GOULDIAN FINCH MONITORING METHODOLOGY

Mt Todd Gold Project

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BASIS OF REPORT

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ABBREVIATIONS

ANZECC	Australian and New Zealand Environment Conservation Council
dB	Decibel
DENR	NT Department of Environment and Natural Resources
DMMP	Dust Monitoring and Mitigation Program
CBG	Corticosterone binding globulin
CORT	Corticosterone
EIS	Environmental Impact Statement
EM	Environmental Manager
EPBC Act	Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*
GFMM	Gouldian Finch Monitoring Methodology
GFMP	Gouldian Finch Management Plan
Jawoyn	Jawoyn Association Aboriginal Corporation
MIC	Maximum explosive mass
MMP	Mining Management Plan
NVIS	National Vegetation Information System
$PM_{2.5}$	Particulate Matter up to 2.5 micrometres in size
PM_{10}	Particulate Matter up to 10 micrometres in size
TAC	Technical Advisory Committee
The Project	The Mt Todd Gold Mine
TPWC Act	NT *Territory Parks and Wildlife Act 2006*
Vista Gold	Vista Gold Australia Pty Ltd

1 Introduction

On 19 January 2018, Vista Gold Australia Pty Ltd (Vista Gold) received approval under the Commonwealth's *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) to re-open, operate, close and rehabilitate the Mt Todd Gold Mine (the Project) (EPBC Act reference number 2011/5967). The Project is located approximately 55km north of Katherine, Northern Territory (NT) (**Figure 1 Mt Todd Project location**).

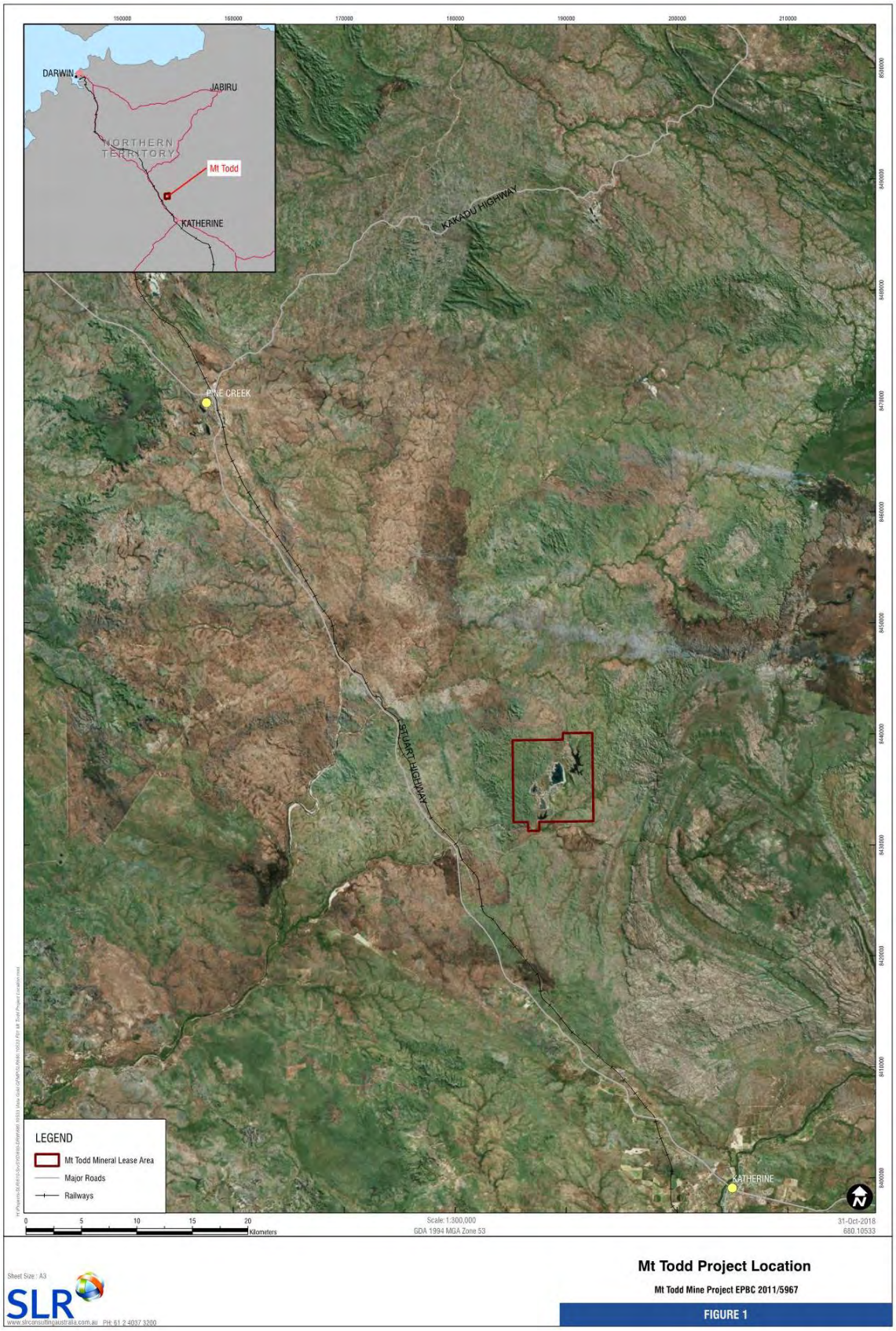
The Approval nominates the Controlling Provisions as:

- Listed threatened species and communities (Sections 18 and 18A of the EPBC Act); and
- Listed migratory species (sections 20 & 20A of the EPBC Act).

The principal species subject to the Controlling Provisions is the Gouldian Finch (*Erythrura gouldiae*) which is known to breed and forage in the Project area and surrounds. This species is listed as Endangered under the EPBC Act and Vulnerable under the NT *Territory Parks and Wildlife Conservation Act* (TPWC Act). The area to be disturbed by the Project lies within the Yinberrie Hills, an area which is recognised as an important bird site at Territory, National and International levels based on the Gouldian Finch population (Ward and Harrison, 2009; Dutson, Garnett, and Gole, 2009; Birdlife International, 2018).

The Gouldian Finch Monitoring Methodology (GFMM) has been developed to monitor environmental variables which are predicted to increase in scale and extent as a result of the Project. The GFMM aims to measure the effects of those variables on the Yinberrie Hills Gouldian Finch population size, distribution and health.

Figure 1 Mt Todd Project location



2 Objectives

2.1 General

This GFMM has been designed to achieve the following objectives:

- To test predicted levels and risk ratings of dust, noise, blasting and light
- To determine whether mining activities are affecting the Yinberrie Hills Gouldian Finch population over the short and long terms
- To allow rapid changes to the management of mine-related effects to the Yinberrie Hills Gouldian Finch population.

2.2 Phase-specific

The Program will capture information across numerous phases of the project life (Phase 1 Baseline, Phase 2 Baseline and Phase 3 (mine operation)). Each of these phases is designed to satisfy a particular set of objectives, as follows:

- Phase 1 Baseline (implemented prior to the decision to proceed with the project)
  - To validate, inform and/or assess measurability of the indicators proposed to be monitored during the baseline and mine operation stages by trialling methodologies for the program components
  - To supplement existing data that has been collected during the development of the 2013 Environmental Impact Statement (EIS) (GHD 2013) or other historic monitoring
  - To better understand any ecological trends or phenomena, related to the Gouldian Finch, existing prior to the commencement of the baseline monitoring
  - To commence the baseline dataset against which comparison may be made of ongoing surveys
  - To establish and/or validate trigger values, including for stress physiology and body condition, dust and noise.
- Phase 2 Baseline (implemented after the decision to proceed with the project)
  - To assess pre-impact environmental indicators related to the Gouldian Finch
  - To inform project management decision making
  - To re-assure the public, regulatory agencies and Vista Gold that key environmental issues are identified and monitored
  - To promote participation and collaboration with relevant stakeholders (e.g. Jawoyn Association Aboriginal Corporation (Jawoyn), NT Government, Charles Darwin University, interested community groups)
  - To utilise pre-baseline data to efficiently and effectively measure nominated indicators
- Phase 3 Mine Operation
  - To assess impacted environmental indicators related to the Gouldian Finch
  - To detect changes in environmental indicators
  - To determine possible or likely causes of change or exceedance of trigger values.

