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AUSTRALIA

TROPICANA GOLD PROJECT

TROGLOFAUNA SURVEY REPORT

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Tropicana Joint Venture

ANGLOGOLD ASHANTI
AUSTRALIA

INDEPENDENCE GROUP NL

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EXECUTIVE SUMMARY

The Tropicana JV (TJV) is currently undertaking a pre-feasibility study on the viability of establishing the Tropicana Gold Project (TGP). The proposed mining operation is located approximately 330 km east north-east of Kalgoorlie on the western edge of the Great Victoria Desert (GVD). Since the discovery of the deposit in 2002, gold mineralisation has been identified over a strike length of approximately four kilometres with two areas of significant mineralisation, termed the Tropicana and Havana deposits (the Resource Area), which form the basis of the proposed TGP. It is currently proposed that the TGP would operate for approximately 10 - 15 years to realize the potential of the resource.

The project is a joint venture between AngloGold Ashanti Australia Limited (70% and Manager) and the Independence Group NL (30% stakeholder).

The TGP will undergo formal environmental assessment at the level of a Public Environmental Review (PER) and in preparation for the PER, the TJV commissioned *ecologia* Environment (*ecologia*) to conduct a desktop review of the proposed operational area to determine if troglofauna species might be present. The results of the review showed that the operational area is not very prospective for troglofauna presence, mainly because no evidence of cavities or voids was found in the 40 – 50 m layer of weathered material that sits above a fresh rock basement. Nevertheless, *ecologia* recommended that a troglofauna sampling survey be performed, primarily because recent surveys had shown that troglofauna might be present in a range of geologies not previously sampled or expected to harbour these organisms. Consequently, a troglofauna survey was undertaken within the proposed TGP operational area in accordance with the EPA Guidance Statement No.54.

The survey consisted of four phases: phase one during September-November 2007 (40 holes); phase two during April - June 2008 (100 holes); phase three during August – October 2008 (42 holes); and phase four during October – December 2008 (26 holes), with samples taken from both inside and outside the proposed mine and infrastructure footprint within the operational area in order to assess impact on potential fauna of conservation value.

Although no troglobitic species were collected in troglofauna traps during phase one, two troglobitic species were found during a stygofauna survey conducted in November 2007. These findings include a single specimen of a troglobitic isopod and a single specimen of a troglobitic centipede collected from sites TPMB100 and TPMB099, respectively. The sites were located within the proposed mine and infrastructure footprint of the TGP operational area. The phase two of the troglofauna survey yielded several more troglobitic specimens, comprising four troglobitic isopods (collected from inside the proposed mining pit) and a single specimen of a troglobitic dipluran from family Japygidae (recorded inside the proposed tailings dam of the mine and infrastructure footprint). Phases three and four both yielded isopod specimens - the specimen from phase three was located inside the proposed tailings dam area of the mine and infrastructure footprint while the specimen from phase four was located outside the mine and infrastructure footprint.

It remains difficult to determine which part of the geology the troglofauna in the TGP operational area occupy. The most prospective candidate for the suitable subterranean habitat is possibly the interface of saprolitic clay and root mats, which contains small voids

created by decayed roots. As this interface extends well beyond the mine and infrastructure footprint, it is reasonable to assume that the troglobitic community is also spread beyond this area. However, troglofauna sampling to date has recorded the majority of species from inside the mine and infrastructure footprint with only one isopod specimen located outside. Further sampling is therefore required to prove the above theory correct and to account for all troglobitic species outside the mine and infrastructure footprint.

In summary, the troglofauna survey confirmed the presence of troglofauna within the TGP operational area both within and outside the mine and infrastructure footprint. Most species were collected from inside the pit area where they will be directly impacted by mining activities, therefore the impact to the troglobitic community from the TGP development is currently significant. Further surveying for troglofauna in areas outside the mine and infrastructure footprint is recommended to account for the dipluran and the centipede.

1.0 INTRODUCTION

1.1 Project Background

The Tropicana JV (TJV) is currently undertaking a pre-feasibility study on the viability of establishing the Tropicana Gold Project (TGP), which is centred on the Tropicana and Havana gold prospects. The proposed TGP is located approximately 330 km east north-east of Kalgoorlie, and 15 km west of the Plumridge Lakes Nature Reserve, on the western edge of the Great Victoria Desert (GVD) biogeographic region of Western Australia (Figure 1). The Tropicana and Havana prospects represent the first gold resource discovered in this remote portion of Western Australia. Drilling to date suggests that the resource represents a multi-million ounce discovery within a new Greenfields gold province. The project is a joint venture between AngloGold Ashanti Australia Limited (70% stakeholder and Manager) and the Independence Group NL (30% stakeholder).

The TGP consists of three main components (Figure 1):

- operational area - this area contains the mine, processing plant, aerodrome, village and other associated infrastructure;
- water supply area - two basins have been investigated, the Minigwal Trough and Officer Basin; and
- infrastructure corridor - two options are under consideration (Tropicana Trans Line and Pinjin Road options).

In preparation for the Environmental Impact Assessment, the TJV commissioned *ecologia* Environment (*ecologia*) to conduct a subterranean fauna desktop review of the proposed operational area. The review indicated that the operational area is not very prospective for troglofauna presence, mainly because no evidence of cavities or voids was found in the 40 – 50 m layer of weathered material that sits above the fresh rock basement. Nevertheless, *ecologia* recommended that troglofauna sampling survey be performed, primarily because recent surveys showed that troglofauna may be present in a range of geologies not previously sampled or expected to harbour these organisms. Consequently, a field survey within the operational area was commenced to investigate if troglofauna are present.

1.2 Survey Objectives

AngloGold Ashanti Australia commissioned *ecologia* to undertake a subterranean fauna survey of troglofauna of the Tropicana Operational Area as part of the environmental impact assessment for the project.

The objectives of the Environmental Protection Authority (EPA) with regards to fauna management are to:

- maintain the abundance, species diversity and geographical distribution of subterranean fauna; and
- protect Specially Protected (Threatened) fauna, consistent with the provisions of the *Wildlife Conservation Act 1950.*

Hence, the purpose of this survey was to provide sufficient information to allow the EPA to assess the impact of the TGP on the local troglofauna within the operational area, thereby ensuring that these objectives are upheld.

Specifically, the objectives of this survey were to undertake a survey that satisfies the requirements documented in EPA's Guidance Statement 54 (EPA 2003), thus providing:

- a review of background information (including literature and database searches);
- an inventory of troglofauna occurring within the operational area, incorporating recent published and unpublished records; and
- a review of regional and biogeographical significance, including the conservation status of the species recorded in the operational area.

The legislative framework governing this report is outlined in Appendix 1.

