
TROPICANA GOLD PROJECT

Public Environmental Review
Vegetation of the Pinjin Infrastructure Corridor
Figure 6.17m

Flora

The Mattiske survey of the Pinjin infrastructure corridor identified 267 taxa from 44 families, 122 genera, the most diverse families were: Myrtaceae (37 taxa), Chenopodiaceae (25 taxa), Mimosaceae (22 taxa); Myoporaceae (18 taxa), Proteaceae (14 taxa) and Papilionaceae (14 taxa).

Listed Species

A search of the WA Herbarium and DEC Flora database identified the potential for two DRF and 20 Priority Flora to occur along the corridor, the survey found one DRF (*Conospermum toddii*) and 13 Priority Flora species within the 20,400 ha corridor (Figure 6.18a-m) (Table 6.5). *C. toddii* was only observed within vegetation community S11.

Vegetation communities known to be favoured by *Eucalyptus articulata* were not observed within the Pinjin corridor, nor were the preferred substrates of *E. articulata*. A combination of not observing the vegetation type, preferred habitat or the species itself suggests that *E. articulata* is unlikely to be located within the Pinjin corridor, and therefore unlikely to be impacted by the Project. The absence of *E. articulata* from the Pinjin corridor has been further confirmed by a genetics project using samples of burnt (and therefore unidentifiable) Eucalypts along the corridor, and reference samples of known *E. articulata* specimens (Appendix 2-F7).

Table 6.5: Priority Flora Species within the Pinjin Survey Corridor

Species	Conservation Status
Baeckea sp. Great Victoria Desert (A.S. Weston 14813)	P2
Dicrastylis nicholasii	P2
Grevillea secunda	P2
Olearia arida	P2
Thryptomene eremaea	P2
Dicrastylis cundeeleensis	P3
Eucalyptus pimpiniana	P3
Microcorys macrediana	P3
Micromyrtus serrulata	P3
Micromyrtus stenocalyx	P3
Comesperma viscidulum	P4
Daviesia purpurascens	P4
Lepidobolus deserti	P4

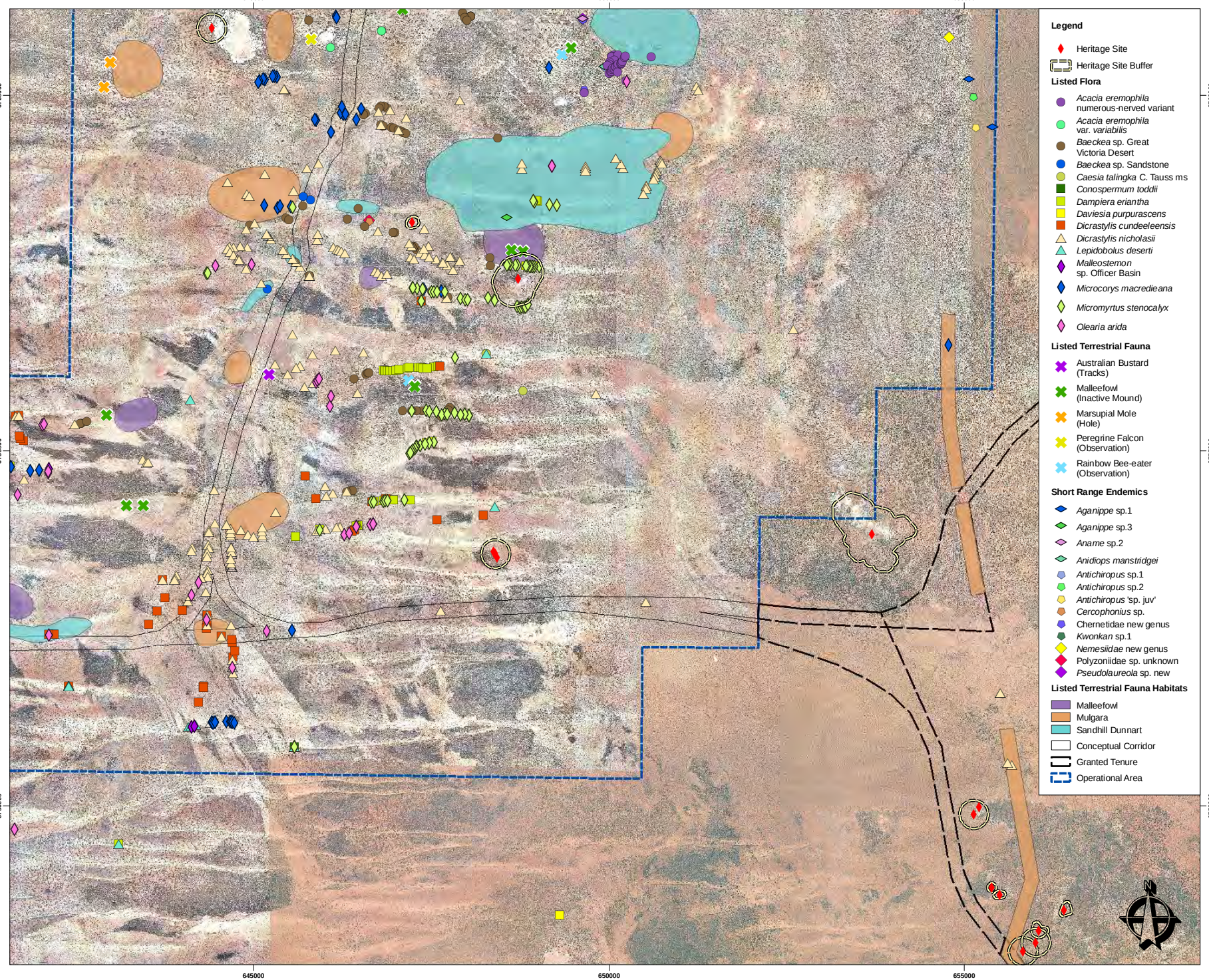
Flora Species of Conservation Interest

Where no previous records exist for taxa in these bioregions, they have been noted as being range extensions. The alignment of the road within the Pinjin survey corridor will avoid this species. Seven flora species were recorded outside of their previously known distributions during the survey.

Section 7.2.2 provides specific information on the level of impact on the listed species located within the proposed infrastructure corridor. No *C. toddii* populations will be affected or removed during the establishment of the corridor. The corridor has been designed to avoid crossing over dunes which are their preferred habitat.

Introduced Species

One introduced (weed) species, *Salvia verbenaca* (Wild Sage) was recorded along the Pinjin Survey Corridor. This species was recorded from five locations all within the Pinjin Pastoral Station.



Imagery is a composite of aerial and sate lite photography

NOTE THAT POSITION ERRORS CAN BE >5M IN SOME AREAS
- AERIAL PHOTOGRAPHY SOURCED FROM LANDGATE 2007
- LOCALITY MAP SOURCED FROM LANDGATE 2008

SCALE

0 0.25 0.5 1 1.5 2

Kilometers

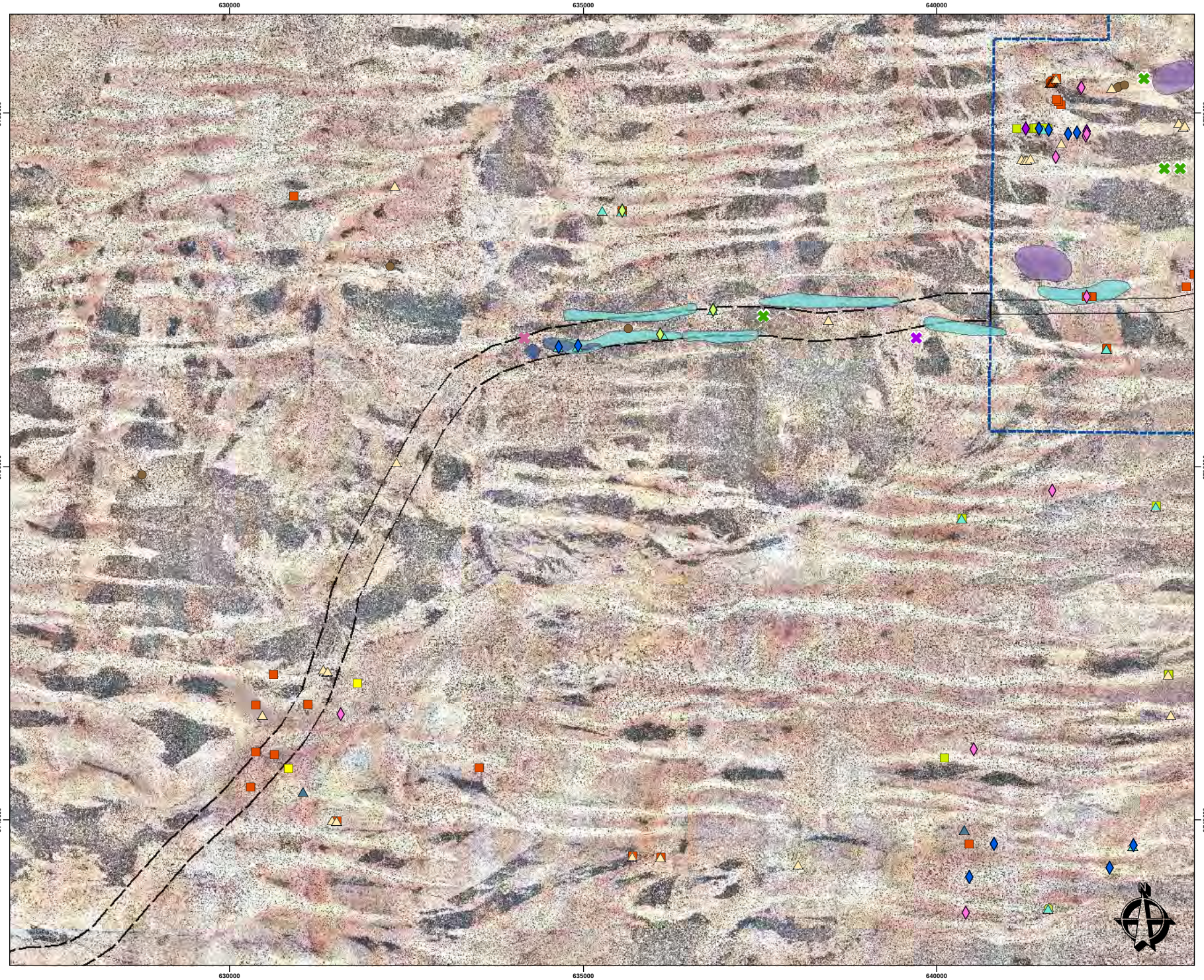
LOCALITY MAP

METADATA RECORDED	PROJECTION
100%	MGA ZONE 51
HORIZONTAL DATUM	**HEIGHT DATUM**
GDA 94	N/A

CREATED BY	CHECKED BY	APPROVED
GWa	BP	FD
DATE	**REVISION**	**DRAWING NO.**
13.08.09	0	351-2.10a

Tropicana Joint Venture
TROPICANA GOLD PROJECT

Public Environmental Review
Flora and Fauna Values and Indigenous Heritage of the Pinjin Infrastructure Corridor
Figure 6.18a