2.3 Indicator-specific

Each proposed indictor has its own set of technical objectives to ensure that specifications regarding precision, confidence, time and space are effective in meeting the general and phase-specific objectives described in **Sections** 2.1 **General** and 2.2 **Phase-specific**. These indicator-specific objectives are described in **Table 1 Summary of indicators, objectives and techniques used in the monitoring program**.

2.4 Relationship with Other Reports

This GFMM should be read in conjunction with the Gouldian Finch Management Plan (GFMP) which includes an assessment of threats, potential impacts and risks to the Gouldian Finch from the Project. This GFMM will be reviewed and endorsed by the Gouldian Finch Technical Advisory Committee (TAC) who operate under the Terms of Reference required under the Approval.

3 Summary and schedule

A summary of the monitoring component is provided in **Table 1 Summary of indicators, objectives and techniques used in the monitoring program**. The current schedule, taking into account the forecast for the financial investment decision and construction staging, is provided in **Table 2 Schedule for the monitoring program**.

Table 1 Summary of indicators, objectives and techniques used in the monitoring program

Variable	Objectives	Techniques	Location	Timing	Outputs	Location of full methodology
Environmental (extrinsic) indicators						
Airborne particulate concentrations	Test concentrations of dust in finch habitats.	Install particulate monitors to carry out monitoring of airborne particulate concentrations	Airborne particulate monitoring stations. Control sites.	Real time monitors (operating continuously).	Data collected from both PM_{10} particulate loggers for varying monitoring locations.	Appendix A Dust Monitoring and Mitigation Program
Dust deposition	Test dust deposition levels in key finch habitats.	Install dust deposition gauges.	Dust deposition stations.	Once per month.	Baseline and ongoing dust deposition levels.	Appendix A Dust Monitoring and Mitigation Program
Noise	Test noise levels in finch habitats. Test project operational noise controls / effect threshold levels and to more accurately define the potential for risk.	Install noise loggers at selected monitoring stations.	Noise monitoring stations.	Until blasting ceases, or until such time that it is considered that noise levels are such that no adverse effects to Gouldian Finches are likely.	Baseline and ongoing ambient noise levels collected from each monitoring station.	Section **4.2**
Blast levels	Test blasting levels in finch habitats. Test project operational blasting controls / effect threshold levels and to more accurately define the potential for risk.	Install blast monitoring units at selected monitoring stations.	Blasting monitoring stations.	Until blasting ceases or such time that it is considered that blasting levels are such that no adverse effects to Gouldian Finches are likely.	Blast level log.	Section **4.3**

Variable	Objectives	Techniques	Location	Timing	Outputs	Location of full methodology
Fires	Assess against objectives and indicators described in the Bush Fire Management Plan. Monitor extent, timing and frequency of fires. Determine what proportion of, and/or influence from, mine-related fires (i.e. asset protection burns and unintended ignitions from road crews or increased traffic) have overall.	Documentation and mapping of fire regimes. Comparison to fire regimes recommended for the species (e.g. Lewis, 2003). Analysis of the North Australian Fire Information website.	Within 10 km of the Controlled Action (i.e. within habitat considered 'important', 'marginal' and 'distant').	Annually	Documentation of fire regimes GIS mapping	Section **4.4**
Light	Test light levels in finch habitats. Test light modelling and to more accurately define the potential for risk.	Test light levels using a lux meter at monitoring stations.	To be confirmed following final lighting specifications developed during the detailed design phase.	To be confirmed following final lighting specifications developed during the detailed design phase.	Light level log and, if required, audit report and recommendations.	Section **4.5**
Water quality	Test water quality in mine-related water bodies.	Analyse water for levels of contaminants.	Water samples taken at the mine's dams or any potential waterbodies with effluent.	Three times per year (two during the dry season and one during wet season).	Water quality data.	Section **4.6**

Variable	Objectives	Techniques	Location	Timing	Outputs	Location of full methodology
Meteorological Conditions	Monitor meteorological conditions across the site.	Install weather station.	Within the mine infrastructure zone.	Daily	Weather log	Section **4.7**
Biological indicators						
Stress physiology and body condition	Determine whether mine-related dust is causing a decline of the Yinberrie Hills Gouldian Finch population by testing predicted dust effect thresholds. Predict how the Yinberrie Hills Gouldian Finch population will respond to forecast dust levels.	Capture bird via mist netting or walk in traps and measuring: Body condition via a muscle score. Haematological condition via blood sampling.	Yinberrie Hills (impact site). 2 control locations.	Annually	Causal effects, trends between populations, and recommendations to mitigation (if required).	Section **5.1**
Relative abundance of Gouldian Finches (population index)	Use point counts of Gouldian Finches to calculate population indices. Detect changes in indices.	Waterhole counts	A selection of known waterholes in the Yinberrie Hills (**Figure 3 Location of known waterholes**).	Annually during late dry season when water is limited, and birds congregate at available waterholes	Population index Raw data for waterhole counts	Section **5.2**

Variable	Objectives	Techniques	Location	Timing	Outputs	Location of full methodology
Relative abundance and distribution of a key non-breeding season food resource (*Alloteropsis semialata*)	Locate patches of *A. semialata.* Assess and monitor patches for extent and condition. Test dust deposition levels in these locations.	Traverse potential *A. semialata* habitat during the early wet season when the species is flowering/seeding.	Areas of potential *A. semialata* habitat identified during early wet season searches.	Annually, during the early wet season.[1]	Record of extent and condition attributes GIS mapping with locations Causal effects, trends of dust levels, and recommendations to mitigation (if required).	Section **5.3**
Gouldian Finch presence / absence	Record incidental sightings to test presence throughout year.	Key environmental staff trained in the recognition of Gouldian Finches and their calls. Records locations with GPS and in the Mt Todd Gouldian Finch sightings database.	Mining lease and Yinberrie Hills.	Continually	Additional contextual (or anecdotal) information	Section **5.4**

[1] A dedicated survey approach will be developed in conjunction with the outputs from Liedloff *et al*. (2009).