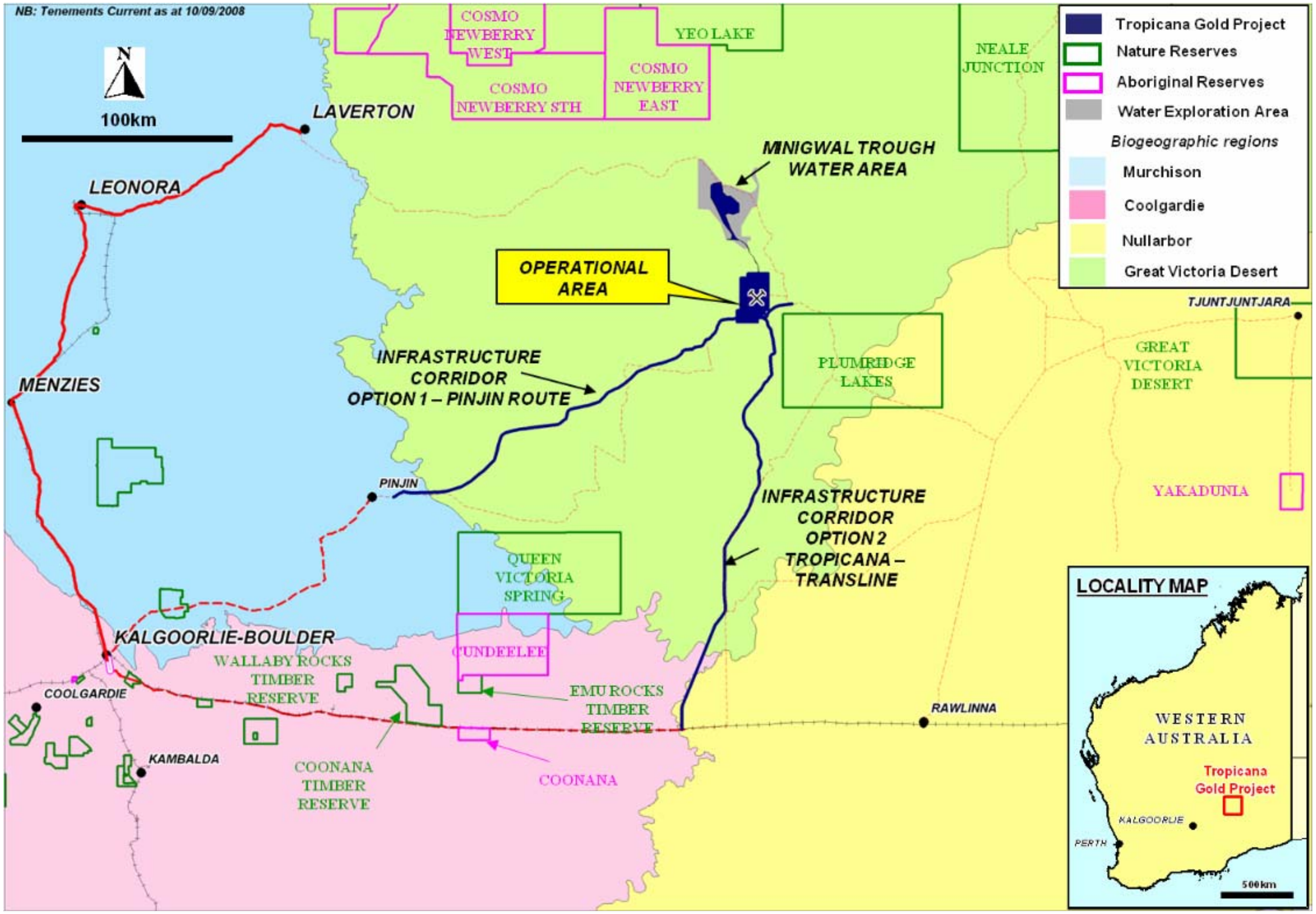

Figure 1 The Tropicana Project Within the IBRA Boundary Map.

(Info from IBRA V6.1, http://www.naturebase.net/content/view/960/1397/)

2.0 Literature Review

Troglofauna are communities of terrestrial subterranean animals that inhabit air chambers in underground caves or small, humid voids. They are divided into three ecological categories: a) troglobites - obligate underground species that are unable to survive outside of the subterranean environment, b) troglofiles - facultative species that live and reproduce underground but that are also found in similar dark, humid microhabitats on the surface; and c) trogloxenes - species that regularly inhabit underground caves and cavities for refuge but normally return to the surface environment to feed. A fourth group, accidentals, wander into cave systems but cannot survive there (Howarth 1983).

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. Many species are relict rainforest litter fauna from previous tropical climate eras (Humphreys 1993) and therefore depend on subterranean habitats that are constantly humid.

The food resources for subterranean ecosystems are largely allochthonous (not formed in the region where found) and carried into caves and cavities by plant roots, water and animals (Howarth 1983).

True troglobites are incapable of dispersing on the surface and thus are subject to dispersal barriers due to geological structure of their habitat. Such dispersal limitations result in extremely small, fragmented species ranges and thus high levels of endemism (EPA 2003) which is characteristic of subterranean fauna worldwide (Strayer 1994). Examples include the millipede *Stygiochiropus peculiaris*, which is restricted to a single cave system at Cape Range (Humphreys and Shear 1993.). Exceptions exist, however - genetic analyses of some troglobitic mites from Pilbara provide evidence that these microscopic organisms have wide-range distribution, suggesting that they use other means of dispersal, possibly on the surface (Biota 2006).

3.0 BIOPHYSICAL ENVIRONMENT

3.1 Climate

The Operational Area is located 330 km east-north-east of Kalgoorlie and 220 km east of Laverton. Average weather conditions in the area can be interpreted from data collected at weather stations in Laverton (to the north-west) and Balgair (to the south-east). A summary of the data is provided in Table 1, Table 2, and in Figure 2, Figure 3, Figure 4 and Figure 5**.**

The climate is described as arid, with summer and winter rain averaging 100 –180 mm (Barton and Cowan 2001b, a). The majority of rainfall occurs during the summer months between January and April and is generally associated with cyclonic rainfall extending inland. Conversely, the region can experience almost no rainfall for the majority of the year with the lowest amount of rainfall received in a year being 65.6 mm at Laverton (1928) and 140.7 mm at Balgair (1991).

Temperatures vary greatly in the region, with the highest maxima at Laverton and Balgair being 46.1 °C (1957) and 47.6 °C (1991), respectively. Lowest minima extend into negative values during the winter months, with the lowest minimum reaching -2.4 °C at Laverton (1969) and -5.0 °C at Balgair (2006).

During the initial survey in September and October 2006, average monthly rainfall varied from 8-16 mm whilst temperatures ranged from the mid to high twenties.

During the subsequent survey in 2008, rainfall was heaviest in February and June while minimum rainfall was received during March, May and August. Average temperature was the highest during January (34.5°C) and the lowest in July (5.7°C).

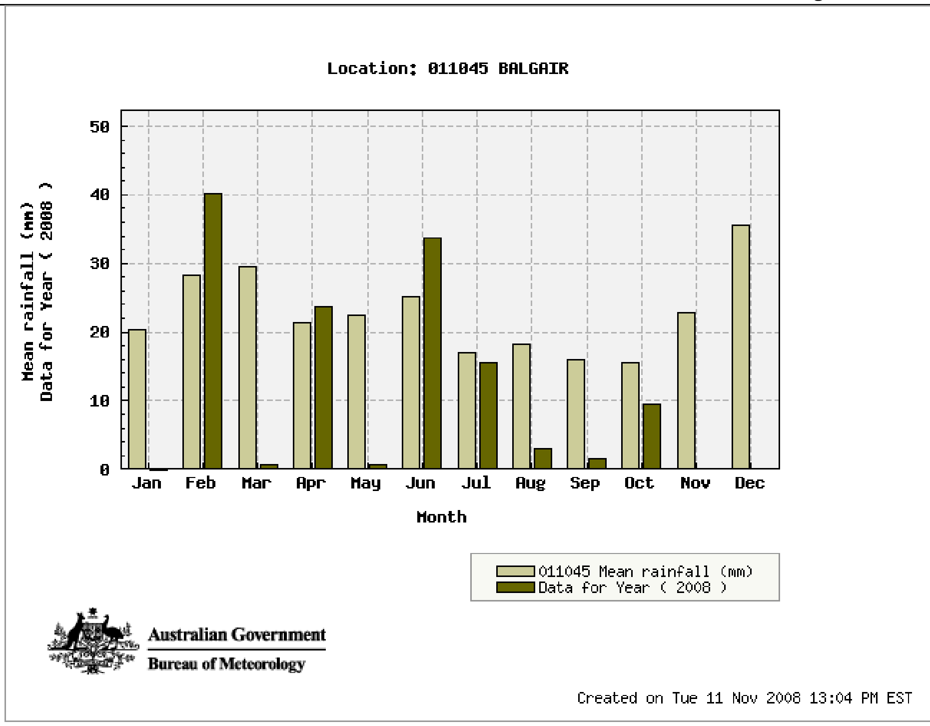

Figure 2 Mean Rainfall (mm) For Balgair from 1983 – 2008

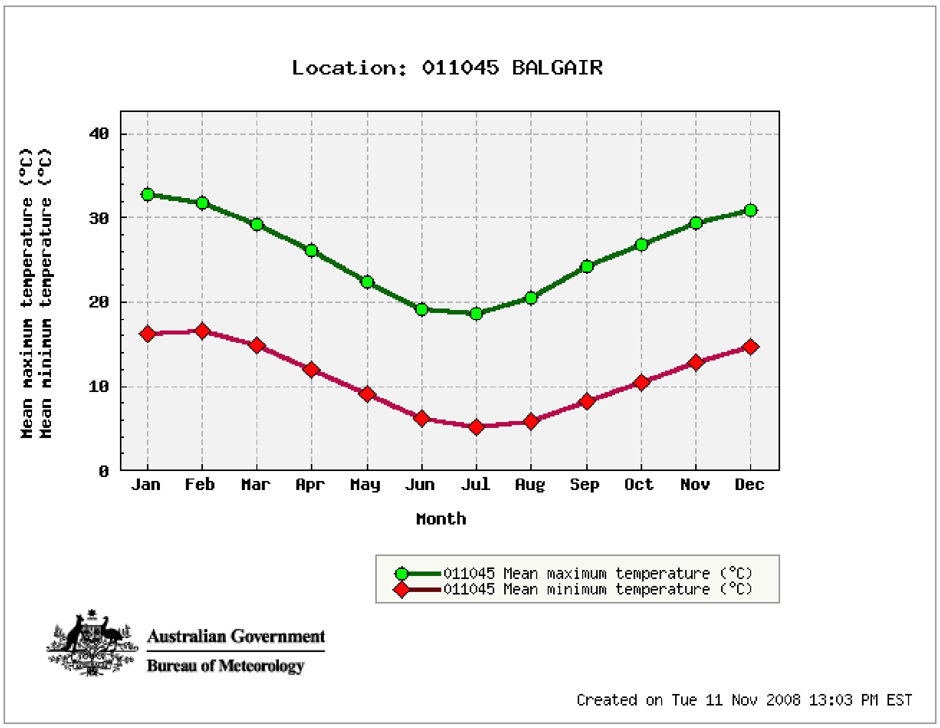

Figure 3 Mean Annual Maximum And Minimum Temperature For Balgair From 1983 – 2008