Legend

Listed Flora

- *Baeckea* sp. Great Victoria Desert
- *Caesia talingka* C. Tauss ms
- *Dampiera eriantha*
- *Daviesia purpurascens*
- *Dicrastylis cundeeleensis*
- *Dicrastylis nicholasii*
- *Grevillea secunda*
- *Lepidobolus deserti*
- *Malleostemon* sp. Officer Basin
- *Microcorys macredieana*
- *Micromyrtus stenocalyx*
- *Olearia arida*

Listed Terrestrial Fauna

- Australian Bustard (Observation)
- Malleefowl (Inactive Mound or Observation)
- Stick-nest Rat (Nest)

Listed Terrestrial Fauna Habitats

- Malleefowl
- Sandhill Dunnart
- Sandhill Dunnart - Marsupial Mole
- Conceptual Corridor
- Granted Tenure
- Operational Area

(No heritage sites)

Imagery is a composite of aerial and satellite photography

NOTE THAT POSITION ERRORS CAN BE >5M IN SOME AREAS
- AERIAL PHOTOGRAPHY SOURCED FROM LANDGATE 2007
- LOCALITY MAP SOURCED FROM LANDGATE 2008

SCALE

0 0.25 0.5 1 1.5 2

Kilometers

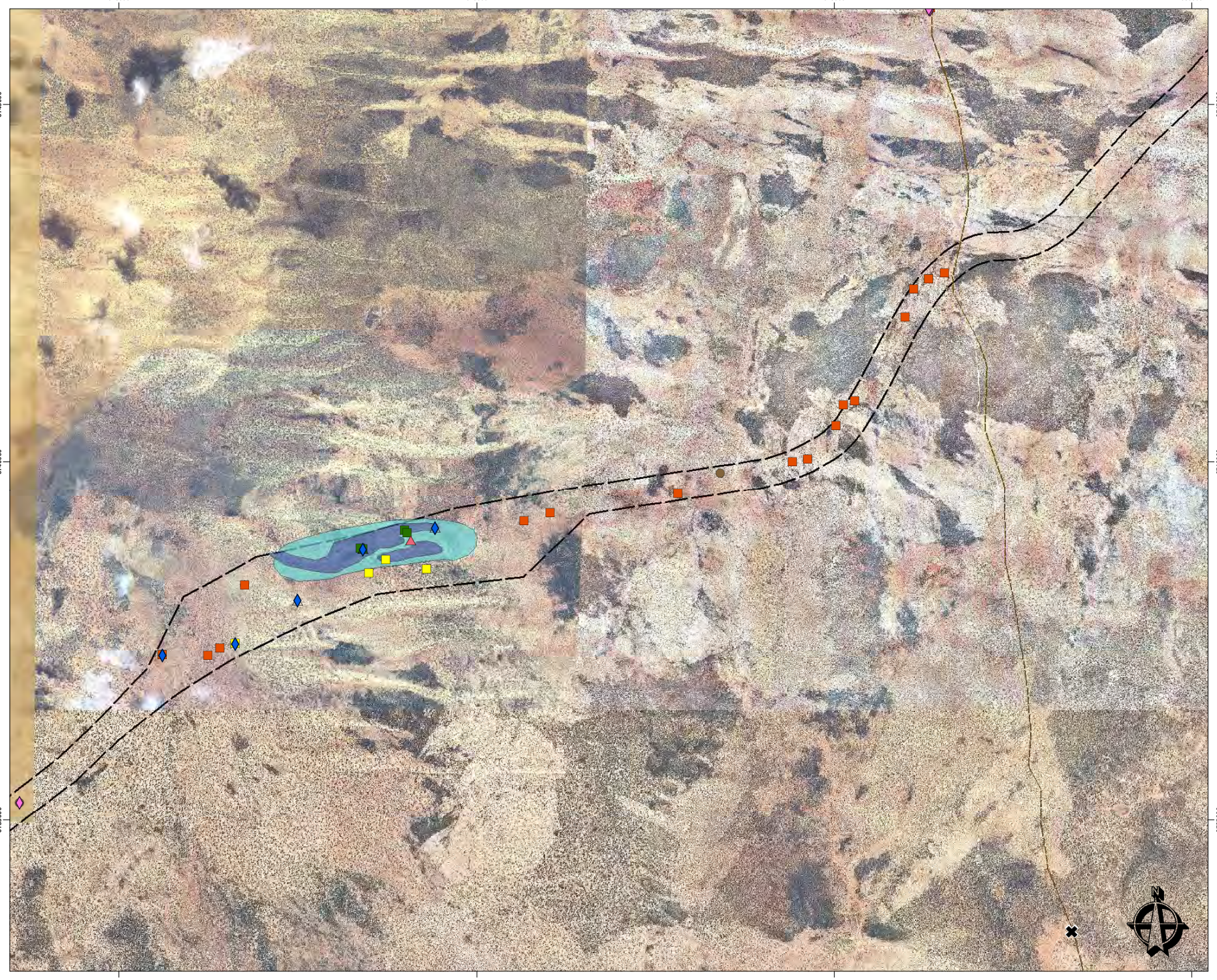
LOCALITY MAP

METADATA RECORDED	PROJECTION
100%	MGA ZONE 51
HORIZONTAL DATUM	**HEIGHT DATUM**
GDA 94	N/A

CREATED BY	CHECKED BY	APPROVED
GWa	BP	FD
DATE	**REVISION**	**DRAWING NO.**
18.08.09	1	351-2.10b

Tropicana Joint Venture
TROPICANA GOLD PROJECT

Public Environmental Review
Flora and Fauna Values and Indigenous Heritage of the Pinjin Infrastructure Corridor
Figure 6.18b



Legend

Listed Flora

- *Baeckea* sp. Great Victoria Desert
- *Conospermum toddii*
- *Daviesia purpurascens*
- *Dicrastylis cundeeleensis*
- *Hibbertia* sp. nov
- *Isotropis canescens*
- *Lepidobolus deserti*
- *Microcorys macredieana*
- *Olearia arida*

Listed Terrestrial Fauna

- Carpet Python (south west subspecies)

Listed Terrestrial Fauna Habitats

- Sandhill Dunnart
- Sandhill Dunnart - Marsupial Mole

Existing Roads and Tracks

- Gravel Road
- Track
- Granted Tenure

(No heritage sites)

Imagery is a composite of aerial and sate lite photography

NOTE THAT POSITION ERRORS CAN BE >5M IN SOME AREAS
- AERIAL PHOTOGRAPHY SOURCED FROM LANDGATE 2007
- LOCALITY MAP SOURCED FROM LANDGATE 2008