Table 2 Schedule for the monitoring program

Variable to be measured	Completed / Phase 1 Baseline				Phase 2 Baseline		Phase 3 - operation					Notes
	2016	2017	2018	2019	2020	202\1	2022	2023	2024	2025	Ongoing	
Extrinsic indicators												
Airborne particulate concentrations	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Likely to exist no further than year 10 of operation
Dust deposition		Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Likely to exist no further than year 10 of operation
Noise		Y	Y	Y	Y	Y	Y	Y				2 years pre- and 3 years post-commencement of operation should be sufficient
Blast levels						Y	Y	Y	Y	Y		First 3 years of operation should be sufficient to detect levels
Fires		Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Likely to be ongoing given its importance in determining its influence Gouldian Finch abundance and distribution
Light		Y	Y	Y	Y	Y	Y	Y				2 years pre- and 3 years post-commencement of operation should be sufficient
Water quality	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Ongoing for regulatory reasons
Meteorological conditions	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Ongoing given its importance to numerous factors regarding mining operation

Variable to be measured	Completed / Phase 1 Baseline				Phase 2 Baseline		Phase 3 - operation					Notes
Biological indicators												
Stress physiology and body condition		Y	Y	Y	Y	Y	Y	Y	Y	Y		Initial assessment period of 2 years pre- and 5 years post-commencement of operation
Waterhole counts		Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Likely to continue given it is a well-established methodology for the species and provides a reasonable indication of long-term abundance in the area
Vegetation monitoring		Y	Y	Y	Y	Y	Y	Y	Y	Y		Initial assessment period of 2 years pre- and 5 years post-commencement of operation
Incidental Gouldian Finch observations		Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Ongoing as it is a simple indication of presence or absence of the species in the area
Trial Projects												
Artificial nest boxes					Y	Y	Y	Y	Y	Y		Initial assessment period of 3 years pre- and 5 years post-commencement of operation should provide sufficient data to analyse and determine trends in utilisation levels
Camera monitoring at waterholes		Y	Y	Y								Initial assessment period of 2 years to determine efficacy
Artificial watering points					Y							Initial assessment of short term project to determine its usefulness as either a bird congregation point or habitat enhancement measure outside the mine's area of influence

Variable to be measured	Completed / Phase 1 Baseline				Phase 2 Baseline		Phase 3 - operation					Notes
Bird physiological monitoring		Y										Preliminary results suggest that this method lack statistical power
Burning regimes / patch research					Y	Y						Following on from Sarah Legge's work in the Kimberley, this may be a good phd project to assess the optimal timing, size and density of burnt patches appropriate to Gouldian Finches in the Yinberrie Hills

4 Environmental Variables

To achieve the above objectives, the Program will measure the following environmental variables:

- Primary
  - Dust
  - Noise and blasting
- Secondary
  - Fire
  - Light
  - Water quality
  - Climatic conditions (e.g. rainfall, temperature, wind speed and direction).

Whilst monitoring of the secondary variables may aid in distinguishing mine related or non-mine related effects, the focus is to test the predicted consequences and risk ratings described in the GFMP (SLR 2018).

4.1 Dust

The Dust Monitoring and Mitigation Program (DMMP) is provided at **Appendix A Dust Monitoring and Mitigation Program**.

4.2 Noise

Four noise loggers have been placed within the Yinberrie Hills, as shown in **Figure 2 Noise and blast monitoring locations**. One is situated to the south west of the existing waste rock dump, and one to the west of the existing Batman Pit (on the eastern edge of the Yinberrie Hills). Two other loggers have been be installed within the mining lease to the north and south of primary noise and blast areas to test predicted levels. Two sampling sessions will be conducted annually (wet and dry season), each of two weeks duration.

4.3 Blasting

Monitoring data from blast emissions will be used (via the blast emissions site laws presented in SLR (2015) to refine subsequent blast designs in order to control blast emission (ground vibration and airblast) levels. Two blast monitoring locations are currently intended to be located as shown in **Figure 2 Noise and blast monitoring locations**.

4.3.1 Blast Monitoring - General Procedure

A program of blast emissions monitoring (airblast and ground vibration) will be developed with reference to the procedures described in AS 2187.2-1993, "*Explosives - Storage, Transport and Use*" and with reference to the ANZECC's "*Technical Basis for Guidelines to Minimise Annoyance due to Blasting Overpressure and Ground Vibration*", September 1990.

4.3.2 Blast Emissions Monitoring Locations

Monitoring will be conducted at the location where the progressively updated (5% exceedance) blast emission site laws predict a level of 130 dB Linear airblast or 5 mm/s ground vibration, whichever is the closer, as well as the distance at which the airblast level of 110 dBLinear is predicted. Currently, these locations are anticipated to be as shown in **Figure 2 Noise and blast monitoring locations**.

4.3.3 Blast Emission Monitors

Blast monitoring instrumentation will be employed to meet the following primary specifications presented in **Table 3 Blast monitor specifications**. The instrumentation will be installed, operated and maintained by suitably qualified or trained personnel. The instruments will be externally calibrated at regular intervals.

Table 3 Blast monitor specifications

Specification	Seismic	Airblast
Resolution	0.016 mm/s	0.1 dB
Range	0.1 mm/s to 254 mm/s	88 dB to 148 dB
Accuracy	3% at 15 Hz	0.2 dB at 30 Hz
Sample rate	Minimum 1024 samples per second per channel	
Frequency response	2 Hz to 250 Hz (3 dB points)	
Communications link	Keyboard and modem	
Recording mode	Full waveform recording and archiving	

4.3.3.1 Monitor Installation

The blast monitors will be operated manually for each blast requiring monitoring.

Vibration velocity geophones will be coupled to the ground via a “star stake” or concrete plinth embedded in the consolidated surface approximately 25 m from the subject building or structure, with the microphone positioned in the free-field.

4.3.3.2 Monitoring Equipment

The automatic anemometer and wind vane station located at the mine will be considered representative of wind propagation conditions in relation to blast emissions throughout the blast monitoring program.

4.3.3.3 Blast Design Records and Predicted Emission Levels

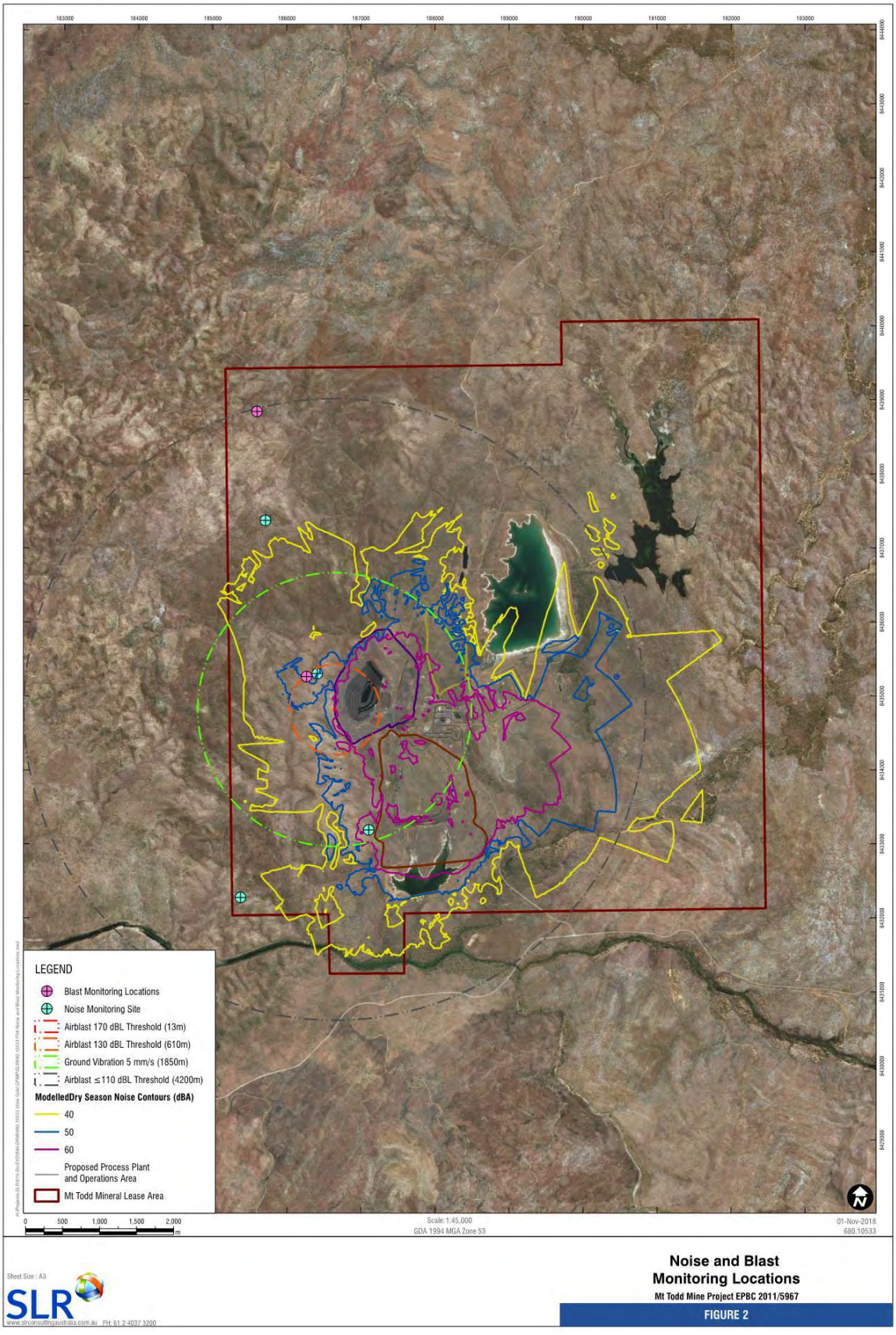
Blast design records will be maintained for all the blast events. The purpose of the records is to assist in the design and optimisation of future events, planning and control of blasting emissions and to provide a traceable system of documentation.