Table 1 Climatic Statistics For Balgair*
(http://www.bom.gov.au/climate/averages/tables/ca_wa_names.shtml)

Statistic	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Average Monthly Records 1983 - 2008												
Rainfall (mm)	20.3	28.2	29.6	21.4	22.5	25.1	17.0	18.3	16.0	15.8	22.8	35.6
Temp. Max.	32.8	31.8	29.2	26.2	22.4	19.1	18.6	20.5	24.2	26.8	29.3	30.9
Temp. Min.	16.3	16.6	14.8	11.9	9.0	6.2	5.1	5.9	8.2	10.5	12.8	14.7
Records for 2008												
Total Rainfall (mm)	0.0	40.2	0.6	23.6	0.6	33.8	15.6	3.0	1.6	9.4	50.7	51.0
Average daily Temp. Max.	34.5	28.4	32.7	27.0	24.9	20.1	18.7	18.6	26.3	28.3	25.7	No data
Average daily Temp. Min.	17.0	15.2	15.4	12.8	9.5	6.7	5.7	4.9	8.5	10.9	12.7	No data

***Latitude:** 31.09 °S **Longitude:** 125.66 °E

** not quality controlled*

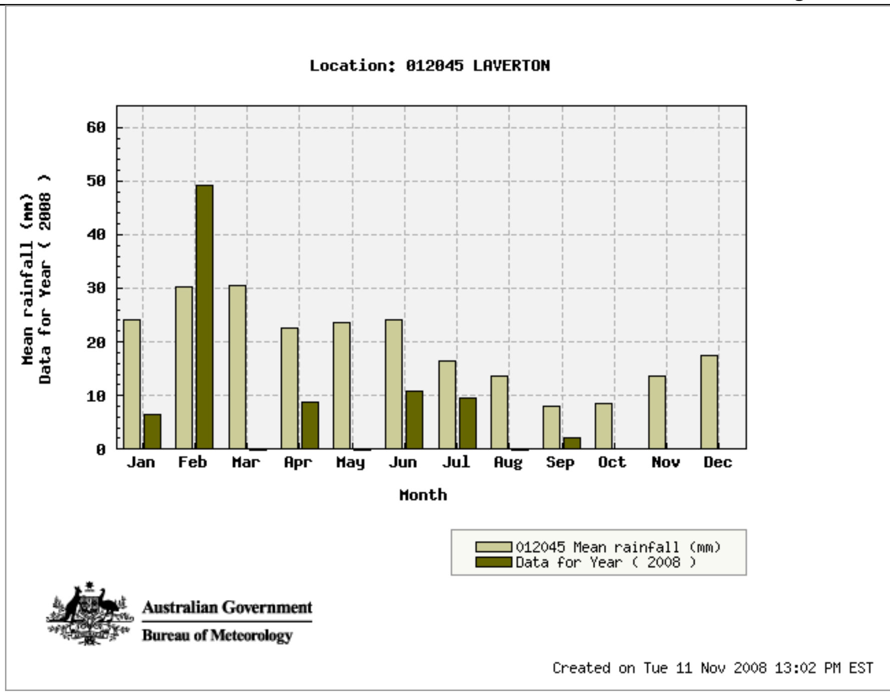

Figure 4 Mean Rainfall For Laverton 1899 – 2008

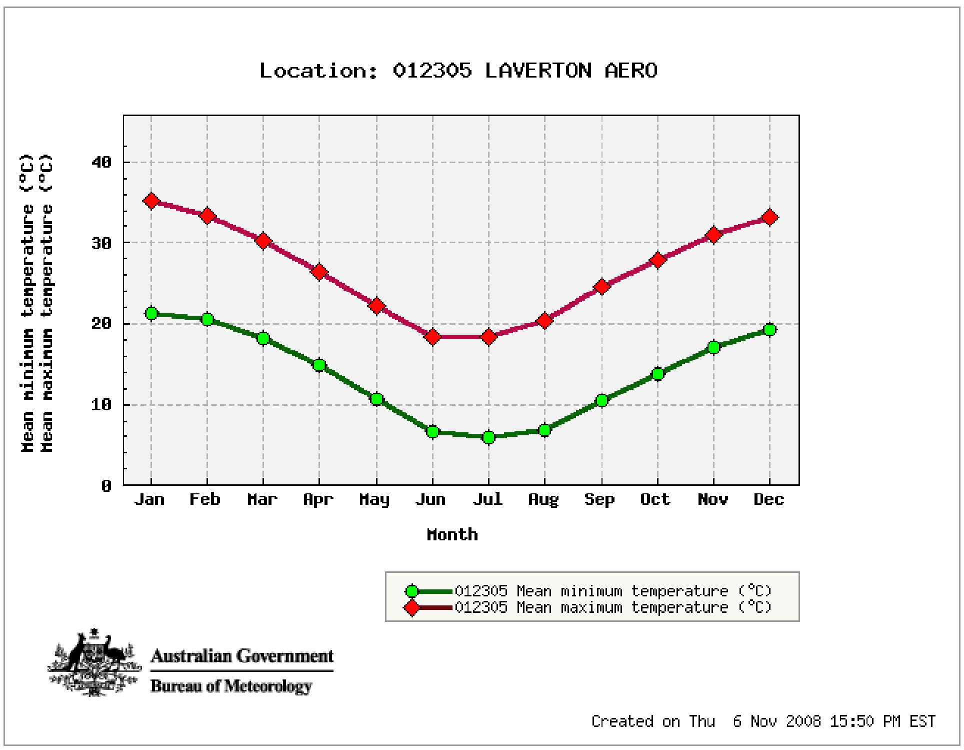

Figure 5 Mean Maximum And Minimum Temperature For Laverton Aero (2.5 Kms From Laverton) 1991 – 2008

Table 2 Climatic Statistics For Laverton*(Where Data Unavailable, Laverton Aero Data Has Been Used – 2.5 Km From Laverton) (http://www.bom.gov.au/climate/averages/tables/ca_wa_names.shtml)

Statistic	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Average Monthly Records 1899 - 2008												
Rainfall (mm)	24.1	30.2	30.4	22.5	23.7	24.0	16.4	13.5	8.1	8.4	13.6	17.5
Average Monthly Records 1900 - 1971												
Temp. Max.	35.8	34.8	31.9	27.2	22.1	18.5	17.8	20.0	24.5	28.0	32.1	34.9
Temp. Min.	20.5	20.0	18.0	13.9	9.5	6.6	5.2	6.4	9.5	12.8	16.6	19.3
Records for 2008												
Total Rainfall (mm)*	6.4	49.2	0.0	8.8	0.0	10.8	9.4	0.0	2.2	0.4	77.0	22.8
Average daily Temp. Max.	38.2	30.8	33.9	27.9	25.6	19.2	19.2	18.9	25.2	30.1	27.2	No data
Average daily Temp. Min.	22.8	18.7	20.0	15.2	11.9	8.1	6.7	5.6	10.7	16.0	14.9	No data

* **Latitude:** 28.63 °S **Longitude:** 122.41 °E

* not quality controlled

* Laverton Aero data (2.5kms from Laverton)

3.2 Biogeography

The Operational Area of the TGP is located within the Great Victoria Desert bioregion (Figure 1), as defined by Thackway and Cresswell in the Interim Biogeographic Regionalisation of Australia (IBRA) Version 6.1 (Department of Environment and Water Resources, 2007). On a finer scale, it is located on the northern border of the Central and Shield sub-regions of the Great Victoria Desert.

The Central region of the Great Victoria Desert is described as an:

> "*arid active sand-ridge desert with extensive dune fields of deep Quaternary aeolian sands overlying Permian strata of the Gunbarrel Basin. Landforms consist of salt lakes and major valley floors with lake derived dunes. Sand plains with extensive seif dunes running east west, occasional outcropping (breakaways) and quartzite hills provide minor relief*" (Barton and Cowan 2001a).

The subregion covers an area of 14,286,995 ha, of which 9.11 % is vested in conservation estates.

3.3 Flora and Vegetation

The operational area is situated in the Helms Botanical District, near the border of the Great Victoria Desert and the Nullarbor Plain, within the Eremaean Botanical Province. At a broad scale, Beard (1975) described three distinct vegetation units within close proximity to and including the TGP:

1. *Acacia aneura* (mulga) low woodland between sand ridges.
2. Tree (*Eucalyptus gongylocarpa*, *E. youngiana*) and shrub steppe between sand hills with hummock grassland (*Triodia basedowii*).
3. *Acacia aneura / Casuarina cristata* (*C. pauper*) woodland (Mulga and sheoak).