SCALE

0 0.25 0.5 1 1.5 2

Kilometers

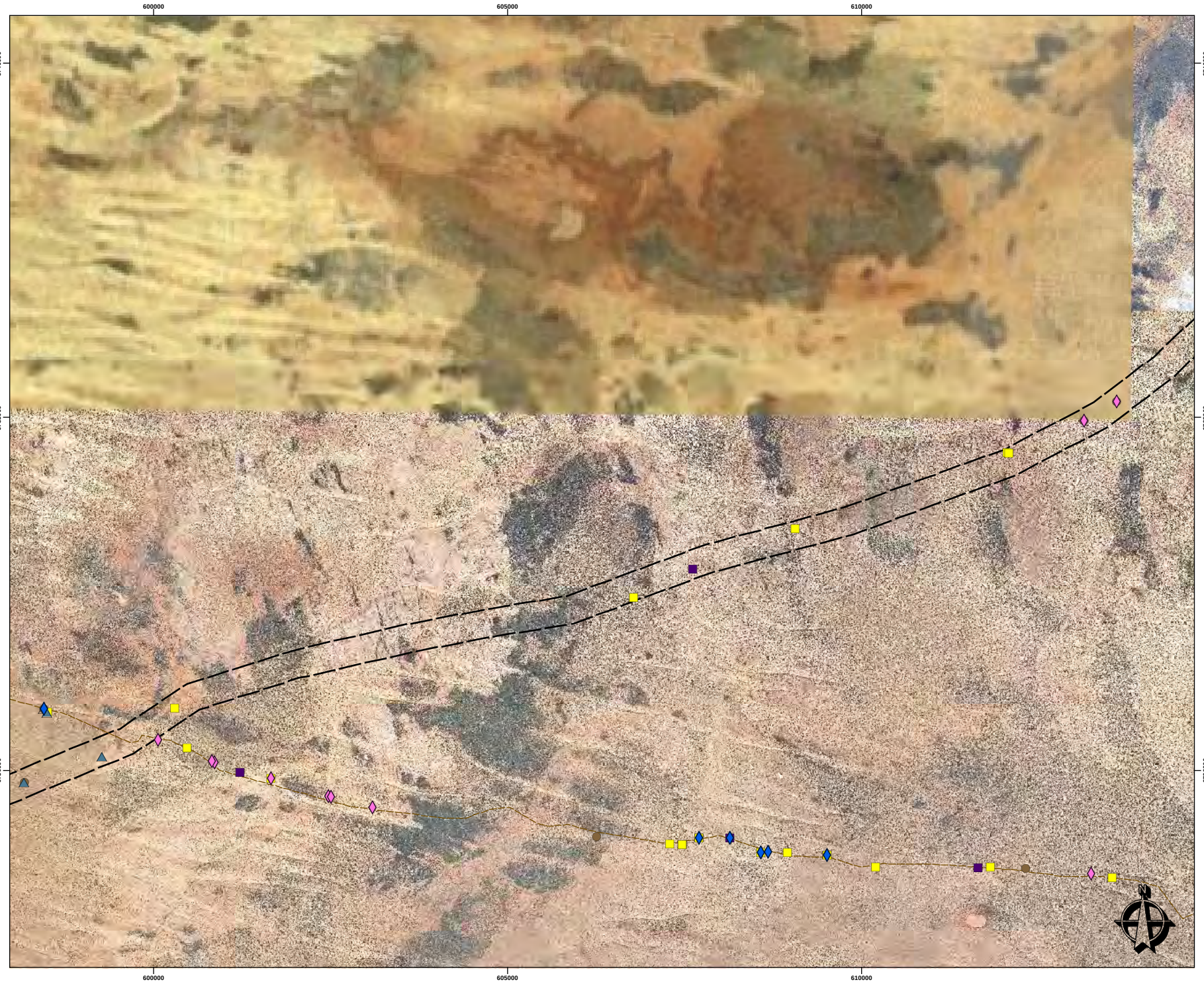
LOCALITY MAP

METADATA RECORDED	PROJECTION
100%	MGA ZONE 51
HORIZONTAL DATUM	**HEIGHT DATUM**
GDA 94	N/A

CREATED BY	CHECKED BY	APPROVED
GWa	BP	FD
DATE	**REVISION**	**DRAWING NO.**
19.08.09	0	351-2.10c

Tropicana Joint Venture
TROPICANA GOLD PROJECT

Public Environmental Review
Flora and Fauna Values and Indigenous Heritage of the Pinjin Infrastructure Corridor
Figure 6.18c



Legend

Listed Flora

- *Baeckea* sp. Great Victoria Desert
- *Comesperma viscidulum*
- *Daviesia purpurascens*
- *Grevillea secunda*
- *Microcorys macredieana*
- *Olearia arida*

Existing Roads and Tracks

- Gravel Road
- Track
- Granted Tenure

(No heritage sites, listed terrestrial fauna or threatened fauna habitat)

Refer to page xxx for vegetation description

Imagery is a composite of aerial and satellite photography

NOTE THAT POSITION ERRORS CAN BE >5M IN SOME AREAS
- AERIAL PHOTOGRAPHY SOURCED FROM LANDGATE 2007
- LOCALITY MAP SOURCED FROM LANDGATE 2008

SCALE

0 0.25 0.5 1 1.5 2

Kilometers

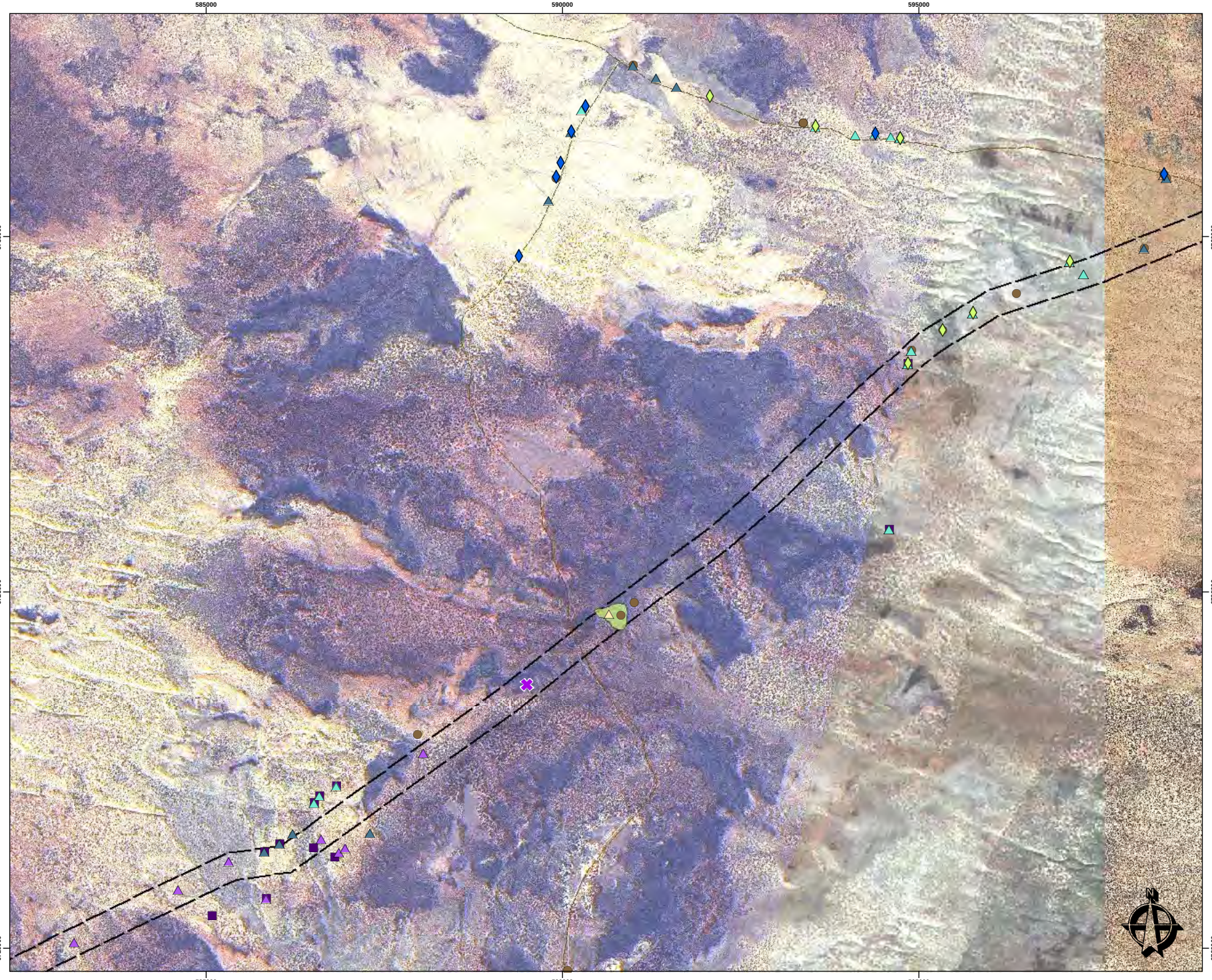
LOCALITY MAP

METADATA RECORDED	PROJECTION
100%	MGA ZONE 51
HORIZONTAL DATUM	**HEIGHT DATUM**
GDA 94	N/A

CREATED BY	CHECKED BY	APPROVED
GWa	BP	FD
DATE	**REVISION**	**DRAWING NO.**
19.08.09	1	351-2.10d

Tropicana Joint Venture
TROPICANA GOLD PROJECT

Public Environmental Review
Flora and Fauna Values and Indigenous Heritage of the Pinjin Infrastructure Corridor
Figure 6.18d



Legend

Listed Flora

- *Baeckea* sp. Great Victoria Desert
- *Comesperma viscidulum*
- *Dicrastylis nicholasii*
- *Eucalyptus pimpiniana*
- *Grevillea secunda*
- *Lepidobolus deserti*
- *Microcorys macredieana*
- *Micromyrtus serrulata*
- *Micromyrtus stenocalyx*

Listed Terrestrial Fauna

- Australian Bustard (Footprints)

Listed Terrestrial Fauna Habitat

- Melaleuca Heath

Existing Roads and Tracks

- Gravel Road
- Track
- Granted Tenure

(No heritage sites)

Imagery is a composite of aerial and satellite photography

NOTE THAT POSITION ERRORS CAN BE >5M IN SOME AREAS
- AERIAL PHOTOGRAPHY SOURCED FROM LANDGATE 2007
- LOCALITY MAP SOURCED FROM LANDGATE 2008