The blasting contractor will provide a description of the blast design parameters prior to each blast event and include the location co-ordinates (East, North, RL) of the blast site (or the distance from the blast site to the blast monitor(s)) and the maximum explosive mass (MIC) to be detonated in any 8 ms interval.

The Blasting Superintendent will verify and approve the proposed blast design with respect to potential blast emissions based initially on the then current 5% exceedance predictive site laws for ground airblast and vibration as described above.

In order to maximise the benefits of the blast monitoring process, the significant blast design parameters, emission levels and meteorological data will be collated and maintained by the Blasting Superintendent for each monitored blast event.

Figure 2 Noise and blast monitoring locations



4.4 Fire

Fire regimes will be monitored throughout the Yinberrie Hills. Information regarding annual fire scar data and the time unburnt or burnt in consecutive years will be obtained from the North Australian Fire Information service and assessed annually.

Further information regarding the comparison of this data between impact and control sites as related to the potential stress physiology, and bird condition monitoring is described in **Section 5.1 Stress Physiology and Bird Condition**.

4.5 Light

Given that the light assessment was based on a number of assumptions including the types of lighting to be used, it is anticipated that the light spill model will be refined following the finalisation of mine site layout and constructions drawings. In addition, whilst the current light spill model demonstrates that it is highly unlikely that light will encroach into the Yinberrie Hills, inspections / monitoring will be undertaken to test the predicted light levels. This program does not contain details of such light inspection / monitoring sites given the uncertainty in detail of the final lighting designs and the low residual predicted risks of mine-related light to the Gouldian Finch. However, final design, installation, inspections and monitoring of light in the Yinberrie Hills will be undertaken in accordance with *AS/NZS 1680.1:2006 Interior and workplace lighting Part 1: General principles and recommendations*.

4.6 Water Quality

Water quality monitoring undertaken across the site includes monthly surface water (ponds, dams and streams); monthly pit profiling; bi-annual groundwater sampling; and Waste Discharge Licence monitoring. These programs, along with current and previous results, are detailed in the 2018 Mining Management Plan (MMP). All monitoring programs are undertaken with appropriate Quality Assurance and Quality Control procedures and these are comprehensively detailed in the 2020-24 MMP.

4.7 Climatic Conditions

An automatic weather station was installed at the Mt Todd site in March 2011 and a second station installed in November 2015. The weather stations record the following meteorological parameters:

- Rainfall
- Wind speed
- Wind direction
- Solar radiation
- Barometric pressure
- Relative humidity
- Air temperature.

5 Biological Indicators

The following attributes will be measured to determine the effect of the above identified potential impacts on the Yinberrie Hills Gouldian Finch population:

- Relative health of finches
- Population index
- Extent and condition of a key foraging food species

Population surveys were originally intended to follow a 'before-after-control-impact' design. However pre-construction surveys have indicated that there are currently no populations/areas of habitat that are suitable control sites (Charles Darwin University, 2018). The survey design has been modified to rely on changes within the Yinberrie Hills detected through comparison of pre-disturbance and post-disturbance data.

5.1 Stress Physiology and Bird Condition

This component has been designed to provide a statistically robust examination of the condition of two co-occurring species of seed-eating finches (the Gouldian Finch, Long-tailed Finch (*Poephila acuticauda*) and) in at least three areas, one of which is in the Yinberrie Hills where elevated dust levels are modelled to occur during mine operation.

5.1.1 Objectives

The stress physiology and bird condition monitoring component has been designed to:

- Determine whether mine-related dust, being the potential threat of greatest concern to the Yinberrie Hills Gouldian Finch population, is causing a decline of the population by testing predicted dust effect thresholds
- Predict how the Yinberrie Hills Gouldian Finch population will respond to forecast dust levels.

5.1.2 Sampling Periods

Sampling will occur biannually, during:

- September – when winds are from the south-east, it is dry, and finches are more likely to congregate at waterholes
- February – at commencement of breeding season when birds are likely to be stressed.

At the Life of Mine scale, a number of key periods and milestones have been developed to accord with identified and modelled levels of potential impact, as follows:

- Phase 1 Baseline – one to two years (prior to the construction period and subject to decisions regarding financial investments and construction commencement)
- Phase 2 Baseline – two years (includes construction and prior to mine operation)
- Early operation – three years (to year 3 of mine operation (i.e. modelled worst case dust level))
- Mid-operation – year 3 to year 10 of operation
- Late operation – year 10 to year 13

- Closure and decommissioning.

5.1.3 Study Species

The study will sample three grass finches (Gouldian, Long-tailed and Masked) for the following reasons:

- The Long-tailed and Masked Finches will act as 'control' species for any observed trend of condition or physiology in the Gouldian Finches (given their apparent similarity in physiology)
- Insufficient numbers of Gouldian Finches may be captured, so gathering data from other species may be warranted
- It is likely that other species of finch will be captured during the process of capturing Gouldian Finches.

5.1.4 Study Sites

A minimum of three sites will be sampled. This includes the Yinberrie Hills, where potential impacts from the Project are predicted (i.e. the 'impact' site), as well as two references sites to monitor trends in areas not exposed to potential mine-related impacts (the 'control' sites). This is considered adequate given the trilateral approach of comparing differences between:

- Impact and control sites
- Three species
- Seasonally between three species and three sites.

Sites will be located within a 10-15 km^2 study area.

Bird congregations will be located at each site during each sampling period in a two stage process:

- Preliminary desktop investigations to identify locations of higher likelihood of bird congregations, including:
  - Sites sampled in previous years
  - Known waterholes
  - Creeks (to locate new water holes)
  - Lowland foraging areas in the early wet season (i.e. start of breeding season)
  - Hilly areas in the late wet (breeding) season.
- Field verification using the information identified during the first stage, using a combination of driving and walking to visually and aurally identify bird congregations.

5.1.4.1 Yinberrie Hills ('Impact' Site)

In the Yinberrie Hills, Gouldian Finches will be captured from within the areas potentially impacted by mine-related effects (SLR, 2016). SLR (2016) undertook a revised risk assessment of potential impacts with results indicating that several potential effects will have a 'medium' risk of having an adverse impact to the Yinberrie Hills Gouldian Finch population. These effects include loss of potential breeding and foraging habitat, dust, and noise.