4.0 SURVEY METHODS

4.1 Survey timing

The subterranean environment (into which troglofauna is restricted) is generally stable throughout the year as the temperature and humidity are regulated by the depths of rock and soil. Some oscillation of humidity is likely to occur after rainfall events, which may lead to temporary expansions of troglofauna populations (B. Durrant, DEC, pers.comm.).

The survey at TGP consisted of the following four phases:

- phase one - September-November 2007 (40 RC/Diamond drill holes);
- phase two - April - June 2008 (100 holes - 40 RC/Diamond and 60 AC drill holes);
- phase three - August – October 2008 (42 AC holes); and
- phase four - October – December 2008 (26 AC holes); for details see Appendix 2.

The sampling was done in both 'dry season' (September-November 2007) and 'wet season' / after rain (April - June 2008, August – October 2008 and October – December 2008). This approach is consistent with the EPA guidance statement 54 (Technical appendix 54A), which states that *"Two seasons of sampling are recommended but, if sampling is restricted to one season, it must be the wet season. An efficient design may be to sample 30 bores in the late wet/early dry season and then again late in the dry season."*

4.2 Site selection

The survey required a representative sample of troglofauna populations from both inside and outside the mine and infrastructure footprint within the operational area in order to assess potential conservation impacts. Sites were selected from pre-existing exploration holes within areas which offered a likely habitat for troglofauna. In total, 87 successful samples from 53 drill holes were collected inside the mining and infrastructure footprint and 109 successful samples from 75 drill holes were collected outside the mining and infrastructure footprint. This sample size is consistent with the EPA guidance statement 54 (Technical appendix 54A), which states that *"it is recommended that at least 60 samples should be collected from areas considered likely to have significant troglofaunal values."*
All drill hole data and GPS co-ordinates can be found in Appendix 2**.**

4.3 Sampling methods

All sampling was conducted by troglofauna traps (1-3 traps per drill hole). This approach is consistent with the EPA guidance statement 54 (Technical appendix 54A), which states that *"In Western Australia (WA) it is common to lower PVC pipe, usually closed at either end with aviary mesh and containing leaf litter… into the bore to align with fissures and voids in the surrounding habitat"*. Additional data collection was attempted using scraping of drill hole sides and trapping of leaf-litter dwelling invertebrates on the surface next to drill holes, however technical difficulties did not allow for a consistent data collection at the time and this data is not presented.

The survey involved the installation of troglofauna traps in drill holes over four sampling phases. Each phase consisted of trap deployment, 60-day colonisation period and trap collection.

In order to sample a range of depths, each RC/Diamond drill hole contained three (3) *ecologia* traps (80 mm diameter) at approximately ten metre (10 m) intervals (i.e. at 10 m, 20 m and 30 m below ground level). Narrower AC holes were sampled using one longer, thinner trap designed by Tropicana field staff (50 mm diameter). These traps were placed at either 10 or 20 m depths depending on the total depth and geology of the hole.

Each trap was filled with damp leaf litter sourced from the area so as to represent the natural habitat sources. The leaf litter was sterilised using a microwave in order to ensure that no contaminates (bacteria or surface invertebrates) could colonise the traps. Using this technique also promotes the breakdown of leaf litter, in turn creating a more inviting environment for any troglobitic species.

Traps were retrieved after a minimum of 60 days. The contents of each trap were transferred into a separate vial or plastic zip lock bag and then stored in a cool, dry environment until returning to the laboratory. Samples were then placed in Tullgren funnels which utilised a 40 Watt light bulb that encourages the movement of invertebrate species away from the light/heat source. As they burrow into the leaf litter to escape the light / heat, they fall into vials of 70% ethanol, where they are preserved for taxonomic identification. Prospective troglobitic species were sorted under a microscope by *ecologia* invertebrate zoologists.

4.4 Species Identification and Curation

All potential troglofauna were examined and vouchered for future reference. Initial taxonomic identification was conducted by *ecologia* invertebrate zoologists; troglobitic species were then submitted to experts in WA Museum for taxonomic confirmation. A list of taxonomic experts is provided in Table 3.

Table 3 List of Taxonomic Experts Used For Identification Purposes

Taxa	Expert	Institution
Isopoda (slaters)	Dr Simon Judd Dr Bill Humphreys	Edith Cowan University WA Museum
Chilopoda (centipedes)	Dr Bill Humphreys	WA Museum
Diplura	Dr Mark Harvey	WA Museum
Acarina (mites)	Owen Seeman	Queensland Museum
Collembola (springtails)	Gilbert Whyte	Ecologia

4.5 Subterranean habitat assessment

Two diamond drill holes were drilled adjacent to TPMB100 and TPMB 099 - the first locations where troglobitic species were identified. The core samples obtained from diamond drilling were examined jointly by *ecologia* invertebrate zoologists and AGAA geologists for a prospective subterranean fauna habitat within the operational area in June 2008. In particular, the presence of large cavities, fractures or porous areas were searched for.

4.6 Survey Team

The *ecologia* staff involved in planning, coordination and execution of the TGP Troglofauna Survey are listed in Table 4.

Table 4 Ecologia Staff Involved With The Survey

Name	Qualification	Position
Magdalena Davis (Zofkova)	PhD (Zoology)	Manager Invertebrate Sciences
Jarrad Clark	BSc. (Environmental Management)	Senior Invertebrate Zoologist
Nicki Thompson	BSc. Zool (Marine Biol.)	Invertebrate Zoologist
Gilbert Whyte	BSc Hons	Invertebrate Zoologist

5.0 RESULTS

Overview

The survey yielded over 3,000 invertebrate specimens representing 11 orders. Six orders had no troglobitic characters: Coleoptera (Rove and Carpet beetles); Lepidoptera (butterflies); Blattaria (cockroaches); Hymenoptera (chalcid wasps); Diptera (biting midges); and Isoptera (termites). These were classified as accidentals and thus excluded from further examinations. Five orders showed adaptations to the subterranean environment, of which three were considered to be truly troglobitic – Diplura (diplurans), Chilopoda (centipedes) and Isopoda (slaters) (Table 5).

Table 5 Summary of Troglofauna Recorded

Organism	Total #	Code	Institution	Expert	Hole ID	Depth (m)	Location
Diplura (diplurans)	1	865_002	WAM	W. Humphreys	TPA 3981	20	Inside
Chilopoda (centipedes)	1	858_023	WAM	W. Humphreys	TPMB 099	stygo net*	Inside
Isopoda (slaters)	1	858_021	WAM	W. Humphreys	TPMB 100	stygo net*	inside
Isopoda (slaters)	2	865_015	WAM	W. Humphreys	TPD 057	10	Inside
Isopoda (slaters)	1	865_017	WAM	W. Humphreys	TPD 057	20	Inside
Isopoda (slaters)	1	865_014	WAM	W. Humphreys	TPRC583? #	20	Inside
Isopoda (slaters)	1	08:0248	*ecologia*	G. Whyte	TPA3977	17	Inside
Isopoda (slaters)	1	08:0845	ECU	S. Judd	TPA 4270	13	Outside

* recorded during stygofauna survey during November 2007. Stygofauna sampling involves deploying a 50 µl and a 150 µl mesh net into a drill hole down to the water column. Each net is deployed 3x and the contents collected, sieved and placed in vials of 70% ethanol with the samples being examined in the laboratory.