SCALE

0 0.25 0.5 1 1.5 2

Kilometers

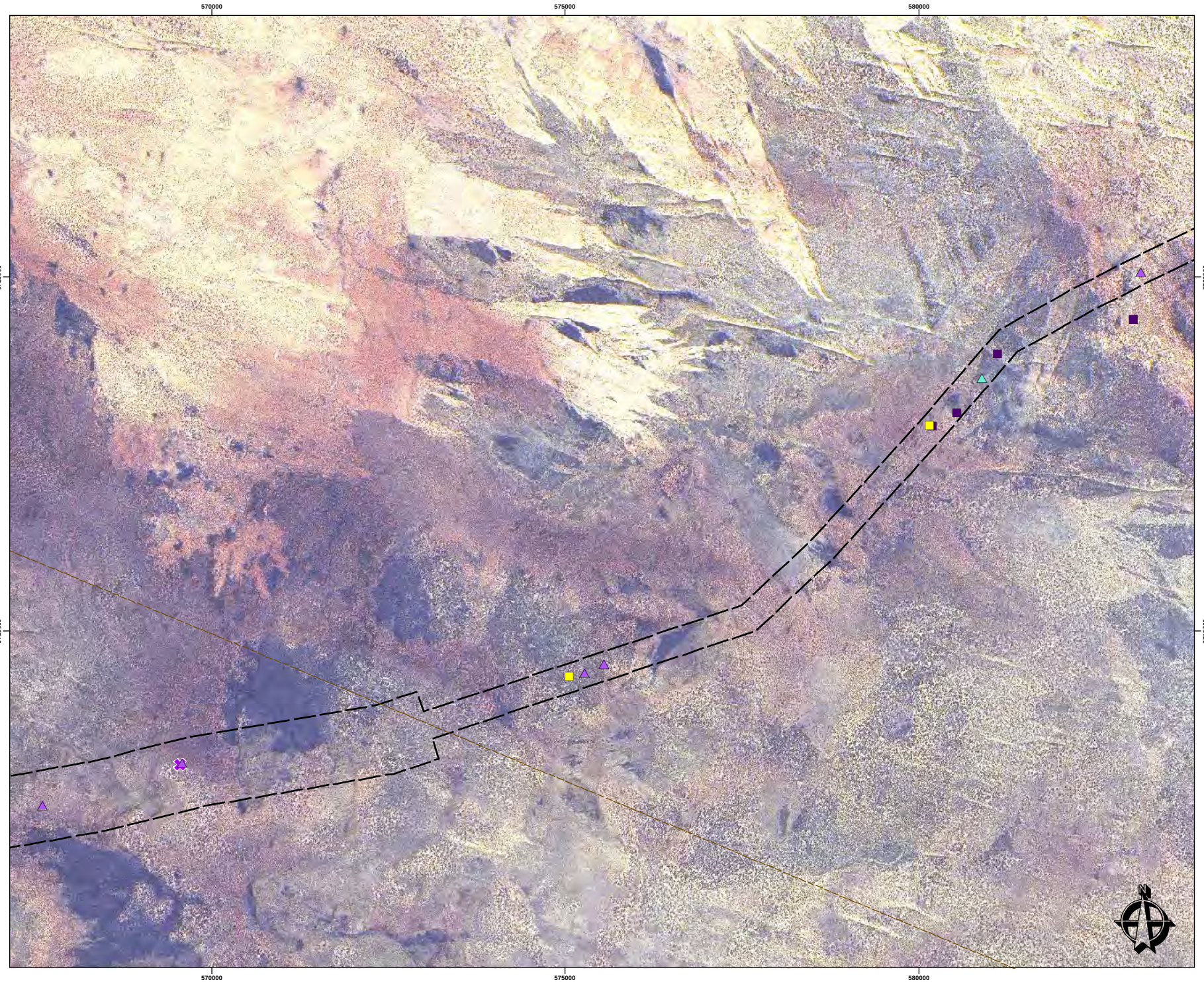
LOCALITY MAP

METADATA RECORDED	PROJECTION
100%	MGA ZONE 51
HORIZONTAL DATUM	**HEIGHT DATUM**
GDA 94	N/A

CREATED BY	CHECKED BY	APPROVED
GWa	BP	FD
DATE	**REVISION**	**DRAWING NO.**
18.08.09	1	351-2.10e

Tropicana Joint Venture
TROPICANA GOLD PROJECT

Public Environmental Review
Flora and Fauna Values and Indigenous Heritage of the Pinjin Infrastructure Corridor
Figure 6.18e



Legend

Listed Flora

- *Comesperma viscidulum*
- *Daviesia purpurascens*
- *Eucalyptus pimpiniana*
- *Lepidobolus deserti*

Listed Terrestrial Fauna

- Australian Bustard (Footprints)
- Rainbow Bee-eater (Observation)

Existing Roads and Tracks

- Gravel Road
- Track
- Granted Tenure

(No heritage sites, threatened fauna habitat)

Imagery is a composite of aerial and satellite photography

NOTE THAT POSITION ERRORS CAN BE >5M IN SOME AREAS
- AERIAL PHOTOGRAPHY SOURCED FROM LANDGATE 2007
- LOCALITY MAP SOURCED FROM LANDGATE 2008

SCALE

0 0.25 0.5 1 1.5 2

Kilometers

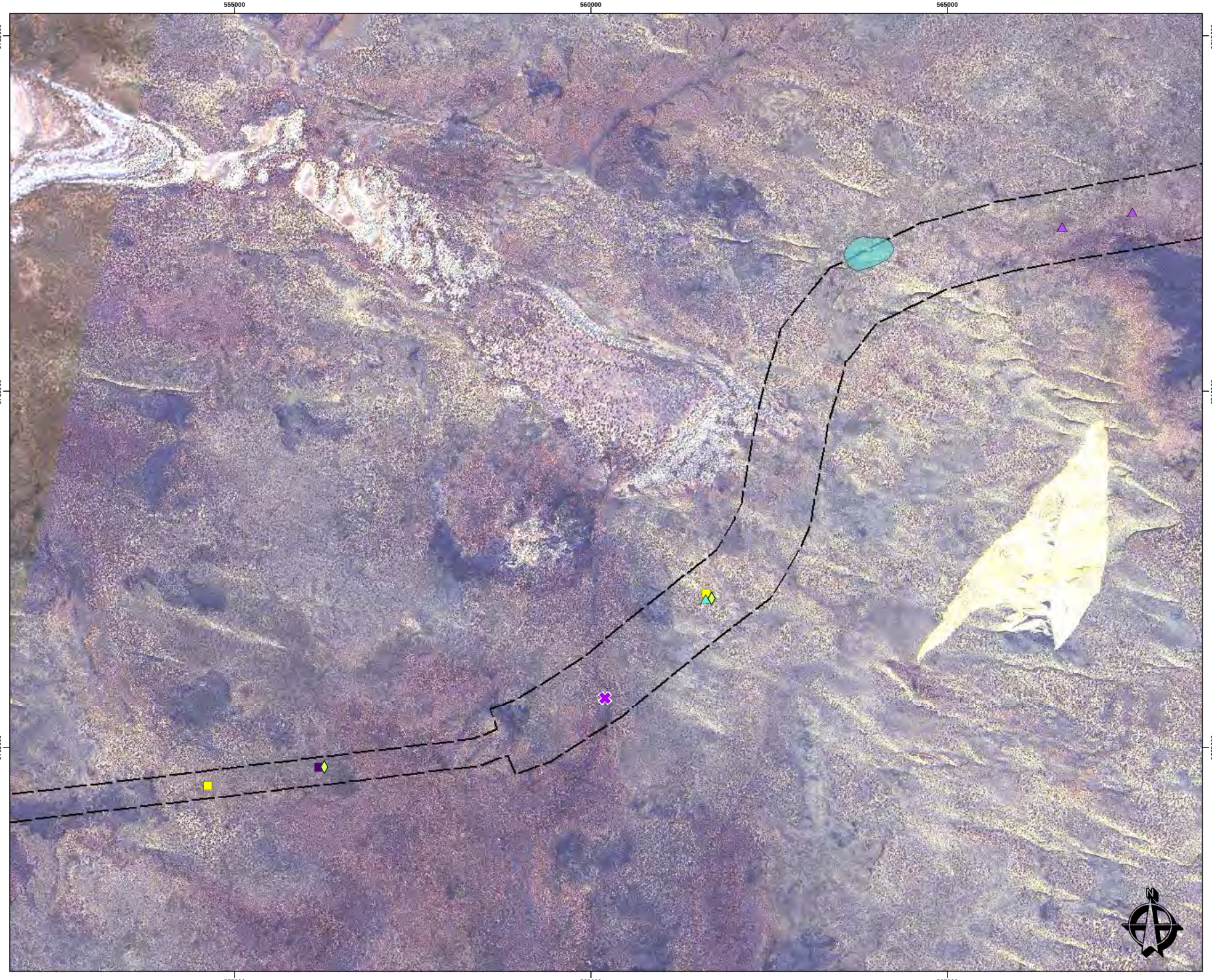
LOCALITY MAP

METADATA RECORDED	PROJECTION
100%	MGA ZONE 51
HORIZONTAL DATUM	**HEIGHT DATUM**
GDA 94	N/A

CREATED BY	CHECKED BY	APPROVED
GWa	BP	FD
DATE	**REVISION**	**DRAWING NO.**
18.08.09	1	351-2.10f

Tropicana Joint Venture
TROPICANA GOLD PROJECT

Public Environmental Review
Flora and Fauna Values and Indigenous Heritage of the Pinjin Infrastructure Corridor
Figure 6.18f



Legend

Listed Flora

- *Comesperma viscidulum*
- *Daviesia purpurascens*
- *Eucalyptus pimpiniana*
- *Lepidobolus deserti*
- *Micromyrtus stenocalyx*

Listed Terrestrial Fauna

- *Australian Bustard (Footprints)*
- *Malleefowl (Footprints)*

Listed Terrestrial Fauna Habitat

- Sandhill Dunnart
- Granted Tenure

(No heritage sites)

Imagery is a composite of aerial and satellite photography

NOTE THAT POSITION ERRORS CAN BE >5M IN SOME AREAS
- AERIAL PHOTOGRAPHY SOURCED FROM LANDGATE 2007
- LOCALITY MAP SOURCED FROM LANDGATE 2008