Possible capture locations include along Batman Creek and at the southern end near the waste rock facility (where some existing waterhole count sites are located). The specific location(s) for bird capture will be as close to the mine processing infrastructure site as possible as this is the area of highest modelled impact. Given that Gouldian Finches are highly mobile, it is likely, at least during the non-breeding season, that they travel in and out of the 'impact area'. Determining the actual amount of time they spend in this area could be difficult however it is probably irrelevant given that we are determining the levels (not time) of exposure and their effect on the health of the bird.

Another suggestion has been to attract birds to artificial watering points to simplify the process and increase the likelihood of capturing a sufficient number of birds. However, it is noted that attracting birds in this way may inappropriately expose higher numbers of birds to mire related impacts. In addition, artificial water points may also attract feral animals such as cats and buffaloes, which in turn could increase the stress levels in the birds. Rather, it is considered appropriate to locate natural water holes and feeding sites. However, this is an option that could be further considered at a later date.

5.1.4.2 Control Sites

A minimum of two control sites will be sampled. There are a series of factors that will influence the location of the control sites. By definition, a control site must be independent of any potential impacts of the variables that are being measured. In this case, as we are measuring mine-related impacts, there are a number of guiding principles that will define the most suitable location for the control sites:

- They should be sufficient distance from the areas potentially affected by the mine so as to ensure that any birds captured have not been influenced in any way by mining activities.
- They should be sufficient distance from each other so as to ensure that birds are not using both areas simultaneously.
- They should be located in areas that contain relatively similar environmental stressors to the 'impact' site (i.e. roughly similar levels of grazing and fire regimes). The objectives and statistical analyses of the study are not designed to measure multiple environmental factors not related to mining activities (rather it is designed to compare body condition and physiology indices between sites).
- It needs to contain similar and appropriate breeding habitat (ideally *E. tintinnans* given that it is the species of tree that Gouldian Finches nest in the Yinberrie Hills).
- It should contain similar understorey flora composition, particularly in relation to food species, as that found in the Yinberrie Hills (i.e. annual sorghum species).
- It needs to contain a known and persistent population (i.e. substantial and consistent number of sightings) of Gouldian Finches (assessed through information received by both government agencies (e.g. NT Fauna Atlas) and through local birdwatching groups.
- It should ideally be in an area that has similar climatic conditions to the Yinberrie Hills (e.g. similar rainfall).
- For logistical convenience, it should be located as close as possible to the proposed mine.

The location of study areas will remain the same for each sampling session, although the specific sampling location within each study area may change according to the location of Gouldian congregations. Between seasons, the species is capable of making long-distance movements (O'Malley, 2006). There are recent sightings of the species at Ethabuka in south-western Queensland, far from any historical or current breeding site (O'Malley, 2006). There are also historic accounts of the species migrating to breeding areas (Berney, 1903; Smedley, 1904; cited in DoE, 2018). These observations, coupled with little genetic variation between Gouldian Finch populations across northern Australia (Heselwood et al. 1998; cited in DoE, 2018), suggest that the species occurs in one or more larger populations, and that the disjunctions observed between the populations might be a consequence of habitat loss or impacts in between (O'Malley 2006).

However, over the short term (e.g. a few weeks), there is evidence that species is largely sedentary, moving locally (<20 km) in response to local changes in the availability of food (Dostine et al. 2001; Higgins et al. 2006; Lewis 2002 pers. comm. cited in O'Malley 2006a; Tidemann 1993a; cited in DoE, 2018; Legge *et al*., 2015). In an eight year study by Legge *et al* (2015), no movement of individuals was detected between their study sites (located 80 km apart) during the sampling periods and the farthest distance an individual was located was 5 km from the original detection point.

Based on this, it is considered sufficient that the control sites must be approximately 20 to 50 km from the outer boundary of the area potentially impacted by the mine. This is likely to ensure that birds captured, particularly in the breeding season, have not recently travelled, or don't regularly travel, into the Yinberrie Hills. In addition, banding the birds may provide some further information regarding local or regional Gouldian movements.

It is likely that the location of control sites will be determined using:

- Consultation with local field naturalist clubs and bird watching tour groups
- Correlation analyses of known records and vegetation sub-groups in the National Vegetation Information System (NVIS)
- Further interrogation of current Gouldian Finch observations (using the NT Fauna Atlas, Atlas of Living Australia, eBird etc.).

These methods will be undertaken at the commencement of the program based upon the guiding principles stated above.

5.1.5 Capture and Handling Methods

Key finch capture and handling techniques include:

- A minimum of 20 individuals of each species at each site will be captured and measured, totalling at least 360 birds per year.
- Finches will be captured using mist nets and walk-in traps set at waterholes and feeding sites, using call playback where necessary.
- Water holes and feeding sites will need to be located prior to trapping. This will involve walking creek lines and looking/listening for Gouldian Finches, other finches, or congregations of others species (i.e. mixed flocks).
- Birds to be captured during fine weather within two hours after sunrise, and less where possible.
- The length of time between capture and blood sampling measured to account for capture stress.

5.1.5.1 Measurement of finch body and haematological condition

Key techniques include:

- Body condition to be measured using one index[2]:
  - Muscle score: shape and relative volume of the pectoral muscles.
- Sampled blood measured for packed cell volume (and haemocrit calculated; haematocrit is an indicator of general health and activity).

5.1.5.2 Measurement of stress indices from plasma

Key techniques (drawn from Legge *et al.* 2015) include:

- Total corticosterone (CORT) and corticosterone binding globulin (CBG) capacity determined from plasma.
- CORT response to handling stress relatively measured with a linear regression (CORT results against handling time).

5.1.6 Banding

Birds will be banded to assist in keeping track of their movements and their life history.

5.1.7 Age

Birds will be aged as juveniles or adults.

5.1.8 Bird Death and Post-Mortem Analysis

It is possible that a small number of birds may die as a result of stress or shock during their capture. In this event, it is proposed that subsequent post-mortem analyses will be undertaken to obtain additional information relating to bird health and condition such as the incidence of air-sac mite. It is intended that this information be then utilised to better understand the interaction of bird health and responses to a range of natural environmental and mine-related stressors including air quality and noise. Air-sac mites are known to compromise the health of Gouldian Finches and the presence of the mite cannot be reliably detected in living birds. Any dead birds will be stored in an appropriate preservative.

5.1.9 Data Analysis

The analysis will focus on determining trends between three levels of variation:

- Location to Location – corresponding primarily to variation of mine-related impacts
- Season to Season – corresponding to variation of climatic/environmental variables
- Species to Species – corresponding to variation
- Season versus Location interaction – corresponding to the inconsistency in how the populations respond over time.

[2] Body condition using fat scores will not be utilised as previous studies have found them not to be particularly useful (Legge, S. Pers. Comm. 2016)

A mixed model analysis of linear and curvilinear regression will be undertaken, with Season (late dry vs wet) and Species designated as fixed factors, and Location (as a surrogate for mine-related impacts) designated as a random factor (covariate) to account for general differences in measures among sample locations. Their influence on the stress and condition measures of keel score, haemocrit, and CORT will be examined.

5.2 Relative Abundance (via Waterhole Counts)

The basis of the waterhole count methodology is as described by Palmer (2008). The following sections have been extracted from this standard protocol.

5.2.1 Objectives

The objective of the waterhole counts is to determine medium to long-term trends in a population index (relative abundance) of Gouldian Finches in the Yinberrie Hills.

5.2.2 Methodology

The waterhole monitoring program will be part of the annual operational schedule for Vista Gold. Where possible, the Jawoyn and NT Department of Environment and Natural Resources (DENR) staff, as well as volunteers (with resources funded by Vista Gold) should be involved in the program.