#See Table 8 for further clarification on TPRC583 identification

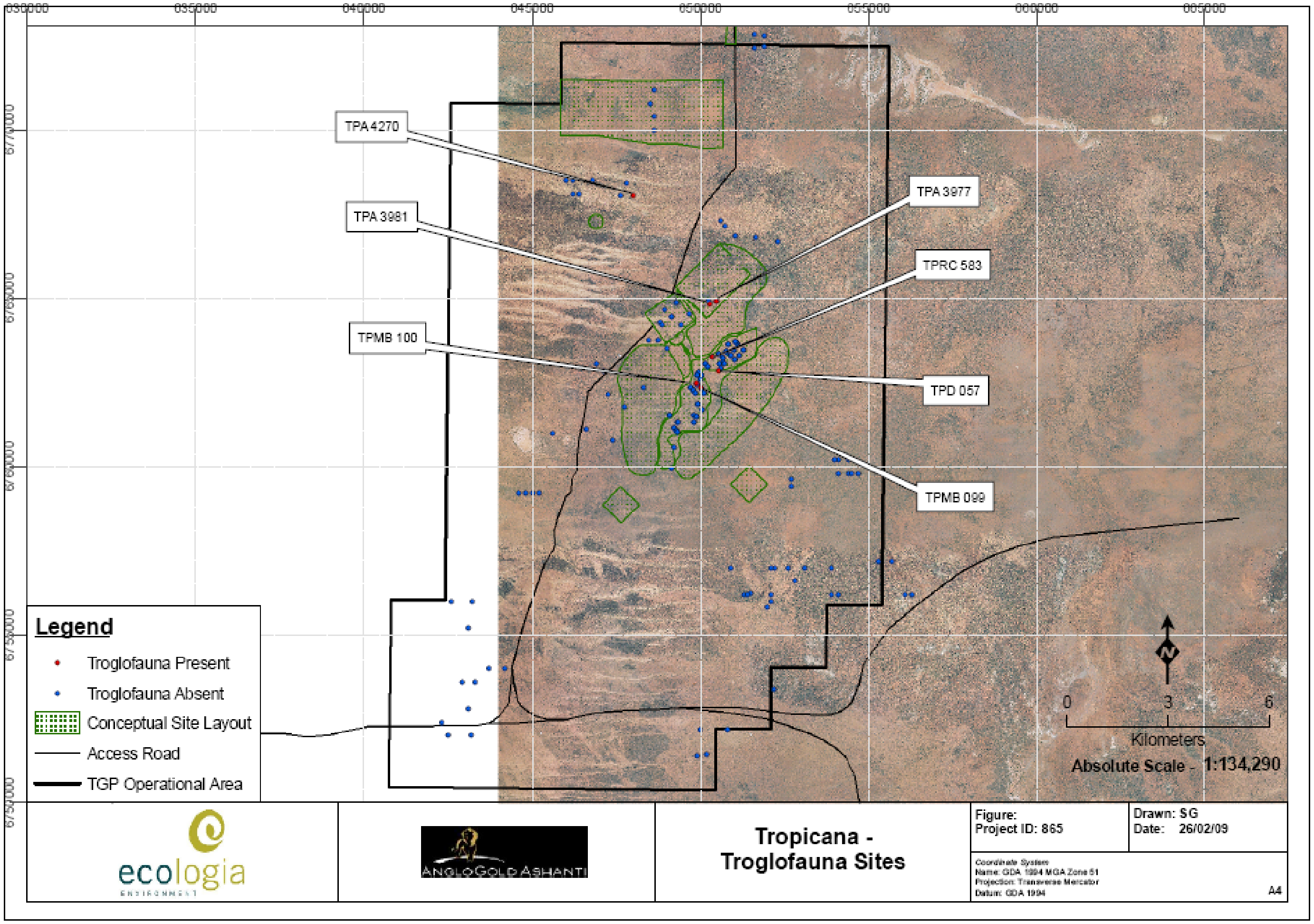

Figure 6 Location of Troglofauna Sampling Sites (including the stygofauna sampling sites where troglobites found)

5.1 Summary of Troglofauna Groups

5.1.1 Diplurans (Phylum Arthropoda, Subphylum Hexapoda, Class Entognatha)

Unknown genus / species

A single dipluran specimen was collected from site TPA3981, located inside the mine and infrastructure footprint in the proposed tailings dam area (Figure 6 and Figure 7). The species belongs to family Japygidae. However, little taxonomic work has been completed on this taxon to date and thus further taxonomic resolution is currently not available. The specimen has been lodged with WA Museum to enable description of the species in the future.

Figure 7 The Troglobitic Dipluran From TGP (Family Japygidae)

5.1.2 Centipedes (Phylum Arthropoda, Subphylum Myriapoda, Class Chilopoda)

Unknown genus / species

A single, dead centipede was recovered from bore water by a Stygofauna net from site TPMB099 located inside the mine and infrastructure footprint (Figure 6, Figure 8). Very little is understood regarding troglobitic centipedes to date. The specimen has been lodged with WA Museum to enable more detailed identification in the future.

Figure 8 The Troglobitic Centipede from TPG

5.1.3 Isopods (Phylum Arthropoda, Subphyllum Crustacea, Class Malacostraca)

Seven specimens were collected from five separate sites, of which all were located within the operational area but four were located within the mine and infrastructure footprint while one was outside. Three specimens were found at site TPD 057 (10 and 20 m depth), one at site TPRC 583[#], one dead specimen was recovered from bore water by a stygofauna net from site TPMB100 (all three sites located in the proposed mining pit outline) and a single specimen was recorded from site TPA 3977 (located in the proposed tailings dam). All specimens were lodged with experts for further advice. (Figure 6, Figure 9). A single specimen was also collected from site TPA4270 (13 m depth), outside the mine and infrastructure footprint, within the operational area. This specimen is currently being examined by the isopod expert Dr Simon Judd (ECU).

Figure 9 The Troglobitic Isopods from TGP

5.1.4 Collembola (Springtails) and Acarina (Mites)

Springtails and mites were recorded from a range of depths at several sites during the survey. Both groups are identified from the top layer of soil where they rely on decaying leaf matter for nutrition and are likely to be troglofiles or opportunistic feeders on the traps. Due to their typical near-surface habitat, they are not likely to be rare or restricted species and are therefore not unduly at threat from the mine and infrastructure footprint.

[#]See Table 8 for further clarification on TPRC583 identification.

5.1.5 Accidental Fauna

A range of non-troglobitic invertebrate fauna were recorded, presumably accidentals which had fallen into the drill holes. These included cockroaches, Carpet beetles, Rove beetles, butterflies, chalid wasps, biting midges, and various forms of larvae. These species were determined as not being troglobitic due to heavy pigmentation and/or well developed eyes and were thus excluded from further studies.

5.2 Habitat assessment

Examination of core samples from the vicinity of the original site (TPMB100) that yielded troglobitic species revealed no obvious habitat suitable for troglofauna colonisation. Only two zones showed some degree of porosity – a part of gneiss rock at 49 m bgl (Figure 10) and a layer of saprolitic clay with root mats of the surface vegetation, approximately 6-7 m bgl (Figure 11). Given that distance to ground water is 30-40 m bgl, the porous part of the gneiss rock is submerged and thus unsuitable for troglofauna colonisation. Thus it seems that the relatively shallow interface of the saprolitic clay with root mats is potentially the only zone suitable for troglofauna habitation.

Figure 10 Layer of Gneiss Rock 49 m bgl With Small Void Spaces. This Zone is Normally Submerged in Ground Water and Thus Uninhabitable For Troglofauna.

Figure 11 Interface of Saprolitic Clay and Root Mats Approx. 6 m bgl. This Layer Contains Very Small Voids Created By Roots of Surface Vegetation and Thus Could Potentially be Utilised as Habitat by Troglofauna.

6.0 DISCUSSION

Despite the fact that very little subterranean habitat seems to be available for troglofauna colonisation in the operational area, the discovery of several troglobitic specimens representing three different orders (Diplura, Chilopoda and Isopoda) as well as over 1,500 specimens representing two troglophilic orders (Collembolla and Acarina) provides evidence that troglofauna communities exist within the TGP operational area. The groups recorded during the survey are known to contain troglobitic species and records from other locations in Australia and around the world already exist (Barr and Reddell 1967; Biota 2005, 2006).

Records of troglobitic diplurans are known from North America (Barr and Reddell 1967) and Western Australia, specifically Cape Range, Barrow island and Mesa formations in the Pilbara (Biota 2005, 2006). Diplurans are small entognathous hexapods ('primitive insects') that somewhat resemble earwigs (Dermaptera). Some species are herbivorous and can be recognised by their soft cerci, however the majority of diplurans are predatory, having a pincer-like cerci which they use to catch prey (Zborowski and Storey 2003), such as the specimen collected during this survey. The predatory status of the dipluran gives some evidence that other troglofauna must occur in the vicinity as prey. The dipluran was located in the proposed tailings dam outline which is inside the mining and infrastructure footprint where it may be directly at threat from mining activities (Table 6, Figure 6).

Little is known about troglobitic centipedes to date, perhaps apart from the fact that they are predators like their surface relatives. Records exist from North America (Barr and Reddell 1967), Europe (Foddai and Minelli 1999) and Australia, specifically from Cape Range, Mesa formations in the Pilbara (Biota 2006) and caves on the Nullabor Plain (Edgecombe 2005). The specimen collected at Tropicana does not resemble species collected in the Pilbara, however further comparisons will have to be made for further taxonomic identifications, particularly with the specimens from Nullabor Plain, as this region is within 60 kilometres of the TGP operational area. The centipede was located inside the proposed mining pit outline where it will be at direct threat from mining activities (Table 6, Figure 6)**.**

Unlike the two previous groups, troglobitic isopods are detritivorous and several formally described species exist. The first records come from Hawaii (Schultz 1973), followed by records from Indonesia (Schultz 1985), Africa (Taiti and Humphreys 2001) and Australia (Biota 2005, 2006; Ecologia, unpublished data). In Western Australia, troglobitic isopods have been collected from Cape Range, Barrow Island and the Pilbara: however, little understanding of the taxonomy exists to date. Six of the troglobitic isopods were located inside the mine and infrastructure footprint (five located inside the proposed mining pit outline and one in the proposed tailings dam) and one was located outside. It is extremely likely that these species co-occur and are preyed upon by the predatory dipluran and centipede.