SCALE

0 0.25 0.5 1 1.5 2

Kilometers

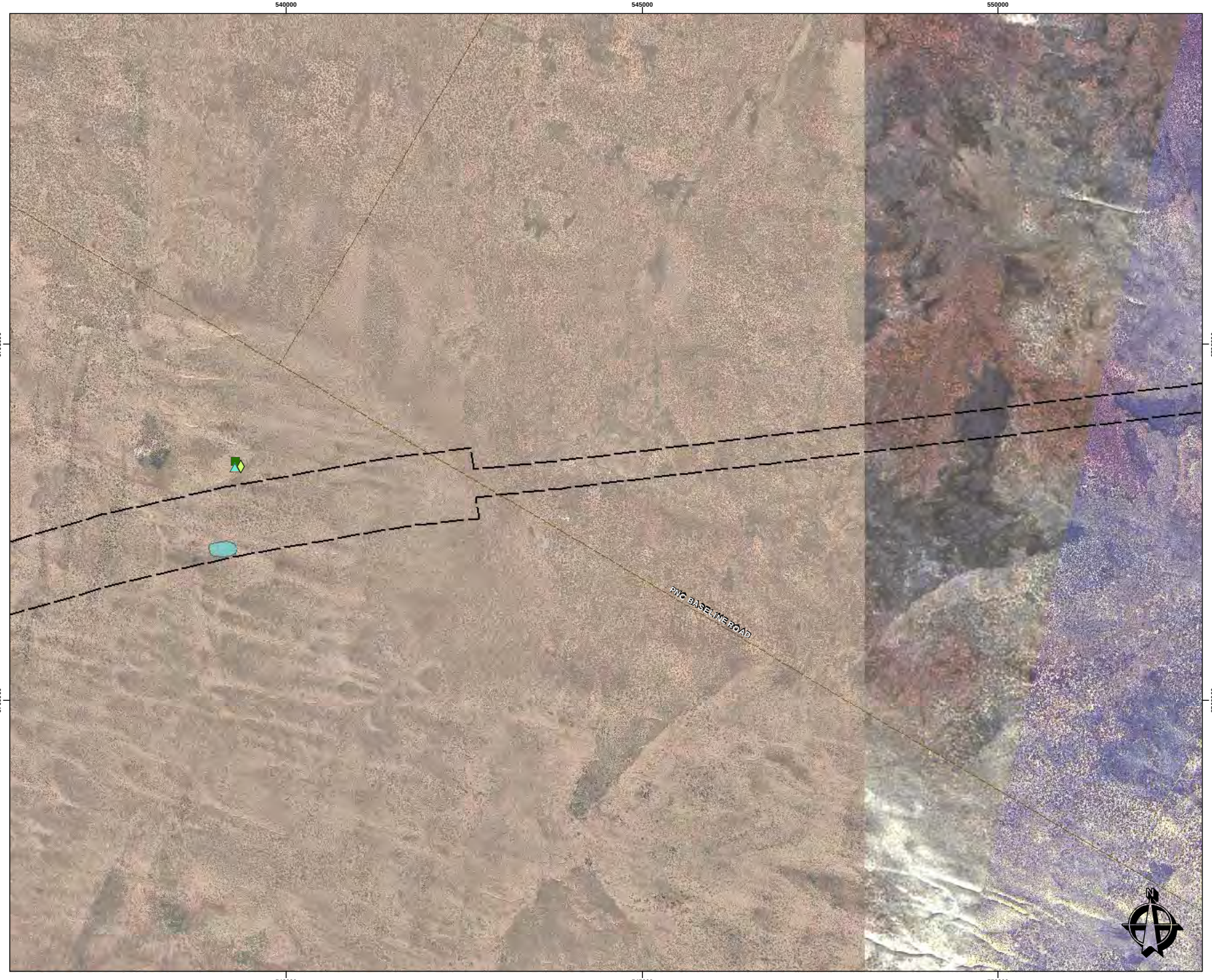
LOCALITY MAP

METADATA RECORDED	PROJECTION
100%	MGA ZONE 51
HORIZONTAL DATUM	**HEIGHT DATUM**
GDA 94	N/A

CREATED BY	CHECKED BY	APPROVED
GWa	BP	FD
DATE	**REVISION**	**DRAWING NO.**
18.08.09	1	351-2.10g

Tropicana Joint Venture
TROPICANA GOLD PROJECT

Public Environmental Review
Flora and Fauna Values and Indigenous Heritage of the Pinjin Infrastructure Corridor
Figure 6.18g



Legend

Listed Flora

- *Conospermum toddii*
- *Lepidobolus deserti*
- *Micromyrtus stenocalyx*

Listed Terrestrial Fauna Habitat

- Sandhill Dunnart

Existing Roads and Tracks

- Gravel Road
- Track
- Granted Tenure

(No heritage sites or listed terrestrial fauna)

Imagery is a composite of aerial and satellite photography

NOTE THAT POSITION ERRORS CAN BE >5M IN SOME AREAS
- AERIAL PHOTOGRAPHY SOURCED FROM LANDGATE 2007
- LOCALITY MAP SOURCED FROM LANDGATE 2008

SCALE

0 0.25 0.5 1 1.5 2

Kilometers

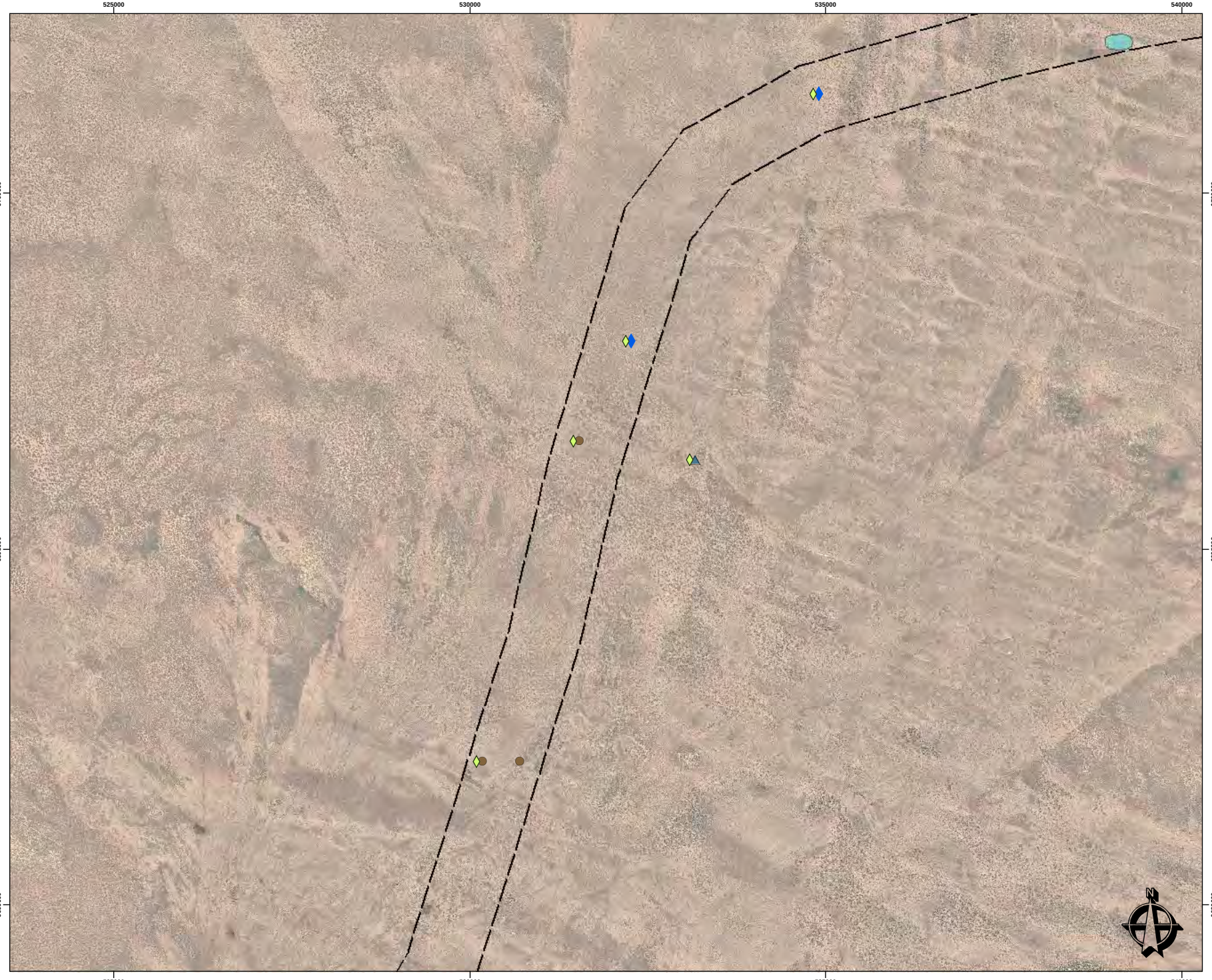
LOCALITY MAP

METADATA RECORDED	PROJECTION
100%	MGA ZONE 51
HORIZONTAL DATUM	**HEIGHT DATUM**
GDA 94	N/A

CREATED BY	CHECKED BY	APPROVED
GWa	BP	FD
DATE	**REVISION**	**DRAWING NO.**
19.08.09	1	351-2.10h

Tropicana Joint Venture
TROPICANA GOLD PROJECT

Public Environmental Review
Flora and Fauna Values and Indigenous Heritage of the Pinjin Infrastructure Corridor
Figure 6.18h



Legend

Listed Flora

- *Baeckea* sp. Great Victoria Desert
- *Grevillea secunda*
- *Microcorys macredieana*
- *Micromyrtus stenocalyx*

Listed Terrestrial Fauna Habitat

- Sandhill Dunnart
- Granted Tenure

(No heritage sites or listed terrestrial fauna)

Imagery is a composite of aerial and satellite photography

NOTE THAT POSITION ERRORS CAN BE >5M IN SOME AREAS
- AERIAL PHOTOGRAPHY SOURCED FROM LANDGATE 2007
- LOCALITY MAP SOURCED FROM LANDGATE 2008