The following sections contain the methodology to be undertaken in order to prepare and implement the waterhole counts each year.

5.2.2.1 Early Dry Season

At the start of each dry season (or when annual field work plans are being prepared), the Vista Gold Environment Manager (EM) will schedule the timing and resources required to undertake the counts.

Counts will need to be undertaken in September with a total survey period of 10 days (each waterhole surveyed for three mornings with the Sunday in between taken off). The survey will ideally involve at least Rangers from the Jawoyn, as well as staff from DENR, and likely community volunteers.

5.2.2.2 Two Weeks Prior to the Survey

Two weeks before the counts start at each site, the EM will undertake a reconnaissance trip to all known waterholes to check for water and, if water present, mark access with flagging tape. The name or number of each waterhole will be written on the flagging tape so there is no confusion regarding waterhole names. Known waterhole locations are found in **Table 4 GPS coordinates of known waterholes** and **Figure 3 Location of known waterholes.** Any new waterholes will be marked also.

Depending on the previous wet season's rainfall, the waterholes may have moved from the previous year, therefore:

- If the waterhole is within 200 m either side of where the waterhole was last year, then it is considered the same waterhole. Any waterholes further than 200 m are to be identified as a new waterhole, and named appropriately.
- If there is no water in a waterhole, there is no need to survey it, but check for waterholes nearby (e.g. walk the creek line).

- If there are lots of little waterholes, do an early morning reconnaissance a few days before the counts begin and see which holes are being used by Gouldian Finches coming into drink. If it is more than one waterhole that is being used, put observers on all ones where the birds are drinking from and then lump all the counts as if it is one waterhole. It also might be possible to count two waterholes at the same time – but this is for experienced observers only.

At this time, the EM will also organise logistics and equipment required (see **Section 5.2.3 Equipment**).

Table 4 GPS coordinates of known waterholes

Site ID	GPS Coordinates (easting, northing) (WGS84)
CP1	186153, 8438607
CP2	182695, 8436568
CP3	183468, 8433192
CP4	187254, 8432564
Cut	182458, 8436029
Figtree	183522, 8433515
Frog hole	183678, 8433605
JG10	182319, 8436445
JG35	181959, 8436977
K?	186897, 8432724
K7	186772, 8432565
NW05	186297, 8438254
Poachers	182597, 8436462
Soak	182499, 8436462

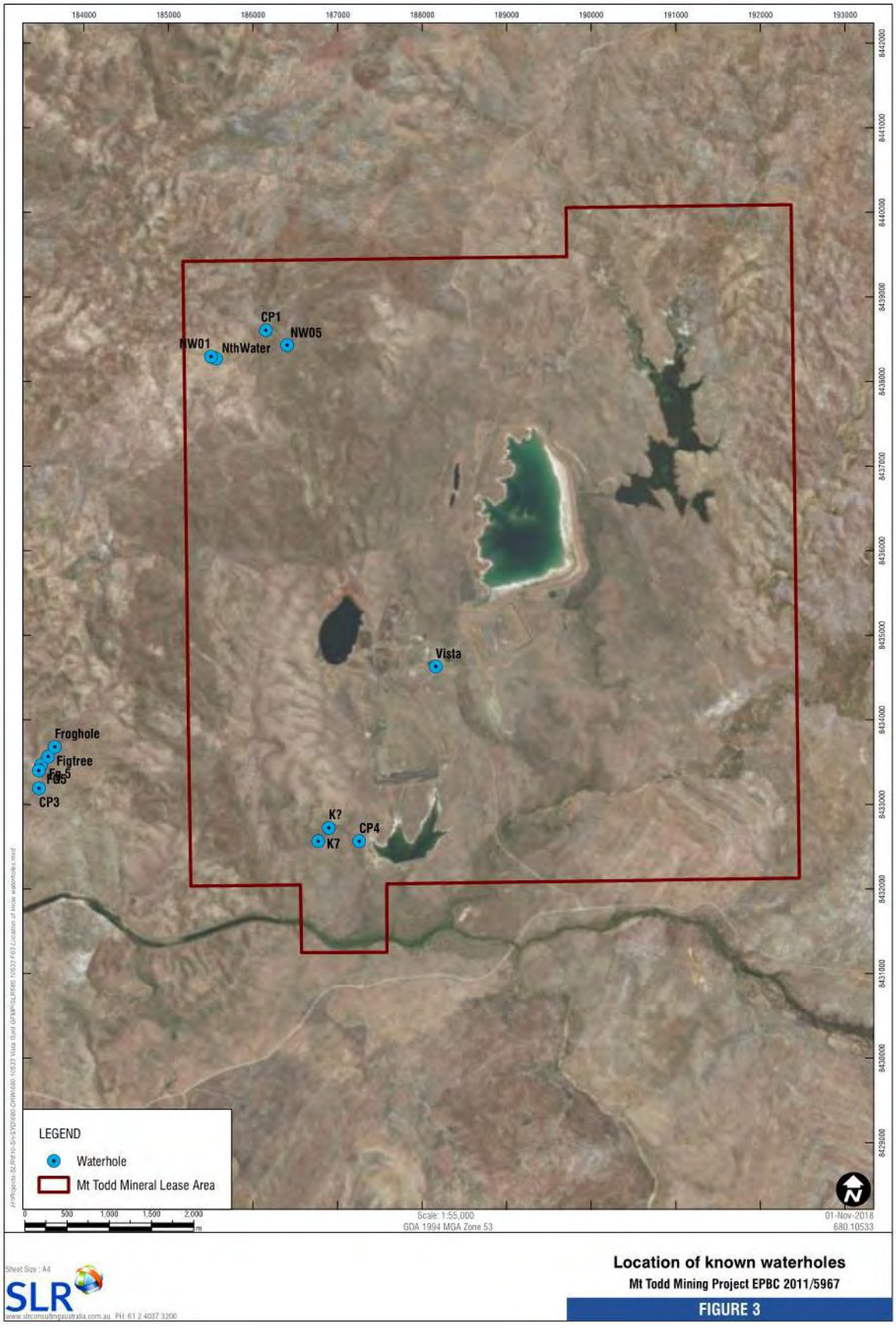
5.2.2.3 During the Survey

The waterhole count methodology is as follows:

- Each team will count any waterhole only once – each morning a team will count at a different waterhole.
- Each waterhole needs to be counted three times in total (so at the end of the entire session there will be three datasheets for each waterhole).
- Counts start at 6.30 am and last for three hours.
- Personnel are to locate themselves near the waterhole as follows:
  - Sit about 15 m from the water's edge, where possible
  - Have the sun behind them but ensuring your shadow is not on or near the water as any movement will flush the birds.
  - Try to avoid being higher than the finches though this is not always possible
  - Have as clear a view of all of the waterhole as possible

  - Try to avoid having to shift position once you have started counting
  - When counting at larger waterholes consider where the finches are likely to drink. They prefer gently sloping edges such as beaches, or rocks just above the water surface. If the pool is very long sitting at one end can encourage the birds to drink at the other end and give you a clear line of sight.
- All Gouldian Finches seen are counted, categorised into adult males and females, and juveniles, as well as the head colour of adults (see images in **Section 5.2.4 Identification**).
- For ease of recording, the datasheet is split into fifteen minute periods. Nonetheless, it is a continuous count.
- If possible, all seed-eating birds using the waterholes are to be counted. However, the priority is the Gouldian Finches.
- Count only birds that come down to drink. Sometimes lots of Gouldian Finches come into drink at once and you may not be able to count individual birds. In this case, estimate group sizes, e.g. 10 black-headed male Gouldian Finches, 5 red-headed female Gouldian Finches, 25 Juveniles, and 40 Longtails. Put these numbers down as your count. Return to actual individual counts as soon as you can.
- If it gets really busy with lots of birds coming down to drink (and this can happen), don't panic. The priorities are:
  - Gouldian adults and juveniles
  - Hooded Parrots
  - Other finch species
  - Other seed-eating birds such as Peaceful and Diamond Doves
- The best method of recording numbers is in a tally system. Four vertical strokes and a horizontal stoke through them represents 5.
- At the end of each morning count, please tally each fifteen-minute segment for each species, and write the total, circled, in the lower right corner of the appropriate square.
- At the end of each morning's session, completed data sheets are to be handed to the EM.