It remains difficult to determine which part of the geology troglofauna occupies. The most prospective candidate for the suitable subterranean habitat is possibly the interface of saprolitic clay and root mats, which contains small voids created by decayed roots (Figure 11). As this interface extends well beyond the mine and infrastructure footprint, it is also reasonable to assume that the troglobitic community extends beyond the mine and infrastructure footprint: however, sampling to date has recorded the majority of species inside the mine and infrastructure footprint and further surveying is recommended to confirm this.

In conclusion, the known distribution of both the centipede and the dipluran is currently restricted within the mine and infrastructure footprint and therefore fully impacted by the TGP. In particular, the centipede was located in the middle of the proposed pit outline whereas the dipluran was located in the proposed tailings dam area (Figure 6, Table 6). The isopods are only partially impacted as they were located both inside and outside the proposed mining area (Table 6). The impact to the troglobitic community from the TGP is currently significant and further surveying is recommended to locate these troglobitic specimens (in particular the dipluran and the centipede) outside the mine and infrastructure footprint where they shall not be directly impacted.

Table 6 Summary of Troglobitic Specimens Impacted by the Mine and Infrastructure Footprint of TGP (Full Impact In Red, Partial Impact In Black)

Class	Order	inside	outside
Malacostraca	Isopoda (Slaters)	TPMB 100, TPD 057, TPRC 583, TPA 4270	TPA 3977
Chilopoda	Chilopoda (Centipedes)	TPMB 099	-
Entognatha	Diplura (Diplurans)	TPA 3981	-

7.0 MANAGEMENT RECOMENDATIONS

Subterranean ecosystems and the fauna they support may face significant risks from a number of mining related processes, most significant of which is the ore extraction process itself, which directly removes the habitat and dependent species. Other risks to sub-surface dwelling species and communities may also occur as a result of surface operations, e.g. surface sealing or clearing and hydrocarbon and other contaminants (Humphreys 2001), which may impact upon the physical and chemical elements of the habitat. However, the lowering of the water table, associated with pit dewatering, may also impact upon troglofauna habitat by altering the humidity of those habitats. Troglofauna are very sensitive to subtle changes in their environment as they are generally adapted to an environment that sees only minor physical, chemical and biological change.

Mining, which is currently being proposed, could potentially have a significant impact on troglofauna habitat by:

- directly removing all or part of their habitat;
- changing the habitat temperature, humidity, elemental ratios, availability of organic matter and interrupting the food chain by exposing voids to atmospheric oxygen, water content and pollutants;
- lowering the water table sufficiently to effect the temperature and humidity of voids immediately above the water table; or
- contamination of habitats through hydrocarbon / chemical spills.

The following management recommendations may mitigate potential risks to troglobitic communities:

- Conducting additional sampling to ensure that troglobitic centipedes and diplurans occur ‘outside’ the mine and infrastructure footprint where they will not be affected by mining activities.
- Confining impacts strictly within the mine and infrastructure footprint.
- Preventing contamination of troglobitic habitats by hydrocarbon / chemical spills as per site procedures.
- Conducting further surveying prior to any pit extensions or amendments.

A risk assessment was undertaken to determine potential impacts arising from the TGP development on troglofauna and the residual impacts following the implementation of management strategies identified in this document. The ‘Significance’ of the risks is classified as either “High” (site/issue specific management programmes required, advice/approval from regulators required), “Medium” (specific management and procedures must be specified) or “Low” (managed by routine procedures). The impact risk assessment matrix is presented in Appendix 3.

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Appendix 1

Legislative Framework

Legislative framework

Subterranean fauna are protected at a State level under the *Wildlife Protection Act 1950* (WP Act) and their environment is protected under the *Environmental Protection Act 1986* (EP Act). The WC Act was developed to provide for the conservation and protection of wildlife in Western Australia. Under Section 14 of this Act, all fauna and flora within Western Australia is protected; however, the Minister may, via a notice published in the *Government Gazette*, declare a list of fauna taxa identified as likely to become extinct, or is rare, or otherwise in need of special protection. The current listing was gazetted on the 22 January 2008.

A Guidance Statement has been developed specifically to advise the public about the minimum requirements for environmental management with respect to subterranean fauna. EPA Guidance Statement 54: *Consideration of Subterranean Fauna in Groundwater and Caves during Environmental Impact Assessment in Western Australia 2003* states that:

"Proposals that, if implemented, could potentially have a significant impact on stygofaunal or troglofaunal habitat by:

- lowering the water table sufficiently to dry out the zone in which some species live, or otherwise artificially changing water tables; or
- changing water quality (e.g. increasing salinity levels or altering haloclines, increasing nutrient levels or the availability of organic matter, or introducing other pollutants); or
- destroying or damaging caves (including changing their air temperatures and humidity)

<u>will</u> be subject to formal EIA (Environmental Impact Assessment) under the EP Act."

The EP Act is "an Act to provide for an Environmental Protection Authority, for the prevention, control and abatement of environmental pollution, for the conservation, preservation, protection, enhancement and management of the environment and for matters incidental to or connected with the foregoing." Section 4a of this Act outlines five principles that are required to be addressed to ensure that the objectives of the Act are addressed. Three of these principles are relevant to native fauna and flora:

- *The Precautionary Principle*

  Where there are threats of serious or irreversible damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation.

- *The Principles of Intergenerational Equity*

  The present generation should ensure that the health, diversity and productivity of the environment is maintained or enhanced for the benefit of future generations.

- *The Principle of the Conservation of Biological Diversity and Ecological Integrity*

  Conservation of biological diversity and ecological integrity should be a fundamental consideration.

Projects undertaken as part of the Environmental Impact Assessment (EIA) process are required to address guidelines produced by the EPA, in this case Guidance Statement 54:

Consideration of Subterranean Fauna in Groundwater and Caves during Environmental Impact Assessment in Western Australia (EPA 2003).

Some subterranean fauna in Western Australia is also protected at a Federal level under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). The EPBC Act was developed to provide for the protection of the environment, especially those aspects of the environment that are matters of national environmental significance, to promote ecologically sustainable development through the conservation and ecologically sustainable use of natural resources; and to promote the conservation of biodiversity. The EPBC Act includes provisions to protect native species (and in particular prevent the extinction, and promote the recovery, of threatened species) and ensures the conservation of migratory species. In addition to the principles outlined in Section 4a of the EP Act, Section 3a of the EPBC Act includes a principle of ecologically sustainable development dictating that decision-making processes should effectively integrate both long-term and short-term economic, environmental, social and equitable considerations.

Appendix 2 GPS and Drill Hole ID Data

Table 7 Sites Sampled During Phase One (Trap Diameter 80 mm). All Holes Located Inside The Mine And Infrastructure Footprint.

Drill hole ID	GPS Coords (WGS 84)				Sep-07 Deployed	Nov-07 Collected
	Zone		Easting	Northing	Depth of Traps	Depth of Traps
TPD 014	51	J	651280	6763459	8,18,28	8,18,28
TPD 024	51	J	650141	6763043	10,20,30	10,20,30
TPD 025	51	J	651103	6763637	10,20,30	10,20,30
TPD 026	51	J	650889	6763284	10,20,30	10,20,30
TPD 027	51	J	650670	6763082	10,20,30	10,20,30
TPD 055	51	J	650605	6762930	10,20,30	10,20,30
TPD 075	51	J	650041	6762716	10,20,30	10,20,30
TPD 129	51	J	649810	6761534	10,20,30	10,20,30
TPD 136	51	J	649806	6761323	10,20,30	10,20,30
TPD 167	51	J	649209	6761144	10,20,30	10,20,30
TPD 168	51	J	649284	6761077	10,20,30	10,20,30
TPD 237	51	J	651148	6763306	10,20,30	10,20,30
TPD 250	51	J	651018	6763153	10,20,30	10,20,30
TPD 260	51	J	650563	6763046	10,20,30	10,20,30
TPD 291	51	J	650096	6762170	10,20,30	10,20,30
TPD 328	51	J	649913	6761853	30,40,50	30,40,50
TPD 331	51	J	650059	6761710	30,40,50	Traps lost
TPD 348	51	J	649863	6761481	10,20,30	10,20,30
TPD 553	51	J	650997	6763461	10,20,30	10,20,30
TPRC 010	51	J	650791	6763387	10,20,30	10,20,30
TPRC 013	51	J	650644	6763247	10,20,30	10,20,30
TPRC 025	51	J	650818	6763637	20,30,40	20,30,40
TPRC 057	51	J	650763	6763413	10,20,30	10,20,30
TPRC 087	51	J	651071	6763677	10,20,27	10,20,27
TPRC 124	51	J	651031	6763708	10,20,27	10,20,27
TPRC 156 D	51	J	649312	6761043	10,20,30	10,20,30
TPRC 159	51	J	649315	6761324	10,20,30	10,20,30
TPRC 206	51	J	649899	6762433	10,20,30	10,20,30
TPRC 208 D	51	J	650037	6762286	20,30,40	20,30,40
TPRC 342	51	J	649707	6762345	19,29,39	19,29,39
TPRC 343	51	J	649771	6762275	20,30,40	20,30,40
TPRC 383	51	J	649086	6761553	10,20,30	10,20,30
TPRC 572	51	J	650538	6763353	10,20,30	10,20,30
TPRC 574	51	J	650677	6763212	10,20,30	10,20,30
TPRC 583	51	J	650358	6763253	10,20,30	10,20,30
TPRC 603	51	J	650216	6762968	10,20,30	10,20,30
TPRC 615	51	J	649931	6762825	10,20,30	10,20,30
TPRC 628	51	J	649900	6762719	10,20,30	10,20,30
TPRC 630	51	J	649998	6762611	18,28,38	18,28,38
TPRC 638	51	J	649848	6762206	20,30,40	20,30,40
Sample Size					**40**	**39**

Table 8 Sites Sampled During Phase Two (Trap Diameter 80 mm). Holes Where Troglofauna Was Found Are Highlighted In Bold. All Holes Located Inside The Mine And Infrastructure Footprint.