SCALE

0 0.25 0.5 1 1.5 2

Kilometers

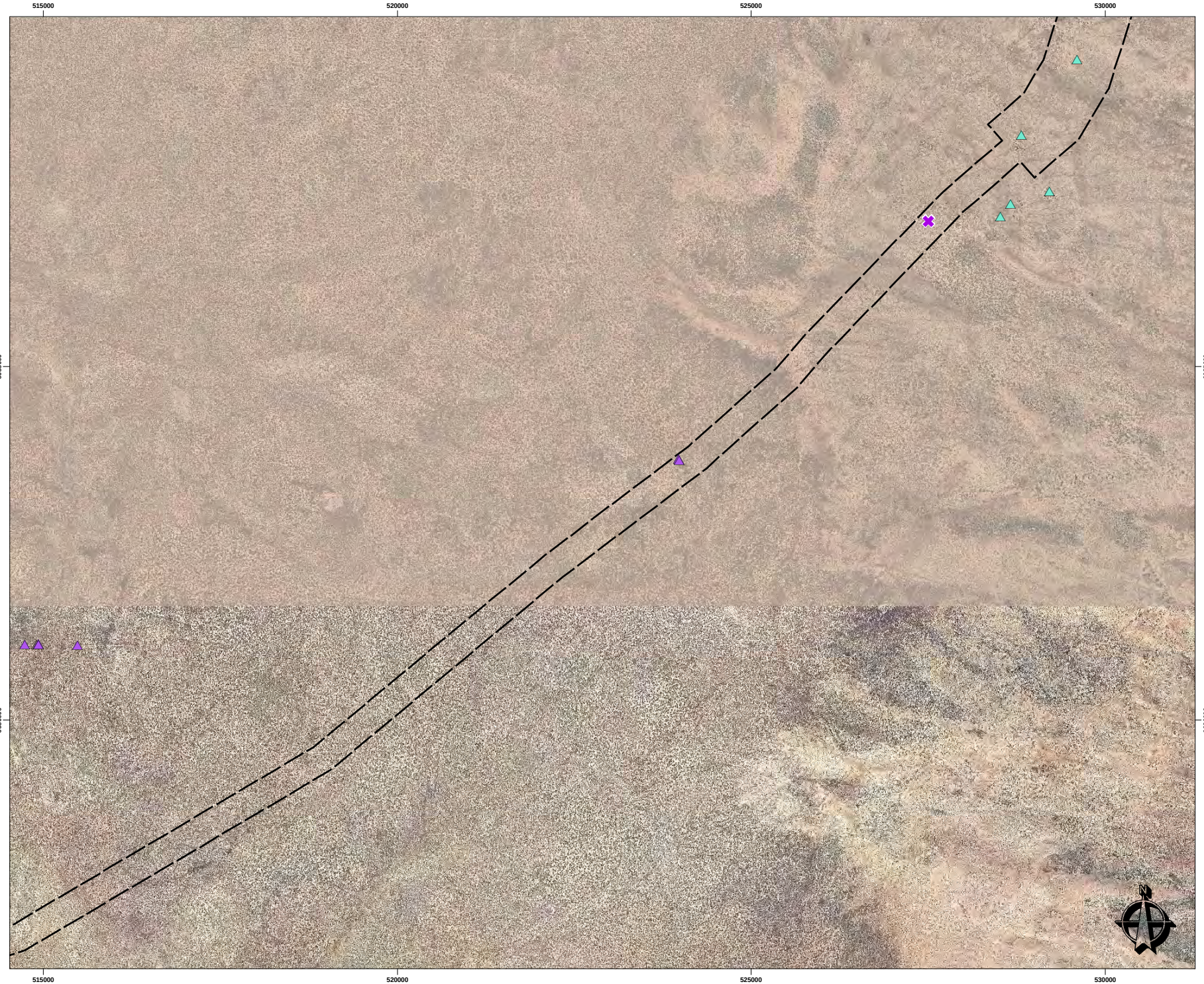
LOCALITY MAP

METADATA RECORDED	PROJECTION
100%	MGA ZONE 51
HORIZONTAL DATUM	**HEIGHT DATUM**
GDA 94	N/A

CREATED BY	CHECKED BY	APPROVED
GWa	BP	FD
DATE	**REVISION**	**DRAWING NO.**
18.08.09	1	351-2.10i

Tropicana Joint Venture
TROPICANA GOLD PROJECT

Public Environmental Review
Flora and Fauna Values and Indigenous Heritage of the Pinjin Infrastructure Corridor
Figure 6.18i



Legend

Listed Flora

- *Eucalyptus pimpiniana*
- *Lepidobolus deserti*

Listed Terrestrial Fauna

- Australian Bustard (Observation, Nest & Egg)

Granted Tenure

(No heritage sites or listed terrestrial fauna habitats)

Imagery is a composite of aerial and satellite photography

NOTE THAT POSITION ERRORS CAN BE >5M IN SOME AREAS
- AERIAL PHOTOGRAPHY SOURCED FROM LANDGATE 2007
- LOCALITY MAP SOURCED FROM LANDGATE 2008

SCALE

0 0.25 0.5 1 1.5 2

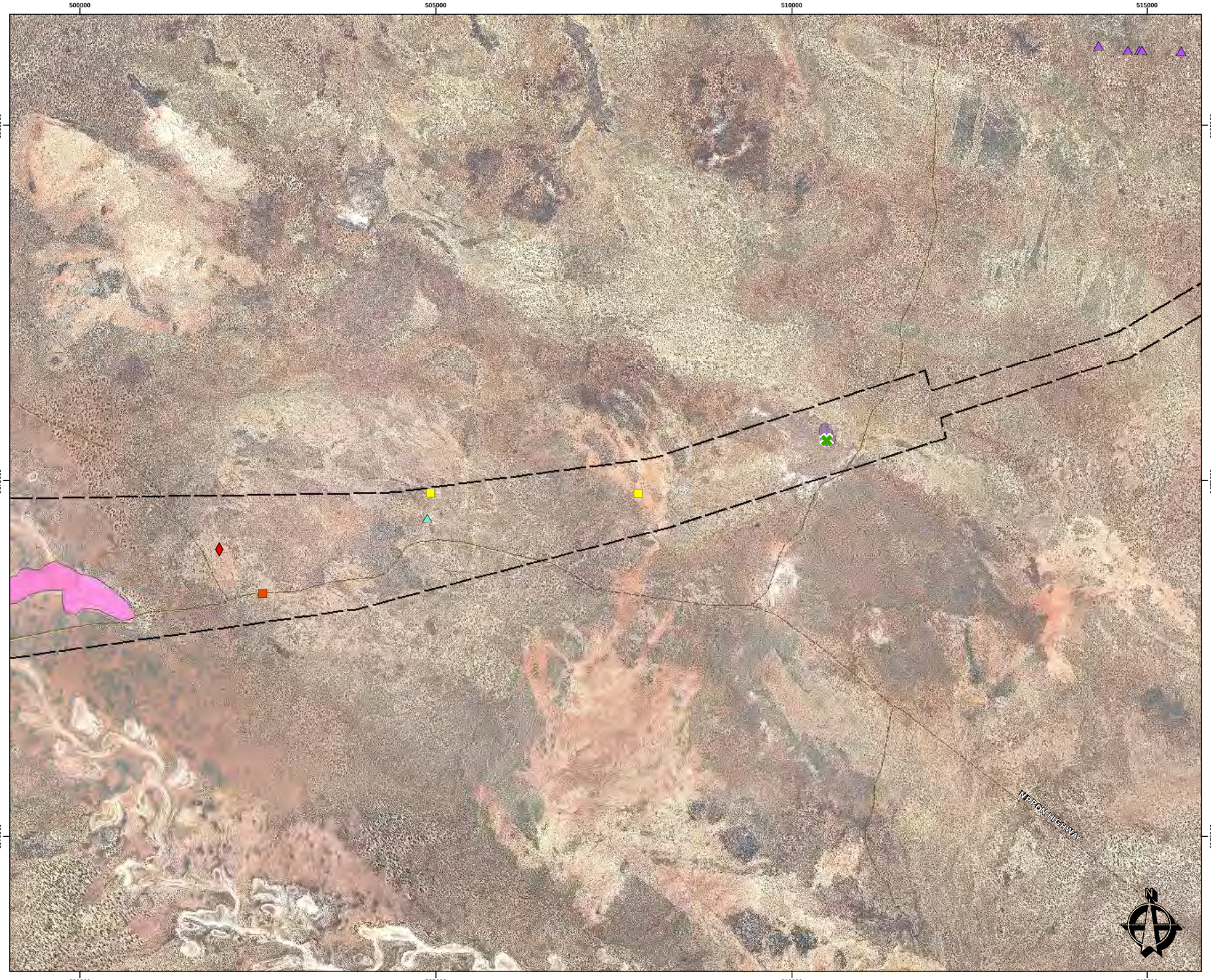
Kilometers

LOCALITY MAP

METADATA RECORDED	PROJECTION	
100%	MGA ZONE 51	
HORIZONTAL DATUM	**HEIGHT DATUM**	
GDA 94	N/A	
CREATED BY	**CHECKED BY**	**APPROVED**
GWa	BP	FD
DATE	**REVISION**	**DRAWING NO.**
18.08.09	1	351-2.10j

Tropicana Joint Venture
TROPICANA GOLD PROJECT

Public Environmental Review
Flora and Fauna Values and Indigenous Heritage of the Pinjin Infrastructure Corridor
Figure 6.18j



Legend

Listed Flora

- *Daviesia purpurascens*
- *Dicrastylis cundeeleensis*
- *Eucalyptus pimpiniana*
- *Lepidobolus deserti*
- *Thryptomene eremaea*

Listed Terrestrial Fauna

- Malleefowl (Active & Inactive Mounds)

Listed Terrestrial Fauna Habitats

- Chenopod Flats
- Malleefowl

Existing Roads and Tracks

- Gravel Road
- Track
- Granted Tenure

(No heritage sites)

Imagery is a composite of aerial and satellite photography

NOTE THAT POSITION ERRORS CAN BE >5M IN SOME AREAS
- AERIAL PHOTOGRAPHY SOURCED FROM LANDGATE 2007
- LOCALITY MAP SOURCED FROM LANDGATE 2008