Figure 3 Location of known waterholes



5.2.2.4 Post-Survey

Following the survey:

- The EM will enter data into the Gouldian Finch Waterhole Survey Database.
- During October, the EM will produce an Annual Report of counts and submit to the relevant agencies.

5.2.3 Equipment

Equipment needed by participants:

- Binoculars
- Clipboard and data sheet
- 2 pencils
- Watch or clock
- Waterhole monitoring Safe Operating Procedure (SOP)
- Chair (optional)
- Water and food
- Bird book
- Sunscreen and hat
- GPS.

5.2.4 Identification

Female Gouldian Finches can be very dull, much more so than bird books suggest. However, similar to the male they will always have a face patch and purple chest (**Figure 4 Juvenile and female Gouldian Finches, and a Long-tailed Finch**). Both red head and black head males and females may be seen (**Figure 5 Red- and black-headed Gouldian Finches**).

Juvenile Gouldian Finches lack the distinct coloured face patch and purple chest of the adults (**Figure 4 Juvenile and female Gouldian Finches, and a Long-tailed Finch**). They are basically a dull olive colour especially on the back, though some may have patches of brighter feathers beginning to moult through as they get older. All juvenile Gouldian Finches have a dark bill.

Please remember that inaccurate identifications are worse than no counts at all.

Figure 4 Juvenile and female Gouldian Finches, and a Long-tailed Finch

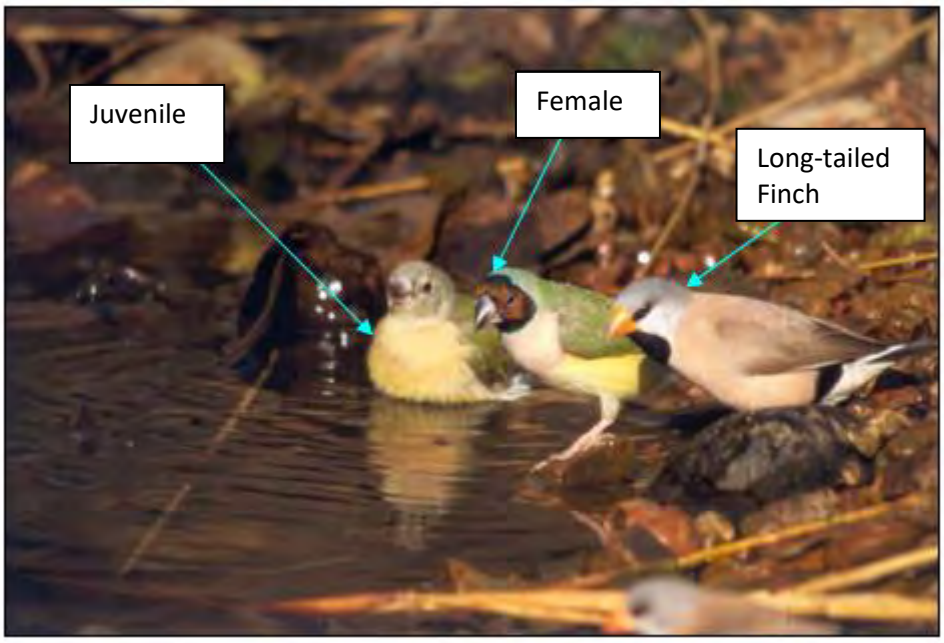
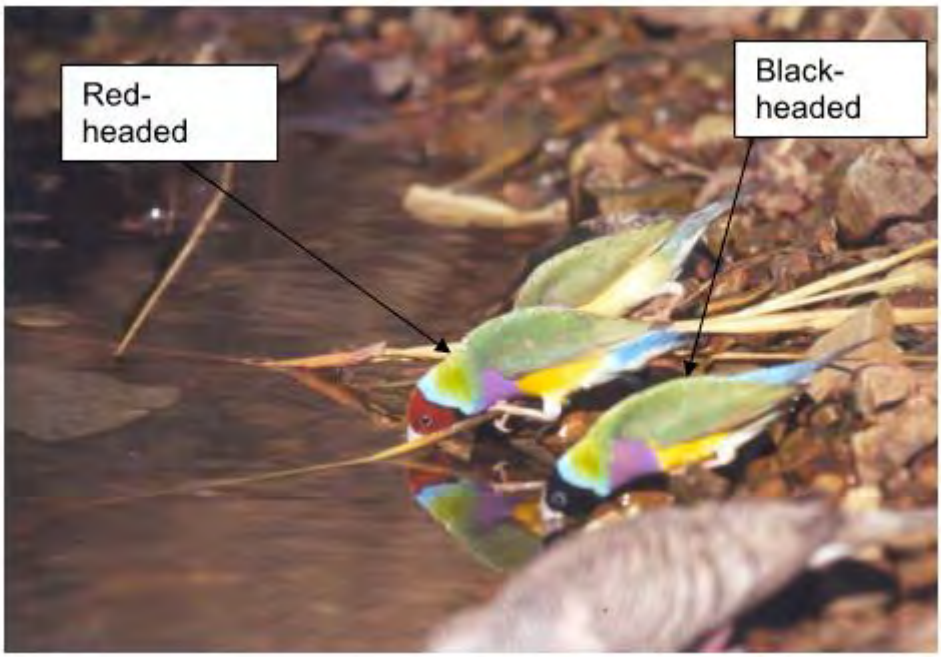


Figure 5 Red- and black-headed Gouldian Finches



Other finches and seed-eating birds that you may see (please familiarise yourself with them):

- Long-tailed Finch
- Masked Finch
- Double-barred Finch
- Pictorella Mannikin

- Chestnut-breasted Mannikin
- Peaceful Dove
- Diamond Dove
- Bar-shouldered Dove
- Common Bronzewing
- Hooded Parrot.

5.2.5 Data Analysis

Every three years, the EM will organise for analysis of trends in abundance.

5.2.6 Responsibilities

The EM:

- The overall coordinator for the field program - they are responsible for the smooth running of the annual counts and liaising with research staff.
- Provides for training to ensure that all participants are familiar with how to identify Gouldian Finches, how to record the data on the data sheet and how to identify the other seed eating birds that come into drink.
- Organises all logistics, equipment and food/water.

Participants:

- Must ensure they are prepared for each day's counts – familiar with bird identification, data recording, have sufficient food, water and equipment.

5.3 Wet Season Foraging Habitat

The vulnerability of Gouldian Finches increases in the early wet season when food and water resources are limited, birds have just developed a new complement of feathers and the breeding season is commencing (Legge *et al* 2015). During this time, there can be low seed availability with numerous consecutively seeding grasses providing critical food supply including Cockatoo Grass (*Alloteropsis semialata*), Golden Beard Grass (*Chrysopogon fallax*), Curly Spinifex (*Triodia bitextura*) and Giant Speargrass (*Heteropogon triticeus*) (Dostine *et al*, 2001). Availability of these grasses, particularly Cockatoo Grass given that it sets seed first, is thought to be a significant bottle neck to Gouldian Finch populations.