Drill hole ID	GPS Coordinates (WGS84)				Apr-08 Deployed Depth of Traps (m)	Jun-08 Collected Depth of Traps (m)
	zone		Easting	Northing		
TPD 014	51	J	651279	6763459	10, 20, 30	10, 20, 30
TPD 024	51	J	650141	6763043	10, 20, 30	5, 10, 15
TPD 025	51	J	651103	6763637	10, 20, 30	10, 20, 30
TPD 027	51	J	650670	6763082	10, 20, 30	Traps lost
TPD 028	51	J	650708	6763053	5, 10, 15	5, 10, 15
TPD 055	51	J	650605	6762930	10, 20, 30	10, 20, 30
TPD 057	**51**	**J**	**650536**	**6762860**	**10, 20, 30**	**10, 20, 30**
TPD 075	51	J	650041	6762716	10, 20, 30	10, 20, 30
TPD 129	51	J	649810	6761534	10, 20, 30	10, 20, 30
TPD 136	51	J	649805	6761323	5, 10, 15	5, 10, 15
TPD 167	51	J	649210	6761144	5, 10, 15	5, 10, 15
TPD 168	51	J	649284	6761077	5, 10, 15	5, 10, 15
TPD 237	51	J	651149	6763306	10, 20, 30	10, 20, 30
TPD 250	51	J	651018	6763153	10, 20, 30	10, 20, 30
TPD 260	51	J	650889	6763284	10, 20, 30	10, 20, 30
TPD 260	51	J	650564	6763046	10, 20, 30	10, 20, 30
TPD 328	51	J	649915	6761853	30, 40, 50	30, 40, 50
TPD 331	51	J	650059	6761710	30, 40, 50	20, 40, 50
TPD 348	51	J	649863	6761481	10, 20, 30	10, 20, 30
TPRC 025	51	J	650820	6763638	10, 20, 30	10, 20, 30
TPRC 057	51	J	650762	6763413	10, 20, 30	5, 10, 15
TPRC 087	51	J	651069	6763670	10, 20, 30	10, 20, 30
TPRC 124	51	J	651030	6763708	10, 20, 30	10, 20, 30
TPRC 156	51	J	649312	6761043	5, 10, 15	5, 10, 15
TPRC 159	51	J	649316	6761324	10, 20, 30	10, 20, 30
TPRC 206	51	J	649898	6762433	10, 20, 30	10, 20, 30
TPRC 208	51	J	650037	6762286	5, 10, 15	5, 10, 15
TPRC 291	51	J	650095	6762170	10, 20, 30	10, 20, 30
TPRC 342	51	J	649709	6762345	10, 20, 30	Traps lost
TPRC 343	51	J	649771	6762275	10, 20, 30	Traps lost
TPRC 383	51	J	649088	6761553	10, 20, 30	10, 20, 30
TPRC 553	51	J	650997	6763461	5, 10, 15	5, 10, 15
TPRC 572	51	J	650538	6763353	10, 20, 30	10, 20, 30
TPRC 574	51	J	650677	6763212	10, 20, 30	10, 20, 30
TPRC 583*	**51**	**J**	**650359**	**6763253**	**10, 20, 30**	**10, 20, 30**
TPRC 603	51	J	650215	6762968	10, 20, 30	10, 20, 30
TPRC 615	51	J	649935	6762825	10, 20, 30	10, 20, 30
TPRC 628	51	J	649899	6762719	10, 20, 30	10, 20, 30
TPRC 630	51	J	649998	6762611	20, 30, 40	20, 30, 40
TPRC 638	51	J	649848	6762206	20, 30, 40	20, 30, 40
Sample Size					**40**	**37**

- information for TPRC 583 is believed to be incorrect. This drill hole was rehabilitated sometime prior to February 2008 and therefore could not have been sampled during Phase two. Drill holes TFRC 2574 and 2573 were both situated close by and it is believed that one of these holes was mistaken for TPRC 583

Table 9 Sites Sampled During Phase Two (Trap Diameter 50 mm). Holes Where Troglofauna Were Recorded Are Highlighted In **Bold**. All Holes Located Outside The Mine And Infrastructure Footprint (Holes Inside Highlight In Red)

Drill hole ID	GPS Coordinates (WGS84)				Apr-08 Deployed Depth of Traps (m)	Jun-08 Collected Depth of Traps (m)
	Zone		Easting	Northing		
SBA 283	51	J	654001	6760200	10	10
SBA 087	51	J	654099	6760200	10	10
SBA 285	51	J	654399	6760200	10	10
SBA 269	51	J	654699	6759800	10	10
SBA 267	51	J	654500	6759800	10	10
SBA 266	51	J	654399	6759800	15	15
SBA 263	51	J	654099	6759800	15	15
SBA 247	51	J	652700	6759600	10	10
SBA 137	51	J	652600	6757000	10	10
SBA 036	51	J	653101	6757000	10	10
SBA 040	51	J	653900	6757000	10	10
SBA 135	51	J	652211	6756994	10	10
SBA 011	51	J	652101	6756200	20	20
SBA 099	51	J	652101	6756000	10	10
SBA 008	51	J	651483	6756209	15	15
SBA 102	51	J	651401	6756200	10	10
SBA 020	51	J	653901	6756200	10	10
SBA 021	51	J	654100	6756200	10	10
TPA 3826	51	J	650610	6767295	10	10
TPA 3828	51	J	650747	6767150	10	10
TPA 3832	51	J	651030	6766865	10	10
TPA 3806	51	J	651650	6766828	10	10
TPA 3977	51	J	650460	6764932	10	10
TPA 3981	**51**	**J**	**650285**	**6764846**	**20**	**20**
TPA 3980	51	J	650228	6764915	20	20
TPA 4002	51	J	649658	6764520	10	10
TPA 3997	51	J	649277	6764889	10	10
TPA 4013	51	J	649148	6764477	10	10
TPA 4012	51	J	648941	6764681	10	10
TPA 4015	51	J	649148	6764477	10	10
TPA 4019	51	J	649426	6764193	10	10
TPA 4029	51	J	648795	6764297	10	10
TPA 4044	51	J	649019	6763491	10	10
TPA 4030	51	J	648857	6764198	10	10
TPA 4041	51	J	648738	6763776	10	10
TPST 046	51	J	648466	6763760	10	10
TPST 018	51	J	647123	6762835	10	10
TPST 021	51	J	646908	6763054	10	10
TPRC 129	51	J	649208	6760579	20	20
TPA 2783	51	J	649143	6759940	10 & 20	10 & 20
TPA 953	51	J	647723	6761771	7	trap stuck
TPST 130	51	J	647262	6762134	5	5
TPA 3093	51	J	645592	6761005	10	10

Drill hole ID	GPS Coordinates (WGS84)				Apr-08 Deployed Depth of Traps (m)	Jun-08 Collected Depth of Traps (m)
	Zone		Easting	Northing		
TPA 1457	51	J	645200	6759200	approx 3	approx 3
TPA 1456	51	J	645001	6759200	10	10
TPA 1455	51	J	644800	6759200	10	10
TPA 1454	51	J	644600	6759200	10	10
TPA 3135	51	J	646605	6761103	10	10
SBA 007	51	J	651300	6756200	10	10
SLA 373	51	J	652000	6755800	10	10
SBA 031	51	J	652099	6757000	10	10
Sample Size					**51**	**51**

Table 10 Sites Sampled During Phase Three (Trap Diameter 50 mm). Holes Where Troglofauna Were Recorded Are Highlighted In **Bold**. All Holes Located Outside The Mine And Infrastructure Footprint; Holes Located Inside Highlighted In Red.