SCALE

0 0.25 0.5 1 1.5 2

Kilometers

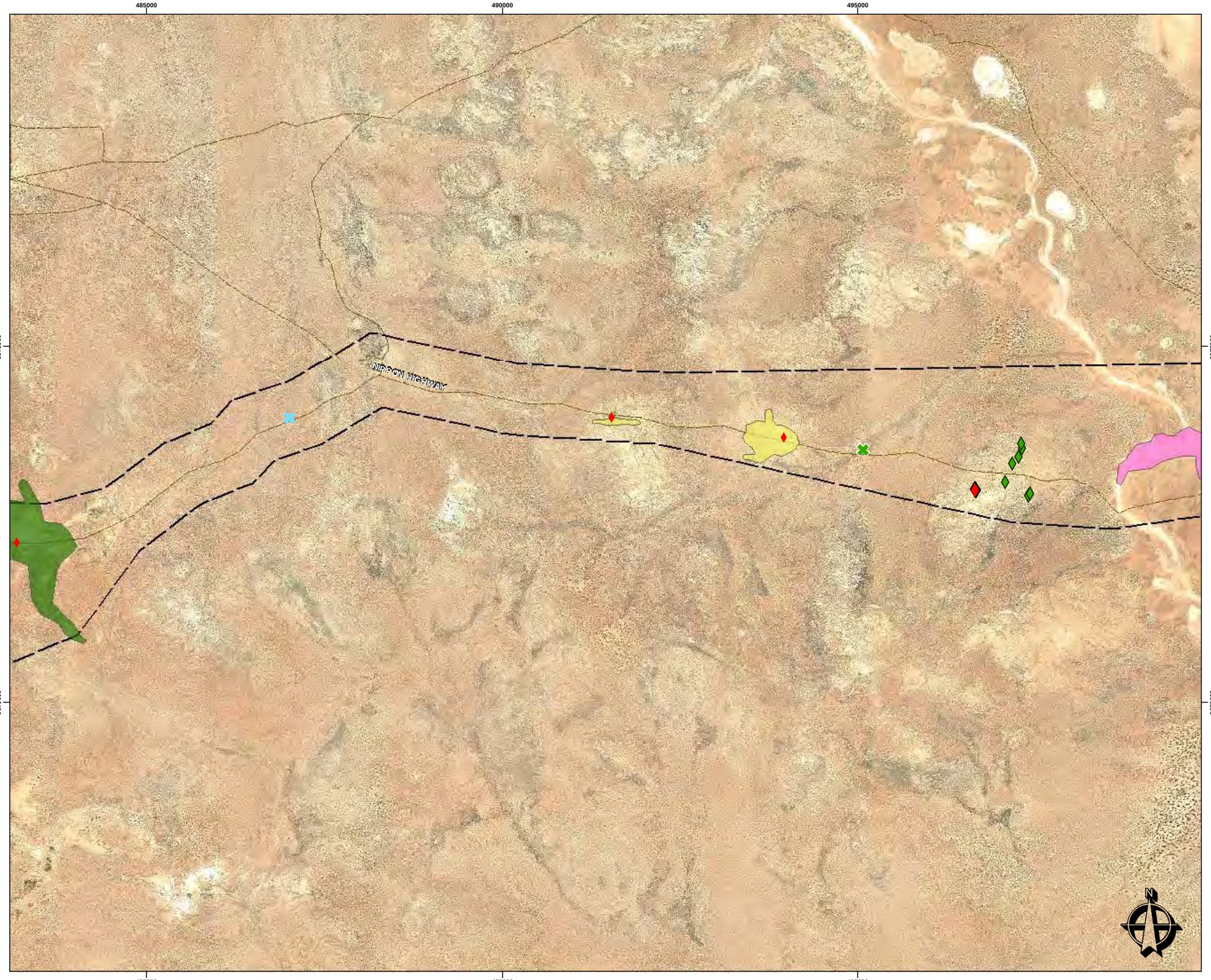
LOCALITY MAP

METADATA RECORDED	PROJECTION
100%	MGA ZONE 51
HORIZONTAL DATUM	**HEIGHT DATUM**
GDA 94	N/A

CREATED BY	CHECKED BY	APPROVED
GWa	BP	FD
DATE	**REVISION**	**DRAWING NO.**
18.08.09	1	351-2.10k

Tropicana Joint Venture
TROPICANA GOLD PROJECT

Public Environmental Review
Flora and Fauna Values and Indigenous Heritage of the Pinjin Infrastructure Corridor
Figure 6.18k



Legend

- Heritage Site

Listed Flora

- *Micromyrtus serrulata*
- *Thryptomene eremaea*

Listed Terrestrial Fauna

- Malleefowl (Observation)
- Rainbow Bee-eater (Observation)

Listed Terrestrial Fauna Habitats

- Casuarina Woodland
- Chenopod Flats
- Granite Outcrop

Existing Roads and Tracks

- Gravel Road
- Track
- Granted Tenure

Imagery is a composite of aerial and satellite photography

NOTE THAT POSITION ERRORS CAN BE >5M IN SOME AREAS
- AERIAL PHOTOGRAPHY SOURCED FROM LANDGATE 2007
- LOCALITY MAP SOURCED FROM LANDGATE 2008

SCALE

0 0.25 0.5 1 1.5 2

Kilometers

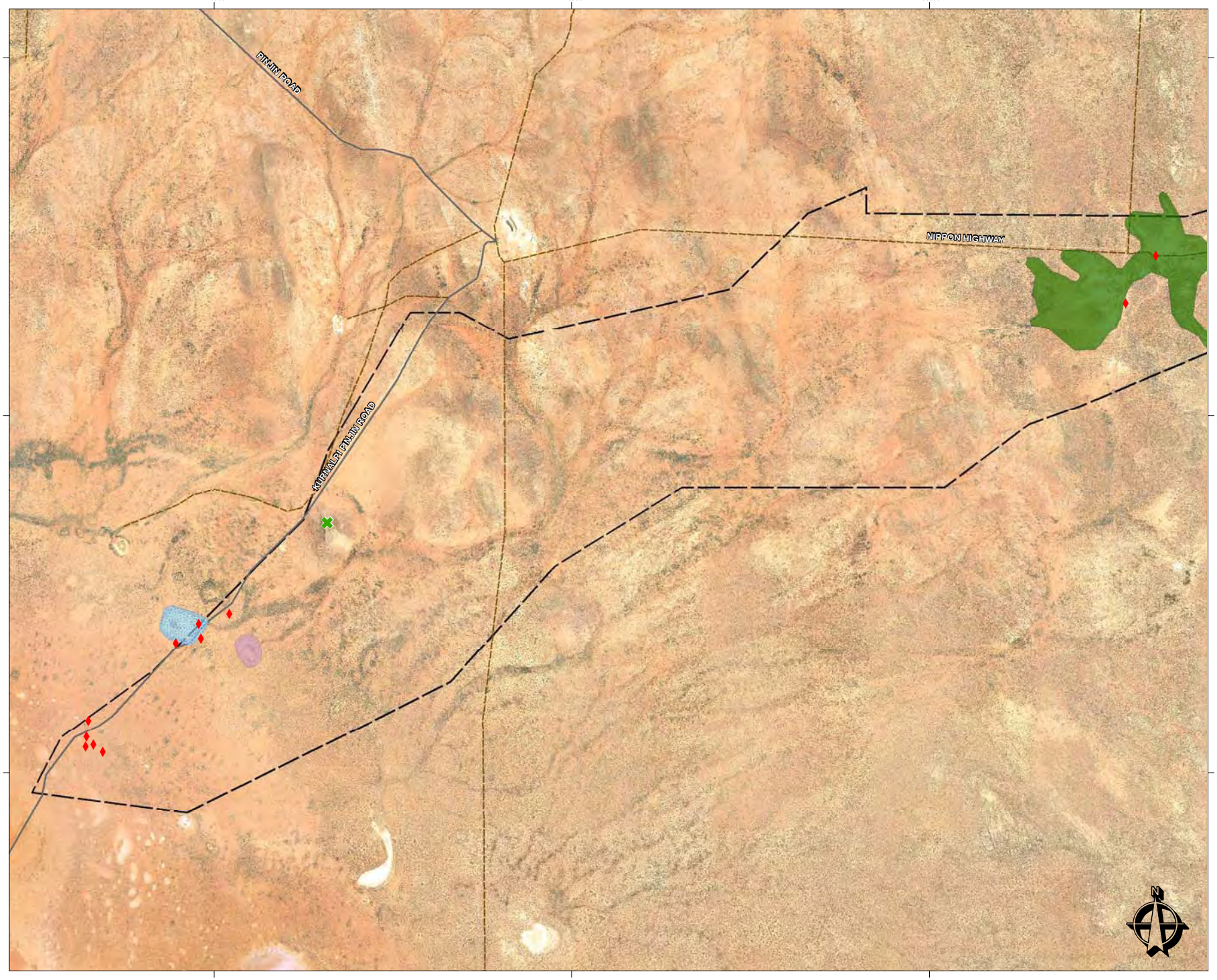
LOCALITY MAP

METADATA RECORDED	PROJECTION
100%	MGA ZONE 51
HORIZONTAL DATUM	**HEIGHT DATUM**
GDA 94	N/A

CREATED BY	CHECKED BY	APPROVED
GWa	BP	FD
DATE	**REVISION**	**DRAWING NO.**
18.08.09	1	351-2.10I

Tropicana Joint Venture
TROPICANA GOLD PROJECT

Public Environmental Review
Flora and Fauna Values and Indigenous Heritage of the Pinjin Infrastructure Corridor
Figure 6.18I



Legend

Heritage Site

Listed Terrestrial Fauna

Malleefowl
(Inactive Mound)

Listed Terrestrial Fauna Habitats

Callistemon Open Scrub
Casuarina Woodland
Water Body

Existing Roads and Tracks

Gravel Road
Track
Granted Tenure

(No listed flora)

Imagery is a composite of aerial and satellite photography

NOTE THAT POSITION ERRORS CAN BE >5M IN SOME AREAS
- AERIAL PHOTOGRAPHY SOURCED FROM LANDGATE 2007
- LOCALITY MAP SOURCED FROM LANDGATE 2008

SCALE

0 0.25 0.5 1 1.5 2

K lometers
1:50,000

LOCALITY MAP

METADATA RECORDED	PROJECTION
100%	MGA ZONE 51
HORIZONTAL DATUM	**HEIGHT DATUM**
GDA 94	N/A

CREATED BY	CHECKED BY	APPROVED
GWa	BP	FD
DATE	**REVISION**	**DRAWING NO.**
18.08.09	1	351-2.10m

Tropicana Joint Venture
TROPICANA GOLD PROJECT

Public Environmental Review
Flora and Fauna Values and Indigenous Heritage of the Pinjin Infrastructure Corridor
Figure 6.18m

6.3.3. Fauna

Vertebrate Fauna

Surveys of fauna values along the Pinjin Infrastructure Corridor were conducted using a number of independent consultants. The primary fauna survey was undertaken by Ninox Wildlife Consulting as a Level One Reconnaissance Survey over two separate field trips in December 2007 and March 2008 (Appendix 2-C6). This survey was supplemented by an opportunistic fauna survey of the Pinjin Station section of the corridor by Jeff Turpin (from Waru Consulting) in February and March 2008 following rain (results included in Appendix A2-C6), and targeted cryptic species surveys by URS (Marsupial Moles; Appendix 2-F5) and Glen Gaikhorst and Cathy Lambert (Sandhill Dunnarts; Appendix 2-F1) (Table 6.6). Fauna surveys have been designed to meet the requirements of the EPA Guidance Statement 56 (EPA 2004d). Habitat assessments for the presence of conservation interest species were incorporated into all the surveys (refer to section 6.2.8 for specific habitat descriptions for the Marsupial Mole, Sandhill Dunnart, Mulgara and the Malleefowl).

Like the vegetation and flora assessment of the Pinjin Infrastructure Corridor, all surveys were conducted over a much greater area than will be directly affected by the proposed infrastructure. This approach was adopted to enable engineers to modify the infrastructure route to avoid or limit impacts on significant fauna habitats.