Given that the mine may affect the condition and extent of foraging areas for Gouldian Finches in lowland woodlands, possibly including some areas with substantial abundance of key food species, including Cockatoo Grass, this Program will quantify and qualify the effects of the mine on potential Cockatoo Grass habitat.

5.3.1 Objectives

The wet season foraging habitat monitoring component has been designed to determine whether dust deposition is affecting the condition and extent of Cockatoo Grass.

5.3.2 Sampling Periods

Sampling for Cockatoo Grass will occur annually during the early wet season when the species is flowering / seeding. The sampling will be maintained, as far as practicable, during the life of the mine.

5.3.3 Study Sites

A total of at least 12 sites comprising six impact and six control sites will be located. Sites will be positioned in sets of two approximately 100 m apart. **Figure 6 Location of dust deposition gauges and Cockatoo Grass monitoring locations** shows the indicative locations of the dust depositional gauges (DDG's) and associated Cockatoo Grass monitoring locations. The Cockatoo Grass monitoring locations will be placed in conjunction with the DDG's given that dust deposition is considered to be the primary mine-related impact on the condition and extent of foraging habitat. The modelled dust deposition from Year 3 of mining operation is provided in **Figure 6 Location of dust deposition gauges and Cockatoo Grass monitoring locations** as this period has been modelled as being the peak period of dust deposition (meaning that at all other periods, the rate of dust deposition should be lower). Three sites are located within the modelled dust deposition contours (impacts sites) and three outside (control sites). All sites will be located within 3 km of historic nesting sites (see **Figure 6 Location of dust deposition gauges and Cockatoo Grass monitoring locations**) as this has been identified as being the most important for foraging during the breeding season (SLR, 2015).

Whilst a review of available literature suggests that no species' specific mapping exists, habitat surrogates have been used to provide a preliminary indication of the potential occurrence of Cockatoo Grass (**Figure 6 Location of dust deposition gauges and Cockatoo Grass monitoring locations**). Additional modelling has been undertaken to further refine habitat containing Cockatoo grass by applying buffers to the Strahla stream ordering from the National Surface Water Geofabric dataset (BOM, 2012; SLR, 2015). This approach was taken given the historic accounts of the species being locally abundant in run-on areas and adjacent to small-scale features such as drainage lines (Dostine *et al*. 2001) and that the species appears to be more prevalent in the lowlands and the more productive parts of the environment (Liedloff *et al*. 2009). The results for this can be found in SLR (2015), and will be utilised to assist in micro-siting the Cockatoo Grass monitoring sites.

5.3.4 Assessment Techniques

Following the location and mapping of sites containing sufficient abundance of Cockatoo Grass, each site will be assessed for the following attributes:

- Size (m^2)
- Seed density (number of seed heads per m^2 x number of filled seed per panicle)
- Level of disturbance, including from fire and feral herbivores, and conditional rating of the patch of Cockatoo Grass
- Evidence of regeneration.

Each site will also contain a fixed photo point to allow visual comparison of sites over time.

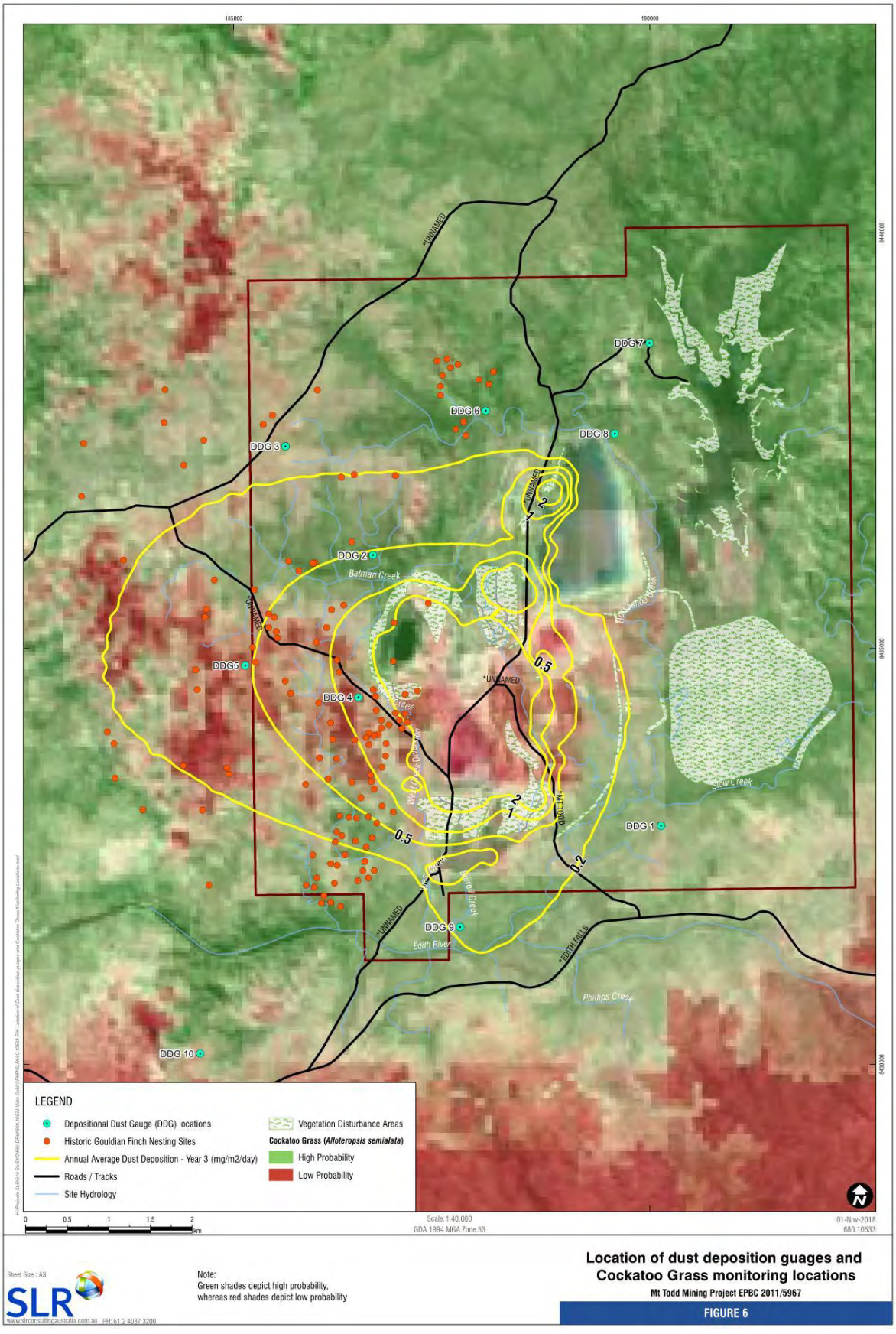
5.3.5 Data Analysis

Each patch of Cockatoo Grass will be analysed against 'treatment' (i.e. impact or control) as well as baseline (i.e. pre-mine) data. A repeated measures analysis will be undertaken to identify overall differences after mine commencement. The analyses will focus on the attributes listed in **Section 5.3.4 Assessment Techniques**.

5.4 Incidental Gouldian Finch Observations

Incidental observations of Gouldian Finches will be recorded in a Gouldian Finch Sightings Register maintained by Vista Gold. It will be updated as necessary (all year round). This data will supplement other data formally collected as part of this Program and may be used to assist in estimating the abundance and distribution of the species in and around the mining lease.

Figure 6 Location of dust deposition gauges and Cockatoo Grass monitoring locations



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APPENDIX A

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