Drill hole ID	GPS Coordinates (WGS84)				Aug-08	Oct-08
	zone		easting	northing	Deployed Depth of Traps (m)	Collected Depth of Traps (m)
SBA 087	51	J	654099	6760200	20	20
SBA 285	51	J	654399	6760200	20	Trap lost
SBA 269	51	J	654699	6759800	10	10
SBA 267	51	J	654500	6759800	8	8
SBA 266	51	J	654399	6759800	10	10
SBA 263	51	J	654099	6759800	6	6
SBA 247	51	J	652700	6759600	15	15
SBA 137	51	J	652600	6757000	10	10
SBA 036	51	J	653101	6757000	15	15
SLA 373	51	J	652000	6755800	20	20
SBA 135	51	J	652211	6756994	15	15
SBA 031	51	J	652099	6757000	10	10
SBA 025	51	J	650900	6757000	15	15
SBA 011	51	J	652101	6756200	10	10
SBA 102	51	J	651401	6756200	20	20
SBA 007	51	J	651300	6756200	25	25
SBA 021	51	J	654100	6756200	10	10
TPA 3832	51	J	651030	6766865	20	20
TPA 3828	51	J	650747	6767150	10	10
TPA 3826	51	J	650610	6767295	10	10
TPA 3806	51	J	651650	6766828	5	5
TPA 4002	51	J	649658	6764520	20	20

Table 10 **cont.**

Drill hole ID	GPS Coordinates (WGS84)				Aug-08	Oct-08
	Zone		Easting	Northing	Deployed	Collected
					Depth of Traps (m)	Depth of Traps (m)
TPA 3997	51	J	649277	6764889	15	15
TPA 3981	51	J	650285	6764846	20	20
TPA 3966	51	J	650996	6764594	15	15
TPA 4013	51	J	649148	6764477	15	15
TPA 4012	51	J	648941	6764681	10	10
TPA 4019	51	J	649426	6764193	20	20
TPA 4030	51	J	648857	6764198	10	10
TPA 4029	51	J	648795	6764297	15	15
TPA 4041	51	J	648738	6763776	15	15
TPST 046	51	J	648466	6763760	13	13
TPST 130	51	J	647262	6762134	4 (blocked at 5m)	4
TPST 021	51	J	646908	6763044	20	20
TPA 1456	51	J	645001	6759200	11	11
TPA 1455	51	J	644800	6759200	15	15
TPA 1454	51	J	644600	6759200	14	14
TPA 3135	51	J	646605	6761103	10	10
TPA 2783	51	J	649143	6759940	20	20
TFRC 2574	51	J	650359	6763273	15	15
TFRC 2573	51	J	650377	6763253	11	11
TPA 3977	**51**	**J**	**650460**	**6764932**	**17**	**17**
TPA 3807	51	J	651725	6766771	8	8
Sample Size					**43**	**42**

Table 11 Sites Sampled During Phase Four (Trap Diameter 50 mm). Holes Where Troglofauna Were Recorded Are Highlighted In **Bold.** All Holes Located Outside The Mine And Infrastructure Footprint; Holes Located Inside Highlighted In Red.

Drill hole ID	GPS Coordinates (WGS84)				Oct-08	Dec-08
	Zone		Easting	Northing	Deployed Depth of Traps (m)	Collected Depth of Traps (m)
SLA 239	51	J	652194	6753399	18	blocked
SLA 165	51	J	650196	6751408	20	blocked
SLA 156	51	J	649904	6751400	10	blocked
SLA 214	51	J	650801	6752196	17	17
SLA 206	51	J	649997	6752200	11	11
KMA 187	51	J	642500	6752000	20	20
TPA 641	51	J	643190	6752009	10	blocked
KMA 166	51	J	642304	6752381	7	7
KMA 151	51	J	643099	6752800	20	20
KMA 108	51	J	643300	6753600	20	20
KMA 106	51	J	642900	6753600	17	17
KMA 088	51	J	643699	6753999	11	blocked
TPA 604	51	J	644190	6754009	13	13
KMA 034	51	J	643100	6755200	19	blocked
TPA 371	51	J	642599	6755999	19	19
TPA 368	51	J	643199	6755999	16	16
TPA 4088	51	J	648627	6771194	15	15
TPA 4130	51	J	648518	6770799	14	blocked
TPA 4171	51	J	648614	6770409	17	blocked
TPA 4209	51	J	648628	6769997	13	blocked
TPA 4248	51	J	646009	6768496	13	13
TPA 4249	51	J	646212	6768495	16	16
TPA 4252	51	J	646807	6768497	14	14
TPA 4257	51	J	647811	6768409	18	18
TPA 4268	51	J	647611	6768084	16	16
TPA 4270	**51**	**J**	**648007**	**6768083**	**13**	**13**
TPA 4261	51	J	646215	6768096	17	17
TPA 4262	51	J	646400	6768096	18	18
APA 172	51	J	656895	6783195	19	blocked
APA 180	51	J	658500	6783199	10	blocked
APA 187	51	J	659898	6783202	9	9

Table 11 **cont.**

Drill hole ID	GPS Coordinates (WGS84)				Oct-08	Dec-08
	Zone		Easting	Northing	Deployed Depth of Traps (m)	Collected Depth of Traps (m)
APA 130	51	J	656890	6784794	17	blocked
APA 136	51	J	658098	6784791	11	11
APA 146	51	J	660088	6784799	16	blocked
APA 097	51	J	656901	6785605	12	blocked
APA 106	51	J	658694	6785596	18	blocked
APA 112	51	J	659901	6785607	17	blocked
APA 059	51	J	659702	6786800	11	11
MHA 042	51	J	654299	6781300	11	blocked
MHA 037	51	J	654592	6780894	5	blocked
SEA 093	51	J	655300	6757200	10	Longer trap (1m)
SEA 095	51	J	655697	6757201	5	Longer trap (1m)
SEA 085	51	J	656297	6756197	15	15
SEA 084	51	J	656087	6756194	12	blocked
TUA 002	51	J	651600	6772846	9	9
TUA 005	51	J	651899	6772837	8	blocked
TUA 021	51	J	651601	6772450	9	blocked
TUA 023	51	J	651889	6772455	9	9
TUA 034	51	J	648552	6774598	14	14
Sample Size					**49**	**26**

Appendix 3

Biological Environmental Impact Risk Assessment for Troglofauna at Tropicana Gold Project

Biological Environmental Impact Risk Assessment

AGAA Tropicana Gold Project		*Location: Great Victoria Desert*					*Date: 01/03/09*				
			Inherent Risk					Residual Risk			
Risk Issue	**Aspect (Event)**	**Impact**	**Likelihood**	**Consequence**	**Risk Level**	**Significance**	**Controls**	**Likelihood**	**Consequence**	**Risk Level**	**Significance**
Mine Site: AGAA TGP											
Mining Operations	Construction of Tropicana / Havana pits	Removal of troglofauna species and habitat	5	3	15	**High**	No controls are available for pit construction; however further sampling outside the mining and infrastructure footprint should be conducted to locate species in areas not impacted by TGP and thus reduce the full impact to some species to partial impact.	5	2	10	**Med**
Mining Operations	Expansion of Tropicana / Havana pits	Removal of troglofauna habitat	3	3	9	**Med**	Ground disturbance should be restricted to that which is necessary and outlined within this report. Boundaries should be clearly defined in the field.	1	3	3	**Low**
Changes to groundwater recharge regimes	Water use for general mine activities.	Changes to humidity of troglofauna habitat	3	3	9	**Med**	Ensure water consumption does not exceed aquifer recharge rates.	1	3	3	**Low**
Contamination of Tropicana/ Havana aquifers	Nutrients, heavy metals or other contaminants adversely impacting troglofauna habitats	Contamination of troglofauna habitat	3	3	9	**Med**	Spills to be cleaned immediately and reported to supervisors.	1	3	3	**Low**
Mining Operations	Subterranean disturbance from blasts and vibrations	Disturbance to animals and habitat	3	3	9	**Med**	Equipment maintenance and correct storage controls in place. Disturbance should be restricted to that which is necessary and outlined within this report. Boundaries should be clearly defined in the field	2	2	4	**low**

Risk Matrix:

Risk Assessment Rating		LIKELIHOOD				
		5 ALMOST CERTAIN Is expected to occur in most circumstance	4 LIKELY Will probably occur in most circumstance	3 POSSIBLE Could occur	2 UNLIKELY Could occur but not expected	1 RARE Occurs in exceptional circumstances
CONSEQUENCES	5 - CATASTROPHIC Significant impact to fauna species of conservation significance or regional biodiversity	25	20	15	10	5
	4 - MAJOR Impact to fauna species of conservation significance in project area.	20	16	12	8	4
	3 - MODERATE Loss of fauna biodiversity in project area.	15	12	9	6	3
	2 - MINOR Short term or localised impact to fauna biodiversity.	10	8	6	4	2
	1 - INSIGNIFICANT No impact to fauna of conservation significance or biodiversity.	5	4	3	2	1

25-12	High risk, site/issue specific management programmes required, advice/approval from regulators required.
6 – 10	Medium risk, specific management and procedures must be specified.
1 – 5	Low risk, managed by routine procedures.