The findings of these surveys are displayed in the previous Figure 6.18a-m, summarised in this section and the full reports are included as Appendices 2-C6, 2-F1 and 2-F5.

Table 6.6: Fauna Surveys for the Pinjin Infrastructure Corridor

Survey	Consultants	Surveys Timing
Level 1 Reconnaissance	Ninox Wildlife Consulting (Appendix 2-C6)	December 2007 & March 2008
Pinjin Opportunistic	Jeff Turpin (Waru Consulting – results incorporated into Appendix 2-C6)	February – March 2008
Marsupial Mole	URS Australia (Appendix 2-F5)	November 2007, March & April 2008
Sandhill Dunnarts	Gaikhorst and Lambert (Appendix 2 F1)	March & May 2008

Birds

A desktop assessment of the survey corridor suggested that 118 bird species could be present. As a result of all of the surveys a total of 81 bird species have been observed along the corridor, 45 bird species were recorded during the Ninox Survey and 75 bird species were recorded during the Waru Survey (note many species were common to both surveys). Some of the additional species recorded in February and March 2008 by Waru Consulting were waterbirds observed around clay plans located on the Pinjin Station, previous surveys of these areas conducted by Ninox Consulting were during dry conditions. The most speciose families were Honeyeaters (Meliphagidae; seven taxa), Warblers (Acanthizidae; five taxa) and Parrots (Psittacidae; four taxa).

Listed Bird Species

The following listed bird species (and/ or their nests) were recorded during the surveys (Figure 6.16a-m):

- Malleefowl (*Leipoa ocellata*) - Listed as Vulnerable under the EPBC Act and Schedule 1 under the WC Act, an individual was sighted and footprints were noted, as were two nesting mounds;
- Rainbow Bee-eater (*Merops ornatus*) - Listed as Migratory[3] under the EPBC Act; sighted on several occasions;
- Wood Sandpiper (*Tringa glareola*) – Listed as Migratory under the EPBC Act; sighted at small lake north of Lake Rebecca (WGS84 51J 469458mE, 6667084mN);
- Common Greenshank (*Tringa nebularia*) - Listed as Migratory under the EPBC Act; sighted at small lake north of Lake Rebecca (WGS84 51J 469458mE, 6667084mN);
- Bustard (*Ardeotis australis*) - Listed as a Priority species by the DEC; a nest with one egg was found in a small remnant of unburnt vegetation on a yellow sandplain (Plate 6.18), more than 50 m from the proposed access Pinjin Infrastructure Corridor plus tracks were observed in the Pinjin Infrastructure Corridor; and,
- Crested Bellbird (*Oreoica gutturalis*) - Listed as a Priority Species by the DEC; sighted during the surveys.

Plate 6.18: Australian Bustard Nest and Egg Observed Near to the Pinjin Infrastructure

[3] Migratory species are those animals that migrate to Australia and its external territories, or pass though or over Australian waters during their annual migrations. Listed migratory species also include any native species identified in an international agreement approved by the Minister. All species on the list of migratory species are matters of national environmental significance under the EPBC Act.

Table 6.7 lists the listed bird species that might also occur along the corridor that were not observed during the surveys.

Table 6.7: Listed Bird Species Likely to Occur Along the Pinjin Infrastructure Corridor

Species	Conservation Status
Fork-tailed Swift (*Apus pacificus*)	EPBC Migratory
Princess Parrot (*Polytelis alexandrae*)	DEC Priority 4
Striated Grasswren (*Amytornis striatus*)	DEC Priority 4
Thick-billed Grasswren (*Amytornis textilis*)	DEC Priority 4
Slender-billed Thornbill (*Acanthiza iredalei iredalei*)	EPBC Vulnerable; DEC Priority 4

Bird Species of Conservation Interest

In addition to the listed bird species; evidence of two other species of conservation interest was recorded within the Pinjin Infrastructure Corridor Survey. These where Purple-crowned Lorikeet (*Glossopsitta porphyrocephala*; edge of its range) and the Blue-billed Duck (*Oxyura australis*; locally significant).

Native Mammals

The desktop assessment of the corridor suggested that 37 mammal species potentially occur within the survey area. Evidence of 12 native mammals was recorded in the surveys (Table 6.8). Evidence of extinct species have not been included in these numbers.

Table 6.8: Mammals Observed or Evidence Recorded Within the Pinjin Survey Corridor

Species	Conservation Status
Australian Dingo (*Canis lupus dingo*)	-
Mulgara (*Dasycercus blythi*)[1]	DEC Priority 4
Western Grey Kangaroo (*Macropus fuliginosus)*	-
Euro (*Macropus robustus*)	-
Red Kangaroos (*Macropus rufus*)	-
Ningaui (*Ningaui ridei* or *yvonnae*)	-
Spinifex Hopping Mouse (*Notomys alexis*)	-
Marsupial Mole (*Notoryctes typhlops* or *caurinus*)[2]	Endagnered / Schedule 1
Sandy Inland Mouse (*Pseudomys hermannsburgensis*)	-
Little Long-tailed Dunnart (*Sminthopsis dolichura*)	-
Hairy-footed Dunnart (*Sminthopsis hirtipes*)	-
Echidna (*Tachyglossus aculeatus*)	-
White-striped Freetail Bat (*Tadarida australis*)	-

1. Burrows likely to be Mulgara where observed
2. Evidence of Marsupial Moles observed via URS trenching survey

Mammal Species of Conservation Interest

Evidence of Marsupial Moles (most likely the Southern Marsupial Mole [*Notoryctes typhlops*], as opposed to the Northern Marsupial Mole) was located within dunal, open scrub and/ or low open woodlands habitats with reddish yellow surface soil along the survey corridor (Figure 6.16a-m).

Targeted surveys for the Mulgara and Sandhill Dunnart did not result in the capture of either of the targeted species, but did identify areas of suitable habitat for each species (Plate 6.19 and Plate 6.20 respectively). As described in detail in section 6.2.8 Mulgara occupy spinifex (*Triodia* spp.) grasslands with medium to dense cover, and the Sandhill Dunnart is highly dependent on spinifex of a particular maturity.

Plate 6.19: Small Burrow (possibly Brush-tailed Mulgara) in Orange Sands

Plate 6.20: Potential Sandhill Dunnart Habitat

Section 7.2.3 described the potential impacts of the conservation interest mammal species recorded during the Pinjin surveys.

Herpetofauna

Twenty three reptile species were recorded during the surveys. No frogs were recorded during any of the surveys. Six species of frog may occur along the road route, these are mainly burrowing species.

Herpetofauna Species of Conservation Interest

No herpetofauna species of conservation significance were recorded during the survey.

Introduced Fauna

Evidence of camels, rabbits (*Oryctolagus cuniculus*), feral cats, donkeys (*Equus asinus*), wild dogs (*Canis lupus*) and European foxes where recorded along the length of the survey corridor. Cattle (*Bos* sp.) and sheep (*Ovis* sp.) were also observed on the Pinjin Station section of the corridor.

6.3.4. Fauna Habitat

Habitats within the Pinjin survey area were diverse and wide ranging and pass through the IBRA bioregions of Murchison and Great Victoria Desert, defined as:

> *"MUR – Mulga low woodlands, often rich in ephemerals, on outcrop hardpan washplains and fine-textured Quaternary alluvial and eluvial surfaces mantling granitic and greenstone strata of the northern part of the Yilgarn Craton. Surfaces associated with the occluded drainage occur throughout with hummock grasslands on Quaternary sandplains, saltbush shrublands on calcareous soils and Halosarcia low shrublands on saline alluvia. Areas of red sandplains with mallee-mulga parkland over hummock grasslands occur in the east."*

> *"GVD – Arid active sand-ridge desert of deep Quaternary aeolian sands overlying Permian and Mesozoic strata of the Officer Basin. Tree steppe of Eucalyptus gongylocarpa, mulga and E. youngiana over hummock grassland dominated by Triodia basedowii. Arid, with summer and winter rain." Environment Australia (2000).*

The common habitats observed along the survey corridor include:

- yellow sand-plain heaths (containing a mixture of unburnt or recovering vegetation);
- yellow and red sand dunes;
- red sand-plains with spinifex and eucalypts;
- orange sand-plains with heath/ tree mix;
- open soft and spinifex grasslands;
- mulga woodlands with varying understorey vegetation and soil types; and,
- open mallee woodlands over spinifex (mainly).

None of the faunal habitats or ecosystems identified within the survey corridor are listed as TECs under the EPBC Act or by the DEC. The most distinct habitats observed along the survey corridor were the yellow sand dunes and sand plains communities. These area maybe the "Yellow sandplain communities of the Great Victoria Desert" which are current listed as a Priority Ecological Communities P3 (ii).

Several habitats identified are considered to be of significance to fauna, some may be considered to be 'island refugia' in that they are limited in area, or are not well represented along the Pinjin Infrastructure Corridor. These include:

- small patch of suitable mulga woodland for Malleefowl nesting;
- woodlands of mulga, *Casuarina, Eucalyptus* and/ or *Callitris*; - a diverse area with important summer flowering food resource for many birds and invertebrates (Plate 6.21);
- granite boulders – open mulga shrubland to 3 m over mixed *Acacia* and other shrubs to 1 m on granite boulder outcropping with some exfoliation, on red loams and granite soils (Plate 6.22);
- expanses of granite sheet – low fringing open mulga and mixed small shrubs on very shallow granite soils;
- Chenopod flats – the area is lined with *Eucalyptus* and low mixed shrubs on gypsum levee-bank dunes;
- dunes and swales containing mature vegetation including *Xanthorrhoea* sp. (Plate 6.23);
- yellow sand-plains and sand dunes (Plate 6.24); and,
- Four Mile Dam (just out of Survey Area) – reported to be a permanent water source.

Plate 6.21: Casuarina Woodland Located at the Pinjin Station End of the Corridor

Plate 6.22: Granite Boulder – Open mulga Shrubland Located Between Pinjin and Ponton Creek

Plate 6.23: Yellow Dune System with Unburnt Mature Vegetation

Plate 6.24: Yellow Dune Vegetation (possible PEC)